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Albrecht Schneider
Arne von Ruschkowski
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Systematic Musicology: Empirical and Theoretical Studies

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EXTRACT

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Introduction: Systematic Musicology and Empirical Research

As is known from many sources, Greek and Hellenic philosophers and scientists directed much of their inquiry to a field covering fundamentals of music and mathematics (see, e.g. Szabo 1978, Barker 2007). Different from biased opinion according to which these approaches were based on mere 'speculation' (by the way, an approach relevant to heuristics), there is evidence that theoretical thought was accompanied by observation of nature as well as by some experimentation. In regard to music, at times also 'practical' issues were taken into account (as is obvious from the writings of Aristoxenus).

Music and music theory again played a central role within the framework of the scientific revolution that took place in Europe between, roughly, 1550 and 1750. It was during this period that basic discoveries relevant to acoustics and psychoacoustics were made (cf. Cannon & Dostrovsky 1981, Cohen 1984). Again, calculation and also 'speculation' were combined with by then much more extended and thorough observations and experiments, many of which had an impact on contemporary organology and instrument building as well as on other areas of musical practice. Also, music theory took up concepts developed in acoustics in order to maintain scientific foundations. In particular Rameau has been criticized for having introduced 'physicalism' into music theory (Handschin 1948), and Riemann has been blamed to have even conducted dubious 'moonshine experiments' to give his harmonic theory a semblance of rigour. Such criticism perhaps is not without reason. It seems inadequate though given the problems any attempt at establishing a 'scientific' music theory (demanding more than just a practical and propaedeutical orientation) had to face.

In fact, it can be shown that a certain amount of 'physicalism' in music theory was, and still is appropriate (or at least unavoidable) if music is considered first and foremost as consisting of sound organized in tonal, temporal, spectral and dynamic patterns (cf. Cogan & Pozzi 1976) that is produced by instruments (including the voice) and is perceived by listeners. Even though Rameau, Tartini, Riemann and other theorists perhaps did not succeed in solving some intricate problems in regard to defining the minor tonality, they rightly underpinned the necessity of including acoustics and psychoacoustics into music theory (cf. Schneider 2010/11). Giving music theory and music related research 'scientific' foundations implies that mathematical treatment of such matters to some degree is not only useful but indispensable (cf. Benson 2006).

From this context sketched in brief, it should be clear that Systematic Musicology as established in the 19th century by Helmholtz, Stumpf and other scientists (cf. Schneider 2008) in part must be considered as a continuation of fundamental research that was begun in antiquity and given new directions in the 16th, 17th, and 18th centuries, respectively. In particular experimental investigations and analytical studies in the field of vibration and sound paved the way for modern musical acoustics. This field, to be sure, was not restricted to theory but included various 'applications' (as is obvious from, for example, Chladni's work on developing new musical instruments; see Ullmann 1996).

Also in the course of the 19th century, areas of research now known as psychophysics and psychoacoustics were established. Empirical studies directed to basic mechanism of pitch perception did yield the now "classical" paradigms of frequency analysis (according to Fourier and Ohm) and periodicity detection (as proposed first by Seebeck and explored in the 20th century by Schouten and his students; see de Boer 1976). Also, models such as the "two-componential" helix for pitch developed by the mathematical psychologist Moritz W. Drobisch as early as 1855 made a lasting impact (cf. Schneider 2008). In 1860, Fechner published his *Elemente der Psychophysik*, in which he discussed, among many other issues, sensation and scaling of pitch and of loudness. In 1863, Helmholtz' seminal book on *Tonempfindungen* appeared, in which he established a framework ranging from acoustics and psychoacoustics to music theory. By 1890, two vols of Stumpf's *Tonpsychologie* had become available (as had the Phonograph and the Gramophone, two inventions that changed music production and distribution as well as reception of music substantially).

