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Unveiling artistic minds: case studies of creativity

Karen Chan Barrett and Charles J Limb

Research on musical creativity and expertise principally relies on cross-sectional or longitudinal experiments comparing groups of subjects (e.g. musicians vs. non-musicians, professional vs. amateur musicians). While this is vital, case studies of individuals may provide valuable insight into the variability underlying real-world creative musical performance and improvisation. We survey recent case study experiments on musical disorders, musical savants, and unique musical abilities as well as exploratory experiments that have studied renowned musicians as single data points. Using these, we build the argument that future research should utilize case studies to gain a deeper, more nuanced understanding of creative musical processes, particularly in world-class musicians whose distinctive talent may reveal unknown information about artistic creativity.

Address
Sound & Music Perception Lab, Department of Otolaryngology — Head & Neck Surgery, University of California, San Francisco, CA, USA

Corresponding author: Barrett, Karen Chan (Karen.Barrett@ucsf.edu)

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Introduction

Over the past decades, neuroscience and psychology researchers have used interdisciplinary techniques to investigate how the brain perceives and processes complex acoustic stimuli such as music. In studies of musical creativity examining performers, composers, or improvisers, groups of artists are generally compared to control subjects while completing experimental and control tasks [1–13]. In short, much of our current knowledge in the music cognition field, and science more broadly, averages the results of a sample cohort of subjects to make inferences about the larger population. This technique is fundamental to the scientific method and necessary to identify statistically robust findings.

When studying artistic attributes such as musical creativity, talent, or unusual musical abilities, however, much information may be lost in averaging subjects together, particularly since art is frequently defined by so-called artistic 'genius' — the statistical outliers. Indeed, the uniqueness of exemplary artists would suggest the opposite notion — that mathematical averaging of multiple artists dilutes findings of interest and significance vital for understanding the artistic brain and the variety in human creative abilities. By treating artists as one homogeneous group of subjects, scientists may be averaging out crucial variability and individuality. Statistical rigor could be increased by studying one subject in depth over numerous sessions and then aggregating those sessions together (e.g. in an fMRI study). However, this method has the drawbacks of patient familiarity with the protocol and resultant changes in brain function due to repetition. It should be noted that for single-subject studies, the goal is quite different from that of random effects analysis, where the purpose of the analysis is to assess the generalizability of the findings to the larger population. In the case of single-subject studies of pre-eminent artists, it is already assumed that the brain activation will never be generalizable to the public. The more important question is whether or not the activation could ever generalize to the population of artistic experts from which the artist might be drawn (in and of itself a troubling proposition). Hence, the unique differences among eminent, accomplished musicians may give us valuable insight into how society's best creative minds operate, yet the methods by which we ought to study single subjects, and the implications of the data for our understanding of human brain function remain unclear.

One can make an analogy to clinical case reports of unusual disease presentations, which are commonplace in medicine — while these reports provide interesting material for consideration, they do not generate or improve standards of care, instead contributing to the body of anecdotal evidence that already exists. By comparison, the randomized controlled trial remains the gold standard by which new treatments are evaluated for our understanding of disease. While in the case of randomized controlled trials we generally consider the mean result to be the most important findings, the best analogy here might be looking at the few survivors of a deadly disease in which the overwhelming majority do not survive, in order to understand the pathogenesis of the condition itself. For our purposes here, the condition would be that of creativity and the rare survivors might represent the genius exemplars/statistical outliers. In this review article, we attempt to build an argument for why we should use case studies to study exemplary musicians when investigating musical creativity, treating each artist

as a unique, individual data point. This review article discusses how case studies are already utilized to study musical disorders (such as congenital amusia), extraordinary abilities (such as in musical savants), as well as aberrant abilities (such as synaesthesia), using this literature as support for why case studies of prominent artists may be useful in research on the neuroscience of musical creativity.

