

# IN THEIR OWN WORDS: USING TEXT ANALYSIS TO IDENTIFY MUSICOLOGISTS' ATTITUDES TOWARDS TECHNOLOGY

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## ABSTRACT

A widely distributed online survey gathered quantitative and qualitative data relating to the use of technology in the research practices of musicologists. This survey builds on existing work in the digital humanities and provides insights into the specific nature of musicology in relation to use and perceptions of technology. Analysis of the data (n=621) notes the preferences in resource format and the digital skills of the survey participants. The themes of comments on rewards, benefits, frustrations, risks, and limitations are explored using an *h*-point approach derived from applied linguistics. It is suggested that the research practices of musicologists reflect wider existing research into the digital humanities, and that efforts should be made into supporting development of their digital skills and providing usable, useful and reliable software created with a 'musicology-centred' design approach. This software should support online access to high quality digital resources (image, text, sound) which are comprehensive and discoverable, and can be shared, reused and manipulated at a micro- and macro level.

## 1. INTRODUCTION

In the last two decades, an astonishing amount of computer technologies have been created for the processing of digitized music and music metadata. Quite a few of these are targeted at musicological research. Very often, such software, standards, services or resources are the outcome of interdisciplinary collaborations between computer scientists, audio engineers, musicologists and/or library scientists. An ever-present subtext in the discourse around these collaborations is the potential of technology to transform the discipline of musicology. Yet the uptake of these technologies in mainstream musicology is not widespread. As a first step in a timely systematic exploration of the area, this paper presents the results of a questionnaire amongst musicologists worldwide, focussing on the use or non-use of technology resources in their daily work processes. Gathering insights into the aims and values of the researchers is an important step towards creating a 'musicology-centred' design practice that is founded on human-centred design methods [1]. The key characteristic of such methods is to focus on human work practices and bottlenecks, and then to select or develop the technologies that remove these bottlenecks while respecting the aims and values of the humans in-

involved. Whereas human-centred approaches to systems design are increasingly used in digital humanities, they have been rarely applied to digital musicology.

The use of modern technology in the digital humanities has been widely explored in the last ten years [2-9]. Existing research has identified domain-specific differences between humanities and scientific researchers in their information behaviours. These appear to be predominantly influenced by the analogue or digitised surrogate nature of the research objects in humanities, and the practices of humanities researchers, which are frequently around lone research. Research indicates that humanists welcome technology when it speeds up workflow [8-9], rely on informal peer networks, primarily access monographs, libraries and private collections, search by browsing and citation chasing, and use exploratory search strategies [2]. The core issue underlying technology adoption is thus not so much technophobia as the acceptability and relevance of technology as part of the research process.

This work sets out to explore the adoption of software tools by musicologists in their digital scholarship practices ("the ability to participate in emerging academic, professional and research practices that depend on digital systems" [10]). These tools, which allow the interrogation of digital musical artefacts (including music notation, digital audio, or contextual texts such as metadata) have been widely reported on and refined through the annual ISMIR conference. However it appears that there is some disconnect between this research strand and musicological users' needs and requirements [11-14]. Although some efforts are made to consider user information needs and behaviours [15-19], these are outweighed by a systems-centred approach to the development of new tools [19]. This may reflect the findings that developers determine the success of their efforts more by the performance of the tool than its uptake by users [5, 6]. However, in the words of Borgman [20]: "*until analytical tools and services are more sophisticated, robust, transparent, and easy to use for the motivated humanities researcher, it will be difficult to attract a broad base of interest within the humanities community.*"

Although, for example, the AHRC-funded Transforming Musicology project [21] attempts to encourage closer collaboration between musicologists, computer scientists and software developers, only a few MIR projects seem to be based on an understanding of the work processes and related technology needs of musicologists [22-24]. Building on recent studies into the adoption of tools and resources by humanists [3, 4, 25], this research presents a large-scale investigation of the digital scholarship practices of musicologists. The results will hopefully contrib-



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ute to the development of usable systems which reflect work practices and attitudes of this community.

