Musical Prodigies
Interpretations from Psychology, Education, Musicology, and Ethnomusicology

Edited by
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Acknowledgments

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Now that all of the authors can see their chapters in the context of the whole book, I hope they will agree that our journey together has been worthwhile. I also hope that our readers enjoy the fruits of our labour.

Gary E. McPherson
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Musicological reports on early 20th century musical prodigies: The beginnings of an objective assessment

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Introduction

The investigation of children's outstanding creative or reproductive musical achievements has a long tradition in the psychology of music (Fisher, 1973; Kopiez, 2011; Lehmann, 2013; Olbertz, 2009; Sloboda, Hermelin, & O'Connor, 1985; Stevens, 1982). However, data-based research using objective diagnostic methods is very rare. Instead, biographical descriptions or descriptive case studies constitute the prevailing approach. In our contribution we will focus on assessment of the perceptual and psychomotor skills (e.g. aural skills such as ear training, playing by ear, pitch identification) of musical prodigies. As will be shown, the use of diagnostic testing or the benchmarking of perceptual skills was not an achievement of 20th century psychology, but originated in the 19th century and can be associated with the work of the German psychologist Carl Stumpf (1848–1936). Unfortunately, the work by Stumpf and others on the development of diagnostic tools in the context of research on prodigies is difficult to access and therefore will be reviewed here. Surprisingly, what we considered to be three independent investigations of prodigies at the outset of preparing this chapter turned out to emanate from a single scientific network surrounding Carl Stumpf (see "Discussion and conclusions").

We will set the stage with a detailed description of an anecdotal report of a benchmark feat of musical memory—the spectacular aural achievement of the 14-year-old Wolfgang Amadeus Mozart—which might allow some cross-historical discussion of the achievements of musical prodigies. Then, we will present Stumpf's largely unknown battery for the testing of pitch discrimination and chord analysis in musical high achievers. His set of tasks was the first step toward a standardized approach, and it was later adopted by contemporary psychologists to investigate the perceptual capacities of three famous composing prodigies, Pepito Arriola, Erich Wolfgang Korngold, and Ervin Nyiregyházi. Their observed aural skills became comparable on the basis of these objective and standardized tasks. Furthermore, Stumpf's ideas mark the beginning of an objective diagnostic approach to outstanding cognitive achievement in children, which manifested itself later in the 20th century with the development of intelligence tests (e.g. by Alfred Binet). Finally, we will discuss the relevance of such assessment tasks in current research on musical prodigies and the pedagogical benefit of this objective approach. We will consider only neurotypical cases; therefore once—whether it was a Latin or a courtly French text, geography, the multiplication table up to 10, or the Old and New Testament. However, music was not his domain of prowess. Tourists, including the composer Georg Philipp Telemann, traveled to Lübeck specifically to visit the child. Telemann was deeply impressed, which is reflected in his evaluation of the child as "worthy of worshipping" (Hennig, 1999). Unfortunately, Heineken had poor health and died in 1725 at the age of 4.

Outstanding aural achievement: Mozart's transcription of Allegri's Miserere

The famous anecdote about Wolfgang Amadeus Mozart's truly amazing aural skills and musical memory goes back to the following historical occurrence. In 1770, the 14-year-old Mozart and his father Leopold arrived in Rome during Holy Week. Both attended the Wednesday service at the Sistine Chapel where Mozart listened to the performance of Gregorio Allegri's Miserere, an a capella piece for two choirs (a total of nine voices) written in the alternatim style (see Figure 5.1). Wolfgang wrote it down from memory, and returned to the Chapel 2 days later on Good Friday to make minor corrections. The piece was famous for non-notated vocal embellishments that were handed down in an oral tradition. Subsequently, at a gathering with members of the choir present, Wolfgang performed the piece on a harpsichord (allowing fewer voices than the original vocal piece) and was celebrated for his astounding feat—which was especially impertinent, since the copying of the score was considered an excommunicable offence.

Leopold reported on this event in a letter to his wife on 14 April 1770 (for details see Vetter, 1998). Unfortunately, no transcription by Wolfgang's hand is extant. Allegedly, the British music scholar Charles Burney (1726–1814) obtained a copy of the transcription on the occasion of a meeting with the Mozarts in Bologna and took it to London, where it was published in 1771 (Byram-Wigfield, 1996). Surprisingly, this handing over of the transcription is not mentioned in Burney's otherwise detailed description of the Miserere and its mysterious importance (Burney, 1773). Although we cannot be sure whether the published version of the piece and Mozart's transcription were identical, at least the visual comparison of the original with Burney's version reveals an impressive congruence—except for small differences in the layout of the text. Vetter (1998) mentioned three more nearly identical copies of Wolfgang's transcription dating from around 1825–1850 (currently located in the archives of the Berlin State Library [Staatsbibliothek zu Berlin2]). Figure 5.2 shows the opening bars of Mozart's transcription from one of those copies.

