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Approaches to the Use of Iconography in Historical Reconstruction, and the Curious

Case of Renaissance Welsh Harp Technique.

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It is an oft-repeated cliché that 'smart is sexy,' and while cynics may find plenty of reason to scoff at the thought, some solace can be taken in the economic success and increase in the social cachet of the 'historically informed performance' (or HIP) movement. Countless millions of people over the last thirty years have been drawn to the world of medieval and renaissance music, many as a result of the exciting new sounds created through the thoughtful synthesis of artistic and intellectual sensibility demonstrated in historical reconstructions of early instruments and their playing techniques. In light of this economic and cultural success, it therefore seems fitting to take a step back and think about how individuals today arrive at a view of historical reality in the world of instrumental performance, especially when faced with images and artifacts which may be interpreted in many different ways. This research, as 'an authentic expression of our contemporary cultural condition bringing new experiences and insights into our world,' [1] is immensely valuable. However, are we justified in going further and asserting that our modern reconstructive work sheds light on 'the way things actually were,' or in other words, that it reveals objective historical truth?

In the following pages I will take a closer look at the research methodology of historically informed performance and propose a refinement based on a probabilistic analysis of the data produced. While the areas of research which might benefit from such an inquiry are virtually unlimited, my specific focus for the purposes of this exercise is the harp technique in late medieval and early renaissance Wales. This is one branch of the musicological tree which remains relatively infrequently visited in early music circles, yet one which, as we will see, is richly rewarding when explored

through the multifaceted methodology and interdisciplinary orientation of modern
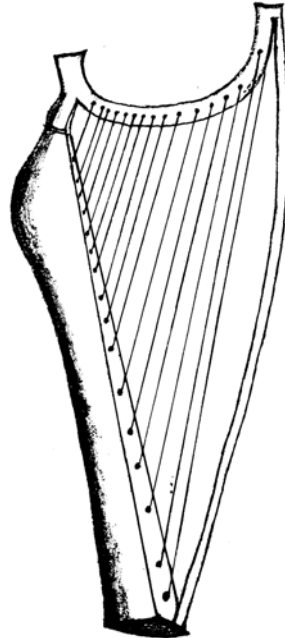
HIP research.

The Harp of Fourteenth Century Wales

In adopting such an approach, it makes sense to first ground our discussion of

instrumental technique in a firm understanding of the physical characteristics of the

instrument itself. Here evidence from archaeology (e.g. surviving instruments),

textual analysis (descriptions of instruments in written sources) and iconography

(illustrations in manuscripts) can converge to form a single compelling picture, as has

been demonstrated many times in the pages of this very journal [2, 3]. The

reconstruction of the Welsh harp is no exception. Recognizably 'Celtic' communities

have used plucked string instruments since at least the first century BC, when the

Greek commentator Diodorus Siculus made the observation that 'Among them [the

Celts] are also to be found lyric poets who . . . sing to the accompaniment of

instruments which are like lyres, and their songs may be either of praise or of

obloquy' [4]. The popularity of the harp in Wales is amply attested in the surviving

works of the court bards (*beirdd* in Welsh) from the eleventh through seventeenth

centuries and in particular in the works of the fourteenth century bard/ literary genius

Dafydd ap Gwilym [5, 6], who make frequent references to the use of the *telyn* (harp) in

bardic performance. Interestingly, the earliest surviving harp that can be firmly

associated with any Celtic country, the so-called Trinity College harp, dates from the

late fourteenth century [7] and thus may be considered an ideal candidate for the sound

of Welsh harpistry. This iconic instrument (quite literally, as it features prominently

in the insignia of the Irish President and the flag of the province of Leinster) is the one

responsible through countless reproductions and recordings for the modern

conception of the sound of the 'Celtic harp' (see illus. 1):

Illus. 1. Trinity College Harp, as seen on the flag of the province of Leinster. Photograph by John Potter. Used with permission of the photographer.

The Trinity College harp utilizes a markedly curved frontpillar and strings of brass,

and in Ireland and Scotland this basic design has been followed faithfully to the

present day. However, despite its temporal proximity to the surviving compositions

of the *beirdd* described above, the Trinity College harp is apparently quite different

from the type of harp familiar to Dafydd ap Gwilym and his bardic tradition. A

drawing made by Lewis Morris in the eighteenth century of 'the Silver Harp, now in

the Mostyn Library, formerly bestowed on the Chief Harper' [8] in the sixteenth century

depicts an instrument with a more elongated shape, a straightened frontpillar, and a

distinctive double peaked frame:

Illus. 2. Mostyn Harp. Sketch by Lewis Morris, in *British Museum Additional MS. 14905* (facsimile). University of Wales Press Board, 1936, British Library shelfmark MUSIC g.2. By permission of the British Library.

