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Previous research has found that annotations Western classical musicians create in their sheet music during ensemble rehearsal play a key role in fostering group coordination during music performance. Despite their important role in musicians' information interactions with sheet music and with each other, a dearth of research exists regarding musicians' annotations. This study conducted a content analysis of annotations that singers in a 100-voice choir created in 158 copies of music while rehearsing two pieces. More than 2,600 annotations were identified and classified according to a coding scheme previously developed by the most extensive study of musicians' score annotations to date. This study characterized choristers' annotations using the coding scheme. This paper offers an assessment of the coding scheme, suggestions for an improved research design, and ideas for future research of musicians' score annotations.

Headings:

Annotations

Music literature

Content analysis

Information sharing

Information resources -- Use studies

Marginalia

CONTENT ANALYSIS OF A CHOIR'S SCORE ANNOTATIONS: CHARACTERIZING ANNOTATIONS AND ASSESSING A CODING SCHEME

by
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Content Analysis of a Choir's Score Annotations: Characterizing Annotations and Assessing a Coding Scheme

The goal of this research study was to observe the characteristics of annotations that members of a large choir created in their scores during ensemble rehearsal. To date, Megan A. Winget's 2006 dissertation research is the largest ethnographic study of how performing musicians create and use annotations in their scores. The study presented in this paper sought to yield data and findings that could be compared with those from Winget's research. Additionally, this study utilized Winget's score annotation coding frame in order to assess its suitability for studying score annotations in a different context and to propose improvements to it. Although Winget's research remains the most extensive study to date, a review of the literature revealed that knowledge of musicians' annotation practices is valuable to the development of a variety of digital systems that support musicians and that further research in this area would be welcome. This study sought to contribute to knowledge of how musicians annotate their music so that digital systems developed in the future will better support musicians' annotative activities. Additionally, past studies of musicians' annotative practices have used instrumentalists rather than vocalists as the population under study or as the prospective user group of a digital music system. The research presented in this paper therefore sought to enrich the research on musicians' score annotations by investigating the character of choristers' score annotations.

Literature Review

Previous Research on Score Annotations

The most extensive ethnographic study to date of musicians' score annotations comes from the field of library and information science (Kaastra, 2011). This research study sought to characterize the information interaction between Western classical musicians and their printed music by examining the annotations that musicians created in their scores. The study regarded musicians' score annotations as artifacts of the musicians' interaction with the musical score, their "primary information object" (Winget, 2008a, p. 1878). As Winget explained:

> The goal of this research project was to explore the ways in which musicians interact with their written music; how a variable work like a performed musical piece is realized for a unique performance; and how musicians' interactions and interpretations, as evidenced by their annotations on their written music, affect the final product (2008a, p. 1878).

Winget's study was exploratory in nature and sought to yield descriptive data regarding the following qualities of score annotations: creation and use; object characteristics; and meaning and utility (Winget, 2008a, p. 1880). Additionally, the study sought to investigate how musicians' skill level, ensemble type, and ensemble role affected their information interaction with their musical scores, as reflected by their score annotations. To this end, Winget's study participants included musicians from six different types of instrumental ensemble that performed Western art music: amateur orchestra, semiprofessional orchestra, professional orchestra, amateur chamber ensemble, semiprofessional chamber ensemble, and professional chamber ensemble.

In order to investigate the research questions posed by this exploratory study, Winget's research drew upon three different methods. First, informal observations of each ensemble's rehearsal process provided context for the creation of their annotations

and meaningful background for interpreting the data produced by content analysis of the score annotations (Winget, 2008a, p. 1880). Second, the musical scores from each ensemble were collected and the annotations that musicians had made in them were analyzed and classified according to a coding frame that Winget designed during data collection and analysis (Winget, 2008a, p. 1883). Finally, semi-structured interviews of 22 musicians served several important purposes: (a) they provided an understanding of the rehearsal, performance, and annotation processes; (b) insights gleaned from the interviews contributed to the development of the coding frame used for content analysis of the musical scores; (c) the interviews allowed the researcher to clarify the meaning and purpose of individual score annotations; and (d) the interviews provided insight into the musicians' creation, use, and perceived value of score annotations (Winget, 2008a, p. 1880-1). Data collection for the orchestral ensembles was incomplete because it was not possible to collect all scores from the amateur orchestra and because the professional orchestra's scores had already been annotated by the semi-professional orchestra. For this reason, some of the findings were based primarily on data gathered from the scores of the chamber musicians (Winget, 2008a, p. 1889).

After analyzing the data resulting from observations, interviews, and content analysis, Winget concluded that "musician annotations are created through the problems or breakdowns in communication that happen in their attempt to work together to perform a musical piece. Musician focus is on collaboration, coordination, and interaction" (2008a, p. 1893). Winget's study analyzed and classified more than 25,000 individual score annotations and found that 78% of these annotations had a purely technical purpose (as opposed to technical-conceptual or conceptual) and that 72% of

annotations were symbolic, rather than numeric or textual. [1] Beyond these observations, the study found that (1) chamber musicians tend to create more annotations than orchestra musicians; (2) second violinists created more annotations compared to the other types of chamber musicians; (3) the more highly skilled ensembles tended to create more annotations than the less-skilled ensembles; and (4) although in general musicians are not formally taught how to annotate their scores, their annotations tend to be standardized and consistent (Winget, 2008a, p. 1893).

Working during the same timeframe as Winget, Kaastra has also closely examined the role of score annotation in Western art music performance, although she did not originally set out with this intent. In her 2008 study titled *Systematic Approaches to the Study of Cognition in Western Art Music Performance*, Kaastra's project was to identify and apply methods of studying music performance informed by both cognitive psychology and musicology. Coming from her background of extensive musical education and training, Kaastra sought to develop a method of studying cognition in music performance that remained "phenomenologically resonant with instrumental practice" (2008, p. ii). In particular, Kaastra focused on the role of musicians' physical gestures (including conversation, body motion, and instrumental play) in fostering musical understanding between musicians as they perform a work of music.

In order to observe closely the physical gestures and cognitive processes implicated in music performance, Kaastra carried out an observational case study of the collaboration between two musicians who rehearsed and performed a piece of Western art music composed for two flutes. The research process entailed observing and video

[1] Please see "Data Analysis Framework" in the Methodology section of this paper for an explanation of these categories in the context of Winget's study.

recording all rehearsals and the final performance and then minutely analyzing data from the video recordings, employing grounded theory methodology to investigate the role that physical gestures played in promoting musical understanding between the flutists during their collaboration (Kaastra, 2008, p. ii).