In our chapter, the term "prodigy" is used to describe "... an individual, typically a child, who displays unusual or exceptional talent or intelligence, quite often in a discrete area of expertise, such as mathematics, music, or chess" (VandenBos, 2007, p. 736). According to Feldman (1993), the Latin word prodigium refers to "a portent or sign, usually of a cataclysmic change, that was 'out of the usual course of nature' " (p. 29). It was considered a heavenly premonition about the future (e.g. predicting an impending catastrophe). The first documented use of the term "prodigy" in the context of a child's outstanding cognitive achievement is the case of Christian Heinrich Heineken (1721–1725), who was born in the Hanseatic city of Lübeck in North Germany (Stevens, 1982, p. 4). Supposedly, before the age of 1, this child could remember everything after hearing it only once—whether it was a Latin or a courtly French text, geography, the multiplication table up to 10, or the Old and New Testament. However, music was not his domain of prowess. Tourists, including the composer Georg Philipp Telemann, traveled to Lübeck specifically to visit the child. Telemann was deeply impressed, which is reflected in his evaluation of the child as "worthy of worshipping" (Hennig, 1999). Unfortunately, Heineken had poor health and died in 1725 at the age of 4.

1 Among these descriptions is the famous report by Thomas Bethune in 1874 on the autistic African American pianist "Blind Tom" (see http://www.trainquotes.com/brochure.html for a list of testimonials and books by Blair (1867) and Southall (1979)).

2 Signature Slg. Teshner 39, fol. 12r-13r and fol. 28r-28v, Slg. Teshner 111, fol. 19r-20v. As Vetter (1998) comments, the manuscripts are very similar with regard to the musical structure. However, they differ in time signature and distribution of text, which makes it unlikely that all copies are based on the same (Mozart's?) original.
Indeed, the original (Figure 5.1) and transcription (Figure 5.2) are strikingly similar. We can conclude that Wolfgang's transcription may have been very close to the original but could not have been compared to it at the time of transcription. In other words, "a feat it was, but not a miracle" (Stafford, 1991, p. 170). Also, scholars do not discuss Leopold's role in the transcription and memorizing after all, two experts, who could join forces in remembering, were sitting in the Sistine Chapel. It is possible that the fuss surrounding Wolfgang's transcription might have been a clever move by Leopold Mozart to increase his son's reputation at the beginning of the visit to Rome.

Another similar but largely unknown memory feat by Wolfgang took place some weeks before the Miserere. As reported by Konrad (1992, p. 414, comment 39), Leopold retold this story in a letter to his sister dated 24 March 1770, and in a letter to his wife dated 27 March 1770. Here, he refers to a "new composition" by Wolfgang, mentioning, however, that Wolfgang had heard this piece (a minuet) previously at a theater performance in Milan. This work (K730) appears to constitute a transcription from memory of a composition by the two minor composers, Florian Johann Deller and Joseph Starzer. This second instance can be regarded as a successful dress rehearsal for the challenge of the Miserere transcription some weeks later.

Given this outstanding memory feat, psychologists have tried to find explanations. For example, Farnsworth (1969, p. 166) assumed that "Mozart's famous 'theft' of the Miserere ... was accomplished through the aid of his eidetic imagery" which refers to the "tape recorder" metaphor of extraordinary achievement in musical memory. However, Farnsworth remained skeptical as to whether such an achievement could be explained by the then unproven theory of eidetic memory (promoted by the German psychologist Erich Jaensch, 1883–1940). Slobooda (1985) suggested that Mozart used highly trained domain-specific strategies of information reduction such as chunking, recognition of harmonic patterns (cadences), or knowledge about style or the specific rules of voice leading which would have been familiar to a composer of his time. Experimental evidence for the use of domain-specific memory strategies stems from a study by Slobooda et al. (1985). The authors investigated the memory of a musical savant by means of a tonal piano composition by Grieg and a piece based on the whole tone scale by Bartok. Both pieces had to be played by ear after repeated listening. The results showed an exceptional—but not verbatim—recall of the tonal piece after seven trials, but a poor rendition of the Bartok piece.

One explanation for Wolfgang's achievement lies in the redundant structure of the work itself (Vetter, 1993): The Miserere is written in the falsobordone style and comprises a sequence of two short alternating five-part and four-part sections of 50–60 seconds length each, separated by plainsong. The verse of each choir is harmonically identical (Byram-Wigfield, 1996) and uses the following sequence of chords: (1) for the five-part section, g(Initium)–d–B–E–F–B, f(Initium)–c–g–B–c–D–G, (2) for the four-part section, g(Initium)–B–F–g–c–D, c(Initium)–g–D–g–c–D–G with harmonies changing every half bar. As Vetter (1993) argued, Mozart had to remember no more than two sections, with an average length of 54 seconds each, to be repeated five times and a coda. Minor corrections 2 days later were also based on five repetitions of each section. Still, young Mozart's transcription of 2 minutes of music with a predictable structure (and potential assistance from a second expert, i.e. his father) remains a considerable feat. Unfortunately, the evidence does not satisfy modern scientific standards regarding control or reliability; they "merely document high achievement under a controlled condition and attribute it to exceptional levels of talents" (Lehmann & Gruber, 2006, p. 457). Despite this limitation, we can today ask if later prodigies would be able to perform at a similarly high level.