Musical disorders and deficits

Case studies have already been used to study deficits and disorders like congenital amusia. Early case studies helped to illuminate the symptoms of congenital amusia — a musical disability resulting in deficits in pitch processing not due to cognitive disabilities or peripheral hearing deficits [14–16]. With increased knowledge about this disorder, recent case studies have illuminated the "heterogeneity [regarding] the nature of the impairment" (pg. 1, [17]), such as in the case of an amusic who can judge musical expressiveness [18] and an amusic musicophile who attempted musical training to combat amusia [19]. While amusia usually manifests as pitch perception deficits, 'beat deafness' is a recently documented form of congenital amusia where individuals struggle to detect regular musical beats. Case studies reveal that amusic individuals have irregular event-related potentials compared to normal controls [20], and that some individuals can struggle with rhythm perception tasks, yet still synchronize to a beat [21].

In addition to its use in studying musical disorders, case studies of unusual patients with preserved musical abilities following supposedly debilitating medical diagnoses are documented in the medical literature. For example, recent case studies detailed how a patient learned a new instrument after developing frontotemporal dementia [22] as well as how an amnesiac patient was able to learn new musical compositions [23]. In summary, for congenital amusia, recent in-depth investigations of specific individuals have illuminated the variability in the disorder. Likewise, while medical diagnoses like dementia and amnesia usually lead to loss of musical abilities, case study research illustrates how an individual can possess preserved musical functions. These case studies therefore offer a more optimistic view on life after trauma, revealing the surprising resilience of musical abilities. Because of this, case studies may prove useful to study not only musical deficits, but also enhanced musical abilities, as in the case of musical savants and prominent musical artists.

Musical savants and aberrant musical abilities

On the other side of the spectrum from congenital amusics lies the case of musical savants, rare individuals with severe cognitive and developmental impairments that yet possess 'islands of skill' such as exceptional musical talent. Case studies of savants [24] give insight into how they learn compositions, think about music, and memorize compositions, as these individuals may utilize different processes from other expert musicians [25–27]. Savant case studies offer a singular research opportunity to probe the neural and behavioral correlates of these remarkable talents. For example, in addition to often possessing extraordinary memory and improvisation abilities, many musical savants also have absolute pitch [28,29]. One recent brain scanning of artistic savant 'GW' suggests that artistic skills in savants are enhanced through intense focus and over learning, which may result in atypical brain development and differences in the thickness of certain cortical structures [30]. While savants are singular and their talent can be idiosyncratic compared to normally developing artistic experts, case study research can teach us how musical talent may be separated from general intelligence. Savants offer a unique opportunity to deconstruct talent in different domains, allowing us to ponder ways in which talent may be nurtured and cultivated (see discussion in Ref. [31]). Moreover, neural scanning, cognitive testing, and perception research on individual music savants may illustrate precisely how savants' brains and behavior differ from non-musician controls. If musical talent lies on a spectrum spanning from nonmusician controls to expert musicians to remarkable savants, biological and behavioral differences underlying musical ability (such as variations in cortical thickness and memory abilities) may exist on a spectrum as well. Case study research on savants helps to explore the 'upper end' of human creative abilities.

Case studies of normally developing expert musicians can also illuminate information about unusual, specialized music abilities such as synaesthesia. Synaesthesia is a condition in which sounds evoke colors; notable musicians such as Olivier Messiaen, Franz Liszt, Jean Sibelius, Duke Ellington, and pop stars like Pharrell Williams and Lady Gaga anecdotally report having synaesthesia.[1] Musical synaesthesia is thought to be quite rare, occurring in only about 0.2% of the population, perhaps due to aberrations in neural connectivity or communication [32,33]. Recent medical reports have used case studies of synaesthestic individuals to better understand how synaesthesia manifests, as well as how it may change with medication or head injuries [34•]. While it is unclear whether synaesthesia is adaptive, harmful, or beneficial, studying individuals with synaesthesia illuminates the outlying boundaries of how musical abilities can manifest.

Musical artists as models of resilience

Thus, case studies have been used to study deficits (i.e. amusia), extraordinary abilities (savants), and unusual abilities (synesthesia). In the case of creativity, science needs to similarly examine individuals who have shown

[1] See this BBC News article: http://www.bbc.com/culture/story/20140904-i-see-songs-in-colour.