Lute tablature as the embodiment of musical cognition

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Music of the past (or even thought about music from past eras) comes down to us exclusively through the medium of manuscript or printed documents. Perhaps the most radical thing we are attempting in this workshop is to look at ways in which documents represent in some way the minds of those who originally created and/or used them. The marks in these documents that tell us most about the music itself are what we call music notation. In what follows, I take as axiomatic the view that a study of what these sources can tell us must start by considering the primary documents themselves (albeit of necessity encoded in machine-readable form) rather than secondary sources or editions.[1]

Very broadly, we can divide music notations into two types, descriptive and prescriptive (although there is a certain amount of inevitable leakage between these categories). Descriptive notations assume a certain set of cognitive assumptions about the relation of the notation to the music itself (e.g.: notes high on the stave sound 'higher' in pitch than those lower down; events to the left occur earlier in time than those on the right[2]) and they thus provide a graphically encoded representation of the structure of the music. A notation of this sort can therefore be read (and often mentally 'auralised') by any musician with an understanding of the general abstract context of those cognitive assumptions – what we might call the underlying 'music theory'.

Prescriptive notations, on the other hand, assume the presence of an instrument, tuned in a certain way, in the hands of a player, and inform him or her what actions to perform to realise the music in sound; such coded instructions are thus almost meaningless to a person without experience of that instrument.[3] Although some prescriptive notations (such as that used for scordatura violin in the 17th and 18th centuries) make use of the symbols of a descriptive notation, these now carry a different meaning, even if the outward appearance is similar. In most prescriptive systems, a rather different system is used, based on a physical rather than a conceptual model, as in lute tablature, where symbols (letters or numbers on a 'stave') giving the positions of the left-hand fingers on the frets and strings as

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[1] In fact, of course, the distinction between primary and secondary sources of 16th-century music is sometimes difficult to make. It might be simpler to say that I regard all sources as of interest, but in making judgments about musical cognition in a certain period I would prefer in all cases to use sources from that period as data rather than modern editions. There is a good case to be made that 'performing' editions, by great performers or composers, for example, can tell us a good deal, but probably at least as much about the editor as about the composer in most cases. [See, for example, Barth, 1991.]

[2] In this case the assumption probably derives from the left-right narrative flow of text in western-European languages such as Latin

[3] In this discussion, I only consider tablatures for stringed instruments, despite the existence of tablatures for other instruments, even wind instruments such as the flageolet.

'coordinates' to produce the required notes are presented together with separate symbols indicating the relative rhythmic onsets of events in the music.[4]

One major effect of this difference between descriptive notations and prescriptive ones such as lute tablature is that the latter can allow a player to perform to a certain level without any but the most rudimentary understanding of the formal rules and theory of music. As well as explaining the derogatory terms in which the opinions of some eminent lutenists were sometimes dismissed in the 16th century,[5] it may also explain the enduring popularity of tablature for transmitting popular guitar music; a recent PhD thesis reported the existence of over 20,000 online tablatures featuring arrangements of the songs of the Beatles alone! [Macrae, 2012]

When we use the information embedded in music notation as data for a study of musical cognition, it is important to realise that we are dealing with a different kind of data than that obtained in, say, a well-controlled psychological experiment. We are now subject to the vagaries of transmission (scribal errors, misprints and source-damage) and run all the risks connected with editorial interpretation where elements of the data are missing, unclear or ambiguous; this is familiar territory to musicologists, but needs proper handling in a computational approach. Arguments built upon a chain of suppositions arising from data that is provisional in this sense may have to be revised or discarded 'on the fly' as alternative interpretations of the data are visited.