On a different occasion, Wolfgang's psychomotor performance was tested by the scientist Lord Daines Barrington (1770). For a more detailed account of Mozart's precocious achievements, see Chapters 23 and 24 of this volume.
Carl Stumpf’s assessment of aural skills

The German psychologist Carl Stumpf (1848–1936) published the second volume of his monumental work *Tonspsychologie* in 1890 (Stumpf, 1965b). A significant part of this monograph was dedicated to his studies of the phenomenon of tonal fusion as the foundation of a new theory of consonance (for more details on the author and his research program see the introduction and self-portrait in Stumpf (2012)). Before the participants started the experiment and decided whether they perceived one or two tones when harmonic (simultaneous) intervals were played in an experimental task, Stumpf conducted a pre-test to ascertain the validity of their judgment. For this, participants sang a given tone played on the piano, decided which of two successive tones was higher, indicated whether they perceived one or two tones when an interval was played, and identified which of two successive intervals appeared more pleasant (Stumpf, 1965b, p. 157). Stumpf assumed that what he called nonmusical persons would have a poor ability to independently focus on the components of two simultaneous tones (Stumpf, 1965b, pp. 345), and he realized that items with an unexpectedly high task difficulty were required for testing “persons with true musical aptitude and musical sophistication” [wirklich musikalisch vernetzter und durchgebildeter Personen] (Stumpf, 1965b, p. 369).

The attentive reader will have noticed the difference between Stumpf’s diagnostic approach to musical skills and that of the psychometric tradition represented by, for example, Francis Galton. Galton (1869) had argued that mental capacity was related to sensory ability—for instance, the keenness of vision, smell, hearing, taste, and touch. Therefore his approach to measuring an individual’s mental capacity involved testing tactile sensitivity, reaction time, and visual and aural acuity (e.g., using the Galton whistle). Galton’s view of the role of sensory acuity for diagnostic testing even influenced Carl E. Seashore who published his first musical ability test in 1919. For Stumpf, however, determining an individual’s threshold for just noticeable differences in frequency was proof of basic perceptual functioning only in order to identify and exclude tone-deaf subjects from his studies. Rather, when he mentioned aural acuity [Hörscharfe], he was referring to the analytical judgment of chords or other complex stimuli as indicators of a person’s musical capacity (Stumpf, 1965b, pp. 369–70). Stumpf’s closest coworker, Erich Moritz von Hornbostel (1877–1935), even argued in his essay on cross-cultural music psychology that aural acuity was inadequate for classifying persons from non-European cultures as musical or unmusical (von Hornbostel, 1910). Instead, emphasis was placed on higher psychic activities [höhere psychische Tätigkeiten], which in modern terms we would call cognitive processes. In other words, for Stumpf the underlying mechanisms of the human relationship with music (for more details see the introduction in Stumpf (2012, pp. 10ff) did not consist of basic perceptual skills (such as pitch discrimination acuity), but rather of comparative, analytical, and abstract “mental operations.”

Another facet of Stumpf’s unconventional approach was that his diagnostic efforts were embedded in his emerging comprehensive system of applied psychology; he was not interested in a mere systematic description of outstanding achievements among children, but in the application of these differential findings. In 1900, Stumpf founded the Berlin Society for Child Psychology [Berlin Verein für Kinderpsychologie] which was the starting point of developmental psychology in Germany—only a few years after G. Stanley Hall conceived and supervised the description of his sample of exceptional children who were also characterized for signs of “early musical manifestations” (see Bohannon, 1896). This new discipline was supposed to counsel teachers and other professionals involved in the field of pedagogy (see also Stumpf’s self-portrait in Stumpf (2012, p. 208)). In other words, Stumpf’s differential approach was the precursor of modern formal, institutional systems of child guidance (Sprung & Sprung, 2006). Later in 1921, Stumpf founded the Department for Applied Psychology in the Psychology Institute at the Friedrich Wilhelm University in Berlin. It was directed by Hans Rupp (1880–1954). This institutional hub with Carl Stumpf at its center will become important for our discussion of the case studies presented next.

Applying tests of perceptual achievement

In this section we will describe how Stumpf’s diagnostic instrument, originally developed for the objective assessment of perceptual skills in adults with “true musical aptitudes” (Stumpf, 1965b, p. 369f.), was applied to three musical prodigies, Pepito Arriola, Erich Wolfgang Korngold, and Ervin Nyiregházi. One could even say that Stumpf’s Berlin school of psychology became the pioneer of competency-based testing in music.

Carl Stumpf’s initial investigation of Pepito Arriola

The psychological investigation of Pepito Arriola (José Rodríguez Arriola, 1895–1954) was probably the first rigorously documented experimental perceptual investigation of a musical child prodigy. Pepito was born in the northern Spain (Stumpf, 1909), and in 1901 he and his mother moved to Leipzig (Germany) to seek instruction and counseling from Arthur Nikisch, the famous conductor and director of the conservatory. In February of 1903, at the age of 7, Pepito visited Berlin and was brought into contact with Carl Stumpf; Pepito and his mother were invited to Stumpf’s private house, which served as a bourgeois salon of rich cultural activities including private concerts and intellectual gatherings (Sprung & Sprung, 2006). Stumpf started a series of psychological tests on Pepito (see Box 5.1), but he was mainly interested in the rules of tonal fusion [Verschmelzung]—the basis of his theory of consonance—and whether they also applied to this extraordinary case.

Box 5.1 Tests used by Stumpf with prodigy José Rodríguez Arriola (“Pepito”) Arriola (1895–1954)

A comprehensive list of the tests used by Stumpf in his investigations with Pepito Arriola is provided in Box 5.1. The most relevant test for the purpose of this study is the **Tone Variator**, which is described in detail below.