This closely resembles the 'Gothic harp' of Europe, whose use has been documented

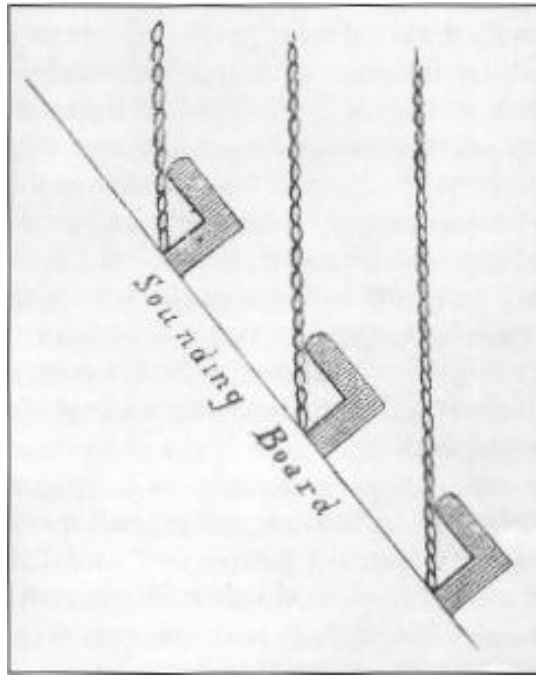in painting and sculpture since the early fourteenth century and was likely used even

earlier:

Illus. 3. Israhel van Meckenem, The lute-player and the harpist (German, late 15th century)
The National Gallery of Art, Washington, DC (USA), Inv. No B20.631. By permission of the National Gallery of Art.

While these images do not indicate the material with which these harps were strung, it seems very likely that they were *not* strung with wire in the Irish fashion. The twelfth century scholar Giraldus Cambrensis (Gerald of Wales) was raised in Pembrokeshire, educated in England and France, and traveled extensively in Wales and Ireland, and in his *Topography of Ireland* (1188) he lists the instruments played in Ireland and notes that 'They also use strings made from bronze, and not from leather'[9]. This could suggest that Welsh harps, or at least the majority of harps that Giraldus Cambrensis was familiar with, were strung with 'leather,' more commonly known as gut. This was scarcely a universal practice, however. In the late fourteenth century the bard Iolo Goch (fl. 1340-90) wrote a composition entitled *Cywydd Moliant i'r Delyn Rawn a Dychan i'r Delyn Ledr* (*Cywydd* in Praise of the Horsehair Harp and Satire on the Leather Harp) which ridicules the many characteristics of contemporary harps that the bard found distasteful. Among the things that meet with Iolo's displeasure are both wire and gut strings; he writes disparagingly that '*Anodd i brentis fis fydd / Ystofi miliast efydd,*' 'It will be hard for an apprentice in a month / to string a brass greyhound bitch' lines 33-34;[10], while at the same time dismissing the use of gut by saying, '*Nid oedd un tant, ffyniant ffydd, / O ddefaid meirw i Ddafydd,*' 'David did not have, flourishing of faith, a single string made from dead sheep' lines 11-12[10] and likening the leather harp's 'gutty sound' *choludd sain;* line 39[10] to (among other things) the sound of a lame goose, an insane Irishwoman, wallowing crows, and the din of hailstones on a stone roof during a thunderstorm lines 49-58[10]. The 'bent column' (*llorf cam*) of the leather harp is subject to further scorn line 42;[10], as he contemptuously labels this design an '*Anfad bla llun bwa llwm, / Enfys ac echrys gochrwm,*' an 'evil plague shaped like a bare bow, / a rainbow and a crooked abomination' (lines 35-36)[10]. Far better is '*yw ymadrawdd hawdd hoyw / Y delyn o*

rawn duloyw,' 'the easy lively expression / of the harp of shining black horsehair' (lines 17-18)[10], which Iolo, with virtuosic command of bardic exaggeration and hyperbole, claims is the type of harp played by the biblical King David and (rather more believably) the bard's more immediate Welsh musical predecessors.