## 2. METHODOLOGY

We created an online survey named ‘What Do Musicologists Do All Day’ (WMDAD). With this survey we wanted to gather data on the research musicologists do, how they use (or don’t use) technology in their research, and how they assess positive and negative aspects of technology. Our main purpose was to collect rich and detailed stories in their responses, which we did by means of open-ended questions, contextualized within demographic data. We were seeking to explore behaviours and attitudes by encouraging the participants to communicate their experiences more freely than in a multiple choice survey. Our emphasis on rewards, frustrations, risks, limitations and benefits was drawn from a desire to encourage constructive responses of both a positive and negative nature, and enable us to build on previous work in digital humanities, particularly [4]. Though the questions are in English, we encouraged the participants to use their own language if they felt more comfortable this way. The questions are shown in Table 1. The survey rubric and questions were carefully designed to encourage musicologists with a broad range of digital skills and experience to contribute to the survey. Responses are anonymous. All participants gave informed consent in the use of the data they provided, following ethical guidelines of the researchers’ institutions.

The survey was published online using the Opinio system. After the final question, participants were linked to a Google Form, where they were given the option to leave contact details if they wished to be informed about the results or participate in follow-up research. These personal data were not linked to the survey responses, maintaining the researchers’ commitment to anonymity of the participants. The link to the survey was posted on various musicological mailing lists (including AMS, IAML (c. 700 subscribers), ICTM, SMT, musicology-all and several national lists). To stimulate wide international participation a mailing was sent to all (c. 700) members of the International Musicological Society and the Society for Interdisciplinary Music Studies (c. 70 members). Invitations to participate were circulated by national societies or lists in Australia, Austria, France, Germany, Netherlands (c. 200 members) and other countries. WMDAD was mentioned a few times on social media. It is not known whether all participants are ‘genuinely’ musicologists, but from reviewing the responses it is clear that they self-identified as such. It is also possible that participation was skewed once the survey link was released ‘into the wild’. Responses were collected from 4 December 2014 until 6 March 2015. Initially, there were some technical issues in showing the link to the Google Form, mainly for IOS devices, resolved after a few days. As a consequence, some participants submitted responses multiple times. Duplicate responses were removed, as were responses that didn’t get beyond the first page (Q1-4). There was only one fake response. Responses in languages other than English were translated by native speakers in

collaboration with the research team who were able to provide explanatory context. The cleaned dataset responses were analysed identifying themes and patterns in the data, using a combination of Excel, SPSS and Nvivo10.

Question	Response
Q1: What is your gender?	male / female / prefer not to say
Q2: What is your age?	choose one of 6 categories
Q3: Please identify your location from this list	pick country from list
Q4: What is your level of education?	bachelor / masters / PhD / other (specify)
Q5: How confident would you say you are using digital systems and materials to find, organise and analyse research materials, and create and disseminate your findings?	5-point Likert scale (low-high)
Q6: Where do you do your musicology research? (you can choose more than one, if you like)	select from 4 categories, if ‘other’, specify
Q7: What is your speciality? (you can choose more than one, if you like)	select from 11 categories, if ‘other’, specify
Q8: What are you currently researching?	Text
Q9: Which is the information or music resource you use most in your musicology research and writing?	choose one of 10 categories, if ‘other’, specify
Q10: Which [Q9] do you use, why?	text
Q11: If you think you may have a preference for using digital or physical resources in your work, why do you think this is?	text
Q12: Tell a story about a rewarding or a frustrating experience (or both, if you like) with technology in your music research.	text
Q13: What do you think are the risks and limitations of the use of technology in musicology research?	text
Q14: What do you think are the benefits of using technology in musicology research?	text