**a)** Test of general intelligence and memory (no detailed information on tests)

**b)** Preference ratings for given intervals with stretched vs. compressed intonation

**c)** Judgment of detuned simultaneous and successive intervals with active adjustment by means of the mechanical Stern Tone Variator

**d)** Determination of just noticeable differences in successive pitches as measured by the Stern Tone Variator

**e)** Aesthetic appreciation of given major and minor chords (produced by tuning forks) and of intervals

**f)** Unprepared transpositions of compositions from score on the piano

**g)** Improvisation (variation task for a given four-bar melody) taking turn with another pianist (at least 10 alternating repetitions)

**h)** Determination of the reference frequency for his perfect pitch

**i)** Reliability of perfect pitch by means of a pitch identification task of randomly selected tones produced by Koenig Tuning Forks

**j)** Reproduction by ear of complex dissonant chords on the piano (see Figure 5.3)
On the basis of Stumpf's comprehensive testing, Pepito's achievement can be summarized as follows.

(a) His memory was excellent, and his intelligence was good but not above average for his age. The investigator Richet gave no information on the psychometric tests used for this diagnosis (see Binet, 1900).

(b) His aesthetic preference showed a bias for intervals with stretched intonation.

(c) In a behavioral experimental task, Pepito adjusted intervals on a mechanical device toward "pure tuning" with a tendency toward stretched intonation (slightly increased pitch of the adjusted tone).

(d) His perceptual frequency threshold for just noticeable differences (JNDs) in the vicinity of 700 Hz was 3 Hz on average; that is, markedly larger than that in adults.4

(e) His aesthetic preference for major and minor chords was balanced, and he favored intervals of sixths over thirds over fifths.

(f) He was able to transpose any composition into any other key.

(g) He improvised with ease while taking turns with another pianist on a given four-bar melody.

(h) The reference frequency of his perfect pitch for A4 was \( f = 453.5 \) Hz, while the reference pitch for the piano tuning at that time was lower (\( f = 435 \) Hz).

(i) He identified randomly presented pitches with great ease and acuity.

(j) He reproduced the dissonant chords (see Figure 5.3) by ear with great reliability, but not without mistakes.

Retrospectively (and excluding Barrington's report on Mozart), Stumpf's approach appears visionary. His test battery, consisting of tasks such as improvisation, playing of chords by ear, or transposition of a given composition, comes close to modern assessments of musicians' key competencies. For example, McPherson, Davidson, & Faulkner (2012, Chapter 3) and McPherson (1995) suggest five such competencies: performance of rehearsed music, performance of music from memory, sight-reading of music, improvisation, and playing by ear. For Stumpf, higher cognitive skills, especially the transposition of a given composition, played a central role in the identification of musical achievement. He considered the skill of transposing "one of the safest characteristics of genuine musical ability" ([eines der sichersten Kennzeichen echter Musikbegabung] Stumpf, 1909, p. 107). The fact that Pepito was of average intelligence is consistent with modern views of the role of mental capacities in the development of expert skills: intelligence follows a threshold function and should be average or above (Brandler & Rammsayer, 2003).

In summary, Stumpf administered psychoacoustic measurements (JND threshold for frequencies, acuity of perfect pitch) as well as tests for testing cognitive skills (analytical aural acuity of complex chords) and aesthetic judgments (major vs. minor chords). The methods he employed required behavioral answers (adjustment of the tone variator or playing by ear), forced-choice discrimination paradigms (JND threshold), and self-reports (preference for intervals). His collection of items (see Figure 5.3) for the analysis of dissonant chords could still be useful today for assessing outstanding children.

Stumpf was cautious in his conclusions and refrained from making predictions regarding the future of Pepito's "genius talent". Instead, he gave his best wishes: "May his talent unfold to marvelous maturity" ([Möge sie sich zu herrlicher Reife entwickeln] Stumpf, 1909, p. 115). Unfortunately, very little is known about Pepito's fate; his career development seemed to have been everything other than splendid. Stevens (1982) cites an enthusiastic review of a recital given in New York (1909) and Fisher (1973) reports that Pepito probably died in the 1940s. As far as we know, he left no permanent traces in music history, either as a pianist or a composer.

von Hornbostel's investigation of Erich Wolfgang Korngold in Vienna

Erich Wolfgang Korngold (1897–1957), who later became a renowned composer of orchestral works, operas, and film music, was born the son of the well-known and much feared Viennese music critic, Leopold Julius Korngold (1860–1945). Erich's first teacher in composition was Robert Fuchs, followed later by Alexander von Zemlinsky, and his early career was endorsed by such prominent musicians as Gustav Mahler (at the time director of the court opera). Early signs of his precocious musical development were considered to be his playing of themes from Don Giovanni on the piano at the age of 5 and his improvisation skills (Carroll, 1997). Although he was not yet 10 years old in 1907 and had had little formal training in composition, Erich composed the cantata Death [Der Tod], followed by the ballet The Snowman [Der Schneemann] which was performed by more than 30 European opera houses within a few years.

