THE ROLE OF ICT IN MUSIC RESEARCH: A BRIDGE TOO FAR?

HENKJAN HONING

Introduction

While the wide spread availability of the computer and Internet undoubtedly has had a major influence on our society, it is less clear what its impact has been on research in the humanities. Critics blame humanities' scholars for conservatism,[1] preferring paper, pen and handwork over novel technological gadgets. Others see the use of computer technologies in the humanities mainly restricted to, but well put to use, in applications like the digital library.[2] Although the latter is an important example of information and communication technology (ICT), it is unclear what the actual impact ICT has had on the research methods and research questions posed. Given the observation that for most humanities scholars the use of ICT has not progressed beyond word-processing, using email, and browsing the web,[3] one could argue that, apparently, there is no real need for more advanced uses of ICT, and hence its impact on humanities research might well be negligible. However, in some specific areas of the humanities, including archeology, linguistics, media studies and music, ICT has allowed new research questions and new methodologies to emerge. In this paper, I will focus on the role of ICT in music research, especially the influence it had on the development of the fields of empirical and cognitive musicology.

Musicology - and beyond

Musicology is a relatively young discipline, with its current architecture largely shaped by Guido Adler in the 19th century.[4] He divided musicology into two major fields of historical and systematic musicology. As the naming suggests, historical musicology is concerned with the history of music, arranged by

International Journal of Humanities and Arts Computing 1 (1) 2007, 61–69
DOI: 10.3366/E1753854808000104

epochs, peoples, empires, countries, provinces, towns, schools, and individual artists using historiographic methods. Systematic musicology is concerned with the investigation of the chief laws applicable to the various branches of music, aesthetics, the psychology of music, music education, and the comparative study in ethnography and folklore. The latter being the category 'miscellaneous', one could say.

While in Adler's time the study of music was restricted to a small elite of music experts, nowadays scholars and scientists from psychology,[5] sociology,[6] cognitive science,[7] cultural theory,[8] and even archeologists[9] also consider music an interesting and important domain to investigate. And they can not be blamed. Music is at least as multi-faceted as language. However, language as a research topic has attracted considerably more research than music. And one can seriously question why the field of musicology did not grow as much as linguistics did in the last fifty years.

Different possible explanations come to mind. One could be that musicology is indeed what some of its critics say: a relatively conservative discipline that studies the cultural and historical aspects of music using familiar descriptive and critical methods, hence leaving out all topics Adler labeled as the systematic field. Another, more attractive explanation could be that musicologists are simply not (yet) equipped with the appropriate knowledge and tools to study music in a truly systematic way. Although most musicologists base their work on texts and scores (using paleographic and philological methods), alternative methods are needed for music with no notation or score (such as the larger proportion of music around the world) or for music in which the actual sound is a more relevant source of information (e.g., electronic music genres ranging from *musique concrète* to drum & bass).

Ethnomusicologists were confronted with this situation early on[10] and it prompted the adoption of methodologies from disciplines like physics (e.g., measurement), psychology (e.g., controlled experiments), sociology (e.g., interview techniques) or anthropology (e.g., participating observation). It is the use of methods from other disciplines that, in my opinion, might have been the cause of some delay in the development of musicology as a field, since mastering this wide variety of methodologies, most of which are never really touched upon in the curriculum of the humanities, is not an easy task.

Fortunately, in the last two decades it became clear what the methodological toolbox for musicologists could be.[11] In the next section two recent strands of musicological research will be discussed – empirical and cognitive musicology – that can serve as an example of the growing role of ICT, measurement, and experimental method in musicology. Both perspectives will be illustrated with an example of recent research.