These sources of information seem to suggest that the Welsh harp was more similar to the instruments of continental Europe than to the 'Celtic' harp of Ireland, a curious assertion which is nonetheless emphatically supported by the use of bray pins on harps of both continental Europe and of Wales but not in Ireland. Found on many surviving instruments of the fourteenth through seventeenth century[11, 12] and clearly visible on the simple and double German harps depicted in Michael Praetorius' *Syntagma Musica: Theatrum Instrumentorum*[13], bray pins are L-shaped slivers of wood set into the soundboard which lightly brush the strings and cause them to buzz without otherwise interfering with their vibration. As concisely summarized by historical harp maker Robert Hadaway, 'They produce a mass of penetrating harmonics which increase the effective sustaining power by making the strings' residual vibration more audible—for us a rather 'Eastern' sound' [11]. This evidently was a cultivated and desired sound in Wales; the seventeenth century bard Huw Machno wrote a *cywydd* requesting a 30-string harp which includes the lines, '*Ceimion wrachïod cymwys / Yn siarad pob teimlad dwys*,' 'curved, bent appropriate brays / speaking every profound feeling' [14]. Moreover, their use in Wales lasted into the nineteenth century, as indicated by the Reverend Thomas Price's accurate descriptions and drawings of the *gwrachod* (bray pins) made from right-angled thorn twigs used by his old harp teacher David Watkins [15] (illus. 4).

Illus. 4. Drawing of *gwarchod* (bray pins) on the harp of David Watkins. From Jane Williams, ed., *The Literary Remains of the Rev. Thomas Price* (Llandovery: William Rees, 1855), British Library shelfmark 12272.e.8. By permission of the British Library.
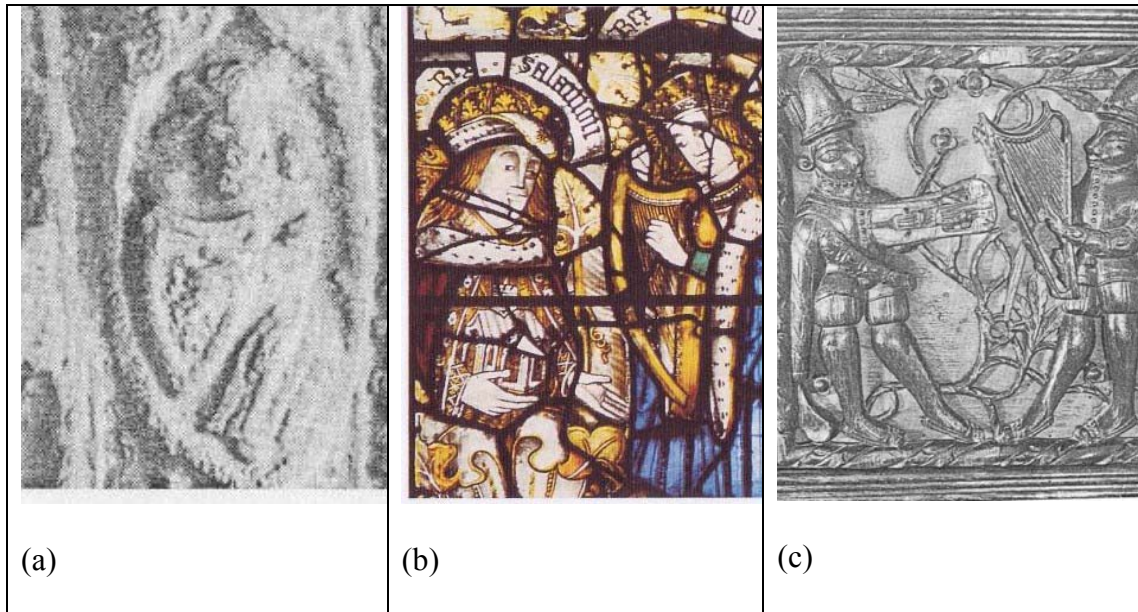
The size of the harp played by the Welsh bards can be inferred by looking at the range of notes required to play the oldest surviving music. While this is a more complicated question than it seems, since the oldest source of Welsh music is the 1613 manuscript of James I's court harper Robert ap Huw which has been raising scholarly hackles since the eighteenth century[16], there is general agreement that the music contained in the manuscript was composed over a long period between the fourteenth and sixteenth centuries, with individual pieces requiring as few as eleven strings and as many as twenty-five strings to play in their entirety [8]. Combining these sources of information, we may provisionally conclude that many of the compositions of the Welsh bards would have been heard on a Gothic bray harp possessing between eleven and twenty-five strings with a straight frontpillar and strings made of black horsehair, though instruments using gut strings were also apparently in frequent use.