Erich Moritz von Hornbostel (1877–1935), who studied this prodigy, was also born in Vienna and trained as a pianist and composer. He later became Carl Stumpf's most important coworker in Berlin and made major contributions to the newly developed field of ethnomusicology.5 His parents' house was a meeting place for Vienna's musical society, and hence it was easy for von Hornbostel to become acquainted with the young boy, Erich, whose father was an important member of the von Hornbostel cultural network. von Hornbostel developed a sequence of complex chords (see Figure 5.4) for his experimental investigation of Erich, who was about 11 years old at the time (1908/1909).6 He may also have used additional examples from scores for testing

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5 For instance, von Hornbostel headed the Berliner Phonogramm-Archiv—the world-famous collection of early music recordings from all over the world—founded in 1904 by his teacher, Carl Stumpf, and himself.

6 Korngold's biographer Carroll (2008) mentions 1908/1909 for this psychological testing, but Révész (1916) gives 1910 as the correct date. It is not clear whether the psychological study of Korngold took place in
Ervin's skills in playing by ear (Révész, 2007, p. 91, footnote 1). The same tasks were used in by Révész 1910 when testing Ervin Nyiregyházi (see the next section). Unfortunately, the experimental reports of Korngold's investigation have been lost, but Carroll (1997) affirms that Korngold outperformed Nyiregyházi with regard to aural acuity.7

**Géza Révész's investigation of Ervin Nyiregyházi**

Ervin Nyiregyházi (1903–1987) was a Hungarian-born American composer and pianist. He sang melodies in tune at the age of 2, played melodies by ear, improvised at the piano at the age of 4, and started formal training in composition at the age of 6. From the ages of 7 to 10, he was observed by the Hungarian psychologist Geza Révész (1878–1955) in the first ever longitudinal study of a prodigy. Révész started his investigation in Budapest in 1910 where he encountered Ervin and continued his investigation in Berlin in 1913 and 1914 after Ervin and his mother had moved to what was then Europe's musical capital (Bazzana, 2008). After a first short report on his case (Révész, 1911), Révész started a series of tests (see Box 5.2) which were repeated in subsequent years. Based on this comprehensive testing, Ervin's achievements can be summarized as follows.

- (a) His intelligence was 2–3 years ahead of his actual age.
- (b) He outperformed all subjects tested by Stumpf (1965a, p. 310) for perfect pitch.
- (c) His preferred adjusted frequency on the Stern tone variator for A4 was $f = 448$ Hz with a mean deviation of 1 Hz.
- (d) He identified the notes of chord numbers 2, 4, and 9 (see Figure 5.3) without error.
- (e) He analyzed about half of the very difficult chords (see Figure 5.4) without error after only one presentation (nos. 2, 4, 5, and 9). An additional note was introduced in two chords (nos. 1 and 3), and three chords (nos. 6, 7, and 8) contained wrong notes, but he corrected all missing or false notes after a second presentation.
- (f) He was able to transpose three-part inventions by Bach into any key. His sight-reading was excellent and he played Tschaikovsky's Fourth Symphony from a full score without problems. The same applied to parts from particular instrumental sections.
- (g) He could play from memory after a few repetitions, and he showed a very reliable long-term storage of learned scores with close to perfect recall in re-tests after 2 and 3 years. He learned to play Robert Schumann's Piano Concerto in A minor, Op. 54 by heart in only 10 days, although he played it through only once a day; Révész (2007, p. 105) concluded that Ervin's memory "was practically equal to that of a grown-up musician of a good ear".
- (h) His piano skills must have been extraordinary, and his interpretations were characterized by an exceptional musical sensitivity and a deep musical understanding.

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7 A collection of laboratory notes by Stumpf and von Hornbostel was recently discovered in Berlin and is currently being prepared for scholarly exploitation. This extensive collection of documents might also contain the missing minutes from Erich's tests. (The collection is housed under the entry "Staatliche Museen zu Berlin—Preußischer Kulturbesitz, Ethnologisches Museum, no signature/Carl Stumpf; Dokumente Abt. Musikethnologie, Medientechnik und Berliner Phonogramm-Archiv").
At the age of 6 he improvised with ease on given musical themes and performed chromatic modulations from one key to any other given key. Transcriptions of some of his improvisations at the age of 7 are presented by Révész (2007, pp. 141–2).

A selection of Ervin’s compositions created from between the age of 7 and 12 are reproduced in the appendix of Révész (2007). These small pieces are characterized by a wealth of melodic invention and orchestral thinking. At the end of his 4-year study, Révész (2007, p. 4) enthusiastically concluded that “my hope of seeing Ervin become a great artist was justified”.

Although Révész might have been motivated by good intentions to abandon the traditional anecdotal level of description and instead adopt a strictly quantitative experimental approach, his study became imbued with his admiration for Ervin. The investigator was enthusiastic about the boy and thus lost his critical distance in largely trying to affirm Ervin’s genius.8 Révész’s later work on talent clearly shows his belief in genetics and genealogies. In retrospect we cannot judge his personality as a child bore a marked resemblance to that of the infant Mozart” (Révész, 2007, p. 3).

