Heroic Frogs Save the Bow:
Performing Musician's Annotation and Interaction Behavior with Written Music

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Abstract

Although there have been a number of fairly recent studies in which researchers have explored the information seeking and management behaviors of people interacting with musical retrieval systems, there have been very few published studies of the interaction and use behaviors of musicians themselves. The qualitative research study reported here seeks to correct this deficiency in the literature. Drawing on data collected from nearly 300 annotated parts representing 15 unique works, and 20 musician interviews, we make a number of functionality recommendations for constructive music digital library tool development. For example, all musicians annotate their written music, although this action seems to become more important as the musician becomes more skilled. Musicians' annotations are comprehensible to anyone who can read music, and are valuable as records of interpretation, interaction, and performance. Musicians annotate at the note (rather than at the phrase or movement) level, their annotations are standardized and formal, and are largely non-text. Music digital libraries that cater to musicians should attempt to provide annotation tools that work at the micro level, and extend the symbolic language of the primary document. Furthermore, preserving the annotations for future use would prove valuable for performance students, professionals, and historians alike.

Keywords: annotation, musician, performance, interaction.

1. Introduction

Although there have been a number of fairly recent studies in which researchers have explored the information seeking [5, 6, 8, 12] and management behaviors [1, 11, 13] of people interacting with musical retrieval systems, there have been very few published studies of the interaction and use behaviors of musicians themselves. Bellini's work on digital music stands [2] and information management in orchestras [3] mentions musician interviews and observations, but in-depth, published reports of musician behavior and information use do not exist.

This is unfortunate, because the information with which musicians interact, the musical score, has special properties that make its study profitable for general theories of information behavior, interaction and use. In addition to providing valuable insight into the annotative behaviors of users interacting with notational, symbolic data, this research also clearly benefits the music information science community, providing a user study of musician's interaction with their written music. Understanding musicians' annotation behaviors will hopefully influence music digital library tool development, and may lead to better interfaces, more contextually relevant retrieval systems, and modified digitization and digitized score preservation policies.

The goal of this research project was to find out more about how musicians interact with their written music. This paper will review our findings regarding musicians' annotation behaviors and provide recommendations for successful tool development in the performative context.

2. Methodology

This project used an ethnographic model with three data collection points: informal rehearsal observation, semi-structured musician interviews, and content analysis of annotated scores.

Because we wanted to focus on exploring the ways that musicians interact with and annotate their written music for the purpose of performance, we wanted both the ability to read music, and the fact that the music was formally written to be the *de facto* means of representation and interaction. Therefore, the user group was limited to classically trained musicians playing classical music. Interesting future work could be done on less formally represented music styles, like jazz, folk and rock.

Table 1 illustrates the six groups of musicians observed in this study.

	Pro	Semi-Professional	Amateur
Orchestral	105	105	12
	2	2	10
Chamber	16	5	4
	4	3	4

We divided score collection into orchestral and chamber musicians to investigate whether the presence of a conductor or interpretative leader made any difference in the quality and quantity of annotations. Furthermore, we wanted to explore the differences between amateur, semi-professional, and professional musicians' interaction, collaboration, and annotation styles.

2.1 Score Annotations: Content Analysis

The field of information and library science (ILS), has only recently discovered the utility of studying annotation behavior, and there are two main approaches to annotation studies in this field. In those technical strands of the field focused on artificial intelligence or knowledge representation, "annotation" seems to be synonymous with automatically generated metadata or machine learning applications [7]. At the more sociological end of the spectrum, annotations are becoming widely recognized as valuable indicators of user interaction with a primary object or text. Essentially regarding annotations as a "reflection of a reader's engagement with a text," [10], these annotation studies focus on studying different user's annotation styles and methods in order to develop new systems for reading, writing, or interacting with digital data. We took the more sociological approach, although there could be some machine learning applications for this research. Table 2 shows the content analysis grid developed for this project.

Table 2. Example Content Analysis Grid. "Specific Purpose" and "Transcript Example" columns are not complete but provide examples.

