Supporting Annotation as a Scholarly Tool—Experiences From the Online Chopin Variorum Edition

John Bradley and Paul Vetch
Centre for Computing in the Humanities, King's College London, UK

Abstract

In a meeting at King's College London in May 2000, John Unsworth proposed a list of seven 'scholarly primitives' which he claimed were 'self-understood' functions forming the basis for 'higher-level scholarly projects, arguments, statements [and] interpretations' (Unsworth, 2000). He claimed that his list summarized activities that were 'basic to scholarship across eras and across media', and went on to say that an analysis of these scholarly primitives might result in a clearer sense of how computing tools could support the scholarly endeavour. Here we focus on the primitive that was second on Unsworth's list, after 'Discovering': 'Annotation'.

Our work on annotation arises out of a developing awareness that established Humanities Computing (HC) areas of interest, do not seem always to connect with the actual *process* of the research work being carried out by most humanists. We claimed in Bradley (2005) that a fundamentally different usage paradigm than those in operation in established HC was necessary to even notice, and then follow-up on, the potential of scholarly annotation as a computer-supported activity.

This article presents our experiences, and the eventual outcomes, of the process of developing annotations tools for the Online Chopin Variorum Edition project (OCVE).[1] Beginning with a brief overview of activities related to annotation in Humanities Computing and Computing Science, we introduce the visible parts of the OCVE project, and address some discussion to the structures behind the scenes that support what it does, reporting what worked and what did not. We conclude by analysing the significance of our findings and describing the direction we think our annotation tool will take.

Correspondence:
Paul Vetch,
King's College
London, London, UK.
E-mail: Paul.vetch@kcl.ac.uk

1 What Do We Mean by Annotation?

We should say from the outset that we are not talking here about the specialized meanings for the term 'annotation' that appear in various computing-related disciplines, in contexts such as 'linguistic annotation'.[2] We are, instead, talking about a process that is perhaps more mundane, and often less thought about: one which, in the paper world, is represented by writing in the margins of a book.

This mode of annotation is noted by William S. Brockman *et al.*, in their report to the Council on Library and Information Resources entitled Scholarly Work in the Humanities and the

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Evolving Information Environment (Brockman et al., 2001). Their report responded to the evident feeling among librarians that digital libraries had not produced the kinds of transformation in scholarship that had been expected at the beginning of digital library development. Brockman *et al.* noted that part of the reason for this sense of disappointment is that digital libraries, as they currently are delivered, do not intersect terribly meaningfully with the process of scholarly research. They continued by examining several aspects of scholarship, and noted that scholarly annotation was evidently an important element of the activities of many scholars. See, for example, this quote from a researcher cited in Brockman *et al.*:

> If . . . I really have to study, learn and absorb what's in [something I'm reading], I make a photocopy and I write in the margins. And I underline, too. But I almost never underline without writing in the margin . . . Otherwise, I can find myself simply underlining, rather than absorbing. (p. 7)

There are two things to note about this description of an annotation process.

Firstly, the researcher quoted above acknowledges a clear distinction between the value of making casual markings (such as underlining) in a book which might happen in a 'semi-automatic' and unthinking way, and the more engaged, cognitive process of writing a meaningful note. Secondly, the evident purpose of writing the note is more strongly to fix the reaction that came into the researcher's head. As John Lavagnino observes in 'Reading, Scholarship, and Hypertext Editions' (Lavagnino, 1997), reading leads to interpretation 'by way of generating reactions that we subsequently seek to describe or explain'. A marginal annotation both clarifies and fixes the reaction it records in the mind of the researcher so that it can more effectively contribute to the process of interpretation.

An important starting point for all discussions within Humanities Computing (HC) must be the Text Encoding Initiative (TEI) (Sperberg-McQueen and Burnard 2002). There, one finds in Section 6.8 the definition of the <note> element which is described in the Guidelines as an element 'provided for the encoding of discursive notes, either already present in the copy text or supplied by the encoder'. This draws our attention to the primary role of the TEI DTD—to define a scheme for marking up pre-existing text, including those which perhaps contain annotations themselves. The comment 'supplied by the encoder', however, is interesting and suggests an alternative appropriate use of this tag by a third party—although in this case it is the person who is identified is someone preparing a text for a digital edition, rather than being an edition user. This, perhaps, reflects the reality of XML when one speaks of annotation as an 'inline' process: if one wants to enrich a text by tagging it one must also, in some sense, own the file annotate in which it is stored.

TEI also introduced a number of strategies for separating the source text from certain kinds of markup (including some kinds of annotation) and it is in these forms that TEI moves closer to the view of annotation we wished to examine with the help of Online Chopin Variorum Project (OCVE)—something that is linked to, but separate from, the material it annotates. In a handwritten note this separation is normally patent: the source to which the annotation applies is the printed text (traditionally provided by the book's author or publisher); whereas the annotation is handwritten (by the 'user' of the book) and clearly does not belong to the source text. The note is a personal comment applied to the text, positioned spatially at or near to the point of interest in the text which brought about the note's creation. It follows that there is a different sense of ownership for the annotation than there is to the source text. We believe that this aspect of annotation is one that most strongly challenges established humanities computing methods as they have evolved so far.

When we see the separation of annotation from the text it applies to, we see coming into focus the forgotten person in some HC paradigms—the end user. With the growth of HC and the increasing importance of markup, the emphasis has shifted from the active user who in the early days of HC applied tools against texts and produced (hopefully) novel results, to the editor, who uses XML and related technologies to provide end users with an enriched version of a text. This has, of course, proven to be very fruitful work and has produced a number of valuable pieces of scholarship, but the materials that have come out of this work leave the end user in the position of being a passive viewer of someone else's material—without even the option of annotation open to users of printed books. The only way for scholars more actively to integrate the digital materials that have emerged out of this HC effort into their own research agenda is to print out interesting web pages and write on them.

Thus, a part of what we hoped OCVE would be about was to begin to investigate what happens when we give end users—not project editors—facilities that allowed them to use the computer to help them develop their own models of what the resource was about. OCVE would provide a prototype of how one would integrate resources stored centrally (a digital library) with tools that allowed independent users to model their own research interests. We believed that personal scholarly annotation, an activity identified by John Unsworth (2000) and Brockman *et al*. (2001) as primitive to humanities research, was amenable to computing support.

2 Other Work in Annotation

The concept of annotation embraces a wide range of possible activities, motivational stimuli and desired outcomes, from the material act of adding marks to a document mimicking basic personal markup schema (for the purposes of providing an aide-mémoire) to the recording of impressions and cognitive processes as part of the interpretive act. The range of tools being developed for annotation broadly maps onto this same range of possible activities.

There are two relevant streams of research we are aware of from computing science. One, in some ways closely related to our own work, is that of a set of researchers centred on Catherine C. Marshall (1998) and Gene Golovchinsky *et al*. (1999) This work was stimulated by the potential for annotation writing afforded by tablet computers—where the user can take a pen-like object and literally write on top of the digital copy—so called digital ink annotations. This work has resulted in a range of papers. One of particular interest to us is an analysis of a collection of handwritten notes in secondhand student textbooks (Marshall, 1998), and one of the results of this work was some consideration of what happens when notes originally written by an individual for their private use become accessible to someone who buys the secondhand copy—thereby becoming more public. The issue of public versus private annotations is further explored in (Marshall and Brush, 2004).