**Table 1.** Survey questions

The full texts were imported into NVivo10 for analysis. After automated removal of stop-words, the remaining terms were ranked by frequency. Recognising the importance of frequency in terms of identifying vocabularies and enabling comparisons between texts, recent work in applied linguistics [26] has found some value in applying the Hirsch index (*h*-index) [27] citation measure approach to text analysis. The percentage of appearance of key terms is generally around the 1-2% level, which is not unusual in this type of work. Most words only appear once. The *h*-point (where term rank = term frequency) provides a threshold whereby important thematic words (autosemantics) lying above this point are considered to be more significant than those below the *h*-point. Here, as stop words (synsemantics) had previously been removed from the texts, this approach enabled the identification of high-ranking autosemantics which were more likely to be related to the theme of the text [26] and was preferable to

arbitrarily choosing the ‘top 10/15/20’ terms as it also enabled comparison between texts. Visualisations of the concordances of the terms in the pre-*h* domain were examined to provide insights into their context. This process was repeated for each autosemantic term in the pre-*h* domain for each text (rewards, benefits, risks, limitations, frustrations). There were between 7,300 and 13,000 words in each of these corpora, each containing between 1,500 and 2,400 unique terms.

### 3. FINDINGS

#### 3.1 Demographics

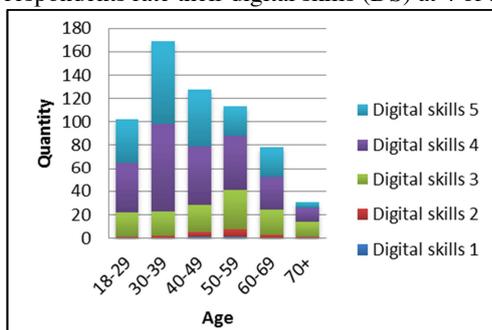
The data presented here focus on those aspects that are relevant to the analysis presented in this paper. The total number of usable responses was 621, coming from 46 different countries. A large majority of survey participants were from two continents: Europe (306) and North America (248). Around two thirds of the respondents (385) were from English-speaking countries.

Responses span all career phases, with the highest representation of the 30-39 age group (Figure 1). Females (314) and males (294) participated in almost equal numbers (13 prefer not to say). The respondents’ level of education is high, with ‘PhD/Doctorate’ (449) and ‘Masters’ (129) as the largest categories. The two most important locations for doing research are ‘Academic institution’ (493) and ‘Library, archive or museum’ (197).

Digital skills	Count
1	2
2	18
3	132
4	256
5	213

**Table 2.** Self-evaluated level of digital skills (1=low, 5=high; mean=4.06, n=621)

Respondents assess their digital skills quite highly (Table 2) but there are considerable age differences (Figure 1). Although anecdotally there is a tendency for digital skills to decrease with age, more than half of the 70+ respondents rate their digital skills (DS) at 4 or 5.



**Figure 1.** Age group and digital skills of participants (n=621)

#### 3.2 Preferred type of resource

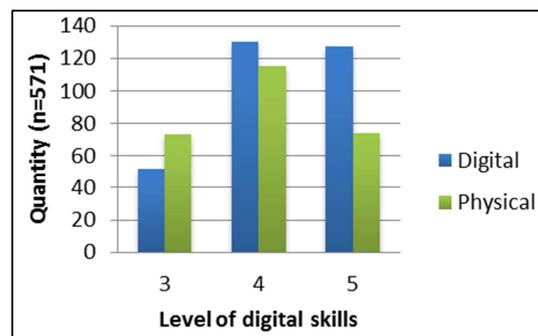
Respondents were asked to choose one type of preferred resource from a list (Table 3). Although some were reluc-

tant to make a choice, overall 319 respondents prefer digital resources, 271 prefer physical resources. Musical resources, whether audio or notation, are preferred by only 43 respondents. However, the responses to Q10 show that a considerable part of the archival and manuscript collections are actually researched for their musical content.