How were these instruments played? Unlike the massive modern pedal harps which must rest on the ground and require players to adjust their bodies to

accommodate them, the 25 string Gothic harp is a relatively small instrument which can be played in any number of positions—resting on the ground, on the player's knee, or even held against the body while the player stands. Finding a satisfactory answer is of some importance, since the playing position of the instrument (for example, whether the player is standing or sitting) determines the range of possible movements of the arms and hands and thus provides definite boundaries on the range of available playing techniques. This is the fundamental problem faced by players of instruments with discontinuous playing traditions, such as the lute and hurdy-gurdy, and to find an answer, players study the visual art of the medieval and renaissance periods, scrutinizing depictions of musicians for evidence of contemporary performance practice that the artist had (perhaps inadvertently) included in his or her work [17, 18]. This is by no means a straightforward task, as artists frequently take liberties depicting their subjects in the interests of creating a more visually arresting work. Therefore, whether consciously or unconsciously, scholars of historically informed performance decide upon a set of criteria by which they will separate evidence of true performance practice from artistic license in medieval and renaissance art, and here is where most problems arise. The distinction between the two alternatives is crucial, yet most articles reveal nothing of how the all-important criteria for making the decision are decided upon. All too often conclusions are based on a 'gut feeling' arrived at through an assimilation of the data influenced not only by the factors we are studying, but also by other aspects of the art, the emotions aroused by them, our attitude towards the work, and even (if your gut feelings are similar to mine) by what we have eaten or done that day via our level of attention and focus. How can we counterbalance the potential errors in judgment which might be caused by these factors?
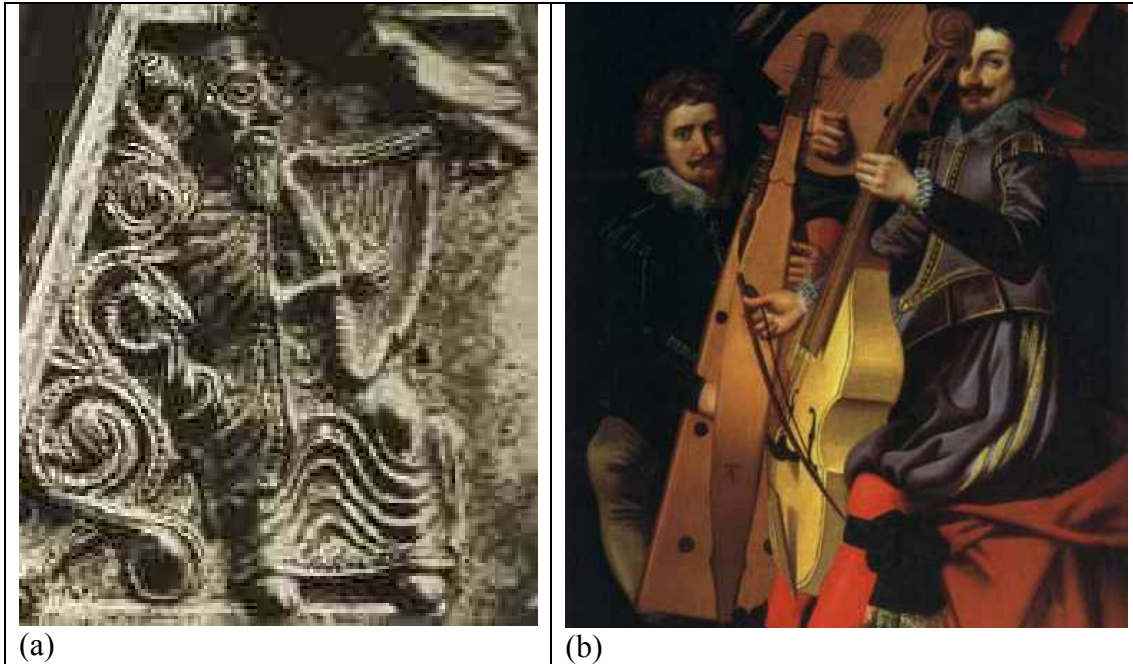
Fortunately, this problem is highly analogous to the situations faced every day by behavioral scientists and sociologists, for whom important facts are often masked by a welter of chance fluctuations caused by individuals simply being individuals—that is to say, behaving in unpredictable ways. Practitioners of these disciplines therefore make frequent use of *inferential statistical analysis*, a technique whereby the data gleaned from a representative sample of interest is compared against the mathematically derived probability that the same results could have occurred by chance[19]. I therefore elected to take a statistical approach in my study of medieval and renaissance harp iconography, focusing on two variables: the shoulder used to steady the harp by the performer, and whether the harpist is standing or sitting while playing. Both are readily depicted in art and have direct effects on performance, as already described in the case of standing versus sitting, while personal experience makes clear that the placement of the harp against one shoulder obscures the treble strings from the hand opposite. Thus in two-handed harp-playing the 'harp-shoulder' hand plays the treble, while the 'anti-shoulder' hand plays the bass.