Although Kaastra initially chose to focus on the musicians' physical gestures, she observed in the course of data collection that additional mechanisms were equally important for "cultivating and maintaining a sense of ensemble" between the musicians (2008, p. 67). She observed that the flutists "had been marking the score to facilitate counting and coordination…counting and marking the score played a huge role in their experimentation with the music" (2008, p. 57). Her data analysis revealed that the musicians relied heavily on annotations they created in their scores, particularly to mark beats and dynamics (2008, p. 67): "Throughout the rehearsal process, the flutists penciled beat marks on the score so that they could listen to each other and coordinate the rhythms between parts" (2008, p. 91). Drawing upon Herbert H. Clark's joint activity theory for the study of language, Kaastra ultimately identified four domains of coordination devices that musicians use to negotiate musical meaning in the activity of music performance: (1) the score, (2) annotations musicians add to the score, (3) real-time bodily movements, and (4) general principles of ensemble performance. Regarding the domain of score annotation, Kaastra wrote:

> The pencil marks are 'keys' to understanding some of the indexical problems of performing the score. The vertical lines help the flutists to line up their parts. The triangles remind them to keep the same internal subdivisions. The curved arrows remind them of their goal to continue the momentum through the rests (2008, p. 108).

Kaastra subsequently revisited the data collected during the study of gesture in music performance, this time in order to investigate how the musicians' score annotations

supported cognitive and meta-cognitive processes of music performance. She presented this research in an article describing the role of musicians' score annotations in coordinating Western Art Music (WAM) performance, drawing upon theory from the field of distributed cognition (Kaastra, 2011, p. 675). The data for this analysis of score annotations consisted of the videotaped rehearsal and performance process from her case study research, as well as the musicians' annotated scores from the study. Kaastra wrote of her procedure: "I observed each annotation as it was made in the rehearsals, including the playing, stoppage of play, and conversation that accompanied each mark. I then classified the marks based on the reason they were used" (2011, p. 677).

Kaastra's analysis of the flutists' annotations resulted in a framework for classifying score annotations based on "their function in supporting cognitive and meta-cognitive processes of performance in relation to the printed score" (2011, p. 675). This framework includes three classes of annotation:

1. Visual salience: annotations that "make existing aspects of the score more visually salient for performance" (Kaastra, 2011, p. 677)
2. Repair/correction: annotations that repair or correct "some aspect of the score, or a cognitive process implied by the score" (Kaastra, 2011, p. 678)
3. Performance anchors annotations that "hold and link internal and external performance processes" (Kaastra, 2001, p. 678)

Annotations and Coordination of Music Performance

Drawing upon theory from the field of communication studies, Winget conceptualized the scores that musicians use in rehearsal and performance as boundary objects. In this theory, a boundary object is defined as "an artifact, document, or even an

idea that helps people from different communities build a shared understanding" that facilitates effective communication across community boundaries (Winget, 2008a, p. 1878). The following quotation from Winget (2008a) further illuminates the concept of a boundary object:

> As Star and Griesemer define them in their seminal article, boundary objects "inhabit several intersecting social worlds," and "satisfy the informational requirements of each of them" (Star & Griesemer, 1989). Instead of demanding full comprehension by every member of a community, "boundary objects serve as a point of mediation and negotiation around intent" (p. 1879).

In the context of music performance, the score as boundary object helps people from different communities (e.g., a composer, a conductor, different ensembles, individual members of the same ensemble) develop a shared understanding of the musical ideas embodied in the score. During the rehearsal process, the score helps musicians communicate about those musical ideas in order to establish their performance goals--what the ensemble aims to achieve in its performance of the musical work. Within this theoretical framework, annotations that musicians create in their scores are conceptualized as "markers of interaction with boundary objects" (Winget, 2008a, p. 1885).

Just as a boundary object facilitates communication among members of different communities, Winget conceptualized Western art music performance as a communicative event and situated the musical score boundary object in the context of a communication model representing musical performance. She defined a model of communication to represent the transmission of musical ideas among the different actors involved in the performance event, which is facilitated by the musical score boundary object. Winget describes this relationship between the musical score boundary object and the communicative event, writing:

> …the musical score was considered the primary means of communication across boundaries—it is the means by which the composer communicates with the conductor and the musicians; the conductor with the musicians; and the musicians amongst themselves. On another level, the score is the means by which the composer/musician unit communicate aurally with the audience (2008a, p. 1882).

As this quotation suggests, Winget's communication model conceptualized the score as a boundary object facilitating a linear, hierarchical communicative event whereby musical ideas are conveyed from the composer's mind to the ears of listeners, ultimately. This event has the following structure: Composer ➔ [score editor, if present] ➔ [conductor/interpretive leader, if present] ➔ performing musician(s) ➔ listener(s). In this model of communication representing musical performance, the composer notates his or her musical ideas as a means of sharing them with others, in this case through written symbolic notation that has become standardized over the course of the history of Western art music. After composition, a score editor may produce a published version of the score with annotations that seek to clarify the composer's intentions, especially if the musical practices of the composer's epoch have become obscured by time. Then, if an ensemble has an interpretive leader, such as the conductor of a choir, this leader studies the score and makes decisions regarding how to express the composer's musical ideas in the context of a particular performance. The leader then communicates these interpretive decisions to the ensemble during rehearsal. Ensemble members also communicate with their colleagues during the rehearsal process. If an ensemble does not have a designated interpretive leader, then the musicians collaborate on making interpretive decisions during rehearsal. Finally, the ensemble communicates its interpretation of the composer's work to listeners through its performance (Winget, 2008a, p. 1882).

Within this model, the score serves as a boundary object by giving the different actors a shared understanding of the composer's musical ideas that they use to

communicate while rehearsing the performance. Winget describes how musicians' score annotations were conceptualized within the study's theoretical framework, writing:

> This research project considered interaction between musician and written music as a form of communication, with the annotations providing evidence of that communicative event, essentially marking spots where some "breakdown" has occurred, requiring clarification, augmentation, or modification of the written instructions (2008a, p. 1882).

Although her original model emphasized the linear, top-down structure of communication in music performance, Winget observed during her study that the musicians' interactions with their written music (captured in their score annotations) shed light on the importance of annotations for lateral communication among musicians in ensemble performance. Ultimately, Winget observed, annotations reflected not only how musicians interacted with their printed sheet music but how they interacted with each other as an ensemble. More specifically, as a boundary object, the score supported communication among musicians by fostering a shared understanding of the ensemble's shared performance goals, thereby enabling coordination of individual efforts and ensemble cohesion. Score annotations created by individuals facilitated successful group work (Winget, 2008a, p. 1890). Winget writes of this enriched perspective on score annotations:

> The annotations in this augmented model represent a more complex interaction between musicians than had been supposed at the outset of this project. The original communication model conceived of annotations primarily as a personal directive to "get it right." Although annotations still have personal ramifications, the importance of "getting it right" is better understood in light of coordinative group work rather than as an individual task. A member of an ensemble does make annotations in order to play correctly, but only because other members of the group rely on consistency in order to achieve reliable group performances over time (2008a, p. 1890).