Mode	General Purpose	Specific Purpose	Transcript Example
Symbol	Technical	Bowing	V (up) or η (down)
	Contextual	Dynamics	< (cresc.) or > (decresc.)
Number	Technical	Fingering	1-5
	Contextual	Tempo	2/2, 4/4
Text	Technical	Bowing	"Save!" "Frog!"
	Contextual	Dynamics	"MAX" "CRESC"

The content analysis process consisted of transcribing each annotation on each collected part, recording the bar number and whether the annotation modified published information; and characterizing each annotation with three levels of description: 1) the annotation *method*: text, symbol, or number; 2) the *general annotation purpose*: technical-physical, or contextual; and 3) the *specific annotation purpose*: like bowing, tempo, dynamics, and cues (among others).

Technical annotations focus on the physicality of playing a specific instrument, exemplified by cues, bowing, breathing, and fingering instructions.

Context-based annotations are specific to the performance context and the players' intentions, interpretations and skill. Dynamics, timing, and phrasing instructions are typical of this group.

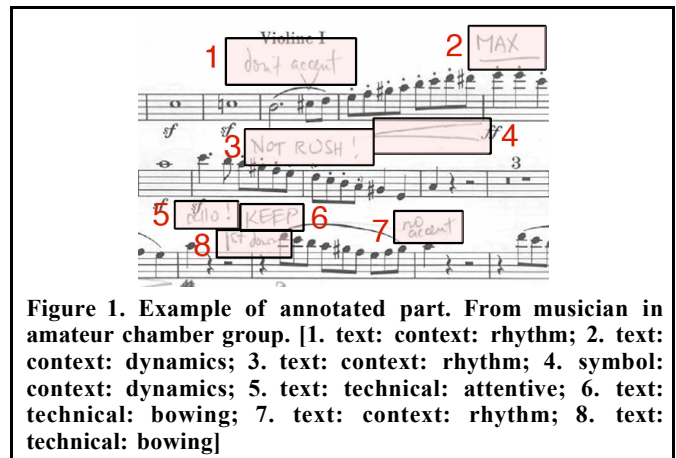Figure 1 shows an example of a marked up annotated score.

Figure 1. Example of annotated part. From musician in amateur chamber group. [1. text: context: rhythm; 2. text: context: dynamics; 3. text: context: rhythm; 4. symbol: context: dynamics; 5. text: technical: attentive; 6. text: technical: bowing; 7. text: context: rhythm; 8. text: technical: bowing]

2.2 Musician Interviews

We conducted semi-structured interviews with all of the chamber musicians from whom we collected scores. The participants in orchestras were self-selecting, but we succeeded in interviewing the concertmaster and conductor for each group. The interview questions were based on Buckland's typology of information [4], and modified for annotation studies by MacMullen [9]. The three interview sections focus on 1) the process of creating annotations; 2) the physicality of those annotations; 3) and the knowledge necessary to create, utilize, and understand the annotations.

2.3 Rehearsal Observation

We attended rehearsals to become acclimated to the rehearsal /performance lifecycle rather than to gather data upon which to build theories. For each group, we observed rehearsals at the beginning of the rehearsal process, towards the middle, and right before performance. This entire rehearsal/performance cycle would sometimes take a week, and sometimes months.

The information gathered from this phase of data collection was very informal and general. While it is

relatively straightforward to collect observational data from a chamber group like a quartet or quintet; it would be nearly impossible to consistently and unobtrusively collect data from a 100-member orchestra.

3. Annotation Characterization

Most of the annotations that musicians make are technical or physical in nature, showing bowings, fingerings, which string to play on, breathing, breaks and articulation. Their annotations are largely non-textual in nature, with symbolic annotations being more prevalent than numeric or textual ones.

3.1 Purpose

The technical / physical annotations represent specific instructions regarding how to play the piece of music. For example, articulation annotations are "specific instructions on how to begin and end the note." Bowing instructions (V or ⊓) relate whether the bow should be moving up or down, or what position the bow should be at the beginning of a note. Breathing and break annotations (denoted by a comma) tell the musician when to take a breath or a break. Fingering instructions (numeric, 1 – 5) define which finger plays which note. Of course all of these technical decisions have aesthetic consequences: a "down bow" for example is louder and its definition is more pronounced than an "up bow," and hence the aesthetic response might be "power" or "force," rather than "sweetness" or "calm."