Resource	Count
Digital books and journals	193
Physical books and journals	188
Digitised archives and manuscript collections	104
Physical archives and manuscript collections	62
Other resource	31
Music audio on computer, phone, mobile device	15
Music audio on tape, record, CD	12
Physical collection of music editions	9
Digital collection of music editions	4
Online music audio collection	3

**Table 3.** Preferred resource (n=621)

It can be seen in Figure 2 that there appears to be a correlation between the preferred format and the level of digital skills, participants with digital skills 3 (DS3) preferring physical resources, while those with 5 (DS5) lean towards digital resources.

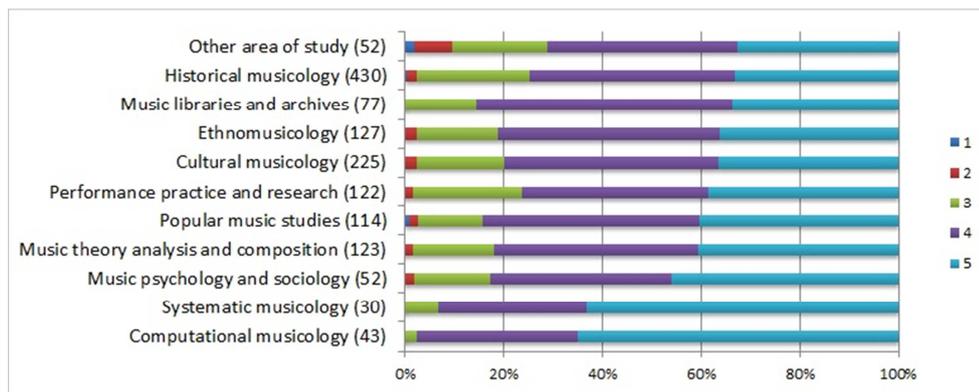


**Figure 2.** Preferred information resource by digital skills (n=571)

The participants were given the option to choose more than one speciality subject. The majority selected historical musicology. The representations in Figure 3 provide some insights into the self-evaluated digital skills across speciality. While computational and systematic musicology shows a higher coverage of DS4 and DS5, performance practice, historical and library / archive / museum research and other areas of study show a higher proportion of DS1-3.

#### 3.3 Rewards

For Q12, an *h*-point of 23 was identified. Terms from the pre-*h* domain are emboldened hereafter. (Respondent code in parentheses.) **Access**, here, is used in relation not only to access to the researchers’ own materials “almost wherever I am” (091) but more widely to **digitized** primary and secondary **sources** such as “databases, online journals, digitised books, scores” (168), “newspaper archives” (201), “quality recordings” (221) and “high-quality color images” (557). This access allows engagement of a high quality: “It really makes me feel I could be



**Figure 3.** Percentage digital skills per speciality (n=1395)

in a library in Italy” (270) and it is not unusual to find this being evaluated favourably in terms of **time**-saved. Further deep analysis through close reading of the texts of the concordances around these key autosemantics highlighted the importance to the participants of using technology to save **time** and increase the speed of their workflow: “...now I can see them all in one afternoon” (022) and minimize the need for travel to engage with a wide range of primary and secondary **sources**. Images of **manuscripts**, scores and digital **books** are considered to be particularly useful, while favourable mentions of **library** catalogues, **digital** archives, scholarly databases and various types of **software** (Sonic Visualiser, Audacity, image manipulation) also feature widely in these texts: “I cannot think what I would be able to do without this software!” (592).

### 3.3 Benefits

The process was repeated, examining the texts describing the participants views on the benefits of technology (Q14). The pre-*h* domain ( $h=35$ ) vocabulary featured some similar terms to those in the ‘rewards’ texts, but included a richer, less concentrated use of terms, reflected by the higher *h* value. This indicates there is a wider range of issues than in the ‘rewards’ texts. Once again, **access** was considered to be an important term in the vocabulary. It creates the “potential to formulate projects or research questions hitherto unthinkable” (003), saving **time** and money, reducing the need for travel to visit **archives** and improving efficiency, enabling researchers to engage with up-to-date **resources** or **materials** (in the physical form as manuscripts or other paper-based documents, or as **recordings**) located globally which would otherwise be out of reach because of distance, cost, or the fragility of unique items. Downsides are recognized: “it can be really time consuming to separate the wheat from the chaff” (313) and “excess of information, lack of a methodology for analyzing recorded sound” (203). It is not only materials that are accessible: “... people, music, documents, can be accessed around the world” (336). This accessibility enables the collection and analysis of **data** “in a way which would not be possible for a human being” (021) which may lead to “...more accurate findings, as many things can be really ‘counted’, not the gut feeling that musicologists in the past had” (039). Gather-