The observations that Winget made concerning score annotations and ensemble coordination cohere with how she conceptualized the score as a standardized-form

boundary object: "This research is based on the assumption that the musical score works as a standardized-form type boundary object, providing standardized methods, procedures, and vocabularies to communicate common processes and goals to various groups within an orchestra or ensemble" (2008a, 1882). Unpacking this definition in the context of Winget's study, standardized Western art music notation provides the standardized procedures and vocabularies that musicians use to communicate about performance goals that the ensemble will work towards through their combined efforts. An example of a shared performance goal would be to perform a *crescendo* at a certain point in a piece. A *crescendo* requires the combined efforts of the ensemble in order to occur; if only one member increases volume, the effect is unnoticeable at best, distracting at worst. Rather, a *crescendo* achieves its effect as the result of all ensemble members (or a defined subset of the ensemble) increasing volume gradually and simultaneously, coordinating their individual efforts. This *crescendo* goal could be refined to specify the particular beat on which volume will start to increase, the rate at which volume will increase, the point at which volume will reach its zenith, and approximately how loud that pinnacle will be (e.g., *forte*; *fortissimo*). Performing such a complex, collective musical gesture requires coordination in the ensemble so that each member takes the correct action at the correct time in order to create the overall desired effect. If a singer creates an annotation in her score to remind her to perform the *crescendo* (i.e., when and how much to increase her volume), this annotation at once captures the ensemble's shared performance goal of creating a *crescendo* as well as the individual action she must take to contribute to the goal. A key function of score annotations, Winget points out, is to coordinate individual actions in order to produce collective actions that achieve the ensemble's shared performance goals.

Winget's assertion regarding the role that score annotation plays in facilitating coordinated interaction among ensemble musicians is based on patterns she observed in the score annotations. She noted that a musician's score tended to be more heavily annotated if that musician's part was:

> responsible for bringing together different aspects of a piece (the second violin often has twice as many annotations as anyone else). Annotation decreases when there is less need of successful interaction (solos for example, or in the case of the first violin carrying the melody) (2008b, p. 9).

First, Winget observed a pattern in the score annotations of second violin chamber musicians. Her content analysis of score annotations revealed that in the three chamber ensembles that participated, the second violinists as a group created 20% more annotations on average compared to the other instrumentalists in the chamber ensembles (i.e., first violin, viola, and cello). This observation led Winget to gather more information about the role of the second violin part during follow-up interviews with chamber musicians. These participants informed her that in Western art music repertoire for string quartet, the second violin part typically has a complex interaction with the "outer" parts, frequently reinforcing the tempo established by the cello and complimenting the melody carried by the first violin. The essence of the second violin part lies not in its musical line taken in isolation but rather in the ways it interacts with the other musical lines to produce interesting harmonic and rhythmic events (Winget, 2008a, p. 1891). The epitome of the second violin part is interaction with the surrounding musical voices and its role, Winget argued, is "managing the collaboration" of the ensemble: "The second violin is the glue that holds the quartet together. Everyone depends on the second violin being consistent, and because annotations help to ensure consistency, the second violin annotates more than everyone else" (2008a, p. 1891).

To reinforce this point, Winget offers the example of the typical role of the first violin in a chamber ensemble. The first violin is typically responsible for playing the melody of the piece, "which is easier to memorize, and less dependent on successful interaction with other members of the group," who are responsible for complimenting the melody and following the first violinist's lead (Winget, 2008a, p. 1891). Thus, Winget argues, first violinists did not create as many score annotations compared to other chamber musicians because the success of their part depended on their individual execution of the melody, while the other parts were responsible for following their lead and interacting with the melodic line.

Considering the observations Winget made concerning the first and second chamber violinists, it is not surprising that she also found that musicians who played solo passages did not annotate those sections of their scores as heavily as sections where they played as part of the ensemble. Winget posited that this finding could be attributed to the idea that success in these passages depended less on coordination with other musicians and more on individual execution: "…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" (2008b, p. 9). The pattern that Winget observed in how solo passages were annotated supports the finding that a key function of score annotation is to facilitate coordinated action toward shared ensemble goals.

Score Annotation Research and the Development of Digital Music Systems

Since the first design specification for a digital music stand was published in 1996 (Graefe, Wahila, Maguire, & Dasna), score annotation has been recognized as a core

functionality by people who have designed and developed digital systems that support music performance, music education, and score libraries. Knowledge of how musicians annotate their music has informed the design and development of these systems. In particular, the fact that Winget's (2006) score annotation research has been cited by developers of digital music stands, digital music education systems, and digital score libraries shows that research into musicians' annotations is valuable to a variety of research and development endeavors and that more research in this area would be welcome, especially considering that Winget's dissertation remains the largest ethnographic study of performing musicians' score annotations to date.

Digital Music Stands. Researchers in the Department of Electrical and Computer Engineering at McGill University developed a system called Open Orchestra, a digital system that provides a musician with an immersive simulation of practicing with a full orchestra, combining the benefits of ensemble rehearsal with the convenience and personalization of solo practice (Olmos et al., 2012, p. 55). The researchers cite Winget's (2008a) research for their understanding of the importance of score annotations for coordinating collaboration among orchestra musicians (Olmos et al., 2012, p. 59). This recognition of the importance of musicians' score annotations to the rehearsal process influenced major decisions that the developers made when designing Open Orchestra's user interface. The developers decided to use a tablet-based digital music stand as the primary user interface and they decided to provide a stylus for user input--in addition to touch-screen input--specifically to afford users a level of "writing efficiency and control" similar to that of a pen for creating annotations in the score (Olmos et al., 2012, p. 59-60).

Digital Systems for Music Education and Collaboration. Winget's research also provided important insights that formed the basis for the design of an online music

education platform in which score annotations play a key role. As a product of her research, Winget offered a series of recommendations to inform the design of digital systems that support score annotation (2008a, p. 1895-6). Researchers at the University of Reunion Island used these recommendations to develop a design for a Web-based music education platform that would support adding multimedia annotations to digital scores, among other functions (V. Sébastien, D. Sébastien, & Conruyt, 2009, p. 3). For example, in the description of their system design the researchers specifically cited Winget's recommendation that digital annotation tools maintain a clear distinction between original score content and user-created annotations (Sébastien et al., 2009, p. 6).

After publishing their initial design idea, the researchers then developed a prototype for this system, called @-MUSE (Annotation platform for MUSical Education). The goal of the system was to provide online music lessons that are generated dynamically in response to a student's progress and interests, rather than requiring that the student complete a linear sequence of lessons. In their system description, the researchers cited Winget's (2008a) study, stating that one of the ideas that guided their design was that @-MUSE should allow musicians to interact with digital scores in a manner similar to how they interact with printed music because musicians' scores support memory and information sharing (V. Sébastien, D. Sébastien, & Conruyt, 2011, p. 386). The researchers concluded that score annotation played a key role in musicians' learning and sought to design a system that took advantage of the pedagogical value of score annotation. The @-MUSE platform would generate music lessons accompanied by score annotations designed to help the student. At the same time, the platform would analyze the student's score annotations to determine specific skills the

student wants to improve and then suggest lessons and exercises to develop those skills (Sébastien et al., 2011, p. 394).

