Intelligence xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Intelligence

journal homepage: www.elsevier.com/locate/intell

Measuring the musical skills of a prodigy: A case study

Gilles Comeau[a,b,*], Yuanyuan Lu[b], Mikael Swirp[b], Susan Mielke[b]

[a] School of Music, University of Ottawa, Ottawa, Canada
[b] Piano Pedagogy Research Laboratory, University of Ottawa, Ottawa, Canada

ARTICLE INFO

Keywords:
Prodigy
Musical talent
Ability
Auditory memory
Pitch memory
Working memory

ABSTRACT

While there is a strong interest in and fascination with music prodigies, very few measurements have been conducted on this rare phenomenon and very little empirical data exist. We document the case of LN, an 11-year-old music prodigy. We tested him on his cognitive skills (non-verbal reasoning and working memory), rhythm and melody discrimination skills, sight reading, improvisation, pitch accuracy, and musical memory. The data were then compared to various controls: a group of music students of the same age group (for cognitive and discrimination skills); three university music students with perfect pitch (for pitch accuracy and musical memory); and a music prodigy of similar age who was tested almost one hundred years ago (for pitch accuracy and musical memory). This is the first study that compares the test results of a contemporary music prodigy with the rare data of a prodigy studied in the early 20th century; the results are remarkably similar. LN's results on cognitive skills confirm the exceptional working memory often associated with prodigies. Most interestingly, musical ability results revealed a phenomenal level of melody discrimination, pitch accuracy and musical memory (skills related to auditory pitch memory), but just average rhythm skills, below average sight reading ability and he was not able to improvise. This suggests the potentially important role of exceptional auditory pitch memory in the development of musical prodigies.

1. Introduction

In recent years we have seen a great deal of interest in exceptional young music performers. Music prodigies are regularly featured in the media, from television appearances on popular programs such as *60 Minutes* and *The Ellen DeGeneres Show* to the more than 13,000 results generated from a search for “music prodigy” on *YouTube*, or to over 3000 videos resulting from a more specific search for “child prodigy piano” on *Google*. Less prevalent, however, is scientific research on the specific abilities of these music prodigies, and case studies with empirical data are quite rare.

Although rare, published reports of music prodigies are not new. Barrington (1770) authored a descriptive account of Mozart at eight years old, which included tests for sight reading and improvisation. Barrington's study of Mozart was outlined years later in a science magazine where the author noted the lack of knowledge about the study despite its value: "for it is a rare thing: a scientist's study of an artist" (Tolansky, 1959). However, it is not until the 20th century that investigation, in the tradition of psychological experimental study, on prodigies began. Such is the case with a 1924 report of a young girl whom musical critics called “youthful Paganini,” in which Stedman was investigating the most effective method to train prodigies. Much later, Feldman and Goldsmith (1986) followed six prodigies for a period of nearly 10 years through interviews conducted with the young prodigies, their parents, and their teachers.

More recently, McPherson (2007) investigated, over a 3-year period, a talented young pianist who was first interviewed when she was 7. So far, almost all case studies have been descriptive in nature, and papers with quantitative measurements and empirical data are rare. Two early German case studies were among the first psychological studies to look into the prodigy phenomena: Baumgarten (1930) examined nine prodigies including two pianists, two violinists, and one orchestra conductor; Révész (1916/2007) observed and tested the young prodigy Erwin Nyiregyházi from 1910 to 1914 (starting when the boy was 7 years old) and reported his findings in *The Psychology of a Musical Prodigy* (initially published in German in 1916 and translated into English by the author in 1925). We then have to move to the 21st century to find more empirical studies on prodigies. In 2003, Ruthsatz and Detterman (2003) used “a summation approach to investigate the cognitive, musical and practice elements involved in becoming an extraordinary performer” (p. 509) and in 2012, Ruthsatz and Urbach (2012) examined the cognitive and developmental profiles of eight prodigies. Besides the results reported in these recent studies, we have little empirical data on the abilities that characterise music prodigies;

* Corresponding author at: School of Music, Piano Pedagogy Research Laboratory, University of Ottawa, 50 Perez Hall, K1N 6N5 Ottawa, Canada.
E-mail address: gcomeau@uottawa.ca (G. Comeau).

https://doi.org/10.1016/j.intell.2017.11.008
Received 29 May 2017; Received in revised form 19 October 2017; Accepted 22 November 2017

while we know they have a good mastery of their musical instrument and are outstanding performers, we have few documented measures on their other skills, those usually referred to as musicianship skills. This paper presents a case study based on observable musical tasks performed under controlled test conditions.

The subject of this paper is LN, an 11-year-old Canadian pianist who is known as a prodigy because of his achievements in various prestigious competitions and his performances with major orchestras. In this study, we investigate how LN performs on specific cognitive tests, on rhythm and melody discrimination, sight reading, improvisation, pitch accuracy, and on music memory tasks. These areas of expertise have been associated with music prodigies in previous descriptive studies (Geake, 1996; Howe, Davidson, Moore, & Sloboda, 1995; McPherson, 2007; Vandervert, 2009), but, according to Ruthsatz & Detterman (2003) have rarely been measured. In order to better understand LN's performance on these skills, we compared his results with various controls. First, LN's cognitive results, and rhythm and melody discrimination results were compared with a group of 40 regular music students in the same age group (10 to 12 years old) and another group of 25 regular music students with the same number of years of piano lessons (4–6 years). Both groups had gone through the same testing procedure. Secondly, LN's pitch accuracy results and music memory results were compared with three university music students with absolute pitch, who completed the same tests. Thirdly, LN's results for pitch accuracy and music memory were compared with a rare set of empirical assessment data available on another music prodigy in the early 1900s, Erwin Nyiregyházi (Révész, 1916/2007). We do not know if music prodigies are alike in the musical skills they possess, so this gave us the opportunity to compare two music prodigies who lived almost 100 years apart.