Another strand of work explored 'web annotation'. Early work in this area is described in (Zohar, 1999), but W3C's 'Annotea Project' contained the beginning of serious, larger scale, development. Annotea is part of the W3C's Semantic Web framework, and defines an XML-based way to represent annotations that could be 'attached to any Web document of a selected part of the document without needing to touch the document' (Annotea, 2001). Web annotation shares the idea of the notional separation between the annotator and his/her source that characterizes the kind of end user annotation we were interested in, although the simplified model of annotator as 'web user' and the source as 'web (HTML) document' would, ultimately, not be so appropriate to our work.

From 2001 until 2002 a series of Microsoft research projects focused on annotation and collaboration, born partly out of interest in new features of the Microsoft Word application (Brush *et al*., 2001). One of the outcomes was the development of the WebAnn environment, developed as a plugin for Internet Explorer and described as an 'online discussion system [. . .] designed to support shared persistent threaded discussions that occur in a precise context'. WebAnn offered an annotation environment within which notes could be added either to user-defined ranges of text or globally to an entire 'page'. Once an annotation was entered by a user, and assuming it was set by that user to be publicly viewable (which was the default), it was available as a 'handle' onto which a threaded discussion could be appended by a community of other users.

An interesting characteristic of the tools we have described here is that for the most part they are predicated on a fundamentally collaborative model. Although most offer users the ability to choose a public or non-public status for a comment, much of the thought going into the display and creation of annotation in these tools is focussed upon making annotations which are designed to be meaningful to other people, rather than primarily for personal use (cf. Marshall and Brush 2004). One of the aims of WebAnn, for example, was to provide an environment within which a network of interconnected (threaded) annotations could be built up to develop a consensus of opinion, essentially for pedagogical support. Collaborative writing is also the focus of various wiki systems, and (Weng and Gennari, 2004) study annotation in this context as a way to streamline the collaborative writing exercise. Annotation for collaboration seems recently to have become a significant topic in humanities computing as well. See, for example, the imaginative work of Brown's Virtual Humanities Lab, reported on in (Zafrin, 2005). Although we were interested in ensuring that collaboration could be supported by our annotation model, annotation for collaboration was not the primary focus of annotation in OCVE. We were trying to develop tools that would support end user annotation for personal use—a use that would, in the end, assist its user in moving from reading to interpretation in the way that both Lavagnino (1997) and Brockman *et al.* (2001) imply.

Annotation as a way of providing better tools for end users is also now becoming a current topic in the digital annotation research community. See Agosti *et al.* (2005) for an interesting example, with direct relevance to our own work.

3 Annotation in the Online Chopin Variorum Project

The OCVE was a pilot project undertaken by a team of people from Centre for Computing in the Humanities, King's College London with Prof. John Rink (Royal Holloway College) between May 2003 and October 2004. The project aimed to construct an online environment which would 'facilitate and enhance comparative analyses of disparate types of source material',[3] which comprised the numerous extant witnesses of Chopin's works. It is worth saying something about the nature of the source material we were dealing with since its particular complexity to some extent shaped the decisions taken in approaching OCVE.

The work of Chopin presents serious challenges to the traditional scholarly presentation of such information because of the fairly unique circumstances surrounding its publication. In order to ensure better copyright protection for his works, Chopin would publish them simultaneously in France, Germany and England. For each publisher, the process was this: a score would be prepared by Chopin, which would sometimes go through a number of rounds of correction made either on the same manuscript, copy manuscript or printed proofs as the material was passed back and forth between Chopin and the publisher. This evolutionary editorial process typically meant that each of the three published first editions showed sometimes very significant differences. As editions were subsequently reprinted there could be further intervention either by in-house editors or proof readers potentially resulting in the introduction of additional amendments. The net result of this is that there can sometimes be in excess of fifteen different witnesses to the same piece.

In print form, a variorum edition is—of necessity—extremely complex, and must employ numerous systems of sigla and shorthand notation in an attempt clearly to represent the complex differences between witnesses of a single work, whilst at the same time modelling the familial relationships linking witnesses together. As John Lavagnino has argued in (Lavagnino, 1997) the presence of such dense scholarly apparatus in a print edition often seems something of a necessary evil: necessary for the sake of completeness and scholarly rigour, and evil for the extent to which the process of reading such an edition is constantly interrupted by the task of having to decode and expand the cryptic apparatus to make sense of what is going on in the text itself and its parallel editions. However, for OCVE the core focus of interest to musicologists is sited precisely within the supporting apparatus, and in trying to understand the relationships between the witnesses, primarily because the source material has often been misunderstood and incorrectly interpreted in the past. The challenge then was to not to try and create a digital library publication modelling the function of a print edition through the use of hypertext, but to use the OCVE project as an opportunity to explore the possibilities afforded by technology such as optical music recognition, image manipulation and the ability to cross-reference and model complex relationships to create a virtual workspace within which to study and compare a corpus brought together in digital form for the first time.

The plans for the OCVE project were structured around three conceptual models for the interrogation of the raw data (which were to be high-quality images of the original Chopin witnesses). The three interrogative models were:

(1) superimposition, whereby it would be possible to lay two images on top of one another in such a way as to make differences between them become apparent;
(2) juxtaposition, enabling the user to select a range of music from a base text and then elect to display one or many excerpts of the same range from affiliate witnesses to allow for cross-comparison;
(3) combination/interpolation, such that a user would be able to combine elements from two or more witnesses together to create a personal 'version' of a work, or to propose in some sense a new 'ur-text'.

The technical implementation of these three models was left extremely open-ended and we were more or less free to decide the approach to be taken. There was a strong feeling that OCVE should focus as much as possible on pushing technology to its limits to provide a showcase for the potential utility of a digital variorum edition.

Perhaps the most significant additional outcome of the first OCVE workshop with musicologists in June 2003 was that what musicologists most wanted was not only a way of being able to explore for themselves the relationship between different witnesses but an environment within which they could actually record their findings too, in much the same way as they would if working with their own personal printed edition. Because of this it was also decided to pursue development of annotation tools as a means of supporting scholarly research using the OCVE prototype.

For scholars of Chopin, the differences between witnesses that can be considered significant occur at much lower levels of granularity than individual bars or notes. Minute alterations in the length of slurs or expression marks, tiny alterations in the positions of performance markings, conventions for scoring sheet music which differ radically from one country to another, all result in pieces for which a wide and 'audible' range of performance interpretation is plausible. It was apparent that some sort of extremely low level symbolic representation could be very helpful here, capable of storing both musical and spatial data from the source images. However, it was also clear that to do this properly would require a great deal of development work with optical music recognition tools together with considerable use of human intervention to ensure that the markup was sufficiently accurate. Although the scholarly orientation of the MEI markup scheme (Music Encoding Initiative) (MEI, 2004) seemed extremely promising in this respect, considerable further work would be needed to extend it so that it could appropriately express these very subtle notational differences.

During the pilot phase, therefore, we elected to work with images of the source material, which were subjected to a rudimentary markup process to break individual scanned pages down into more meaningful units. We chose to work at the level of the bar, primarily because in Chopin's music the number of bars tends always to remain stable across different versions; his pieces underwent many very minor changes but none of the substantive revision we find in contemporary composers such as Lizst, for example, for whom the bar is not a convenient mode of comparison because his work was more fundamentally and extensively unstable over time. The bar, then, became the unit of comparison for the juxtaposition and superimposition views. This approach was not without drawbacks, mainly having to do with material which does not comfortably sit within a 'bar' (for example, key signatures, phrase marks, page titles, footer text and copyright information) yet which is of clear interest to a musical scholar. Nevertheless working with this simplified model allowed us to progress quickly with developing a working environment.