ing, organising, processing, manipulating and analyzing data are key benefits for some members of this community: “modern technology provides new research opportunities, it helps to work in a time-saving way and it makes communication easier and faster.” (286). The ability to **share** research data, ideas and findings

more easily is also highlighted (“whether it be in formal ‘journal’ form or informal such as facebook, email, or texting” (249).

### 3.4 Risks

For the texts relating to ‘risks’ the *h*-point was 20. The recurring theme of **access** here (Q13) focuses on how “the vast majority of resources have not been digitized” (65) and the risk of loss of knowledge (through lack of comprehensive digitized collections, or closed subscriptions) and loss of artefacts (through failure of or developments in technology). It is suggested that “immediacy of access to a wide range of material encourages a rapidity of response and decision” (015) which may lead to more superficial research and there are fears that physical objects may even “be overlooked” (319) leading to “privileging digital sources” (188). Some of the views on **access** link to those on **availability**. Excessive amounts of available resources may lead to “complacency and overconfidence” (052), “an incomplete and imbalanced picture” (186) or “laziness” (numerous). There is evidence of strong feelings in these texts that the wide availability of digitized resources may mean that “musicology will be too superficial and lose authority as a serious contribution to society” (604) and that by focusing on electronic journals rather than **books** this may lead to “apparently clever new historicist readings that are in fact shallow.” (424). This links to a strong view that technological determinism is a problem: “Technology ... cannot replace using the grey stuff between the ears” (003). While concerns about the risks of losing or corrupting insufficiently preserved or stored **data** appear, there is a fear that the problem in concentrating on the interpretation of large datasets may be “that is not feasible to listen through and analyze. It disincentivizes selective recording” (312) and “need[s] to be done with extreme care” (100). The tension between **digital** materials and the **materiality** of **physical sources** and **resources** reinforces this apparent fear of superficiality and, particularly, incompleteness of research “[s]ome things cannot be gleaned from digitized copies only” (090). For some, digital materials are not to be trusted because of the “seduction” and “temptation” of their (inherent) “shallowness”. This is not the only view: “From my informatics-biased standpoint, the use of digital technology in music research is a clear net-positive as a way to augment and enhance traditional musicological approaches” (410).

### 3.5 Limitations

The 'limitations' texts *h*-point was 22. The fears around **materiality** are echoed in the comments on limitations (Q13), partly because increased **access** to the **digital** manifestation of **information** objects can be seen to lead to decreased availability of the physical item, and those which have not yet been **digitized** are also considered to be unavailable. Costly subscriptions to academic journals (JSTOR is particularly popular) are a concern to unaffiliated researchers and those within academia alike (as subscriptions may be limited to on-site access): *"digitization thus increasingly creates a dichotomy of researchers"* (337) and Open Access is not seen to successfully solve this issue. The requirement to have access to the Internet and competency in the use of technology is also seen as a limitation by some. The use of **archives** continues to reflect the concerns around the **materiality** argument and develops on the theme of comprehensive research practices: *"Carl Ludwig's 'Repertorium Organorum' may be hellish to use, but it's still indispensable"* (058). The opportunities for *"serendipity"* through browsing the physical **library** are particularly highlighted: *"Browsing in the digital realm is a far less productive activity than browsing in library stacks"* (068) and digital archives *"do not always capture the creative process, or iterations, of materials"* (420). **Search** for **sources** may be incomplete, *"missing the surrounding context"* (037) and particularly OCR is limited. It seems likely there is a role for **libraries** here in terms of developing the search skills of their users alongside the functionality of their search interfaces: *"I'm never certain that all bases have been covered in a search"* (233). When speaking about primary research **sources**, again the materiality is paramount: *"It is much easier to turn a page physically"* (341) as well as authority: *"Digital materials can be posted by anyone"* (492). Although the participants generally seem happy to either **read books** online or from the shelf (with some strong exceptions relating to materiality, eye-strain and the tendency to skim electronic materials), they are wary of the problems around e-books' usability and long term access.