The field of research that emerged in the course of the 19th century, and that was labelled Systematic Musicology (Systematische Musikwissenschaft), included empirical orientation and experimental methodology from the very beginning. One could point to Helmholtz' experiments on the sensation of combination tones as well as on roughness and beats (Helmholtz 1870, 239-331), or to Stumpf's many experiments on *Verschmelzung* (Stumpf 1890, § 19), in which he acted as both "experimenter" and "subject". Stumpf gave meticulous descriptions of his observations, which were obtained in compliance with explicit rules. However, experiments where a researcher reports what he has perceived when listening to certain sound stimuli might be looked upon with suspicion by such 'empiricists' demanding "objective" measurement. Of course, Stumpf conducted also experiments with subjects having little musical training and competence, and he even gave some quantitative data in regard to perception of 'tonal fusion' (number of judgements for certain interval categories relative to percentages of correct judgements; see Stumpf 1890, 144-149). He considered such data illustrative, as they were mostly corroborating what he had already found for himself, yet not in any way decisive since the importance of a judgement for Stumpf was largely correlated with the musical competence of the experimenter acting as observer, and by no means dependent on the sample size (in Stumpf's view: a number of *n* "unmusical" subjects cannot "outweigh" one professional expert in music as their judgements are less solid and reliable, and more prone to error and circumstantial influences). It is perhaps not surprising that, after decades of experiments where researchers were often counting on observations obtained from 'random samples' comprising *k* subjects, Manfred Clynes (1995), a researcher also trained as a professional artist, stressed the role of the musical expert as someone who can do the most profound and valid judgements in experiments on music (his claim is that adequacy of judgements correlates significantly with musical proficiency).

Of course, data obtained from a single informant or subject in an experiment can constitute 'empirical evidence'. The term 'empirical' in this way should not be interpreted in the very narrow sense it was given in the context of behaviorism and operationalism in the 20th century. From a philosophical perspective, 'empirical' in Kant's epistemology (KdRV B74/75) means a mode of thinking that includes sensation and perception, and which leads to *Anschauung* (images and formation of concepts relating to objects that are 'real') as complementary to 'pure' reasoning based on abstract notions. Brentano (1874) in his philosophical psychology extended 'empirical' even to phenomena accessible by what he described as *innere Wahrnehmung* (not to be confused with 'introspection'), for example, objects stored in long-term memory (e.g., melodies) that can be 'perceived' internally.

Hume (1748/2006) had stressed the fundamental importance of experience against a priori thought and abstract reasoning (though he considered the latter legitimate in mathematics). Notwithstanding Hume's sceptical chapters on making inferences for the future from observations of past events, it was a methodology based on induction that guided much of 19th century science (along with some similarly strong concepts such as 'evolution' [natural, technical and social] and [technical and social] 'progress'). In opposition to idealist and 'mentalist' orientations, 19th century philosophy of science as developped by John Stuart Mill and Auguste Comte advanced arguments to focus research on what is 'real', 'observable', and 'positive'. Mill's (1843/1973, book III) justification of 'induction' was influential in many ways; even the concept of 'unconscious inferences' (which is an integral part of Helmholtz' theory of perception) can be identified as an offspring of 'inductivism'.

The works of Comte and Mill became well known also in Germany and Austria where 'empiricism' was further advocated by Ernst Mach whose writings on science and scientific method as well as on topics of psychology and psychophysiology where widely read around 1900-1920. At Vienna, in the 1920s and early 1930s, philosophers and scientists (coming from various disciplines ranging from mathematics and physics to linguistics and psychology) constituted a movement known as 'neopositivism' (cf. Haller 1993) that became quite influential in the United States, and in disciplines such as psychology (cf. Boring 1950). The first decades of the 20th century also saw the vast development of mathematical statistics (by Karl and Egon Pearson, Ronald Fisher, Jerzy Neyman, and others) that was a crucial condition for a new paradigm to emerge in psychology summed under the title of "The Inference Revolution" (Gigerenzer & Murray 1987, ch. I). It was during the years 1940-1955 that statistical concepts gained a prominent place in experimental design, and that testing of hypotheses as well as using inferential statistical methodology were regarded state of the art (if not mandatory) in psychological research. Researchers were expected to present "significant" results (by refuting a "null hypothesis" H_0) if they wanted to see their work published.