3.1 Juxtaposition

Juxtaposition was achieved using the rudimentary bar markup applied to the images as described earlier. The full page images of the manuscripts and printed scores were stored within the a database, above which a user interface was developed so that a user could choose a witness from a list of those available, and would then be presented with a large image of the first full page. Clicking any bar on this page would cause the system to dynamically generate images of the same bar, across all available witnesses, and present them together on a screen such as that shown in Fig. 1. The user could then reposition each bar image anywhere on the screen by using their mouse to 'drag and drop', mimicking the function of popular GUI environments. Additional controls were provided to allow a user to hide a bar image, and to switch to a full page view of a selected bar image (i.e. selecting a different witness to examine). In this way it was possible for the user to arrange individual bar images to allow for comparison by juxtaposition whilst also catering for individual preference. Because a user might spend some time arranging images to his or her satisfaction, a mechanism was put in place to remember the positions of the individual bar images and restore these saved positions when a user changed the bar context (for example, by selecting to view the next bar).

3.2 Superimposition

Superimposition was achieved using the ability of most web browsers to control, via javascript, the alpha channel of objects within the viewport. Some initial trials were done using witnesses which had fairly major, albeit difficult to spot, differences between them, and it became apparent that by

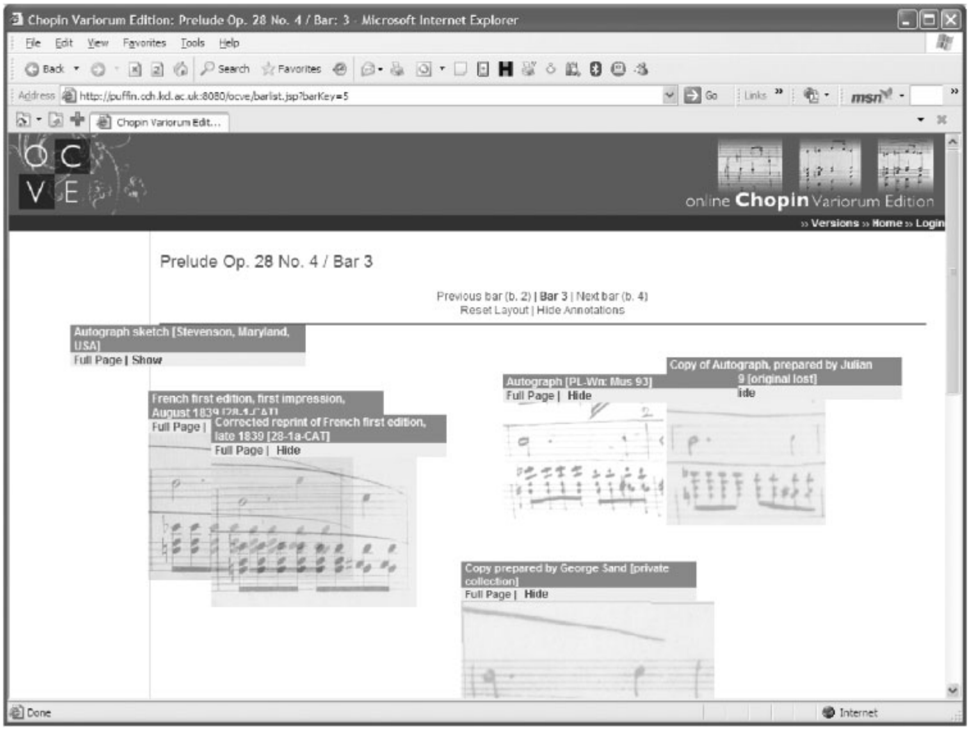
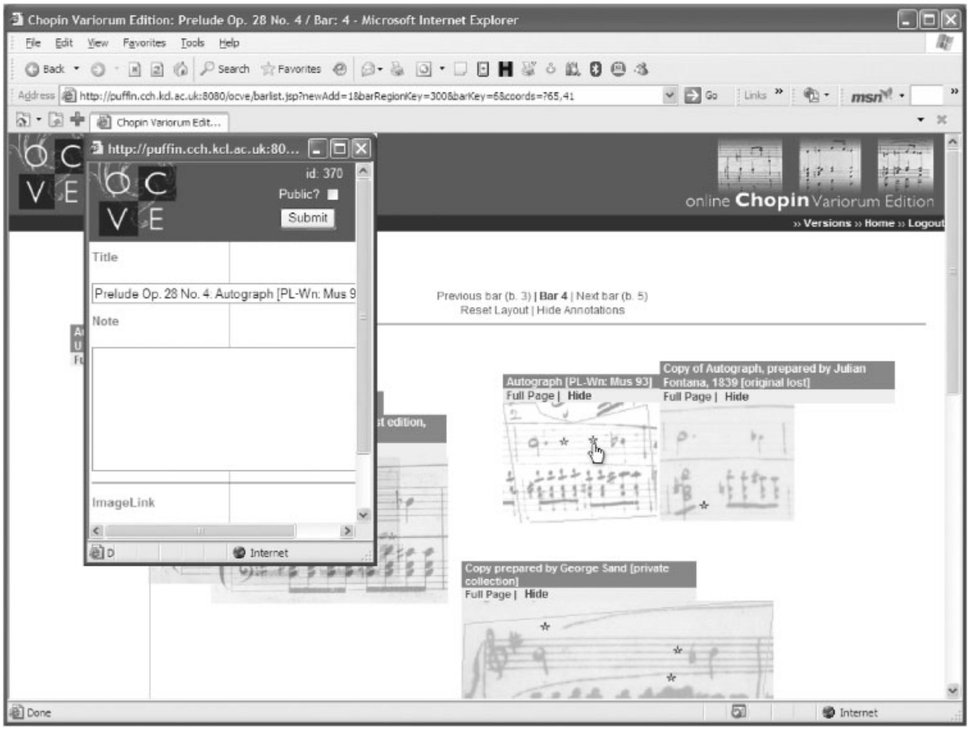

Chopin Variorum Edition: Prelude Op. 28 No. 4 / Bar: 3 - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://puffin.cch.kcl.ac.uk:8080/ocve/barlist.jsp?barKey=5
Go Links msn
Chopin Variorum Edit...
O C V E
online Chopin Variorum Edition
» Versions » Home » Login
Prelude Op. 28 No. 4 / Bar 3
Previous bar (b. 2) | Bar 3 | Next bar (b. 4)
Reset Layout | Hide Annotations
Autograph sketch [Stevenson, Maryland, USA]
Full Page | Show
French first edition, first impression, August 1839 [28-1-CAT]
Full Page |
Corrected reprint of French first edition, late 1839 [28-1a-CAT]
Full Page | Hide
Autograph [PL-Wn: Mus 93]
Full Page | Hide
Copy of Autograph, prepared by Julian
9 [original lost]
ide
Copy prepared by George Sand [private collection]
Full Page | Hide
Done
Internet

Fig. 1 OCVE's juxtaposition screen

laying two such pieces on top of one another and altering by degrees the opacity of the uppermost piece, allowing the lower piece to show through, was certainly helpful. It was also found that rapid alternation between 0% and 100% opacity was an extremely successful aid to spotting differences between witnesses.[4] The key drawback of this technique was that it was only truly useful for witnesses which were, in the first place, similar—as for example with a printed first edition of a score and a revised later edition, since in this case the revisions were inevitably based on the same printing plates. There were situations where the technique was more broadly useful, but a further difficulty to overcome was that of scale—to compare images there had to be a common scale. This was achieved in the vertical axis by scaling images to a common rastral height.[5] Obviously to achieve a similar effect in the horizontal axis as well would not have been possible without deforming the images, which was generally felt not to be helpful. In the OCVE pilot, superimposition was partially implemented as an additional feature of the juxtaposition screen described earlier; each bar image in fact has its alpha channel set by default at 50%, so it was possible to move bar images over one another for an elementary superimposition effect; alternatively, mousing over the images would set them to 100% opacity. This is one of the areas that could have been substantially assisted by basing the overlay on symbolic notation representations.