Digital Score Libraries. Finally, score annotations themselves have been proposed as the potential basis for a digital library. Orchestral Bowings Online is a prototype for a digital library of orchestral bowing annotations developed by Barbara Barnett-Stewart, who was then an intern at the Philadelphia Orchestra's Riccardo Muti Library and a graduate student in library and information science at Rutgers University. The library's goal would be to offer access to public-domain orchestral scores with bowing annotations already written in. Barnett-Stewart argued that this collection of annotated scores would be helpful, for example, if an ensemble were performing a particular piece for the first time. The ensemble may not have the resources or time available to create bowing annotations for the entire string section, so scores that already contain bowing annotations would provide a valuable starting point for the ensemble (Barnett-Stewart, 2013, p. 2). Barnett-Stewart cited Winget's research in her explanation of the value and feasibility of Orchestral Bowings Online. She noted that many of the musicians Winget (2008a) interviewed were willing to share their annotations with other musicians and that many of the interviewed musicians expressed a belief in the enduring value of score annotations beyond their original context of creation and use as resources for future generations of musicians and music scholars (Barnett-Stewart, 2013, p. 2-3).

The descriptions of the digital music systems described above indicate that the developers considered score annotation a key functionality to provide and that they considered the way musicians annotate important to their design decisions. Their citations of Winget's (2006) research also indicate that developers of these systems are interested

in learning how best to support score annotation functions and that they would welcome additional research into musicians' score annotations to inform their design decisions.

Research Justification

Further research in the area of musicians' score annotations is justified for two primary reasons:

- Winget's 2006 study remains the most extensive study of performing musicians' score annotation practices to date, indicating that a dearth of research persists in this area and that research should continue in order to generate more knowledge about musicians' score annotations. This study sought to be part of that effort by investigating the same phenomenon that Winget did (i.e., the score annotations that musicians create during ensemble rehearsal) but in a different context.
- The fact that Winget's research has been cited by developers of various digital music systems suggests that additional research in this area would be welcome to developers of these systems. Furthermore, the fact that Winget's research was cited by developers of digital systems suggests that research into analog score annotation is valuable to system developers who wish to translate analog score annotation successfully to the digital realm.

Research Questions and Goals

This study sought to achieve the following goals:

- To use Winget's (2006) coding frame in order to ascertain whether it could be applied successfully in a context different from that in which it was originally developed.
- To generate suggested improvements for Winget's (2006) coding frame.

Additionally, this study sought to address the following research questions:

- What are the annotation object characteristics of the score annotations created by a large choir during ensemble rehearsal? The following annotation object characteristics will be assessed:[2]
    - Annotation Mode: in which mode were the annotations created--text, symbol, or number? Which mode was most prevalent and which mode was least prevalent?
    - Annotation Specific Purpose: which specific purposes were present in the choir's annotations? What were the most common and least common specific purposes for the choir's annotations?
    - Annotation General Purpose: how many of the choir's annotation's were technical, technical-conceptual, and conceptual?
    - What were the annotation object characteristics of annotations created by individual sections of the choir (soprano, alto, tenor, and bass)? How many annotations did each section create, and how heavily did each section annotate its music?

[2] Please see "Data Analysis Framework" in the Methodology section of this paper for an explanation of these annotation object characteristics.

Methodology

Summary

This research study consisted of conducting a content analysis of the annotations that members of a large choir created in their copies of two choral works that they had previously performed. The choir that created the annotations is non-professional and community-based, has approximately 100 singers (both men's and women's voices), and performs mostly sacred, classical Western choral works. The two choral works examined during content analysis were selected purposively from the choir's library of sheet music. The content analysis reviewed 158 copies of sheet music and identified more than 2,600 individual annotations. Each annotation was recorded in a spreadsheet and classified according to the data analysis framework developed by Winget's study of score annotations (Winget, 2006; Winget, 2008a). The data recorded in the spreadsheet were then quantitatively analyzed in order to describe object characteristics of the choir's annotations and to compare annotations made by subsections of the choir to each other.

Epistemological Justification for the Research Design

The goal for this research was to learn about how musicians interact with their musical scores. Wildemuth and Spurgin have observed that "[t]he primary foci of [the information and library science] field are recorded information and people's relationships with it" (2009, p. 297). Grounded in the field of information and library science, this study conceptualized the relationship between a musician and a musical score as an information interaction, wherein the musical score is an information object containing information that a musician interacts with when rehearsing and performing a musical work. This study's perspective on this phenomenon and its epistemological approach to

researching it are based on the dissertation of Megan Winget. As Winget did in her study, this research conceptualized the annotations that musicians create in their musical scores as products of musicians' interaction with their scores (2008a, p. 1878). In order to learn about how musicians interact with the information in their scores, this study focused on analyzing the score annotations that musicians created, which reflect their interactions with the score.

This approach is consistent with the field of information and library science's justification for examining documents and artifacts as a means of learning about people's information behaviors. As Wildemuth explains, "[p]eople often leave traces of their behavior in the documents they create or on the artifacts with which they interact…Thus existing documents or traces of physical evidence may be a source of data about people's information behaviors" (2009, p. 158). A musical score can be conceptualized as a document in the sense that its primary feature is an "inscribed text" (in this case the "text" is musical notation) that contains an "intentional message, fulfilling a particular purpose of its creator" (Wildemuth, 2009, p. 159). The creator in this case would be a composer, most often.

Wildemuth goes on to explain that "[a]s people interact with information, they often leave physical traces of their behavior behind" (2009, p. 160). These physical traces are considered artifacts of people's information interaction behavior. In the context of this study, musicians interact with the information contained in a document (i.e., a musical score), and the annotations they create in this document can be interpreted as artifacts of their information interaction with the document. Studying musicians' score annotations, then, is a way to learn about how musicians interact with the information contained in their musical scores. However, annotations reflect musicians' interactions not only with

the information contained in their scores but with other information sources involved in the rehearsal process as well. For example, Winget observed in her research that musicians' annotations reflect their interactions with their fellow musicians "in their attempt to work together to perform a musical piece" (2008a, p. 1893). Similarly, Kaastra (2008) identified score annotations as one of four domains of ensemble coordination in music performance. Studying annotations as artifacts of information interactions that occur during the rehearsal process is therefore a valid means by which to characterize musicians' interactions with information in their scores as well as to gain insight into how musicians manage information interactions as they coordinate their efforts as an ensemble.