Of equal importance to the selection of variables in a study of this nature is the determination and characterization of the sample to be studied. For a reconstruction of the playing techniques of the Welsh *beirdd*, the ideal source of information would obviously be a random sample of indigenous Welsh art of the eleventh through seventeenth centuries which depicts harpists at work. Unfortunately, out of 1,241 paintings, engravings, manuscript illustrations, and sculptures studied[21], only seven met these criteria, and a general guideline of statistical analysis in the social sciences is that reliable analyses require total sample sizes of at least 35. Several of these images are shown in panels A-C of illus. 5.

Illus. 5. Welsh harp iconography. (a) King David with his harp. Late 13th century (?), stone carving, south doorway, St David's Cathedral, Dyfed. By permission of y Comisiwn Brenhinol Henebion Cymru. (b) King David with his harp. 1533, stained glass, Dyserth Church, Clwyd. (c) Tudor crowther and harpist. 1550-1570, woodcarving, Cothele House. By permission of the National Trust Photo Library.

Anecdotally, it is interesting that in those images in which the harper was human (see below), 100% depicted the players standing, with one foot in front of the other and leaning their harps against their left shoulders. The apparent use of this playing position in Wales may, however, simply be a result of a small sample size and indeed at first glance the truth of such a finding seems counterintuitive; no modern harp is played while standing, even by 'traditional' players of harps in Wales, Scotland and Ireland [22] (see panels A-B of illus. 6).

Illus. 6. Irish/Scottish harp iconography. (a) Harper from Bronze book-shrine, c. 1050-1100, Breac Mhaodhog. By permission of the National Museum of Ireland. (b) An Irish Harper at a Danish Court. 1622. Reinhold Thim, Musikhistorisk Museum, Copenhagen. Photography by Ole Woldbye. Picture used by permission of the Danish Music Museum—Musikhistorisk Museum & The Carl Claudius Collection.

In light of the common Celtic heritage of the British Isles and the apparent similarity of the Welsh harp to the harps of mainland Europe, the scope of this iconographical inquiry was therefore widened to include images of non-pedal (i.e. non-'modern') harps from the eighth through the seventeenth centuries from continental Europe, as well as from the historically Celtic regions of England, Scotland, and Ireland. This resulted in a pool of 57 images. Seven of these images were excluded from further analysis because the only harper visible in the composition was either an angel or a mermaid, where the artist may not have believed that the laws of physics and gravity need apply and therefore depictions of the positions of harp performance may not have any resemblance to those by necessity forced on humans. One further image was excluded on similar grounds because the player was an ape, leaving a viable iconographical sample of 49 images[23].

Even with clear dependent variables and a well-characterized sample, however, how can we define 'true performance practice' and 'artistic license' in ways amenable to quantitative analysis? The key lies in a healthy respect for the difference between intentional and unintentional, or random, variation. The depiction of a harp resting against the performers' left or right shoulder in an image, or the depiction of a harper in a standing versus sitting or kneeling position, is the result several factors. One of these is obviously the way that the artists saw their models holding their instruments. For example, modern classical harpists lean the harp against their right shoulder, while players of 'Celtic harp' lean the instrument on their left shoulder[24]. Such basic elements of playing posture are likely to be constant across a performer's career, and (as suggested above) held in common by performers who subscribe to the same school of harp playing. This is an example of intentional variation, and can be taken as evidence of true performance practice.

However, it is also possible that the artist (on the basis on personal taste and a myriad of other unknown factors of image composition) decided to depict the harpist in an inauthentic playing position. We can attempt to name and control as many of these factors as possible. For example, 'paired images' of two harpists facing each other can introduce an artistic element that impacts playing position, as can geometric constraints arising from the embellishment of initials such as a 'B' or 'D' in manuscripts. Examples such as this can be identified and excluded (as indeed they were in the present study). However, from the perspective of a modern observer trying to learn historical harp technique, in many other cases the variation due to artistic license cannot be firmly associated with anything we can name (it is 'unintentional' within our system), and instead simply muddies the waters of our analysis and causes errors. The problem of this 'error variation' is compounded by

the fact that paintings, manuscript illustrations, and bas-relief sculptures (which comprise the majority of medieval and renaissance musical iconography) are two dimensional, and harpists are almost always depicted in a profile view, presumably so that the characteristic shape of the harp and strings are readily identifiable. This can result in considerable ambiguity, as it does in panel (a) of illus. 5. In this sculpture it appears that the harp is leaning on the player's left shoulder, yet because of the artist's choice of a full left-sided profile it is also possible that the harp rests against the right shoulder and the distinction is invisible from the viewer's vantage point.