3.3 Annotation

Annotation of the OCVE witnesses was possible, in the original pilot, by entering a special annotation mode, for which it was necessary to login to the website. This done, an ‘Add Annotation’ link was visible once the user had selected a witness. The user was then able to click any point on the image where there was something significant or noteworthy: a pop-up window was provided into which comments and a label could be added (Fig. 2), and in the background a coloured marker was added to the image at the point where the user had chosen to



Chopin Variorum Edition: Prelude Op. 28 No. 4 / Bar: 4 - Microsoft Internet Explorer

Address http://puffin.cch.kcl.ac.uk:8080/ocve/barlist.jsp?newAdd=1&barRegionKey=300&barKey=6&coords=765,41

http://puffin.cch.kcl.ac.uk:80...

id: 370

Public? □

Title

Prelude Op. 28 No. 4. Autograph [PL-Wn: Mus 9

Note

ImageLink

Previous bar (b. 3) | **Bar 4** | Next bar (b. 5)
Reset Layout | Hide Annotations

Autograph [PL-Wn: Mus 93]
Full Page | **Hide**

Copy of Autograph, prepared by Julian Fontana, 1839 [original lost]
Full Page | **Hide**

Copy prepared by George Sand [private collection]
Full Page | **Hide**

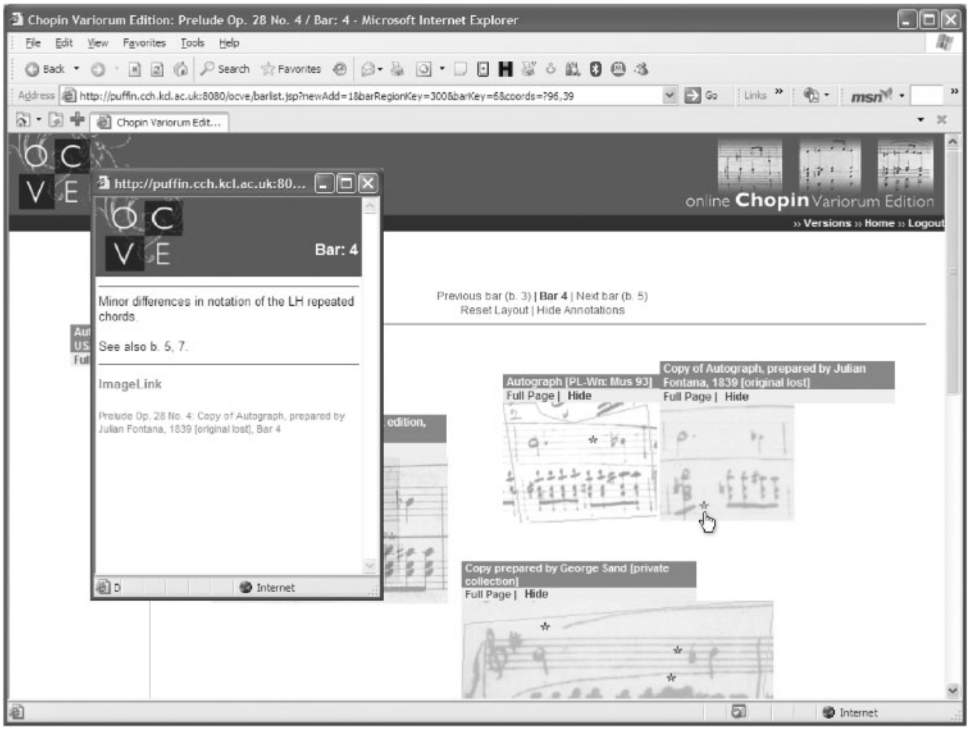
Fig. 2 Adding an annotation

append the annotation. The user could additionally decide whether or not to make the annotation publicly available (by default, annotations were set to be private, i.e. visible only to their creator). Once the annotation had been written, it was stored to the OCVE database, at which point the user would be returned to the witness image. In the same way, once a user had logged in it was also possible to add annotations in juxtaposition view. We had anticipated that the juxtaposition view would facilitate quite considerably users' analysis of the witnesses and so allowing annotations to be made in this view was important.

Although the creation of annotations was only possible for registered users, annotations with the public flag set were visible at all times in both the juxtaposition (bar) and full page views, where they were represented by blue asterisk markers dynamically superimposed on the images by the OCVE application (Fig. 3). Clicking on an asterisk would open the annotation in a popup window; the asterisk marking the selected annotation would turn red to help the user identify which annotation was being viewed.

3.3.1 *Organizing annotations*

Annotations, once made, could then be filed within a hierarchical structure, using an annotation management interface. The idea of the annotation organizer arose as a direct result of the OCVE plan to support scholarly use of personal annotations. Based on our stated premise that each annotation serves as a record of a 'reaction' (to use Lavagnino's term) to the text which might eventually feed into useful scholarly interpretation, we sought to further encourage this process by providing the scholar with a fluid mechanism for grouping and regrouping their notes in whatever way they saw fit. Over the course of a number of iterations, scholars could gradually work over their annotations, associating them in various ways, until helpful groupings (and by extension, it was hoped, interpretation) emerged. In the Social Sciences, this kind of text-work is called qualitative research (QR), and several


Chopin Variorum Edition: Prelude Op. 28 No. 4 / Bar: 4 - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://puffin.cch.kcl.ac.uk:8080/ocve/barlist.jsp?newAdd=1&barRegionKey=300&barKey=6&coords=?96,39
Go Links msn
Chopin Variorum Edit...
OCVE
online Chopin Variorum Edition
» Versions » Home » Logout
http://puffin.cch.kcl.ac.uk:80...
Bar: 4
ImageLink
Internet
Previous bar (b. 3) | Bar 4 | Next bar (b. 5)
Reset Layout | Hide Annotations
Autograph [PL-Wn: Mus 93]
Full Page | Hide
Copy of Autograph, prepared by Julian Fontana, 1839 [original lost]
Full Page | Hide
edition,
Copy prepared by George Sand [private collection]
Full Page | Hide
Internet

Minor differences in notation of the LH repeated chords.

See also b. 5, 7.

Prelude Op. 28 No. 4: Copy of Autograph, prepared by Julian Fontana, 1839 [original lost], Bar 4

Fig. 3 Viewing an annotation

prominent pieces of QR software have been developed to support this activity. There is further discussion of this aspect of research in the humanities and some of the possible parallels found in models provided by the Social Sciences in (Bradley, 2003).