### 3.6 Frustration

Notable in the 'frustrations' texts (Q12) (*h*-point=26) was the appearance of **software** brands, particularly **Finale**, **Sibelius**, **Office** and **Word**. These frustrations are important issues when considering the self-assessed digital skills of the participants. Despite most participants describing themselves as being 3 – 5 in digital skills, they are suffering from **software** (or **programmes**) being difficult to integrate with the idiosyncrasies of musical research practices as well as being time-consuming to learn, unreliable and unnecessarily updated. Although users may be familiar with Linux, LaTeX and Sonic Visualiser, some participants are not working with modern **software**.

More generally, **documents** here are generated by the researchers and may be unexpectedly reformatted in some way by software, while **data** can be *"the bane of my existence"* (198) in terms of entering, and is easily lost or corrupted if it has not been backed up (an *"annoyance"* (368)). **Books** (electronic or physical) and **recordings** can be difficult to **find** because **library** catalogues are not

always intuitive, and e-books are difficult to read because library e-reader interfaces are *"unfriendly"* (081) and *"difficult to use"* (086). Hardware can create difficulties – **computers** can be *"very old"*, *"slow"*, and can *"crash"* – intervention by intermediaries may be required, although these can be unreliable.

Although there is an understanding that not all resources have been digitized, and that material artefacts are still extremely important as research objects in their own right, there is clearly frustration that online access, facilitated by seamless search, is not comprehensive and universal. There are issues around varying levels of **online access** to **digital** journals and databases caused by *"patchy institutional subscriptions"* (212) or as an outcome of being in the field or unaffiliated researcher status. This is compounded by problems with **search**. Within e-books or databases there is an expectation that full-text search is readily available (and fully functional) with high precision (*"There are a lot of bogus references to items .. that show up in search engines"* (301)) and recall (*"the database search was not picking up articles/reviews that I knew should be there"* (284)) anticipating user context: *"If one searches for 'organum' in the database 'Academic Search Premier' -- all sorts of medical journal articles pop up."* (233).

Lack of **time** is a big problem for these participants, not to be wasted on *"learning software that I don't end up using"* (363). Infrequent use of complex software in research workflows leads to difficulties: *"Every time I come back to it, it feels like I have to learn it all over again"* (363).

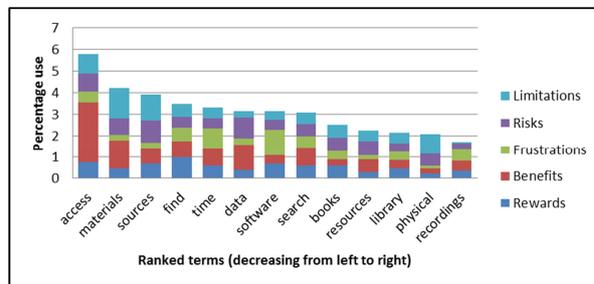


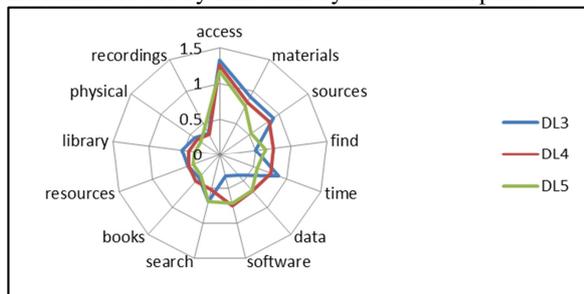
Figure 4. Key terms ranked by percentage use

## 4. DISCUSSION

On examination of the various pre *h*-point vocabulary analyses discussed above, it is clear that while the participants are enthusiastic about the rewards and benefits of the use of technology in their research, they have strong reservations around the risks and limitations of these technologies, which are often realized through frustrations when trying to achieve their research objectives. In particular the issues around **access**, **books** and **sources**, **finding** and **searching** and **time** are considered to be both positive and negative (Figure 4).