However, what is important is that we have no reason to think that *in general* artistic license favours a standing harpist, or a right-shouldered harp. Similarly, there is no *a priori* reason that an artist of any country would feel compelled to depict a musician facing left or right. This is important, since it indicates that if artistic license and error are the only things operating in the system we are as likely to conclude that an image depicts a left-shouldered harp, or a standing harpist in right-standing profile as a right-leaning harp or a sitting harpist in left-handed profile. On any given occasion, the appearance of these traits are as unpredictable to a human observer as the flipping of a coin, and like a coin toss each possibility should occur on average one half of the time, or have a probability of .5. We can therefore look at the pool of images to see whether there is any evidence that knowledge of this sort affected the artists' depictions of harpers. If the depictions of harpists' bodies and hands were influenced by nothing other than 'artistic license' and chance, then the distribution of standing vs. sitting/kneeling harpers, and the distribution of harps leaned on the left vs. the right shoulder, should be close to their chance probability of .5. If, on the other hand, the artists were accurately portraying these details of the harpists' playing positions, the distributions should differ significantly from their chance probabilities

of .5. Furthermore, if there is a 'nation effect,' where harpists of one nation held their harps differently from those of another, then this will be noticeable in the distributions as well. With these ideas in mind, let us now examine the results.

Origin of art	Gender of harpist	standing playing position (%)	% of harps leaned on left shoulder
Czech Republic (n = 1)	Male (n = 1)	100	0
	Female (n = 0)	**	**
Netherlands (n = 1)	Male (n =1)	100	100
	Female (n = 0)	**	**
England (n = 2)	Male (n = 1)	0	100
	Female (n = 1)	0	0
Flanders (n = 10)	Male (n = 7)	85.7	14.3
	Female (n = 3)	0	33.3
France (n = 16)	Male (n = 13)	61.5	30.8
	Female (n = 3)	33.3	33.3
Germany (n = 3)	Male (n = 1)	100	100
	Female (n = 2)	0	50
Ireland (n = 4)	Male (n = 4)	0	100
	Female (n = 0)	**	**
Italy (n = 3)	Male (n = 3)	100	33.3
	Female (n = 0)	**	**
Scotland (n = 2)	Male (n = 2)	50	0
	Female (n = 0)	**	**
Spain (n = 1)	Male (n = 1)	0	100
	Female (n = 0)	**	**
Wales (n = 6)	Male (n = 6)	100	100
	Female (n = 0)	**	**

** = Not Applicable

Table 1. Summary of the main features of the 49 examples of European harp iconography analyzed.

To illustrate the basic power of this kind of analysis, let us compare the proportions of male and female harpers depicted. Since men and women each make up approximately 50% of the world population, one would expect if everything were equal that the musicians depicted in art would mirror these proportions. However, 80.9% of the harpers in our sample were male while 19.1% were female. Why is

there such a discrepancy between the ratio of men to women observed in the data and that which was expected from the global population? Inferential statistics do nothing more or less than calculate the probability that pure, blind chance is the sole reason these numbers differ. In this particular instance, this is best achieved with a procedure known as a 'one sample t test'[25,26], and we can see that the probability that these two proportions are different solely by chance is small indeed, $t(48) = 5.3$, $p < .001$[27]. That is to say, if the corpus of medieval and renaissance art truly contained equal numbers of male and female harpers, and we were to keep drawing random samples of 47 images and calculating the proportion of men to women in each one, fewer than 1 in every 1000 of the samples (the 'p value' of the statistic above) would have 81% men and 19% women. In the social sciences, inferential probabilities less than 5 % (.05) are generally considered 'significant' and worthy of further consideration—a standard far exceeded in this comparison. We therefore conclude that it is highly unlikely the corpus of medieval and renaissance art contains equal numbers of male and female harpers, and rather that men are depicted significantly more frequently than women. This statistical conclusion agrees well with the information gleaned from contemporary written sources which contain the names of far more male than female musicians [28-30].