In the most influential piece of software that initially rose out of QR—Nud*ist—a hierarchy was used to represent the user's developing interpretation of the text. Individual observations about the text (at the bottom of the interpretation tree) would be grouped together to form low level concepts, and then in turn low-level concepts would be grouped into higher-level issues/concepts, and so on. In the end, as one moved from the tree's trunk towards its leaf nodes one moved from the most general conceptual groupings (branches) to more specific concepts lower down, and eventually to the notes that represented direct responses to the text—generally appearing as leaves in the tree. In OCVE, then, we also provided a hierarchical structure to organixe concepts. Each concept was entered into the system in the form of a note, which could comprise either just a label (functioning simply to give the concept a name), or a label together with descriptive text. The user was able to group concepts together simply by attaching new notes to existing notes, thereby adding an additional level to the topology. Although there was technically no difference between a note which formed a 'branch' in the structure, and a note which was a 'leaf', what tended to happen was that scholars tended to create notes at the 'branch' level with labels only, as a means of structuring their full annotations, which they only attached at the leaf level. The structure that resulted was comparable with a file system folder structure, with notes being used purely as a grouping mechanism at branch levels, and providing detailed information only at leaf level.

In the pilot scheme, all of the annotations were global to the system, although the intention had been to extend the annotation scheme to allow for 'ownership' such that each user could have a personal annotation tree. This would certainly be necessary if annotation for this purpose is to be further developed.

4 Technical Basis of the Annotation Tool

Although the project team ultimately came to view annotation as a mechanism by which the scholarly team could represent materials that they wished to publish—critical apparati for example—one of the goals of the OCVE project was to consider how annotation would also help the end user as a place where he could record and organize his/her ideas.

Annotation by the scholarly editorial team could be thought of as a part of a publishing cycle—developed over a period of time, and then, at the end, finally set as a relatively static component of a then stable publication. In contrast, however, annotation by end users could be added at any time—indeed it was likely that personal annotations would be added *after* 'publication', rather than during publication preparation. This dynamic character of end user annotation needs to be modelled by technologies that work well with dynamic processes. Thus, our prototype is built on top of a relational database since the relational model, and the database engine that implements it, is designed exactly for this kind of dynamic process—and is more or less universally employed throughout the computing industry for the storing of dynamic data because it meets this need so well. The images were not stored in the database (although the database engine we used could have accommodated them), but everything else was, including the metadata (limited in OCVE 1) about the pieces of music and the sources provided in this prototype system, together with information about where the bars were on the images. The database contained a rudimentary formal model that brought together information about a particular source with information about the rather more abstract sense of the 'work' in the sense understood by musicians. The database model can be seen in Fig. 4; a more sophisticated model is now being developed for the second phase of the project.

Annotations were stored in the database as well—they were the actual 'dynamic' material here, after all—and since for OCVE we had only page images as sources each annotation had therefore to be anchored to a spot on the image,

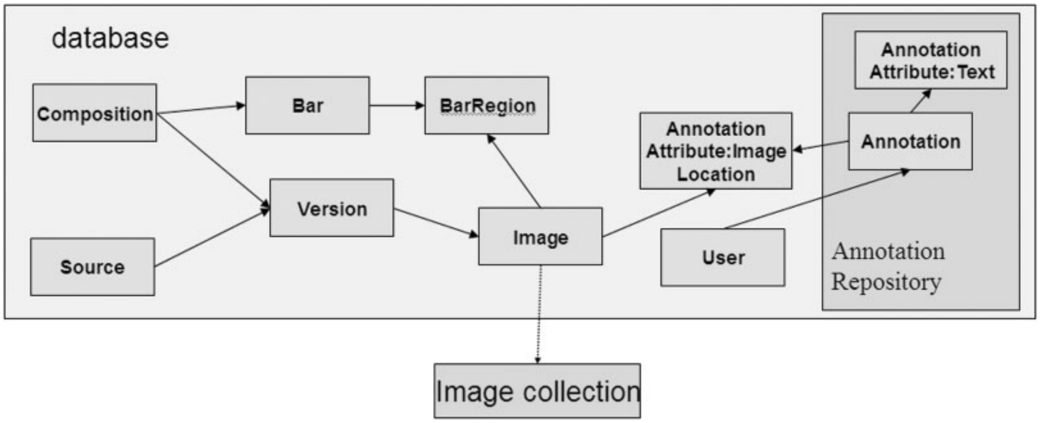


Fig. 4 Digital Entities in OCVE 1

the formal definition of the link anchor specified (1) in which image the annotation was connected to, (2) the x–y coordinates it was linked to, and (3) for the sake of computer performance, the particular bar in which the annotation was connected (if it was, in fact, in a bar at all). The database model allowed for an annotation to be linked to more than one spot: this would allow a single annotation to contain some text that compared one point in the music to another in any other image, work, or source in the collection.

Having constructed a formal model that expressed the various aspects of annotation that we were interested in, we needed to design mechanisms to allow both the project team and end users to create and manage annotations themselves. OCVE is a digital project which was to be delivered over the web. Thus, the technology our users were going to have to use with OCVE was determined for us—the browser. Other aspects of the technology were similarly largely predetermined. First, user's personal annotations, would be made accessible by means of a web application (we chose to create ours using the Tomcat engine and some technology we have developed in-house called **rdb2*java*** which facilitates the connections between a web application and a database) that could simultaneously show the underlying structure of the OCVE materials, and the annotations on top of them. All the data, including user annotations, would be stored in the central database that sat behind the web application.

Browser technology has had a kind of Moore's law of its own over the past number of years—the increase manifesting itself not in terms of speed, but in terms of sophistication and complexity. The simple viewing of static web pages is no longer the only facility that today's web browsers provide, and particularly in the implementation of the juxtaposition page we took advantage of a number of the newer mechanisms—CSS, the DOM and JavaScript.

5 What Worked and What Did Not

OCVE was a first prototype, and as such it achieved its main goal—not so much to produce definitive versions of its components, but instead to provide a model of what might be built that could be examined, discussed, and evaluated by all OCVE participants from technical developers to musicologists. Thus, OCVE 1 represented a partially working vision of how one might extend existing models of variorum editions. The evaluation revealed much interest, bordering on amazement, by musicologists in the juxtaposition view. This was not perhaps surprising: the juxtaposition tool broadly corresponds to text-oriented juxtaposition tools available in various systems that support the development of variorum editions. OCVE's main extension here was the provision in a 'standard browser'—such as one would find pre-installed on a computer—of mechanisms to allow the user to layout the juxtaposed material in ways that suited his/her interest. Indeed, some of our users reported that they found that having the ability to drag images around the screen was so evocative of a desktop GUI environment that they found themselves attempting to perform other GUI gestures, such as mouse selection, and finding that they could not do so!

Annotations did not prove to be as successful. There ended up being two kinds of uses in OCVE.

First, there was a significant amount of effort put in by the scholarly team to use the annotation tool as a mechanism to record *apparatus criticus*. As a way of representing this material, annotations worked reasonably well—a few minor adjustments in how annotations could be collected together so that they could be presented in a 'commentary' view might be the next step. This was relatively successful.

The most significant failure was in the expected second use—assessing how end users might make use of annotation tools to record their own materials. Of course, one of the reasons why this failed was inherent in the nature of the pilot: in the end there was too little material in OCVE (only two one-page preludes in twenty five versions) to provide a valid test. The original project plan had intended to include a much larger and potentially more complex and interesting work in the prototype (The *Barcarolle* in F-sharp major, op. 60). In the end, various issues (including a number of non-technical ones) prevented this from happening. The two small preludes that were included did not engage any of the research interests of our musicologist end users, and so any serious test of annotations for end users did not happen. Although there was no independent annotation by musicologists done in OCVE 1, we did monitor a limited amount of experimental interaction with the annotation system by musicologists, and the following observations are drawn from this.