This paper is important as it provides another good example of a prodigy's very high measures on working memory supporting the idea of dissociation between working memory and other measures of intelligence. This study also suggests another type of dissociation noticeable with prodigies, this one within the different subskills related to the specific domain in which a prodigy excels. As our results will show, music prodigies are not exceptional in every skill associated with music expertise. In this particular case, LN shows outstanding results in skills specifically related to auditory pitch memory while being average or below average in some other musical skills. These findings might indicate the important role that exceptional auditory pitch memory plays in the development of musical prodigies.

1.1. General intelligence and working memory

When looking at the literature on general intelligence and prodigies, we find that superior intelligence (Ruthsatz & Detterman, 2003; Simonton, 1994) or good intelligence (Vandervert, 2009) is a common feature. Following their investigations of six young prodigies, Feldman and Goldsmith (1986) concluded that contrary to an academic genius who shows extremely high IQ and can perform well in many domains, prodigy's talent is domain specific and requires above average cognitive abilities but not extreme intelligence. Ruthsatz and Urbach (2012) who investigated the cognitive profiles of eight prodigies, four of which were music prodigies, also observed that while prodigies had at least a moderately elevated level of intelligence, their full scale IQ scores were not consistently on the extreme end of the spectrum. However, exceptional working memory has been identified as a characteristic for all music prodigies for whom we have relevant data (Révész, 1916/2007; Ruthsatz & Detterman, 2003; Ruthsatz & Urbach, 2012; Stedman, 1924). LN's case study provides another example of an apparent dissociation between working memory, which always seems to be high in prodigies, and other measures of intelligence that are (in LN's case) average to above average.

1.2. Musical skills and auditory pitch memory

Feldman and Goldsmith (1986) described prodigies as highly specialized children in one particular domain. Since then it has become fairly common to view prodigies as being domain specific (Ruthsatz & Detterman, 2003; Ruthsatz, Ruthsatz, and Ruthsatz-Stephens, 2014). However, while children's outstanding performances might be domain specific, there is a possibility that a prodigy may not be exceptional in all of the sub-skills associated with a particular domain. Equally revealing are the musical abilities that musical prodigies are not consistently displaying. LN's case study shows amazing scores on sub-skills related to auditory pitch memory, but average or even low scores on other musical skills not dependant so much on auditory memory.

2. Case history

Through written correspondence and transcribed interviews with both LN's mother and his current piano teacher, as well as an interview with LN, we were able to develop his case history. LN was born in 2005 to highly educated parents and is the second of four children. His parents are academics and have no musical background; however, two of his three siblings play the piano (the youngest, at only two years old, was still too young for music lessons at the time of this study). When LN was one year old, his older brother provided an early source of music exposure with his daily practice on the family electronic keyboard (they later acquired a grand piano). As a toddler, LN showed early expression of music, humming melodies before he was able to talk. When he was three years old, his elementary school music teacher recognized his absolute pitch ability and suggested to his mother that he study music, so at age four, he began a program of group lessons for children and their parents. LN appears to have already been motivated to learn music. His mother writes: "He naturally feels music. When he was 4 years old, he could take a music book, sight read and play through page-by-page for hours." (LN's mother, personal communication, March 15, 2015). After two years in the program, LN started formal piano lessons and briefly studied with one teacher before transferring to his current piano teacher when he was eight years old. From then on, his rate of progress was very impressive and matched a group of 16 prodigies that we studied previously (Comeau, Vuvan, Picard-Deland, and Peretz, in press). When compared to a sample of 277 piano students, we found that this group of 16 prodigies progressed through the grade levels almost three times more quickly than regular students (2.08 vs 0.73 grades per year). LN's rate of progress was 2.75 grades per year.

LN mentioned in his interview that he likes to play the piano and loves his piano lessons, although he sometimes struggles with practice. This is supported by his mother who acknowledges that in the past, practice was hard and boring for him, especially slow practice. She encourages LN by providing him with organization and reminders, adding that he would otherwise only practise 1 h a day. LN's teacher (Dr. M.) also talked about the difficulty encountered with the frustration and boredom LN sometimes experiences in practice. Dr. M. has worked to overcome this issue. The teacher would share stories with LN and bribe him with the promise of practicing together over Skype as practice buddies. While practice is sometimes a challenge for LN, he understands the importance of willpower, and knows that learning music requires effort, persistence, and practice. During the interview, LN indicated more than once that his success is the result of a lot of practice and hard work.

LN also recognises the importance of a good teacher and his mother is very appreciative of his current piano teacher. "Even though LN is gifted, he could not win any music competition before he met his current piano teacher, Dr. M. Great teaching makes a huge difference." (LN's mother, personal communication, March 15, 2015). Dr. M., who has worked with other gifted students, talks of LN with great affection as he describes his humour, personal charm, healthy childish love of climbing trees and monkey bars, as well as his connection with Russian