We can apply the same techniques to analyze the artistic evidence of performance practice of medieval and renaissance harp playing. When considered collectively these images of harpers from across Europe do not seem to provide any sure indication of harp placement in performance. 57.4% of the harpers are depicted standing compared to 42.6% sitting or kneeling, which is not significantly different from a chance distribution[31]. Similarly, 48.9% of the harpers are depicted holding their instruments against their right shoulders while 48.9% leaned their harps against

their left shoulder[32] (in one image it was impossible to tell). However, this aggregate analysis is misleading, since further probing revealed that female harpers were significantly more likely to be depicted playing in sitting or kneeling position than chance alone would predict, while male harpers were more likely to be depicted standing[33]. This could indicate that the artists followed different aesthetic rules when depicting women and men, so in the future we will limit ourselves to studying solely the images of the male human harpists.

Armed with this information, let us compare the 'Celtic' iconography with that gathered from the rest of Europe. Strikingly, 100% of male Irish harp players are seated, with all harps resting against the left shoulder, while in the images from continental Europe, only 28.6% of the harpists are seated, and only 35.7% of the harps are resting against the left shoulder. The likelihood of this occurring by chance is very small indeed[34], and we can conclude that harp playing position was different in Ireland than it was in continental Europe. The iconographical evidence also suggests that harp playing in Wales was a hybrid of these two styles, with the harp leaning on the left shoulder (Irish style) but played standing as in the European images, and with inferential statistics we know how likely it is that in the future we would draw samples in which the Welsh and Irish playing positions are identical (a less than 1 in 1000 chance) or in which the Welsh and European positions were identical (a 1 in 500 chance)[35] . The study of the art thus reinforces the conclusions drawn from textual and archaeological studies of the instruments themselves, and offers direction for modern players interested in playing early Welsh repertoire in a historically-informed way.

More importantly, however, the empirical approach outlined here may be of use to scholars in any number of fields fascinated by questions of historical practice

and reality. To my eyes the great strength of inferential statistics lies in the

acceptance of the gaps in our knowledge, the recognition that we not omniscient and

will never possess all the facts about how the music we love was originally

performed. We are not forced into the fallacy of pretending that the puzzle is

comprised only of the pieces we can see. Rather, we can assess the quantity and

quality of what we have learned, and make an informed decision about the path we

wish to pursue while remaining open to the very real possibility that things may be

otherwise. Such an approach also highlights the importance of the individual mind in

the construction of history. As Friedrich Nietzsche wrote in *Untimely Meditations*,

'the study of history is something salutary and fruitful for the future only as the

attendant of a mighty new current of life . . . that is to say only when it is dominated

and directed by a higher force and does not itself dominate and direct'[36]. The

framework of historical awareness and quantitative savvy gives this force free rein,

and a clear view of the problems and pitfalls it must overcome.

1 John Butt, *Playing with History: The Historical Approach to Musical Performance* (Cambridge: Cambridge University Press, 2002).

2 Anthony Rowland-Jones, 'Iconography in the history of the recorder up to c. 1430-Part I', *Early Music* 33/4 (2005), 557-574.

3 Donald Gill, 'Vihuelas, Violas, and the Spanish Guitar', *Early Music* 9/4 (1981), 455-462.

4 Diodorus Siculus, *Bibliotheca Historia* (London: William Heinemann Ltd, 1939).

5 John Gwenogvryn Evans, ed., *Facsimile and Text of the Book of Taliesin* (Llanbedrog, 1910).

6 Thomas Parry, ed., *Gwaith Dafydd ap Gwilym* (Caerdydd: Gwasg Prifysgol Cymru, 1952).

7 W.H. Grattan Flood, *The Story of the Harp* (London: Walter Scott Publishing, 1905).

8 Robert ap Huw, *Musica: British Museum Additional MS. 14905* (Cardiff: University of Wales Press Board, 1936).

9 Giraldus Cambrensis, *The history and topography of Ireland* (Harmondsworth: Penguin Books, 1982).

10 Dafydd Johnston, ed., *Iolo Goch: Poems* (Llandysul: Gomer Press, 1993).

11 Robert Hadaway, 'The Re-Creation of an Italian Renaissance Harp', *Early Music* 8/1 (1980), 59-62.

12 Tim Hobrough, 'Early Harp Attitudes', *Early Music* 8/4 (1980), 507-508.

13 Michael Praetorius, *Syntagma Musicum* (Basel: Bärenreiter Kassel, 1959).

14 William Taylor, 'Two Worlds of the Welsh Harp', (Troy, NY: Dorian Recordings, 1999).

15 Jane Williams, ed., *The Literary Remains of the Rev. Thomas Price* (Llandovery: William Rees, 1855).

16 For an excellent introduction to this fascinating document the interested reader is referred to Sally Harper, ed., Welsh Music History. Special Issue (Cardiff: University of Wales Press, 1999).