Perhaps the major technical problem with the handling of annotations for personal use was in the area of Human Computer Interface (HCI). It soon becomes apparent in modelling any annotation system that a user's experience of making an annotation is all important; anything which a user perceives as a hindrance to recording his responses to a text indicates a fairly profound problem. One characteristic of the process of paper annotation is that at no time does a user need to expend any energy on deciding an appropriate format, say, for an annotation. She/he is free to annotate spontaneously; what is important is, first, the provision of a seamless, fast way of composing the annotation and simultaneously associating it spatially with the region of the source text which has provoked a response. Following the basic tenets of HCI work, our annotation interface had to strive for the same degree of 'naturalness' as that provided by pen and paper. Indeed, this is a part of the reason why Catherine Marshall and other's research on annotation is connected with the appearance of the tablet computer. We did not have the resources to deal with the management of digital ink and expected that our users would not either, so our annotation mechanisms made use of conventional computer interaction—pointing, clicking, and typing.

There were, then, in OCVE three components of the HCI aspect of annotation: *viewing* (existing annotations); *creating* new annotations; and *organising* annotations into a hierarchical structure. We will discuss each of them briefly in turn.

5.1 Viewing

To begin, we will compare the experience of revisiting printed pages with annotations already on them with that of revisiting an OCVE image with annotations already attached. In a book there are few spaces available for annotations, which must be squeezed in around the text. On the other hand, every time the page is revisited, all the annotations are immediately visible. Both these space and visibility issues were dealt with differently in OCVE from the paper model. The computer screen is not very large, but the decision to show annotations in a separate popup meant that annotations did not need to be squeezed around our text-images so as not to obscure them.

On the other hand, pop-ups have become a problem with modern security-conscious browsers some of which require the user to specifically indicate that pop-ups may be shown.

In OCVE, when a user revisited a page the annotations themselves were not immediately shown—only the spot to which they were attached on the page, known as the annotation anchor. The user had to click on the anchor marker to see the attached annotation note. This does, of course, result in a rather different user experience from paper annotations. Instead of being immediately confronted with all the annotation material, the user can (indeed must) choose which ones to look at and which ones to ignore before She/he has even seen them. Moreover, the user must make his/her selection based only on what little information is provided by the position of the annotation anchor. With the click and view model it is certainly impossible for the user to quickly take in at a glance what all the annotations are about—something that might be possible on paper. Surprisingly, given this significant difference, this approach (view only when requested) nevertheless seems to be the commonly provided model for web annotation, and our users did not express any difficulty with it.

Although we did allow the annotation note text to be moved around on the screen, the annotation anchor itself, superimposed on the image to indicate a linked annotation, was not movable, and a strong case can be made for why this might need to be the case. However, some of our musicologists were worried that the anchor would invariably obscure the area of the page upon which it sat, and an option was added near the end of the development to allow all the annotation markers to be hidden at the request of the user so that the entire page could be seen unmarked (or perhaps unmarred) by the annotation anchors.

In summary, although our annotation model was substantially different from the one provided by tablet computers (which offer a paradigm closer to paper-oriented annotation as it is actually practiced by scholars), it seems that the model we used worked reasonably well for the viewing of pre-existing annotations.

5.2 Creation

The creation of annotations is another point of comparison with paper-oriented methods. The act of deciding to annotate, and the process of sorting out the form it should take is by its very nature one that interrupts the process of continuous reading. However, as we can see from the quote earlier from the Brockman *et al.* (2001) paper, from the perspective of the annotator this interruption is a welcome one—allowing for thoughts to take shape and clarify sufficiently so that they could be set down in words. The paper model, writing with a pen or pencil on the paper, seems to cause little or no undesired further interruption in the reading/thought process of the annotator.

Adding of annotations in OCVE 1 was a more complex procedure. Firstly, our model required the user to first 'sign on' so that the ownership of the annotation could be noted. Annotations had to be stored on our server, rather than locally, and this necessitated users identifying themselves to the server. We found that our test users sometimes began to use the system without signing in and then discovered something that they wished to annotate—the signing in process acted as an interruption to the thought process, although it was at least only necessary once for that session. One way to minimize this interruption would be the use of a 'just in time' login box, which would discretely pop up and offer the user a chance to login as soon as they use a function for which user credentials are required, rather than forcing them to visit another page altogether.

Secondly, the process required that the annotator first click where she/he wanted to attach the annotation to. Once that was done a pop-up box would appear which provided a place to record what the annotation was to be about. The user had then to remember to push the 'submit' button so that the text She/he entered was sent back to the OCVE server for storage. Clearly the need to push the 'submit' button interfered enough with our users' thought processes that on a number of occasions the annotator forgot to do so, and the text was lost.

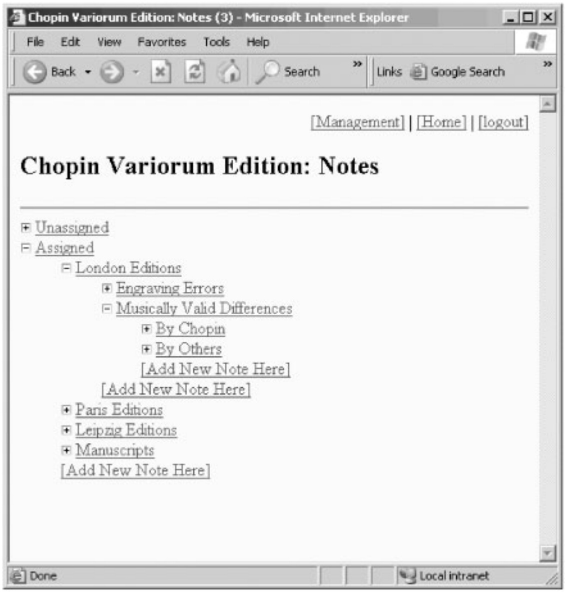
One further related problem with the use of the single mouse click to trigger annotation addition was that the OCVE interface also used the single click gesture to indicate the shift from full page to juxtaposition mode. We addressed this conflict by adding the option of allowing the user to switch between an ‘annotation mode’ (where the click was interpreted as a request to add an annotation) and a ‘viewing mode’ (where the click meant switch to the juxtaposition view centred on the selected bar). This worked well enough, but only just. A better user interaction paradigm would probably have made use of a secondary mouse gesture such as a right click, or ‘CTRL + click’, such that the primary mouse gesture (left- or single-click) would be reserved for switching between the full page and juxtaposition modes, whilst the secondary gesture might indicate that the user wanted to create an annotation (for example). Unfortunately, it is difficult at this point to provide reliable support for secondary mouse gestures as described here within the context of a web browser.

It might seem to the reader that these issues are related to the minutiae of current browser technology. However, there is an important principal here: seemingly workaday (and ephemeral) HCI gestures such as we describe here constitute the biggest obstacle to successfully modelling annotation—which is after all such an elegant and simple process on paper—on a computer. The annotation process is highly sensitive to the practical burden it places on the mind of the annotator, and the process outlined earlier, whilst not preventing users from creating annotations in our system, nevertheless constituted a clear interruption in the cognitive process which flows from a having initial thought to the desire to record it more or less spontaneously. The spur-of-the-moment nature of annotation was important to us here, and the way in which our software handled this aspect of its character proved just as significant as the means of storing and organizing the annotations themselves.