Musicians' score annotations are considered accretion artifacts, since they are left behind or "deposited" on the document. The annotations analyzed in this study are considered "natural" artifacts since the musicians created them during their normal rehearsal activities without any influence or control from the research study, which relates to a strength of using documents and artifacts as data sources: the unobtrusive quality of the research (Wildemuth, 2009, p. 160). As Wildemuth explains, when documents and artifacts are the data sources, "the process of data collection will not influence their content in the same way that more intrusive methods (such as interviewing someone or directly observing her) have an effect on the information behaviors being studied" and, therefore, "at least in some instances, this type of data could be a more accurate representation of the phenomenon of interest than data collected through self-report" (2009, p. 158). Although directly observing musicians annotating their scores during rehearsal or interviewing them regarding their annotation practices would have been additional methods of studying score annotations, closely examining the musicians'

scores and the annotations therein was the most valid method of analyzing the physical qualities of the annotations themselves, as physical trace data.

Although examining artifacts of the musicians' information interactions had the advantage of being unobtrusive, it is important to note that triangulation is critical when documents and artifacts are data sources. As Wildemuth clearly advises, "In essentially every study, data obtained from documents or artifacts will need to be analyzed in combination with data obtained using other methods" (2009, p. 161). The absence of triangulation and the sole reliance upon content analysis of documents and their artifacts is a weakness in the design of this research study and restricts the types of questions that this research can address with validity. Indeed, the exclusive use of content analysis of the score annotations confines the results mostly to the realm of description, addressing questions of what and how many, instead of being a valid way to reveal the purpose of the annotations or the underlying motivations that the musicians had for creating them—questions of how and why. Nonetheless, the method can validly investigate questions such as how heavily different ensembles (or subsets of an ensemble) annotate their scores, the distribution of annotations in a score, whether annotations tend to be textual, symbolic, or numeric, and, in many cases, the musical concept the annotation primarily relates to (dynamics or tempo, for example). However, the annotations themselves are relatively ambiguous with respect to their underlying motivation, and ascribing them meaning and purpose required a significant amount of interpretation on the part of researcher during content analysis. As a result, the researcher's perspective was thoroughly integrated into the data collection and analysis, although, as Wildemuth notes "…to interpret the meaning of a document correctly, the researcher must know quite a bit about the social context in which it was created" (2009, p. 160).

In the absence of triangulation, the ambitions of the current study were tempered with respect to the types of questions it could address with validity. Its goal was to describe the characteristics of annotations that choristers created in their scores during ensemble rehearsal. Despite the limited scope of this study's aims, part of its contribution lies in adding depth to Winget's project by studying the same phenomenon (score annotation) in a different population (choristers) in order to make comparisons of score annotation characteristics. Winget (2006) studied score annotations created by a variety of instrumental ensembles, while this study examined the annotations of a large choir and sought to compare the characteristics of annotations Winget observed among instrumentalists with characteristics of the choristers' annotations.

Access, Feasibility, and the Decision to Use the Musical Scores

The research design of this study must also be situated in the context of the issues of access and feasibility. The researcher has a background of musical education and training in Western classical piano and voice, including numerous years of choral singing. She had previously sung with a large community choir in the Research Triangle region of North Carolina and had established a good rapport with the choir's management personnel. The researcher also possessed familiarity with the choir's library of sheet music, patterns of sheet music use, and rehearsal practices. Consequently, when the researcher learned of Winget's (2006) research and decided to launch a related study, the choir in which she had previously sung presented itself naturally as a possibility for access to an ensemble and its annotated sheet music. The researcher did consider the possibility of studying multiple ensembles (as Winget did) in order to compare the annotation characteristics of different types of vocal ensembles (such as a chamber

ensemble of 16 voices compared to a 100-voice choir); however, the researcher would not feasibly have been able to control important variables, such as the piece of music rehearsed or the amount of rehearsal time devoted to the piece, in order to make valid comparisons between the groups.

Having decided to study the annotation characteristics of one large choir, the researcher then considered questions of which method(s) to apply in order to study the choir's score annotations. One possible method would have been to observe choristers during ensemble rehearsal as they created annotations. However, several obstacles precluded this method. First, the choir's size (approximately 100 voices) would have made observation of all the singers' annotative practices impractical and would have necessitated sampling of the population. However, selection of a sample of individual singers for scrutiny during rehearsal would have been highly intrusive; the researcher could reasonably expect singers to annotate very differently under direct observation compared to normal rehearsal circumstances. Additionally, the method of participant observation would have confined the researcher's observations to one small section of the choir and would not have yielded a representative assessment of the annotation characteristics of the choir as a whole. The researcher concluded that observation of singers during rehearsal may have yielded insights regarding the role of score annotation in the choir's rehearsal practices and about the role of the conductor in annotation creation. However, such observation would not have enabled close study of the characteristics of choristers' individual annotations. Consequently, observational methods were not employed in this study, although the researcher's previous experience singing in the choir significantly influenced the process of data collection.

Conducting interviews with choir members to ask them questions regarding their

annotation practices would have been another method of studying the choir's score annotations. Interviews with individual choristers would have been an effective means of answering questions related to annotation purpose and meaning, since these qualities were often difficult to discern just by looking at the physical characteristics of the annotations themselves. Making judgments about the purpose and meaning of singers' annotations required extensive interpretation on the part of the researcher (discussed below), and interviews with individual singers may have allowed for clarification of annotations that the researcher found ambiguous in meaning and purpose. Although interviews with individual singers regarding their annotations could have enabled a more valid assessment of annotation purpose and meaning, the time involved in arranging interviews ultimately precluded their use in this study.

As described above, in this study musical scores were conceptualized as documents containing information that musicians interacted with during ensemble rehearsal, and annotations that musicians created in their scores were conceptualized as artifacts of the information interactions that occurred during ensemble rehearsal. Considering the theoretical stance adopted in this study, it was deemed appropriate to subject the score annotations to content analysis, since in the academic field of information and library science documents and artifacts are frequently analyzed using some form of content analysis (Wildemuth, 2009, p. 161). Moreover, content analysis of score annotations was a method utilized in Winget's (2006) research, which is the most extensive analysis to date of musicians' score annotation practices (Kaastra, 2011). Undertaking content analysis of the choir's score annotations was therefore considered an appropriate method for addressing research questions regarding annotation characteristics that were similar to those in Winget's (2006) study (e.g., the representational form

annotations usually take—text, symbol, or number; annotation patterns of subsets of the ensemble).

To conclude, in view of what was feasible within the timeframe available for the study and in the interest of closely examining visually salient characteristics of individual annotations, it was decided that content analysis of score annotations created by the choir would be the method employed in this study, despite the disadvantages of using artifact analysis in isolation. The choir's management personnel granted the researcher access to the choir's library of sheet music for the purpose of analyzing the annotations therein.