THE ROLE OF OBSERVATION: EMPIRICAL MUSICOLOGY

Empirical musicology, or 'new empiricism' as the musicologist David Huron calls it,[12] grew out of a desire to ground theories on empirical observation and to construct theories on the basis of the analysis and interpretation of such observations.[13] It came with the revival of scientific method promoting the pursuit of evidence and rigorous method, after a period of considerable criticism on scientific method in the postmodern literature.[14] The arrival of new technologies, most notably that of MIDI[15] and of the personal computer, were instrumental to the considerable increase in the number of empirically oriented investigations into music.[16] This increase in empirical research is also apparent in the founding of several new scientifically oriented journals, including *Psychology of Music* (1973), *Empirical Studies in the Arts* (1982), *Music Perception* (1983), *Musicae Scientiae* (1997), and most recently *Empirical Music Review* (2006).

A seminal example of this development is a study by Nicholas Cook on the well-known conductor Wilhelm Furtwängler (1886–1954).[17] This study was prompted by a longstanding disagreement between two music scholars: Paul Henry Lang, who was a record critic for *High Fidelity* magazine in the late 1960s, and Peter Pirie, a musicologist and author of *Furtwängler and the art of conducting* (1980).[18] According to Lang, Furtwängler was a 'dyed-in-the-wool romantic, favoring arbitrary and highly subjective procedures in tempo, dynamics and phrasing', with the word 'arbitrary' referring to Furtwängler's inability to keep a steady tempo.'[19] Peter Pirie could not disagree more with Lang's characterization of Furtwängler's conducting. For Pirie, the way Furtwängler performed Beethoven was anything but arbitrary. He considered Furtwängler's 'flexible declamation' a fundamental aspect of his conducting style.[20] Such an argument is a typical example and result of a critical approach to the study of art, an approach that often results in unresolved differences in interpretation, even when, at least for some research questions, this is not needed at all.

Cook tried, in his 1995 study, to objectively answer the question of whether Furtwängler could (or could not) keep a steady tempo. For this he chose a straight-forward, yet for musicologists relatively novel, empirical approach by simply measuring the tempo fluctuations in a variety of commercially available recordings (using off-the-shelf ICT hard- and software).[21] A fragment of these measurements is presented in Figure 1. For the two historic live recordings shown here, most interpretative details were kept the same by Furtwängler, revealing very similar slowing down or speeding up patterns at characteristic structural points in the musical score. While some detail in the use of timing and tempo was changed, overall, Furtwängler had a clear, decided upon, idea of how the tempo for this composition had to be conducted, and was able to stick to this interpretation even in a concert recorded two years later. Using these relatively