The scheme of formulating (in the most simple case) pairs of hypotheses (H_0, H_1) and then "test" $H_0 : H_1$ works perfectly well since it assumes (often implicitly) that two points X_i and X_j representing the [arithmetic] means for a random variable from two samples drawn at random from a population are sufficiently apart from each other ($X_i \neq X_j$) as well as from the mean of all means derived from samples (i.e., the 'population parameter', μ). It can be shown that for a random variable representing a property or feature that is normally distributed within a given population, the likelihood for the two cases H_0: $\mu - X_i = 0$ and H_0: $X_i = X_j$ to occur in a standard normal distribution is close to zero. That is, H_0 represents the two most unlikely cases, and hence can be typically "refuted" with ease while it is more demanding to "prove" H_1 (see Bortz 1984, ch. 5).

The "Inference Revolution" led almost directly to the "mind as computer" metaphor since some models of causal reasoning apparently treated the mind as calculating a Fisherian ANOVA including the F-test in making decisions (cf. Gigerenzer 2000, ch. 1). The "Inference Revolution" was followed by what has been labelled "The Cognitive Revolution" (see Gardner 1987), which includes several and quite diverse ingredients (from the rise of computer science and 'artificial intelligence' to developments in brain research and neurophysiology, not to forget a reactivation of Gestalt psychology within a new framework). One of the welcome effects of this 'revolution' was a to break the barriers of behavioristic 'empiricism' and to restitute 'the mind' as a meaningful area of research accessible to both theoretic reasoning and empirical investigations (see Botterill & Carruthers 1999, Metzinger 2003). The paradigm of cognitivism opened fresh perspectives for inter- and transdisciplinary research that soon included perception and cognition of music (see, e.g., Howell et al. 1985, Sloboda 1985, Dowling & Harwood 1986, Bregman 1990, Leman 1995, 1997, Godøy & Jørgensen 2001, Deliège & Wiggins 2006). In the context of cognitivism, modelling, simulation and also advanced statistical methodology have gained central roles (cf. Leman 2008, Müllensiefen 2010).

Two recent volumes (24, 2008 and 25, 2009) of the *Hamburger Jahrbuch für Musikwissenschaft* have been devoted to Systematic and Comparative Musicology (see Schneider 2008, Bader 2009). Both volumes offer a range of studies from musical acoustics, psychoacoustics, psychology of music and neurocognition but also include articles on 'systematic' music theory (as different from historical approaches) and on methodological issues. Further, both volumes contain ethnomusicological contributions as well as articles dealing with folk and popular music(s).

The volume at hand shows a similar pattern of content reflecting a broad spectrum of research as well as an inter- or transdisciplinary perspective (which was characteristic of Systematic and Comparative Musicology from the very beginning). Some of the articles include considerations and results that may be of use in 'applied' contexts such as public health or sound system design. After all, it has been argued that 'science' these days should take greater responsibility in regard to 'society' at large, meaning the days of small elitist circles working within 'peer groups' of experts secluded from 'the world' may be numbered, or at least that 'the public' may want to see even more benefits from science than it did already (cf. Nowotny et al. 2001). Though Systematic Musicology almost by definition has a focus on fundamental research covering musical acoustics and psychoacoustics, psychology of music and related areas (cf. Leman 1995, 1997, 2008, Schneider 2008, Bader 2005, 2009, Godøy & Leman 2010), this does neither preclude practical applications nor that sociocultural phenomena are duly considered. In this respect, the present volume offers articles on popular and folk music as well as a study of concepts and ideologies pertaining to “ethno” and folk music research in addition to those papers that take an approved or new 'empirical' direction in regard to method and content.

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Albrecht Schneider Arne von Ruschkowski