Sampling

Sampling in this study refers to the selection of choral works from the choir's sheet music library for use in the content analysis. The sampling method used in this study was purposive rather than random. The researcher established criteria in order to produce a data sample conducive to investigating the study's research questions. As Zhang and Wildemuth have noted, "…samples for qualitative content analysis usually consist of purposively selected texts, which can inform the research questions being investigated" (2009, p. 309). It is important to emphasize that, due to the sampling method, this study's findings are not generalizable to a larger population of content—in this case, score annotations (Spurgin & Wildemuth, 2009, p. 298).

The research concerns that the data sample was designed to address were twofold. First, the focus of this study was score annotations because these annotations are artifacts of information interactions that occur in a very specific context. This context is the ensemble rehearsals during which musicians prepare to perform a musical work for a unique occasion. The entire context of performance (including the date of rehearsals, the

rehearsal space, the conductor, the anticipated audience, etc.) is unique to each individual instance of performance. Annotations are artifacts of the information interactions that occur during a particular cycle of rehearsal and performance, and they are unique reflections of their performance context. Although annotations from many different performances can accumulate over time in sheet music, this study was interested not in accumulated annotations but rather annotations that reflect a single instance of rehearsal and performance and the information interactions that occurred in that instance. Additionally, much of the research and development of digital music performance systems aims to support musicians during rehearsals, so it was deemed important to study artifacts from an individual rehearsal process, rather than annotations generated over a period of time through different performances and by different people.

The second major research concern that governed sampling was an interest in comparing the annotations of subsections of the choir (i.e., sopranos, altos, tenors, and basses) to each other. The implications of this consideration for the data sample are described in detail below.

The researcher ultimately established the following criteria that guided the selection of pieces from the choir's sheet music library for the data sample:

- T**he piece had been used only by the choir of interest.** This criterion was important because the sheet music in the choir's library is utilized by several different choirs. The researcher therefore verified to the best of her ability that the two pieces in the data sample had been performed only by the choir under study. The researcher consulted electronic records of the choir's past performances and the choir's management personnel in order to verify that only the choir of interest had previously rehearsed and performed the pieces.

- **The piece had been performed by the choir only once.** As described above, this criterion was necessary because the score annotations were being studied as reflections and products of information interactions that occurred during a specific instance of rehearsal and performance. Pieces that had been used more than once would have contained annotations that reflected multiple performances. Additionally, the interest researcher's in comparing the annotation characteristics of different sections of the choir (i.e., soprano, alto, tenor, and bass) made it important to capture one performance instance in order to be able to compare singers who had collaborated during the same performance process. Additionally, for pieces that had multiple previous uses, it may have been difficult to identify the vocal line in which an individual annotation was made. The sheet music library's physical organization was helpful with respect to this criterion because pieces are generally arranged in the order the choir acquired them, and newer, less-used pieces are consequently in an easily identified location. Again, the researcher utilized electronic records of the choir's past performances and consulted the choir's management personnel to verify that, to the best of her knowledge, the choir had performed the sampled pieces on only one previous occasion.
- **The piece was notated so that each vocal line was printed on a separate staff throughout most of the piece.** This criterion facilitated identification of the vocal part in which an annotation appeared so that voice parts could be compared to each other in terms of the characteristics of their annotations. It was important to be able to identify easily which voice part an annotation was anchored in, and this identification was easier if each voice part was notated on a separate staff.

- **The sample consisted of two different pieces from the library.** It was hoped that utilizing two pieces in the data sample would mitigate the effect that an individual piece's style or difficulty level would have on the character of the choir's annotations. The risk of using only one piece was that the characteristics of the annotations could be attributed in large part to characteristics of the music itself. Using multiple pieces as data sources allowed the study to investigate the character of the annotations themselves rather than the annotations exclusively in the context of a particular piece.

Based on the above criteria, the data sample ultimately consisted of two pieces that strongly contrasted in style and level of difficulty. Between the two pieces, there were 229 total copies, and 158 of these copies contained annotations.

Data Analysis Framework

Once the content analysis method was selected for studying the choir's score annotations, a data analysis framework was required to code the annotations according to salient characteristics related to the study's research interests. The researcher elected to use an existing data analysis framework that Megan A. Winget developed through content analysis of more than 25,000 score annotations (2006). As Zhang and Wildemuth have noted, "[c]ategories and a coding scheme can be derived from three sources: the data, previous related studies, and theories" (2009, p. 311). This study used an existing framework for two primary reasons. First, using Winget's framework would facilitate making comparisons between the results of her study and the results of this study. Zhang and Wildemuth go on to explain that "[t]he adoption of coding schemes developed in previous studies has the advantage of supporting the accumulation and comparison of

research findings across multiple studies" (2009, p. 311). Therefore, Winget's framework was chosen in the interest of comparability. Secondly, Winget's framework was used in this study in order to assess a) whether it could be applied successfully in a context different from that in which it was originally developed and b) what changes might improve the framework for use in the future. The Discussion section of this paper presents an evaluation of the framework and suggested modifications.

When the decision was made to apply Winget's framework to this study, the researcher also decided to attempt to apply it following Winget's code definitions and examples as closely as possible. This effort required that the researcher thoroughly understand Winget's codes (a) in order to code in a manner consistent with Winget and (b) so that when the researcher encountered novel annotations for which there was no explicit guidance from Winget the researcher could make coding decisions that were consistent with Winget's examples and definitions. To this end, the researcher closely studied Winget's code definitions and examples and reviewed them during data collection. This amounted to a sort of "coder training" that the researcher did in order to enter the same "mental frame of reference" as Winget so that coding would be consistent with hers as much as possible (Spurgin & Wildemuth, 2009, p. 301).

This paper provides a description of the data analysis framework. However, since this study sought to replicate Winget's coding and apply her definitions as faithfully as possible, readers are referred to Winget's dissertation for the most accurate and complete description of the framework (Winget, 2006).

The data analysis framework consists of classifying each score annotation according to three annotation object characteristics: annotation mode, annotation general purpose, and annotation specific purpose. Annotation mode refers to "the representational means used

to convey information" (Winget, 2006, p. 60). Three annotation modes were taken into account for this study: symbolic, textual, and numeric. These categories are mutually exclusive, requiring that annotations that appear to combine multiple modes in one conceptual unit be "split up" for analysis.[3] An annotation is classified according to whether it is represented as text (characters A-Z), number (characters 0-9), or symbol (i.e., any character that is neither text nor number). Additionally, in this study an annotation was classified as symbolic if a singer had drawn a circle around elements printed in the score.

The second parameter is specific purpose. Specific purpose refers to the particular aspect of ensemble performance that the annotation relates to and can also be interpreted as the particular impetus that motivated the singer to create the annotation. This category is meant to capture the specific musical purpose of the annotation. For example, if a singer drew a check mark symbol between two notes, this symbol typically indicates that the singer wants to remind herself to breathe at that time in the music. The annotation's mode is symbolic and its specific purpose is "breathing." Breathing and diction do not appear to have been specific-purpose categories in Winget's original framework (2006). However, the researcher added them in order to suit the context of this study, since breathing and diction are important aspects of music performance for singers. Similarly, "fingering" was a specific-purpose category not used in this study, since fingering is an aspect of instrumental rather than vocal performance. Examples of the different specific-purpose categories are provided below in Tables 1-3.