In contrast to this euphoric forecast of a splendid career as a pianist and composer, Nyiregyházi’s later life was a disaster. After immigrating to the USA in 1920, he first succeeded in continuing his career as a pianist. But from 1923 on, finding new engagements became increasingly difficult (Bazzana, 2008). He ended his living by arranging piano reductions of film scores; he was in fact homeless, did not possess his own piano for decades, spent a large part of his life in poverty, and was married 10 times to women who pitied his utter helplessness in ordinary life. After decades of oblivion, Nyiregyházi celebrated a short comeback (Bazzana, 2008; 2008) .

The young Ervin Nyiregyházi was ambivalent about taking part in a psychological study. On the one hand, he did not mind the sessions with Révész and “saw them as outlets for his creativity, [and] opportunities to talk about subjects that mattered to him with an intelligent, learned man who took what he said seriously” (Bazzana, 2008, p. 28). On the other hand, Nyiregyházi believed in retrospect that “Révész had missed his essential personality” and that Révész “never suspected my real feelings” (p. 34). Nyiregyházi put it bluntly to his last wife: “It wasn’t me. The Révész book is a counterfeit” (Bazzana, 2008, p. 34).

Discussion and conclusions

Based on these interesting descriptions of the three prodigies, arrived at using related methodologies, we might ask whether they can be regarded as objective scientific evidence of these children’s singular excellence. Further, what conclusions can we draw from these case studies for research on prodigies across history?

In his time, Révész was still a captive of 19th century ideas concerning the aesthetic genius. Many anecdotes circulated and, like the one we discussed in detail earlier in this chapter, probably

8 Interestingly, Révész attributes a much higher musical talent to Mozart (Révész, 1916), and it is unclear to us if he really believes what he is saying in light of the conflicting evidence of Ervin’s performance, or if he is simply afraid of his readership’s reaction to the fact that Ervin matches Mozart’s performance.

9 Some of his audio recordings can be found on YouTube; a video recording of a recital given in Japan in 1980 is available at http://www.youtube.com/watch?v=Y6qby4RvaAq3I and a film documentary (from 1978) is available at http://www.youtube.com/watch?v=g9_BdhMPOGU.

remained unquestioned.10 Music researchers may have been looking for “reincarnations” of Wolfgang Amadeus Mozart that would fit the mold of the inexplicable. Conversely, Stumpf and von Hornbostel were much more scientifically interested, but were probably unaware of the conclusions they might be able to draw from the individuals they investigated. Interestingly, despite their status as prodigies, none of them achieved lasting fame in music history. Thus success in an artistic career may require much more than precocious achievement.

We believe that Pepito Arriola, Erich Wolfgang Korngold, and Ervin Nyiregyházi were not singular or unique with regard to their precocity. For the reasons discussed in this section, we believe that they demonstrate what many children are or would be able to do under favorable circumstances—and have been able to do in the past as exemplified by Mozart. In our view, the reported case studies mirror a strong selection bias due to chance geographical and personal proximity of researcher and prodigy; Thus the prodigies were not selected out of a larger population because they were so extraordinarily brilliant, but because access to them was convenient.

The most important piece of evidence for our claim is that all of the cases were recruited in Berlin—the cultural capital of Europe at the beginning of the 20th century. We can demonstrate by means of a network analysis how researchers living in Berlin or having close contact with the Berlin psychological community gained access to the prodigies (see Figure 5.5). And it was the psychologist Carl Stumpf who played a central role in this constellation. How so? Owing to Stumpf’s successful political activities, his Psychological Institute in Berlin became one of the leading institutions. In 1909 he initiated the renaming of the “psychological seminar” at the Friedrich Wilhelm University in Berlin as the Psychological Institute. He founded the Phonogram Archive (comprising an important ethnomusicalological collection of recordings) around that time (see also Ziegler, 1998), and subsequently established the Institute as one of the three leading German institutions (the other two were Leipzig and Göttingen (see Sprung & Sprung, 2006)). Stumpf’s prime interest concerned tonal fusion as a key concept in the perception of consonance in music. From

10 Another Mozart myth concerns his composing without prior sketching, which was only refuted in the 1990s (Konrad, 1992).
his perspective, perceptual experiments with musical prodigies were helpful in understanding how this perceptual performance was related to musical skills and age.

The relationship between Stumpf and von Hornbostel was easy to understand because von Hornbostel was his most important pupil and his coworker for three decades. In 1901, von Hornbostel left Vienna and moved to Berlin to build up the Berliner Phonogramm-Archiv with Stumpf. Although von Hornbostel was not the mere proverbial "armchair ethnomusicologist", but also conducted field research, he was probably glad to be in Berlin as it was the ideal place where musicians from all over the world, such as ensembles of Native Americans, Siamese theatre groups, or circus groups, would pass through and perform. Of course, many prodigies were likely to come to Berlin as well. Thus, the "spider-in-the-web strategy" of waiting for outstanding or exotic events and collecting data on them was familiar to von Hornbostel. With his Viennese background as a member of a culturally interested and wealthy family (high society), von Hornbostel was a natural part of the cultural and musical networks and had easy access to prodigies such as Erich Wolfgang Korngold.