17 R.A. Higgins and R.P. Winnington-Ingram, 'Lute-players in Greek Art', *The Journal of Hellenic Studies* 85 (1965), 62-71.

18 Harvey Turnbull, 'The Origin of the Long-Necked Lute', *The Galpin Society Journal* 25 (1972), 58-66.

19 There is an enormous literature on this topic, but for the present purposes an excellent introduction to the field may be found in David C. Howell, Statistical Methods for Psychology (Pacific Grove: Duxbury, 2002).

20 John Allen Paulos, *Innumeracy: Mathematical Illiteracy and Its Consequences* (London: Penguin, 1990).

21 Drawn from Giraldus Cambrensis, The history and topography of Ireland (Harmondsworth: Penguin Books, 1982), Michael Praetorius, Syntagma Musicum (Basel: Bärenreiter Kassel, 1959), Michael Wilson, The National Gallery in Colour (London: Charles Letts and Company Ltd, 1973), Robert Bartlett, ed., Medieval Panorama (London: Thames and Hudson, 2001), Edmund A Bowles, Musical Performance in the Late Middle Ages (Paris: Minkoff and Lattès, 1983), Edward Bunting, Ancient Music Of Ireland (Dublin: Hodges and Smith, 1840), D. Roy Saer, Y Delyn Yng Nghymru Mewn Lluniau. The Harp in Wales in Pictures (Llandysul: Gomer Press, 1991).

22 D. Roy Saer, *Y Delyn Yng Nghymru Mewn Lluniau. The Harp in Wales in Pictures* (Llandysul: Gomer Press, 1991).

23 It should also be noted that of the 47 images of harpers in the sample, nine appear to be depictions of the Old Testament figure King David. Depictions of David are the most frequent images of musicians in medieval iconography, and while an argument could be made that this 'iconic' and mythical status should preclude images of David from the study, as the angels and apes were, these images were retained for a number of reasons. First,the quality of the images is such that it is not always clear whether a depiction of King David is specifically intended. Rigourous enforcement of this criterion would thus result in the exclusion of a large quantity of useable data. Second, the King David images are not markedly different from the other images in any way, and in many cases include instrumental details (such as the depiction of bray pins in exemplars from Wales) that agree with information gleaned from other sources.

24 Edward Bunting, *Ancient Music Of Ireland* (Dublin: Hodges and Smith, 1840).

25 The mechanics of this statistical comparison are described in Howell, but briefly a one sample t statistic is the difference between the observed and expected values (i.e. the ration of men to women in the art minus.5) to the 'standard error' of the sampling distribution (i.e. the standard deviation of the scores divided by the square root of the number of items in the sample). That is to say, a t statistic of 5 indicates that the difference between the numbers is five times greater than the amount of apparent 'jitter' and variation inherent in the sample itself. Other tests are appropriate in other situations, and for the remainder of this paper the statistics, and their descriptions in Howell, will appear in an endnote

26 David C. Howell, *Statistical Methods for Psychology* (Pacific Grove: Duxbury, 2002).

27 If the analysis is repeated without the images of King David, the results are similar, $t(37) = 4.96$, $p < .001$.

28 Elin M. Jones, ed., *Gwaith Llywarch ap Llywelyn 'Prydydd y Moch,'* (Caerdydd: Gwasg Prifysgol Cymru, 1991).

29 Thomas Gwynn Jones, ed., *Gwaith Tudur Aled* (Caerdydd: Gwasg Prifysgol Cymru, 1926).

30 Erwain Haf Rheinallt, ed., *Gwaith Gruffudd Fychan ap Gruffudd ab Ednyfed* (Aberystwyth: Canolfan Uwchefrydiau Cymreig a Cheltaidd Prifysgol Cymru, 1995).

31 $t(48) = 1.022$, $p = .312$.

32 $t(47) = 0$, $p = 1$.

33 independent sample $t(16.57) = 4.25$, $p = .001$. See ref. 21, p. 201-203.

34 Kruskal-Wallis $\chi^2 = 12.158$, $df = 2$, $p = .002$ See ref. 21, p. 719-720

35 Dunnett's t, std. error $= .202$. See ref. 21, p. 401-402.

36 Friedrich Nietzsche, *Untimely Meditations* (Cambridge: Cambridge University Press, 1983).