The prevalence of these physical/technical annotations illustrates the importance of physicality in performance. Musicians are focused on correctly and reliably performing a piece, and that involves physically hitting the right notes with the right fingers, and drawing the bow across the strings in a specific and particular way.

Contextual annotations are those related to specific performance contexts, like cues and characterization of difficult parts, dynamics and tempo; and are based on the performance space, the expectations on the group, and the skill level of the musicians. It is conceivable that many of these notes could be considered technical in nature: tempo in particular has connotations of specific technical procedures. However, the annotations are general to the ensemble, not specific to a particular instrument or musician.

3.2 Mode

The majority of annotations are symbolic in nature, followed by numeric and finally by text. Symbolic annotations cover the whole gamut of annotation purpose. There are symbols for attentive notes, like the eyeglasses; for contextual notes, like dynamics marks; and for technical notes, like articulation and bowing instructions. That most of the annotations are symbolic may be because the musicians are simply extending the symbolic language of musical notation for their own use. The most commonly annotated elements (bowing, articulation, and dynamics) are annotated using the common symbols associated with those musical procedures. Further, a musician is likely to use the same representation system as used in the written score at that point in the score: when the published work uses a "<" to denote a "crescendo," the musician is more likely to extend the lines of the crescendo mark to make it longer, or start it earlier, rather than writing "cresc.," or "ff." However, there are instances where the musician reinforces a textual note ("cresc.," or "ff") with a symbol and vice versa.

Numeric annotations are used for fingering, timing, reminders regarding which string to play on, and bar or phrase numbers for navigation. Numeric annotations are also very prevalent, and are used equally by musicians of all skill levels. This democracy of use might be due to the difficulty in conveying many of these concepts using any other mode of communication. Although there are some symbolic representations of tempo, those symbols were only used as an annotation once in all of the collected parts, and that was by a professional chamber player. Likewise, fingering could be communicated by writing "pinky" or "thumb," but is much easier to simply write "5" and "1" respectively. While a very few musicians prefer to write finger names using text, the vast majority use finger numbers.

Musicians may also use textual annotations, although this is the least common method of musical annotation. There are examples of musicians using words to denote any musical procedure, but as their skill level increases, the likelihood of their using words diminishes. There are only a few examples of natively textual musical annotations, and those are related to attentive cues specifically. When one needs to listen to the cello for whatever reason, there is not a symbol or number for "cello," so it is most natural to write the word "cello," or "viola," or whatever instrument that needs attention. Interestingly, the more skilled a musician becomes, the more symbol-like these annotations become. "Cello" becomes "VCL" (for violincello); "viola" becomes "VLA;" the first violin is "V1" or sometimes even "I" and the second violin is "V2" or "II." Less serious musicians might even be more likely to write the names of the musicians instead of the instrument they play.

4. Musician Characterization

Different musicians annotate differently. We divided these differences based on musician skill, instrument played, and mode, whether the musician plays in a chamber group or orchestra.

4.1 Skill

There are a number of distinctions between amateur and professional musicians' annotations. First, professional musicians tend to use musical symbols more regularly to communicate with themselves about musical matters. They have internalized the symbolic language of music to the degree that they easily communicate using it. Symbols seem to be a very succinct and efficient way for musicians to communicate necessary information back to themselves.

A second, more subtle difference is in the quality of the professional's versus the amateur's annotations. Professional musicians are more distanced from the music they play, while being more invested in its reliable performance. The professionals who participated in this study are more likely to distance themselves personally from the music they perform and this is borne out by their symbolic, highly technical annotations. Music for them is a profession where they practice and collaborate effectively, and their musical ability and commitment make success possible. For the amateur and less invested semi-professional, music is an avocation. It is a hobby. Because rehearsal attendance is not practically mandatory, amateurs do things like rehearse because they want to. Their notes and methods of communicating are therefore more personal as well. They use words instead of musical symbols. They refer to their friends rather than the instruments their friends play. For example, if a professional needed to remind himself to listen for the cello, he would write "cello" or "VCL." The amateur is more likely to write the name of the cellist, "Matt." It infers that the amateur musician isn't listening to the cello, but to Matt, and infers a more personal relationship to the performance than the professional has.