The next important component in the Berlin network is the relationship between Géza Révész and Ervin Nyiregyházi. As early as 1907 at the age of 4 (and before he moved to Berlin in 1913), Ervin presented his compositions to the famous cellist David Popper and the composer Julius Erkel, both professors at the conservatory in Berlin (Révész, 2007). Popper even participated in Stumpf's experiments on tonal fusion, since Stumpf mentioned Popper's outstanding aural acuity (Stumpf, 1965b). Prior to his work in Berlin, Erkel had been professor at the conservatory in Budapest, the city in which Révész and Ervin lived. It is plausible that Révész knew the boy from Budapest and reactivated the network with Popper and other musical experts following Ervin's move to Berlin in 1913. Also, Révész was in close contact with von Hornbostel and Stumpf. Although he was critical of Stumpf's consonance theory of tonal fusion (see also Révész, 1913), Révész used Stumpf's and von Hornbostel's experimental materials for testing aural acuity in his work with Ervin Nyiregyházi (see Figures 5.3 and 5.4). Additionally, Révész mentioned his musical memory obtained from von Hornbostel for the test of Ervin's musical memory (Révész, 2007). In 1915, Ervin Nyiregyházi was again in contact with Stumpf and von Hornbostel for further examination of his perfect pitch and ability to analyze chords. This aural acuity was judged by both researchers as "quite marvelous" (Révész, 2007, p. 83, footnote 1). Finally, Révész reports that Stumpf had heard Ervin playing in Berlin after 1915 and then expressed his admiration to Révész (1916, p. 86) (the name of Stumpf is only cited in the German version).

For completeness, one more psychologist should be mentioned. This is Franziska Baumgarten (1899–1970) who contributed to Stumpf's Festschrift on the occasion of his 80th birthday in 1928 with the manuscript, "Psycho-Physiology of Work and Psycho-Technique" (see Sprung & Sprung, 2006, p. 324). Although we have not reported her findings in this chapter, her work on prodigies is a staple in the history of psychology of the gifted. After finishing her dissertation in Zurich in 1910, Baumgarten moved to Berlin in 1914 and became a coworker of Hans Rupp at Stumpf's Institute for Applied Psychology until she returned to Switzerland in 1924. In Berlin she also attended the lectures of the Gestalt psychologists Max Wertheimer and Wolfgang Köhler, both of whom belonged to the inner circle of Carl Stumpf's colleagues. From 1918 until 1924 she was a member of the committee which assessed gifted pupils in Berlin [Kommission zur Prüfung besonders begabter Berliner Gemeindeschüler], demonstrating her special interest in questions of developmental psychology and psychometric ability testing. According to Daub (1996), Baumgarten was fully integrated in Berlin's psychological scientific community. Here, Baumgarten collected relevant data for her famous study on nine prodigies from different fields (Baumgarten, 1930). Her strategy of recruiting suitable participants for her studies has a striking similarity to the waiting game used by von Hornbostel: Through newspaper advertisements she learned of visiting prodigies from different fields, whom she then invited to participate in her experimental design. In her own words, she only had to wait and read the advertisements because most of the prodigies visited the metropolis to present themselves. When they responded, there was only a short testing time: "The performing prodigies are migratory birds. They often appear in a city once, rarely come back, and stay only for a very short duration—about 1–2 days". [Die auftretenden Wunderkinder sind Zugvögel. Sie erscheinen in einer Stadt oft einmal, um selten dahin zurückzukehren, und bleiben nur ganz kurze Zeit, etwa 1–2 Tage.] (Baumgarten, 1930, pp. 4–5) This explains why most of her case studies are not in-depth analyses.

A statistical analysis of newspaper reports on musical prodigy performances between 1798 and 1848 in different European cities makes it clear that prodigies had to live—or at least stay temporarily—in Vienna, Berlin, Prague, Frankfurt, or Paris (Kopiez, 2011). In the first half of the 19th century, about 35% of all reports concentrate on these five musical centers. In other words, overly enthusiastic statements like those by Révész regarding Ervin Nyiregyházi should be read with caution, because it is likely that there were dozens of prodigies with similar potential (as reported extensively by Stevens (1982)) who remained undiscovered by scientific networks. If, in fact, the prodigies described here were representative of the larger population of prodigies, we should be able to identify similar cases, albeit not as well documented.

One such case is the prodigy composer Josef Gabriel Rheinberger (1839–1901) who was raised far away from a major city in the small city of Vaduz, in Liechtenstein, until he was 12 years old. When he moved to Munich, the town was still a Bavarian province with a population of about 90,000 (at the same time Berlin had a population of more than 400,000). Rheinberger was an accomplished organist and composer at the age of 12 (see the analysis of works and education in Petersen (2016)). Despite being a true prodigy, Rheinberger had almost no chance of being discovered by scientists at an early age.

Even in Berlin there were undiscovered prodigies. In 1913, the young pianist Claudio Arrau (1903–2008) came to Berlin with his mother on a grant from the Chilean government to pursue his musical education (Ervin Nyiregyházi was living there at the same time). Arrau gave his first recital in December 1914 (Bazzana, 2008) and even stayed in Berlin as a professor at the Stern Conservatory until 1940. We do not know of any connection with Stumpf's scientific networks. Arrau was not considered for psychological investigation, perhaps because of a lack of prodigious composing skills (no information on Arrau's efforts in this direction is reported by Horowitz (1982)), but fortunately he became one of the most outstanding pianists of the 20th century.