5.3 Organization

Finally, as described earlier, we explored the development of tools to assist the annotator in organizing his/her annotations hierarchically. The intent was to provide a space where the hierarchical structure could be set up and then constantly revised by the user as the issues that were represented by the annotations became clearer.

By default when users made annotations, they were automatically categorized as ‘unassigned’ and it was then for the user to decide whether or not to add meaning to the annotation either by categorizing it within an existing note tree structure, or by adding a new category for it to reside in. Annotations and categories were treated as having the same status within the tree: thus, an annotation placed within the category—say—‘Differences in comparison to E^{1}’—could also act as parent category for other nodes, to which further child annotations could be appended, and so on. Within a hierarchical organizing principle, the annotation management system was designed to be completely flexible, such that it was left entirely up to the user to decide a suitable taxonomy by which to organize the annotations. An example of the beginning of a possible user-managed hierarchy can be seen in Fig. 5 (shown in the earlier version, without the graphical livery that was subsequently added). Here, a user is interested in organizing the textual variants, as noted in the annotations, by publisher, and then by the nature of the variant (possible engraving error, and then musically valid variations by Chopin

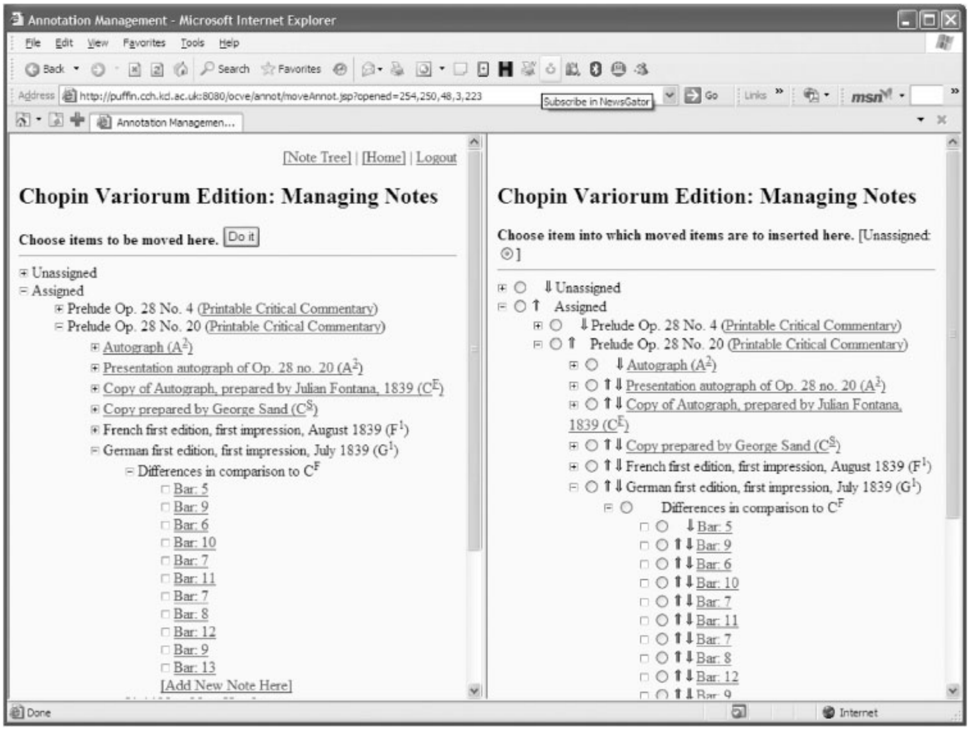

Chopin Variorum Edition: Notes (3) - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Links
Google Search
Done
Local intranet

[Management] | [Home] | [logout]

Chopin Variorum Edition: Notes

- Unassigned
- Assigned
  - London Editions
    - Engraving Errors
    - Musically Valid Differences
      - By Chopin
      - By Others
      - [Add New Note Here]
    - [Add New Note Here]
  - Paris Editions
  - Leipzig Editions
  - Manuscripts
  - [Add New Note Here]

Fig. 5 A personal annotation hierarchy


Annotation Management - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
http://puffin.cch.kcl.ac.uk:8080/ocve/annot/moveAnnot.jsp?opened=254,250,48,3,223
Subscribe in NewsGator
Go
Links
msn
Annotation Managemen...
Done
Internet

[Note Tree] | [Home] | Logout

Chopin Variorum Edition: Managing Notes

Choose items to be moved here. Do it

⊞ Unassigned
⊟ Assigned
⊞ Prelude Op. 28 No. 4 (Printable Critical Commentary)
⊟ Prelude Op. 28 No. 20 (Printable Critical Commentary)
⊞ Autograph (A^2)
⊞ Presentation autograph of Op. 28 no. 20 (A^2)
⊞ Copy of Autograph, prepared by Julian Fontana, 1839 (C^E)
⊞ Copy prepared by George Sand (C^S)
⊞ French first edition, first impression, August 1839 (F^1)
⊟ German first edition, first impression, July 1839 (G^1)
⊟ Differences in comparison to C^F
□ Bar: 5
□ Bar: 9
□ Bar: 6
□ Bar: 10
□ Bar: 7
□ Bar: 11
□ Bar: 7
□ Bar: 8
□ Bar: 12
□ Bar: 9
□ Bar: 13
[Add New Note Here]

Chopin Variorum Edition: Managing Notes

Choose item into which moved items are to inserted here. [Unassigned: ◉]

⊞ ○ ⇓ Unassigned
⊟ ○ ⇑ Assigned
⊞ ○ ⇓ Prelude Op. 28 No. 4 (Printable Critical Commentary)
⊟ ○ ⇑ Prelude Op. 28 No. 20 (Printable Critical Commentary)
⊞ ○ ⇓ Autograph (A^2)
⊞ ○ ⇑⇓ Presentation autograph of Op. 28 no. 20 (A^2)
⊞ ○ ⇑⇓ Copy of Autograph, prepared by Julian Fontana, 1839 (C^E)
⊞ ○ ⇑⇓ Copy prepared by George Sand (C^S)
⊞ ○ ⇑⇓ French first edition, first impression, August 1839 (F^1)
⊟ ○ ⇑⇓ German first edition, first impression, July 1839 (G^1)
⊟ ○ Differences in comparison to C^F
□ ○ ⇓ Bar: 5
□ ○ ⇑⇓ Bar: 9
□ ○ ⇑⇓ Bar: 6
□ ○ ⇑⇓ Bar: 10
□ ○ ⇑⇓ Bar: 7
□ ○ ⇑⇓ Bar: 11
□ ○ ⇑⇓ Bar: 7
□ ○ ⇑⇓ Bar: 8
□ ○ ⇑⇓ Bar: 12
□ ○ ⇑⇓ Bar: 9

Fig. 6 The OCVE annotation filing screen

himself and others). Other users might organize the same annotations according to their own research bias. In fact, as noted earlier, this 'playing with the hierarchy' did not occur, although the system was used by the project editors to organize and present the critical apparatus as annotations. Thus, although there was no serious testing of our hierarchical manager as a tool for developing a structure over time, we did explore this potential to some extent ourselves.