One of this study's less intuitive findings is that the higher the musician's skill level, the more annotations he is likely to have. Professional musicians have by far the greatest number of annotations, and this is true across orchestral and chamber musicians. There are a number of explanations for this: first, amateur musicians mentioned that they liked to try to remember different instructions, and saw the performance process as something of a game. They were the group least likely to have a pencil with them during rehearsal. Most professional musicians, however, said that they are "100%" likely to have a pencil at rehearsal, and many mentioned that they would be "very embarrassed" to have to borrow one.

Professional musicians know that their individual skills and methods must merge seamlessly with others in the group. The group's earning power, which is dependent of the quality of their performance, is likewise dependent on individual members performing the piece correctly and reliably. Because "getting it right" is so important for success (both individually and as a group), professional musicians tend to not leave very much to chance, and see their annotations as an effective method to ensure success.

4.2 Instrument

Annotations are a reflection of a musician's engagement with a piece of music. Often this engagement represents challenging elements for either the individual or the group. Although there tend to be an average of one or two annotations per bar of music (a piece with 350 bars of music will typically have around 350 annotations), those annotations are not clustered evenly. There will sometimes be forty or fifty measures of un-annotated music, and four or five measures where every element has a mark.

Musicians indicated that these sections were indeed the most difficult parts of the piece, although they were not the sections commonly understood to be the most difficult. For example, Shoskatovich's String Quartet, #11, Op. 122, played by the professional chamber group, has virtuoso parts for both the first violin and the cello. However, this piece was the least annotated piece for the professional group generally, and the particularly difficult phrases were totally un-annotated by both the cello and the first violin. When asked about this, these two participants mentioned that 1) they'd need to concentrate during these difficult passages and annotations would have been distracting; and 2) during these virtuoso phrases or sections, these instruments are often playing alone, so the need to "get it right," is purely individual. This suggests that annotations, in this context, have a specifically collaborative character.

Also, the presence of numerous annotations suggests that some instruments have more responsibility for the smooth functioning of the group as a whole. In the chamber music groups, across skill level, the second violin often had twice as many annotations as anyone else, and sometimes had four times as many annotations, while the first violin had the smallest number of annotations. When asked about this, the professional first violin player had two explanations: 1) the second violin is often responsible for thematically and functionally tying together all of the other instruments. Because the second violin both backs up the tempo set by the cello and supports the melody played by the first violin, the second violin has more information to keep track of, and more responsibility for "getting everything right." They have to interact with everybody in the group, and use annotations to keep track of those interactions. 2) The first violin typically plays the melody, which is easier to memorize, and less dependent on successful interaction with other members of the group. Everyone else has a responsibility to follow the first violin's lead. The need to annotate is therefore less urgent for the first violin than it is for everyone else in the group, but especially the second violin, whose "job" is to manage interaction among the different instruments.

4.3 Mode (Orchestra versus Chamber)

Chamber musicians are much more prolific annotators than orchestral musicians; and their annotations' purpose range between technical, attentive, and contextual; whereas the purpose of orchestral annotations are almost purely technical.

The disparity in the amount of annotations orchestral and chamber musicians produce might be due to the different power hierarchies in the two groups. If we accept that annotations represent interactions that the musician has with the written music, and those interactions themselves represent performative decisions made by the musician, then it is only natural that chamber musicians would make more performative decisions and hence make more annotations than orchestral musicians, who are making relatively few performative decisions on their own. There are many consequences of this chain of command in chamber versus orchestral music. As discussed earlier, the fact that the first violin, who is often considered the

"leader" of a quartet, carries the melody which everyone follows, has the result of his having fewer annotations than everyone else in the group because his responsibility within the group is to lead rather than to manage the collaboration. The musician tasked with managing the collaboration, the second violin, often has twice as many annotations as anyone else.