Despite these dangers and difficulties, there seems no doubt that enough reliable data can be derived from historical musical sources to allow us to carry out useful investigations of musical cognition at some level; by the same token, if used properly modern editions can also provide suitable data-sets for this, as long as the limitations of the approach are understood. The one outlined by Marcus Pearce in his talk depends on large quantities of simple pitch/duration data; the precise chromatic pitch-spelling of music before 1650 is, in countless cases, likely to be subject to the convictions or intuitions of modern editors, unlike the diatonic data on which it is based. While this may be an unsatisfactory state of affairs according to the precepts of conventional (modern) harmony, models built on diatonic pitch will thus be less subject to 'noise' arising from differing applications of *musica ficta* and in this sense more objectively reliable than those which use the full chromatic data.[6]

It is useful to think of musical documents as conveying three types of information: explicit, implicit and hidden. For example, a 16th-century vocal part conveys explicit diatonic pitch but the details of chromatic pitch are implicit, and affected by the application of rules and customs of performance

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[4] This system (at least for the indication of pitch), using a code of unique symbols for the string/fret coordinates, was first developed in China as early as the 8th century; it was independently re-invented by Conrad Paumann in the mid-15th century with the addition of signs for rhythm values above the stave.

[5] The Bolognese music theorist, Giovanni Spataro (1458-1541), expressed in a letter to the organist Cavazzoni his surprise that his friend and fellow-theorist, Pietro Aaron (1480-after 1545), had sought the opinion of a mere 'pulsatore de istrumento' ('instrument-strummer'), Marco dall'Aquila (one of the most distinguished lutenists of his age), in a subtle theoretical matter. [Prosser, 2007]

[6] It will, of course, be most interesting to discover whether there is a significant difference in predictive capability between the two pitch systems.

practice that are only available to us in vestigial form from treatises that often diverge in their advice. (I shall be mentioning examples of hidden information later.)

My own research centres on music for the lute which survives almost exclusively in tablature. The Electronic Corpus of Lute Music (ECOLM) is intended to enable the study of the large repertory of music for what was arguably the most important instrument of the Renaissance for those who do not understand tablature.[7] Within the ECOLM system,[8] full-text encodings of complete sources (where possible) are stored and managed in a relational database that is most conveniently accessed via task-specific interfaces which only require a reasonably up-to-date web browser. The encoding system is TabCode, an ASCII-based code that, while reasonably human-readable in its basic form, is intended to be hidden from users most of the time, as its more advanced features render its appearance somewhat daunting to the non-technical reader.[9] A server-based system can render pages of tablature from TabCode using appropriate fonts with or without the page-layout of the original source.

At the beginning of ECOLM, photographic images of the original sources were not presented publicly, mainly for rights reasons. In the current funding phase, a project in partnership with the British Library and the UK Lute Society, we are encoding a significant proportion of 300 items of 16th-century printed music which were recently made available as digital images on a rights-free basis by the BL in the Early Music Online project.[10] We are using state-of-the-art optical recognition methods to encode both lute tablature and mensural notation (Optical Tablature Recognition [Dalitz and Karsten, 2005; Dalitz and Pranzas, 2009] and Optical Music Recognition [Pugin, 2006], respectively). Inevitably errors will occur in the automatic recognition process, and to ensure the encoded versions correspond exactly with the original sources we are enlisting members of the highly-active online community of lute players, all of whom are entirely familiar with tablature notation, providing them with a special editing interface that requires no special computer skills.

The present ECOLM corpus of around 2,000 lute pieces will thus be expanded by a further 1,000 or so, with approximately the same number of vocal items encoded in the MEI format. [MEI, n.d.] Together with the EMO metadata, which includes the full BL catalogue record for each book, this provides the basis for a remarkably rich potential research environment for the study of 16th-century music which could be exploited in a number of different ways.

Tablature can be seen as a kind of program listing giving time-stamped instructions for sounding notes on an instrument. This is remarkably close to what a MIDI file does for a synthesiser; in fact the Spanish keyboard tablature used by Cabezon even uses a number representation essentially identical to that of MIDI. What lute tablature does *not* do is tell the player how long a note should sound (though I shall be coming back to this point later), nor how its pitch should be spelt diatonically (is this note a “g

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[7] ECOLM has received three grants from the Arts and Humanities Research over the past twelve years; it is currently funded until the end of 2012 under the AHRC’s Follow-On Funding Scheme.

[8] http://www.ecolm.org

[9] TabCode is fully documented on the ECOLM web-site.