The last parameter of annotation classification is general purpose. An annotation has a

[3] The implications of defining the unit of analysis according to mode of representation are considered in the Discussion section of this paper.

general purpose that is technical, technical-conceptual, or conceptual. The categories are based on the degree to which an annotation relates to physical actions involved in music performance. Technical annotations provide explicit instruction for how to translate the score's musical notation into a physical action (e.g., take a breath; put these fingers here; move the bow like this; turn the page quickly; watch the conductor). A technical annotation directly translates into a concrete physical action the musician takes. Examples of technical annotations are provided in Table 1.

As Winget (2008a) defined this category:

> Technical annotations were defined as those that are specifically concerned with the physicality of performing the piece: which fingers to place on which strings (fingering), how to hold and pull the bow across the strings (bowing), where to look or what to listen for (attentive notes), what notes to play (pitch), how to begin and end playing those notes (articulation), and how to navigate through the piece (navigation). These annotations have an immediate, physical, and specific meaning… All of these annotations relate to the physical transformation of performance: how to translate what is written into what is played (p. 1883).

Table 1

Technical Annotations

Specific Purpose	Transcription Examples	Mode
Attentive	[star]	Symbol
	[eyeglasses]	Symbol
	"be ready"	Text
Breathing	✔ [check mark drawn between two notes, conveying "breathe here"]	Symbol
	"N.B." [written between two notes, meaning "don't breathe here"]	Text
Diction	[slash drawn through the letter "r" of the word "prayer" printed in score lyrics]	Symbol
	"Mah" [written beneath the word "my" printed in score to convey an altered vowel	Text

	sound]	
Navigation	[writing in measure numbers]	Number
	"Thither" [written in the margin after the last measure of the page to indicate the first word at the top of the following page, in order to negotiate a page turn]	Text
	[notating a pitch in the margin after the last measure on the page in order to indicate the first pitch the singer will have to sing immediately following the page turn. This helps the singer negotiate the page turn]	Symbol
Pitch	[circle drawn around new key signature]	Symbol
	↑[up arrow drawn immediately left of note, indicating the pitch is higher than the singer thinks it is]	Symbol
	"1/2" [written between two notes separated by a minor second (or half step) interval]	Number
	[circle drawn around two notes separated by a perfect fifth interval]	Symbol
	"5th" [written between two notes separated by a perfect fifth interval]	Text

The technical-conceptual category is more nebulously defined:

> Technical-conceptual annotations have a level of abstraction not present in the purely technical annotations... Specifically, technical-conceptual annotations include timing/rhythm, dynamics, and contextual information, both representational and informational… While there is a significant physicality present in these technical-conceptual annotations, in that they are conveying a musician action that should be taken, their meaning is less specific, and the execution is not necessarily immediate or precise… Whereas the purely technical annotations are quite specific and denote the personal action an individual

> performer must take to make coordination and reliable repetition possible, the technical-conceptual annotations are more general, and often involve the coordinative and interpretative efforts of the entire performing ensemble (Winget, 2008a, p. 1884).

However, it is readily apparent that specific purposes such as dynamics and timing involve coordinated action on the part of the entire ensemble. Performing a *crescendo*, for example, requires not only that individual musicians adjust the volume of their playing (or singing) but that the group coordinate its increase in volume so that it occurs at the rate specified by the score and the conductor. Similar group coordination is required for performing changes in tempo and for keeping subsections of the group rhythmically aligned with each other so that one subsection is not "dragging" the tempo or accelerating it. Table 2 provides examples of technical-conceptual annotations.

Table 2

Technical-Conceptual Annotations

Specific Purpose	Transcription Examples	Mode
Dynamic	"f" [meaning *forte*]	Text
	< [*crescendo* dynamic wedge]	Symbol
Timing/Rhythm	"SLOW"	Text
	"1" [written above a note to show where this beat falls]	Number
Informational Contextual	"WTH weak sauce" [reflects the singer's personal attitude towards an aspect of the piece]	Text
Representational Contextual	[circle drawn around notes in a vocal line other than the annotator's own vocal line]	Symbol
	[arrow drawn from a note in a different vocal line to a note in the annotator's vocal line]	Symbol

The last general-purpose category, conceptual, is characterized by its distance from the realm of physical action and its existence purely in the realm of abstract

thinking. Winget defines this category as annotations that reflect a way to conceptualize the music (e.g., "*feroce*" or "lyrical") but do not translate explicitly into a physical action. These annotations reflect how a musician thinks about the music on a purely abstract level. Of course, these abstract ideas influence how the musician physically executes the music, but they are not explicit instructions for what to do physically. For example, a musician may write "Get mad!" to capture an emotion she wants to express through her playing. Additionally, annotations related to phrasing reflect how musicians conceptualize the structure of a piece of music but do not explicitly indicate how they will play the music (Winget, 2008a, p. 1884-5). Table 3 provides examples of conceptual annotations.

Table 3

Conceptual Annotations

Specific Purpose	Transcription Example	Mode
Emotive	"Get mad!"	Text
	"lyrical"	Text
Phrasing	[brackets or slurs drawn around a group of notes]	Symbol

Data Collection Procedure

Data collection began with an initial "trial period" before the data sample and choice of data analysis framework were finalized. This trial period consisted of coding 34 annotations from two pieces (one of which was not included in the final data sample) using Winget's (2006) framework and codes presented in Kaastra (2011). As a result of this trial period, the sampling criteria and choice of a data analysis framework were revised and finalized. Sampling was then completed and content analysis proceeded

according to Winget's framework.

The data collection procedure consisted of the following steps:

- For each copy of a piece, the copy was given a cursory examination to ensure that it had been previously used (i.e., there were annotations present for analysis). If there were no annotations present, the copy was set aside and not included in the content analysis.
- If annotations were present, the copy was assigned a number, which was written in pencil on the back of the copy.
- Then, for each annotation that appeared in the copy, a row in a spreadsheet was created in order to record its classification using the data analysis framework as well as additional descriptive metadata (listed below).
- Each annotation was classified according to its annotation mode, specific purpose, and general purpose (described above). These classifications were recorded in the spreadsheet..
- The following additional metadata were also recorded in the spreadsheet for each annotation in order to facilitate data collection and analysis:
    - Annotation ID number: an automatically generated number unique to each annotation.
    - Copy number: the copy number of the piece in which the annotation appeared.
    - Piece title: the title of the piece in which the annotation appeared.
    - Bar number: the measure number(s) in which the annotation appeared.
    - Voice part: the vocal line in which the annotation appeared (soprano, alto, tenor, or bass).