In an orchestral setting none of the musicians have individual responsibility for either carrying the melody (except in the case of solos, which are generally not annotated) or for managing collaboration among instruments. The conductor has those responsibilities, and the musicians look to him for technical, attentive, or contextual cues – they don't need to make the notes that chamber musicians must, because they are operating in a much less egalitarian society. They make no performative decisions; they make very few personal annotations on their music.

As mentioned before the most prevalent type of annotation on an orchestral piece is technical: the fingering and bowing instructions for the strings (violin, viola, cello, double bass, and plucked harp), the fingering and breathing instructions for the winds (flute, oboe, English horn, clarinet, and bassoon; French horn, trumpet, trombone, and tuba), and the pitch changes for the percussion section (usually one person who plays everything: kettledrums or timpani, snare and bass drums, cymbals, triangle, and xylophone).

Orchestral musicians serve the intellectual will of the conductor. The feeling that their annotations give is that orchestral musicians are following orders. In many cases their annotations are given to them from the section chair, who has received orders from the concertmaster (first chair violin), who has often received information, if not outright direction, from the conductor.

As mentioned earlier, most of the orchestral annotations are technical. When asked why orchestral musicians write so few non-technical notes, particularly emotive ones, the professional chamber musicians said that an orchestral musician would be "laughed off the stage" if they started making those sorts of personal annotations. So there are some cultural norms at work, which don't allow for orchestra members to make emotive or contextual decisions or even allow those decisions to see the light of day in performance.

5. Recommendations for Music Digital Libraries Development

All performing musicians make annotations on their written music. Their annotations are largely non-text, and are formal and standardized. The annotations are commonly understood by anyone who is able to read music, and musicians value certain annotations, like those of highly skilled musicians, or their mentors; and do not value others. Musicians annotate for a number of reasons: precise technical or physical direction on how to play specific notes or phrases, general contextual clues on the feeling and tone of the piece, and as reminder notes to

listen for a cue, or turn the page. These findings have a number of applications for the Library and Information Science community.

5.1 Collection Development & Preservation

Although it is difficult to make recommendations for tools that do not yet exist, we know that musicians highly value annotated parts from their mentors or respected colleagues. All of the more invested players had a story to tell about "saving" (i.e., copying) some annotated parts from beloved teachers; or how "precious" their old annotated parts were to them. Currently, annotated parts are erased when they are either returned to the library or the rental agency and all that information is lost forever. Unless the musical part comes from a particularly famous musician or composer, annotations are erased for digitization as well. Although this practice is understandable for physical objects – annotations can be distracting – if annotation tools are ever developed for music digital libraries, that information could be saved for future students learning the piece, or scholars studying a piece's particular performance history.

5.2 Annotation Tools

If a music digital library caters to performance students or working musicians, the development of annotation tools is vitally important. All musicians annotate, although the quality and quantity of those annotations varies across skill level, instrument, and mode of play.

Most of the annotations are at the note or elemental level, and are dependent on context. Although annotations can be symbolic, numeric or textual, they are mostly symbolic or numeric, extending the symbolic language employed by music notation. Any annotation tool developed for music digital libraries should provide functionality for annotating notes and musical elements using the language of the primary document itself.

Music annotation, like musical notation, is highly structured and standardized. Instead of providing stylus functionality where the musician simply "writes" on a screen whatever they want to write, it might be interesting to develop a system architecture that would preserve the annotations in a structured and standardized way for future use.

6. Conclusion

Whether they are used for technical or contextual purposes; whether they are symbolic, numeric or textual; or whether there are a lot or few of them; musical annotations are an almost ubiquitous process for performing musicians.

This research can best be used to define tools and needs that must be met for development of a fully functional digital library for performing musicians. These needs include the ability to annotate at the micro level using symbols, numbers or text, and to allow for different modes of annotation dependent on musician performance mode.

7. Acknowledgments

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