[10] Funded by JISC UK; web-site at http://www.earlymusiconline.org

sharp" or an "a flat"?), although the latter can often be determined by context assuming a certain tuning of the open strings.

Approximately one half of the 16th-century repertory for the lute comprises arrangements ('intabulations') of vocal music (by the late 16th century this included some intabulations of instrumental ensemble music). These took several forms, from literal note-for-note translations of the music into the instrumental medium (usually idiomatically embellished), through similar translations with interpolated free-counterpoint 'glosses', to more abstract fantasies based more-or-less consistently on a vocal model.[11] In fact there are certainly many examples of the latter for which, because it is not explicitly named in the title, the vocal model remains to be discovered. [See Ness 1988]

Sometimes intabulations of the first kind were intended to be played along with singers, so that (some of) their parts were continuously doubled. This does not fit well with our modern concept of vocal chamber music. But we also know that some players were especially esteemed for their art in playing intabulations as solos. In a letter written by the highly musical Moritz, Landgrave of Hesse, (himself a composer and lutenist) in 1595, the great and internationally famous English lutenist John Dowland is merely described as 'a good composer', while his contemporary, the Flemish Gregorius Huet is singled out as a 'perfect' lutenist, in particular citing his performance of motets and madrigals. [Poulton 1972, p. 34]

Intabulation can be approached along a continuum between 'idealistic' and 'pragmatic'; an ideal intabulation would reproduce all the voice-leading of the original (presumably audibly), while a pragmatic one may simply outline a single voice in a recognisable form with an accompaniment that might diverge from the remaining voices in the original, usually to make the music easier to play on the lute. (Or could there be an aesthetic motivation? At what point does arrangement become composition?)

Can we distinguish these approaches? Given a vocal model, it may be possible to rank the extent to which the original voices are reproduced in various intabulations by counting which notes have been omitted. This is a fairly straightforward matter of pattern-matching on the pitch/time dimensions of the two versions. This is an example of the use of *explicit* information.

However, from this explicit information we might be able further to determine a good deal of *implicit* information concerning, say, which voices are globally more important to reproduce in an arrangement (e.g. it would be surprising if maintaining the superius and bassus were not of high priority), and which local contexts lead to changes in the global pattern (e.g. is the precise voice-leading of inner voices maintained at cadences, or is there a tendency for it to be replaced by stock lutenistic clichés?).

Both of these examples of explicit and implicit information are essentially *bottom-up*, and have something to tell us about the way 16th-century lutenists understood the music they wished to perform.

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[11] This is a frequently-explored topic in musicological research; two seminal papers are Ward 1951 and Brown 1974

On the other hand, there are a number of 16th-century treatises on arranging vocal music for lute which, although they do not necessarily agree in every aspect, can provide a good source for *top-down* expert information that might be compared with the bottom-up evidence of the musical sources themselves or, indeed, used to supplement it as extra data in our investigation of music cognition.[12]

An interesting further line of enquiry concerns the specific motivation behind each of the sources. While this is largely a matter of conventional document scholarship to which computational techniques cannot be applied in any obvious way, it has bearing on the information content of those sources. Many of the early printed books, including all those from Petrucci, contain instructions on reading the tablature, sometimes extended to include explicit advice about lute-playing – in some cases it is explicitly intended for those who cannot hire a lute-teacher. In the case of manuscripts, it turns out that the majority of sources from all periods of the lute's history can in some way be associated with teaching; often they are written by a lute master, sometimes with interesting interpolations or comments by the pupil. Other sources were compiled in order to preserve the music for posterity

The explicit and implicit examples I mentioned above would, of course, have their parallels in any form of musical notation that conveys pitch information, including mensural notation. Tablature, however, is also a source of what might be called hidden information – hidden, that is, from those who do not play the instrument. Such information embraces the 'performative' dimension, and it is here we introduce the concept of *embodiment*: what the player's hands can achieve to realise the music in terms of sound.[13] As any beginner on an instrument soon learns, some things are harder to play than others. This applies on the level of individual notes – open strings are obviously easier to play than stopped ones – as much as to 'vertical' combinations of notes such as chords; those that involve large physical stretches between the fingers or painful distortions of the hand are clearly harder to play.