A further plausible case could be constructed from the biography of Sergey Prokofiev (1891–1953). He started composing and playing the piano at the age of 5. At age 9, Sergey tackled his first opera, at 11 his first symphony. He was raised in rural Russia, but the family had ties in Moscow, where Sergey was finally accepted in 1904 as a student of the composer Alexander Glazunov. It is more than likely that he would have excelled on von Hornbostel's test, but there was—to our knowledge—apparently no interest in the scientific study of prodigies in Russia at the time.

Many more cases will remain hidden from our scientific curiosity forever, unless further letters or descriptions emerge that can be integrated into our general knowledge. Regardless of what their investigators thought about the three case studies—whether or not they considered their prodigy to be the pinnacle of early achievement—in retrospect, the reports on these children can be viewed as truly representative descriptions of prodigious performance by classically trained children at the turn of the 20th century. The participants were not selected for their uniqueness or singularity, but constituted a rather random sample of convenience. Unlike the many undocumented cases, they became incidentally trapped in the Berlin scientific network which Stumpf had spun around himself.
This fact opens up the possibility of comparing precocious achievement across history using the anecdotal report regarding Mozart’s achievement discussed at the beginning of this chapter (for a more detailed account of young Mozart’s achievements, see Cowgill (this volume, Chapter 23) and Keefe (this volume, Chapter 24)). It appears that the documented aural performance and analytical skills of the three Berlin composing prodigies should be considered equivalent to that of the young Mozart. Their pianistic skills also appear to be outstanding, if we include sight-reading, playing from memory, and transposition. Of course, stylistic concepts (increased complexity of harmonic progression during the Romantic period) and technical demands on piano playing had changed since Mozart’s time, requiring an accelerated skill acquisition in later prodigies (Lehmann & Ericsson, 1998). In essence, it appears that Mozart’s performance was not clearly superior to that of the prodigies in the early 20th century.

Unaware of the later significance of their separate findings, Stumpf and his coworkers in Berlin amassed pieces of evidence that help us today in assessing historically earlier performances. They also provided test material which we have presented in our figures and that can be used for testing contemporary and future prodigies. Modern research on prodigies, development of musical expertise, and skill has to develop theories that will hold across time without exception. The basis of such theories are clear descriptions of achievements at the outer limits of performance.

Although precocious musical development may not be a sufficient condition for a successful career as a musician, it may be an advantage (if not even a necessary condition) (see also Chapters 1 and 18 of this volume). The historical materials on prodigies (covering roughly 150 years) presented in this chapter reveal that complex aural skills at the upper end of the scale are measurable and comparable across studies. More than 100 years ago in Berlin the assumption was made that domain experts, even at young ages, do not distinguish themselves through mere sensorial acuity but through the acquisition of complex cognitive adaptations and mental representations of domain-specific material that result from extensive training on relevant tasks. This tenet is still upheld by many music researchers and music educators today.

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Chapter 6

Early and late bloomers among 120 classical composers: Were the greatest geniuses also prodigies?

Dean Keith Simonton

Introduction

The history of Western classical music is well stocked with prime examples of one-time child prodigies who grew up to become great composers. Wolfgang Amadeus Mozart is no doubt the most famous case, yet in actual precocity he is closely rivaled, if not surpassed, by Felix Mendelssohn. Even when composers cannot claim to have been bona fide prodigies, they can at least be considered exceptionally precocious, so much so that it is not uncommon for classical composers to leave a lasting mark on the repertoire despite dying at an unusually young age. Franz Schubert died at 31 and Giovanni Battista Pergolesi at 26. Perhaps the most outstanding illustration is Juan Crisóstomo Arriaga, the “Spanish Mozart,” who composed some attractive string quartets when he was only 16 and died before his 20th birthday. Arriaga may not be the most illustrious composer in history, but it is remarkable that a composer can die so young and still receive at least a passing mention—as has just happened in this chapter.

To be sure, not all great classical composers were so precocious, and even less prodigious, in their musical prowess. If Ludwig van Beethoven had died as young as Pergolesi had, he would likely be unknown to us today; his three Opus 1 Piano Trios would probably not have been sufficient to ensure his immortality (the No. 3 in C Minor notwithstanding). Worse still, other composers were outright late bloomers, not finding their distinctive voice until rather late in their careers. If Anton Bruckner had died at age 40, it is very doubtful that he would have left a single work in the standard repertoire. Indeed, although considered largely a symphonist, it was not until he was 50 that he produced his first masterpiece in the symphonic form. César Franck, Leó Janáček, Elliott Carter, and Iannis Xenakis provide additional illustrations of late-blooming composers.

These examples and counterexamples then raise the fundamental question that inspires this chapter. Does being a child prodigy help or hinder later acclaim as a classical composer? Are Mozart’s life and career typical or exceptional?

I will address this key issue by reviewing and interpreting the empirical findings of two separate studies. The first investigated the amount of time it takes to acquire sufficient expertise to begin making lasting contributions to the classical repertoire (Hayes, 1989). The second investigation entailed a far more extensive inquiry into how classical composers vary in the acquisition of this expertise (Simonton, 1991b). What these two investigations share is an interest in the acquisition of domain-specific musical expertise and its consequences. This interest is highly relevant because a musical prodigy is a person who somehow managed to accelerate that acquisition process, attaining exceptional expertise at an exceedingly young age (cf. Radford, 1990; Simonton, 2014a).

As will be seen in the second study, this acceleration can actually consist of two parts: (a) initiating