One technical challenge was in providing a browser-driven mechanism to allow the user to structure their annotations. You can see the functional prototype we provided as a user interface for annotation management in Fig. 6. The interface allowed the user to move both annotations and notes (together with their requisite subnotes and annotations) within the hierarchy structure by selecting a note to be moved in the left frame, and indicating a target position in the tree on the right. Users could also add and delete notes. However, although the prototype offered all the functions the user needed to develop and maintain a personal hierarchy, the interface that supported it seemed constantly to get in the way. Although our test users understood the hierarchical model, the interface which supported the creation of the hierarchical structure, and the filing of things in it (shown in Fig. 6) proved too clumsy. Here was the point where the limitations of the conventional browser model became the most difficult to manage. A more comfortable interaction paradigm—drag and drop—was obviously a better one, but browsers are not naturally equipped to support a user's drag and drop operations.

6 What We Learned

Firstly, our experience quickly showed us that a publishing project such as OCVE was not an entirely satisfactory environment in which to develop a tool specifically for end users. Among our colleagues, a tool's importance was interpreted primarily as to how it facilitated the project editor's task, and little resource was available within the project to consider how the annotation tool might operate for anyone else. This is, of course, understandable. Funding for projects such as OCVE is allocated to the potential editors, not (at least directly) to the potential users. Funding is tight enough, and the editorial task often complex enough, that resources are simply not left over to support development of items that do not support the primary activity—producing the edition. It is, therefore, clear that simply appending the development of end user tools on the back of e-publishing projects is not effective; some different strategy which places a greater emphasis on the potential worth of such tools is essential, although on the other hand work to develop tools for end users can only usefully proceed when it is backed by a resource that is rich enough to interest those same end users.

Secondly, it is now much more apparent to us that support for end user annotation in the context of a web browser-based delivery mechanism is limited by the design limitations of the browsers themselves. Browsers are specifically designed to support user *viewing* of material provided over the internet. Modern ones are complex enough beasts that it is possible to extend them to do all sorts of things beyond the fetch/view/click model that forms the basis for all browsers since Mosaic. However, doing so leads one down the path to an obscure and extra-standard world of browser plugins, Javascipt, CSS and potentially XML support. Furthermore, browsers are not well designed to support the development and manipulation of local structured materials. In the end, at present, end user annotation crosses a boundary between what can be done with a browser and designed in the context of the WWW into the area of applications and data models.

Thirdly, we have found that the 'web annotation' model that has inspired much WWW-oriented research and development is inappropriate at least for our goals here. In OCVE, annotations are not attached to the HTML page that delivers the image (as they are with 'web annotation' tools), but conceptually to the image itself. This allows the appropriate annotations to be shown even when single bars, extracted from the full-page image for each source, are shown in the juxtaposition view. Attaching annotations not to a webpage—where material happens to be presented—but to the digital representation of the material it represents, is highly desirable. Images, and image chunks, could be shown in several different contexts in OCVE. Thus, the job of showing an annotation anchor could only be done on the machine that had structural knowledge of these resources—in OCVE's browser-oriented model, this had to be the OCVE server itself. Our future work will be exploring ways to store personal annotations on the client machine rather than on a central server, and to achieve this properly will require dealing with the sharing of structural data between a central server and the client software.

One of the surprising results from our work with annotations in OCVE was in the nature of the connection between the annotation anchor (in our case, the coloured asterisk that indicates that an annotation has been attached) and the source upon which it is placed. The OCVE scholars were, in the end, never totally comfortable with attaching these anchors to any part of the image. They wanted to think of the annotation as belonging to the bar of music, whereas, in reality almost all the annotation content was not about the bar as a whole but a bit of the notation in the bar. In some cases, even the bar might not be right—if the annotation observed a musical phenomena that continued over several bars. Of course, placing the marker directly over the relevant notation would simply have obscured it. The issue of exactly where to place an annotation in a text is often also an issue in text-oriented projects that are using TEI—sometimes the locality of reference for the annotation is not clear.

We have concluded, ultimately, that the issue of the locality of reference is one of the core distinctions between public and private annotations. In public annotations, (relevant both to our OCVE researchers who were placing public annotations that provided *apparatus critici* to the text, and in many TEI publishing projects), the placement constitutes part of a public statement, and it is expected that if the placement poses difficulties, some thought will be applied by the annotator to get it 'as right as possible'. For private annotation, on the other hand, the placement is often casual, and indeed too much thinking about exactly where it belongs would interfere with the recording process that the creation of a private annotation was supposed to support. Indeed, text-oriented annotation—linked to a specific selection of text—might well compel a user to tie the reference down when it should, in fact, be left somewhat vague. This distinction between public and private annotation has also been noted in (Marshall and Brush, 2002).

We also thought about annotations in the context of textual stability. Annotations in a book will always be in the right place because the material in the book does not change. This, of course, cannot be said about the WWW, and indeed, there has been much work done on how to keep annotations synchronized with the right spot in an WWW page as the page is changed (Brush et al., 2001). We think, however, that OCVE should be thought of more in the context of the digital library than in the WWW in general. In the digital library, there has been a growing recognition by those who maintain such libraries that they have a duty to preserve what they publish in perpetuity. FEDORA, for example, provides a versioning mechanism so that even if a better version of some material comes along, the first version will continue to be available. Indeed, at one time at least the FEDORA development team was considering not having a 'delete' tool for resources at all!

7 Future Work on Annotation

There are three major areas that seem to us to be ripe for continued work in the second phase of the OCVE project. The first relates to the design of mechanisms that support not only personal, but also public and collaborative annotation.

In OCVE, we imagined that users might wish to comment on publicly provided annotations. This is already possible in the model we have put in place in that any annotation or note can contain a further subset of notes, and this content can be contributed by someone other than the original note's author. One use of this containment mechanism could be to store remarks made by others—a kind of multi-person blog attached to a single annotation, similar to the threaded annotation provided within WebAnn. We are, in fact, at the time of writing developing a similar mechanism for one of our other projects—the Digital Image Archive of Medieval Music (DIAMM)—so that online discussions about any of the images in the archive will be possible.

Other work on OCVE 2 will involve a continued evaluation of how annotation mechanisms can better be supported. New browser technology and strategies such as AJAX better allow us to provide the user with an enriched experience—although a number of fundamental problems (such as the provision of personal annotation storage space on a local computer) seem not to be in the purview of browser developers at this time. It turns out that an entirely separate project undertaken by one of us will tackle the issues of annotation of internet-served material from an application rather than browser perspective. This might well connect in the end with OCVE.

When thought of as annotation for end users we believe that annotation takes on a number of new aspects of computing that have been underrepresented in HC in the past few years. However, we believe that research and development in these areas may result in tools and techniques that might result in more of our humanities colleagues taking up some of the goals of humanities computing—to use the computer in the way to materially benefit humanities research.

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Notes

[1] The Online Chopin Variorum Edition pilot project has been under the direction of Prof. John Rink (Royal Holloway, University of London) in conjunction with Dr Marilyn Deegan and Mr Harold Short (King’s College London).

[2] In this context, ‘annotation’ refers to descriptive or analytic notations applied to raw language data.

[3] Online Chopin Variorum Edition Project Description, available online at http://www.ocve.org.uk/content/description.html (May 2005)

[4] This effect is in wide use in other fields. Cf. for example, the open source Flicker utility (http://open2dprot.sourceforge.net/Flicker/flkHome.html) which is used for comparison of complex scientific images. A similar technique as also used during the work on the Gutenberg Bible, the HUMI Project at Keio University (http://www.humi.keio.ac.jp/en/introduction/index.html)

[5] The term ‘rastrum’ is derived from the five-nibbed pen used to draw musical staves, and refers to a single five-line stave; hence the’rastral height’ is the height of a five-line stave.