But it applies further in 'horizontal' combinations: a sequence of notes that requires several changes of left-hand position is harder to play than one where the left hand is stationary (even if it involves the same actual pitches). Then there is the matter of sequences of chords, which may involve the re-positioning of several fingers between members of the sequence. A note requiring a change of hand-position, or a chord that is hard to play takes longer to reach. Without a lot of practice this can give rise to an ugly gap in a musical phrase; alternatively, however, a feature of this sort might, according to context, be regarded as deliberate, maybe suggesting an implicit point of articulation in the music.

Left-hand fingerings are sometimes given in early sources (especially manuscripts); right-hand (plucking) fingerings of a simple kind are more-or-less ubiquitous: the use of a dot under the letter or

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[12] A comprehensive list of printed Italian lute tablature instructions is given in Fabris 1997.

[13] I should stress at this point that I do not believe this is in any way unique to the lute, and much of what I have to say applies to most other instruments. Many of these matters are routinely discussed by piano and violin teachers, of course, and a large body of musical literature in the form of tutors and performing editions has been effectively devoted to expressing the musical cognition of individual performers and teachers by embodiment techniques such as fingering.

cipher representing an isolated note to indicate the use of the first finger is universal, and always occurs in the metrically-weaker position, the stronger notes being taken by the thumb.

While this use of the right-hand first finger is mentioned as a rule by almost all treatises on lute-playing at all periods, it does not, I think, tell us very much about musical cognition, except in the rather exceptional case of a few early manuscript lute-tablature sources in which the rhythm signs are missing altogether. In such cases, right-hand fingering dots are present, and clearly gave important implicit metrical information to the player which had to be conveyed in performance.

More obviously dealing with the kind of musical cognition this meeting is concerned with are the various signs used in lute tablatures to tell the player which left-hand fingers to hold down (so-called 'tenuto' signs). While like chord-sequences these need to be interpreted with some understanding of their embodied context (literally-followed tenuto signs can vary greatly in difficulty of execution), they often carry clear and fairly unambiguous implications about how voice-leading should be interpreted by the player. The extent to which this matches with an original vocal model can be measured, and will vary depending on that arranger's attitude to the model.

In the musicological literature, the most-frequently discussed aspect of lute intabulations has traditionally been the application of *musica ficta*, the necessary addition of accidentals to the basic diatonic information provided by mensural notation. This has given rise to a great deal of controversy, especially where any attempt is made to use this evidence to support one or other universal theory about the subject; there seems to have been a great deal of diversity of opinion even in the 16th century. An advantage of a computational approach beyond the expected and necessary degree of objectivity (in both coverage and application) is that each case can be considered on its own merits and yet simultaneously contribute to a cumulative understanding of the topic, in which the precise context is embedded and brought to bear on the discourse.

An interesting side-issue is the analysis of lute tablatures to determine what role *musica ficta* played in the composition and notation of music that is *not* based on a vocal model. In turn this relates to the fascinating question of the relation of lute tablatures to modality (see Frans Wiering's talk) and the gradual emergence during the 16th century (especially marked in the genre of dance music) of what was before long to emerge as 'modern' tonality.

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BIOGRAPHY

Tim Crawford worked for 15 years as a professional lutenist before becoming an academic. He joined Goldsmiths, University of London in 2004, where he was appointed as Professorial Research Fellow in Computational Musicology in 2011. His musicological work is mostly centred around lute music, especially that of the 18th century. He is the current editor of the *Complete Works* (over 650 pieces) of the German lutenist, Silvius Leopold Weiss (1687-1750). Other research has involved music for the viola da gamba, the early violin and other instruments in Germany, France, Holland and England. Since the early 1990s he has been active in the rapidly-expanding field of Music Information Retrieval; he was the UK coordinator for the international project, OMRAS (Online Music Recognition and Searching), which involved a team of almost a dozen part- or full-time researchers. He is currently President of the International Society for Music Information Retrieval.