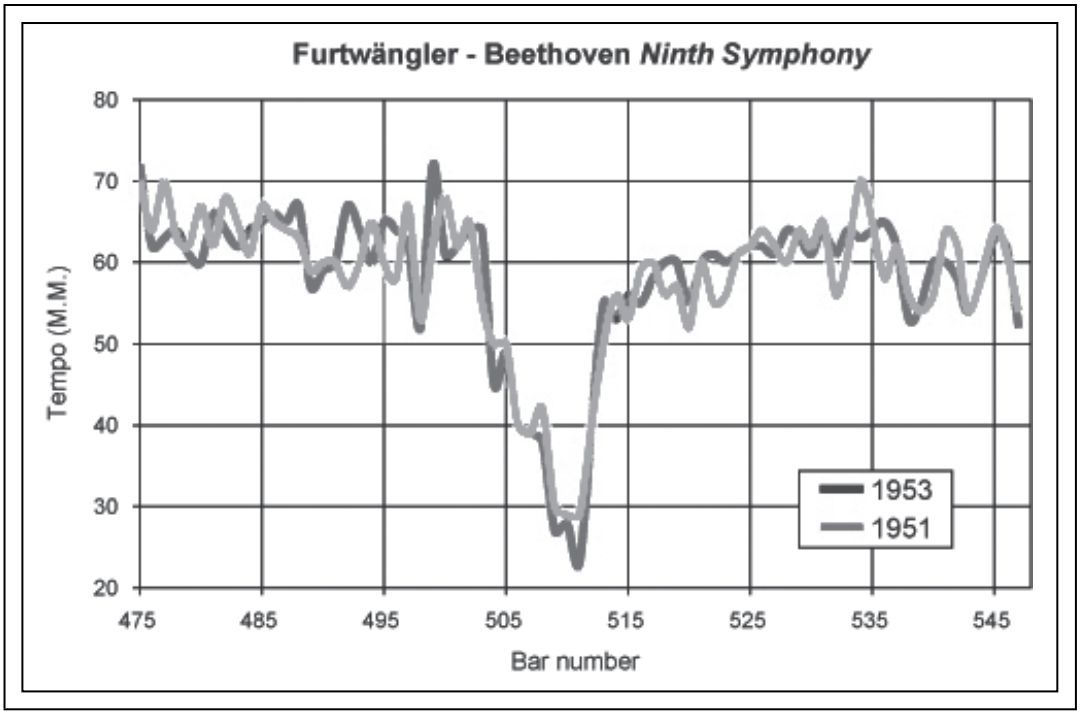

Figure 1. Tempo measurements of Furtwängler's 1951 and 1953 live recordings of Beethoven's Ninth Symphony (coda). The numbers on the x-axis refer to the bars numbers in the musical score, the numbers on the y-axis refer to the measured tempo (the higher the faster).[22]

simple measurements of tempo, Cook could decide the longstanding argument in favor of Pirie.

THE ROLE OF CONTROLLED EXPERIMENTS: COGNITIVE MUSICOLOGY

As discussed above, empirical musicology became relatively successful in the 1980s, giving a new boost to music performance studies. It proved a convincing alternative to the idea that music performance is too subjective to study scientifically. However, empirical results solely based on the method of measurement resolve only part of the research questions relevant to music research. For example, one has to keep in mind the possible discrepancy between what one measures (cf. Figure 1) and what a listener is actually aware off or perceives in a musical situation (cf. Figure 2). While 'new musicology"[23] invoked the frame of subjectivity (in fact declaring it impossible to study the

arts scientifically), the advocates of cognitive science approached it in a more constructive way by refining scientific tools that allows one to study subjective experience. The application of these methods and techniques to music gave rise to the domain of cognitive musicology (or music cognition), an area of scientific inquiry that materialized in the margins of psychology, computer science, and musicology.[24]

An example of this line of research is a study on the use of timing and tempo in piano music.[25] It combines techniques from ICT and computer science with methods from experimental and cognitive psychology aiming to answer questions on the commonalities and diversities as found in music performance: what is shared among music performances and what changes in each interpretation? More specifically, the study addresses the question whether an interpretation changes when only the overall tempo of the performance is changed. Instead of measuring performances (as in the Furtwängler example discussed above), in this study the question was operationalized: can listeners hear the difference between an original recording (by one pianist) and a manipulated, tempo-transformed recording (by another pianist)? The tempo-transformed recording was originally recorded at a different tempo but was made similar in tempo to the other performance using an advanced time-scale modification algorithm. The task was to judge which of the two performances – now both in the same overall tempo – was an original recording while focusing on the use of expressive timing. (See Figure 2 for a fragment of the user interface of the online listening experiment).[26]

What can we expect the results to be? One hypothesis, based on the psychological literature, suggests that listeners can not hear the difference (the 'relational invariance' hypothesis). Since the timing variations of the pianist are scaled proportionally, both versions will sound equally natural, so that the participants in the listening experiment will consider both versions musically plausible performances, and, consequently, just guess what is an original recording. An alternative hypothesis is that listeners can hear the difference (the 'tempo-specific timing' hypothesis). It is based on the idea that timing in music performance is intrinsically related to global tempo. When the timing variations are simply scaled to another tempo (i.e., slowing it down or speeding it up proportionally) this may make the performance sound awkward or unusual, and hence easier to identify as a tempo-transformed version.