In Figure 5 the use of the key terms is broken up by digital skills of participants: the closer to the centre the line becomes, the less frequently the term is used. This data is incomplete (n=2 for DL1; n=18 for DL2) and un-

likely to be representative (reinforced by close examination of the terms in context) and is not included here. However it is interesting to observe that there appears to be more emphasis on technical terms (**software, data**) by DL5 while the least frequently used term by DL3 is **software**. **Libraries** are emphasized by DL3, while **sources** are ranked lower by DL5 than by their counterparts.



**Figure 5.** Key terms and digital skills ranked by percentage appearances in texts

The general consistency in the ranking of these terms is notable, reinforcing the idea that there is likely to be an agreed vocabulary and common practices within this community. Also, a common set of disciplinary values seem to emerge from the responses, emphasising qualities such as completeness, depth of analysis, accuracy, reliability, serendipity and the materiality of resources. It was observed above that musical resources were preferred by only a minority (7%) of the respondents. One possible explanation is that researchers study known musical items and mainly gather information *about* the music. However, many researchers study the musical content of archives and manuscript collections, and editing music is often their core activity. This relates in an interesting way to shortcomings that are observed in music printing software such as Finale and Sibelius, especially for creating scholarly editions of early music. Also, no tool support is reported for managing editorial data. There is clearly a case to be made for the development of systems that support the entire editorial workflow.

In summary, the (self-defined) musicologists who kindly took this survey and provided us with their thoughts clearly have access to technology (they did the survey online) and have positive and negative views (often held simultaneously) about its value in their research process. They may work unaffiliated and alone, or in an office with colleagues, and it is quite likely they are interested in historical or cultural musicology, or popular music studies. They are really excited about the increased access afforded by digital technologies and resources but some are wary of how digitization may make research superficial, undermining the discipline. They are habitual readers and want context-dependent access to physical and digital artefacts. They use software when it contributes to their workflow, and have a range of levels of digital fluency. Respondents rated their digital skills quite highly. However, the problems they report with consumer technologies suggest that they often overrated themselves. Also, there are many signs of insecurity in working with digital resources. Digital methodologies are ap-

parently not yet well integrated with mainstream research practice.

## 5. CONCLUSIONS AND FUTURE WORK

It is suggested that the research practices of musicologists reflect wider existing research into the digital humanities and that efforts should be made into supporting the development of their digital skills and in providing reliable user-centred software. This software should support online access to high quality digital resources (image, text, sound) which are comprehensive and discoverable, and can be shared, reused and manipulated at a micro- and macro level.

In the above we have presented an initial analysis of the WDMAD data, and while the size of the sample allows some generalization we recognize that there are likely to be differences amongst sub-disciplines within the population. Further work will examine the data at a more granular level, providing better understanding of work practices within sub-disciplines. Resources and software mentioned by participants also merit attention, for example for creating a collection of application scenarios. Finally, a comparison of the vocabularies used by musicologists and MIR researchers to describe technology may help to identify areas where misunderstanding may arise or values may clash. After completing this analysis, we will make the data available in a form that guarantees the anonymity of the participants.

Although it is too early to know in detail what musicologists do all day, we will use the findings of the WDMAD survey to guide the next steps in our research, which will include in-depth interviews, work with focus groups and co-design of prototype tools in the pursuit of answering this rather big question. Ultimately, we hope to raise the awareness of the importance of musicology centred design, and to contribute to the systematic creation of usable software and resources that enhance (and may ultimately transform) musicological research.

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