The results of this study are summarized in Figure 3. The majority (on average, 70%) of the 162 participants (primarily students of the University of Amsterdam and Northwestern University) could correctly identify an original recording by focusing solely on the timing used by the pianist (since both fragments had the same tempo). This result was taken as support for the tempo-specific timing hypothesis – which predicts that a tempo-transformed performance will sound awkward as compared to an original performance – and

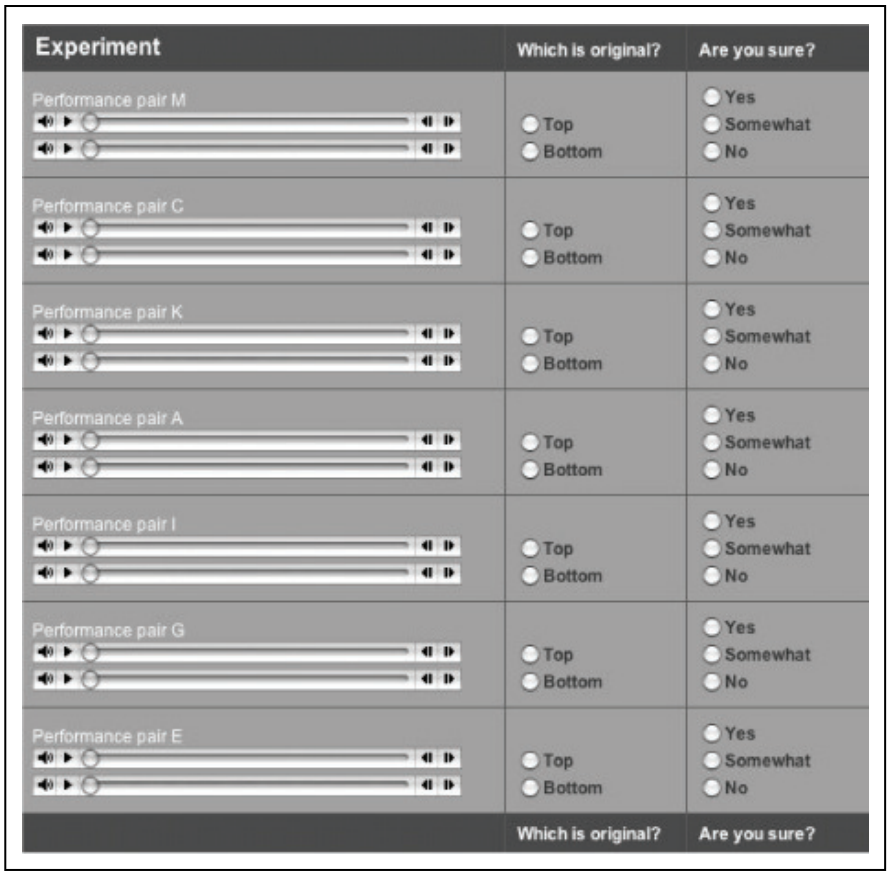

Figure 2. Fragment of the internet user interface showing the presentation of the audio fragments that had to be compared (see http://www.hum.uva.nl/mmm/exp/).

as counterevidence for the relationally invariant timing hypothesis, which predicts that a tempo-transformed performance will sound equally musical or natural. As such this result cleared up a longstanding argument of whether performers do or do not adapt their timing to the tempo chosen, and, if so, whether listeners are sensitive to this.[27]

This study is just a small example of how methods from cognitive science – choosing an experimental design that allows one to use real music (i.e., CD recordings instead of MIDI performances, or even clicks or simple sine tones) and subjective judgments by a panel of experienced listeners – allow scientific inquiry of music perception and performance. The example also hints at the further potential of ICT for empirical studies in the humanities. The technology

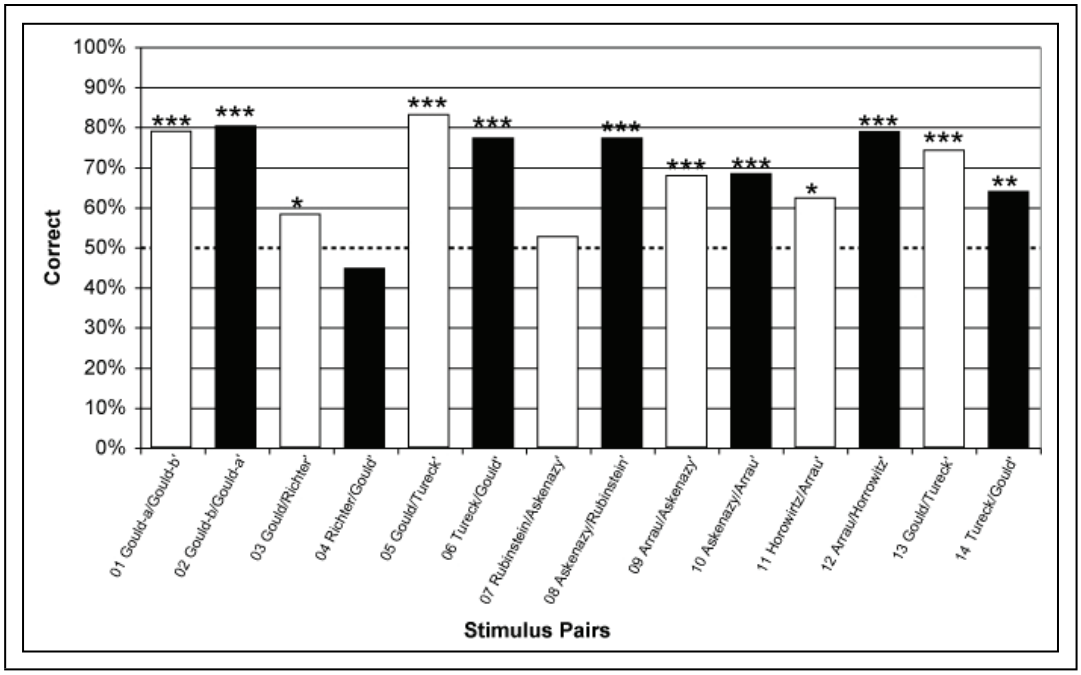

Figure 3. Results of a listening experiment (162 participants) using compositions from the classical and romantic piano repertoire as recorded by pianists such as Glenn Gould, Vladimir Horowitz and Rosalyn Tureck (A quote indicates a tempo transformed recording; Statistical significance levels are indicated with asterisks; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).[28]

used here (for a more elaborate description, see Honing, 2006), combines widely available ICT technology with well-understood methods from the social sciences. Together, they form a powerful toolkit for the modern musicologist and opens up a whole new area of cognitive research in the arts and humanities.

CONCLUSION

The past two decades have witnessed a significant increase in scientifically inspired music research in which the role of ICT, measurement, and experiment became influential methods that contributed to a further understanding of music as a process in which the performer, the listener, and music as sound play a central role. These developments not only enriched musicological research itself, it also influenced the main issues addressed in other areas of research like psychology and (neuro)cognition, slowly diminishing the 'trade deficit' that

musicology built up over its existence as a discipline. For example, music was for years only a minor topic in the psychology text books, hidden away in a section on pitch perception, in recent years several disciplines, ranging from cultural theory to archeology and psychology to computer science, have shown a growing interest in the scientific study of music. This puts music in the center of attention and research activity – next to language, where it belongs.

END NOTES

[1] See, e.g., W. Bijker & B. Peperkamp (eds.). *Geëngageerde geesteswetenschappen – Perspectieven op cultuurveranderingen in een digitaliserend tijdperk*. The Hague 2002; and a critical commentary G. de Vries, 'Dienstbare alfa's', *De Academische Boekengids*, 4/4, (2004).

[2] See, e.g., E. Viskil. *Een digitale bibliotheek voor de geesteswetenschappen. Aanzet tot een programma voor investering in een landelijke kennisinfrastructuur voor geesteswetenschappen en cultuur*. NWO-Gebiedsbestuur Geesteswetenschappen, The Hague 1999.

[3] D. Robey, J. Unsworth & G. Rockwell, 'National Support for Humanities Computing: Different Achievements, Needs and Prospects', *Proceedings of the ACH/ALLC Conference*, University of Victoria, 2005.

[4] G. Adler, 'Umfang, Methode und Ziel der Musikwissenschaft' in: *Vierteljahresschrift für Musikwissenschaft* 1 (1885).

[5] D. Deutsch (ed.), *Psychology of Music* (2nd edition), New York 1999.

[6] S. Frith, *Music for pleasure: essays in the sociology of pop*, New York, 1988.

[7] H. C. Longuet-Higgins, *Mental Processes. Studies in Cognitive Science*, Cambridge, MA 1987.

[8] E. W. Said, *Musical Elaborations*, London 1992.

[9] S. Mithen, *The Singing Neanderthals: The Origins of Language, Music, Body and Mind*. London 2005.

[10] C. Seeger, 'Systematic musicology: Viewpoints, Orientations, and Methods', in: *Journal of the American Musicological Society* 4, (1951), pp. 240–248,

[11] See, for example, T. DeNora, 'Musical Practice and Social Structure: a Toolkit', in: E. F. Clarke & N. Cook (eds.), *Empirical musicology: Aims, methods and prospects*, Oxford 2004, p. 37.

[12] D. Huron, 'The New Empiricism: Systematic Musicology in a Postmodern Age', Berkeley, University of California 1999, http://www.music-cog.ohio-state.edu/Music220/Bloch.lectures/3.Methodology.html, p. 2.

[13] J. Rink, (ed.) *The Practice of Performance: Studies in Musical Interpretation*, Cambridge 1995; E. F. Clarke & N. Cook (eds.) *Empirical musicology: Aims, methods and prospects*, Oxford 2004.

[14] For an overview of this discussion see D. Huron, 'The New Empiricism'.

[15] Commercial standard for the exchange of information between electronic instruments and computers.

[16] See for an overview, e.g., E. F. Clarke, 'Rhythm and timing in music', in: D. Deutsch (ed.), *Psychology of Music* (2nd edition), New York 1999, pp. 473–500; A. Gabrielsson, 'The performance of music', in D. Deutsch (ed.), *Psychology of Music*, New York 1999, pp. 501–602.

[17] N. Cook, 'The conductor and the theorist: Furtwängler, Schenker, and the first movement of Beethoven's Ninth Symphony,' in: J. Rink (ed.), *The Practice of Performance,* Cambridge: Cambridge University Press, pp. 105–125.

[18] P. Pirie, *Furtwängler and the Art of Conducting*, London 1980.

[19] P. H. Lang, 'The Symphonies'. In: *The Recordings of Beethoven as Viewed by the Critics from High Fidelity*, Westport, Connecticut 1978.

[20] P. Pirie, 'Furtwängler and the Art of Conducting'

[21] Cook used a technique that involved playing the CD in the CD-ROM drive of a computer and tapping the space bar of the computer keyboard in synchrony with the onset of each bar, its inter-bar intervals (IBI) being recorded and converted to a measure of tempo (1/IBI).

[22] Adapted from Cook, 'The conductor and the theorist'.

[23] New Musicology: a branch of music scholarship that is guided by a recognition of the limits of human understanding, an awareness of the social milieu in which scholarship is pursued, and the realization of the political area in which the fruits of scholarship are used and abused.

[24] H. Honing, 'The comeback of systematic musicology: new empiricism and the cognitive revolution' *Dutch Journal of Music Theory* **9**/3 (2004) pp. 241–244.

[25] See for more details H. Honing, 'Evidence for tempo-specific timing in music using a web-based experimental setup'. *Journal of Experimental Psychology: Human Perception and Performance,* **32**(3), (2006); H. Honing, 'Timing is tempo-specific'. *Proceedings of the International Computer Music Conference*, Barcelona (2005) pp. 359–362.; H. Honing, 'Is expressive timing relational invariant under tempo transformation?' *Psychology of Music* (in press).

[26] To realize this technology in an academic environment is an interesting topic on its own (Google the word 'Vulpennenbeheer' to get a rough idea).

[27] B. H. Repp, 'Relational invariance of expressive microstructure across global tempo changes in music performance: An exploratory study.' *Psychological Research* **56** (1994) pp. 269–284.

[28] Adapted from Honing, 'Evidence for tempo-specific timing in music using a web-based experimental setup'.