- Annotation transcription: a visual approximation of the annotation. Annotations that took the form of text or numbers were copied verbatim, while symbolic annotations were approximated as closely as possible based on the characters available in Microsoft Excel.

In addition to using a spreadsheet to record each annotation, the researcher also maintained an extensive research journal throughout the course of the study in order to document selecting the data analysis framework, determining criteria for the data sample, selecting the data sample, learning how to use Winget's framework, and decisions the researcher made regarding how to apply the framework when there was no clear, explicit guidance from Winget's examples or definitions. This research journal was highly important because it documented the researcher's coding decisions and the reasoning behind them for reference later in the data collection process.

Several measures that could have improved the validity of this study's results were not incorporated into its research design. The Discussion section of this paper presents suggested improvements to the research design.

Data Analysis

Before presenting the results of the content analysis, it is important to discuss the nature of the products of this study. The content analysis method employed in this study incorporated qualitative aspects, such as purposive sampling and data collection that integrated the researcher's subjectivity. However, the resulting data is quantitative in character. The manner in which Winget's data analysis framework was employed enabled counting of features of the content. The researcher was able to quantify how many annotations were textual, symbolic, and numeric, for example. Each category in the data

analysis framework can likewise be quantified by counting the number of times it appeared in the data, and this numerical data can be manipulated using various statistical methods. Such research products are typical of quantitative content analysis (Zhang & Wildemuth, 2009, p. 309). "By contrast," as Zhang and Wildemuth proceed to describe,

> the qualitative approach usually produces descriptions or typologies, along with expressions from subjects reflecting how they view the social world. By this means the perspectives of the producers of the text can be better understood by the investigator as well as the readers of the study's results (Berg, 2001). Qualitative content analysis pays attention to unique themes that illustrate the range of the meanings of the phenomenon, rather than the statistical significance of the occurrence of particular texts or concepts (2009, p. 309).

Unlike Winget's study, which, in addition to content analysis of score annotations, collected data from informal rehearsal observations and semi-structured interviews with musicians, this study used content analysis of score annotations exclusively. Although this method enabled quantification of physical features of the annotations, as well as the concepts they represent, this study's explanatory power is limited without corroboration from other sources of data collection. In other words, the methodology used in this study is not able to access the meaning behind the numbers. Without insights from other sources of data—such as interviews with choir members—this study does not have the means to explain why the content analysis yielded the numerical results that it did. The research design would have had to incorporate triangulation of data collection in order to gain insight into aspects of the choristers' behavior that could explain the results of the content analysis.

What the researcher can do, however, is provide insight into the content analysis process and explain how decisions made during data collection influenced the results of the content analysis. It is hoped that these insights from data collection will not only

provide valuable context for interpreting the content analysis results but also inform the research design of future score content analyses.

Comparison of voice parts. One goal of data collection and analysis was to compare the characteristics of annotations created by each vocal section of the choir (soprano, alto, tenor, and bass). This comparison of groups is similar to Winget's study (2006), in which groups of musicians were compared by skill level (amateur, semi-professional, and professional) and ensemble type (chamber or orchestra). During score content analysis in this study, each annotation was classified according to which vocal line it appeared in (soprano, alto, tenor, or bass), and it was presumed that the placement of an annotation in a particular vocal line indicated the voice part of the singer who created the annotation. In this way, this study was able to compare annotations created by sopranos, altos, tenors, and basses in the choir. The voice parts were compared based on annotation mode, general purpose, and quantity.

Measuring annotation quantity. The data analysis also sought to measure annotation quantity in order to compare the tendency among singers of different voice parts to create annotations and, among the singers who created annotations, how many annotations they created in their music. Annotation quantity was assessed using three calculations: percentage of the choir's annotated copies, percentage of the choir's total annotations, and average annotations per bar of music.

It may first prove helpful to explain how the choir's total number of annotated copies was calculated. This study used two pieces from the choir's library for the content analysis. Although all copies of both pieces were scrutinized for evidence of annotations, not every copy contained annotations, and this phenomenon can be explained by two factors. First, the choir typically orders several more copies of each piece than it actually

needs for its current members to provide extra copies in case copies are lost or singers forget their music.[4] Therefore, there are typically more copies of a piece than there are singers. A second factor is that singers may be more inclined to annotate certain pieces compared to others, and the decision to annotate appears to be based partly on the difficulty of the music. For example, 58% of the total copies of the first piece analyzed for this study contained annotations, whereas 79% of the copies of the second piece contained annotations. Based on the dates the choir performed these pieces, a similar number of singers would have been present for the rehearsals, which precludes a difference in the number of singers present as a factor. Rather, it is more likely that fewer singers felt inclined to annotate the first piece because they did not perceive it as very musically challenging (indeed, it was originally commissioned for a children's choir), while more singers felt inclined to annotate the second piece due to its harmonic and melodic complexity, challenging rhythms, and difficult page turns. However, further research is needed in order to determine the effect of the perceived difficulty of a piece on the number of annotations a singer creates in the piece. In any event, only those copies that contained annotations were used to calculate the figures presented in this section.

First, the distribution of the annotated copies among the four voice parts was calculated to determine how many copies were annotated by sopranos, altos, tenors, and basses, respectively. The number of copies that were annotated by an individual voice part was divided by the total number of copies that contained annotations (from the entire choir and for both pieces combined) and then converted to a percentage. For example, 158 copies of music contained annotations, and 48 of these copies were annotated by sopranos. Therefore, sopranos contributed approximately 30% of the annotated copies.

[4] Approximately 100 singers are members of the choir.

This figure provides an indication of each voice part's tendency to create any annotations in their music.

Second, the distribution of the choir's total annotations among the four voice parts was calculated to determine how many annotations were created by sopranos, altos, tenors, and basses, respectively. The number of annotations created by an individual voice part was divided by the total number of annotations created by the choir as a whole across both pieces and then converted to a percentage. For example, tenors created 324 of the 2,684 annotations created by the choir as a whole. Therefore the tenor part created approximately 12% of the annotations observed in this study. This figure provides an indication of how many annotations the singers who decided to annotate created in their scores; it reflects how heavily those singers who created annotations annotated their scores.

Finally, the average number of annotations per bar of music was calculated for each voice part and for the choir as a whole. The number of annotations created by an individual voice part was divided by the total number of measures in all the copies of music annotated by that voice part.[5] For example, altos created a total of 1,054 annotations, which was divided by 4,072 bars, which was the total number of measures in the 57 copies of music annotated by altos. Like the percentage of the choir's total annotations, this figure indicates how heavily annotations were created by those singers who decided to annotate their music. Taken together, these three measures indicate the tendency of a particular voice part to annotate its music and--for those singers who decided to annotate--how heavily they annotated their music.

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[5] In this study the total number of measures in an individual piece included those measures in which no vocal line was written (for example, an introduction played by the organ). The total number includes all measures in the piece, from start to finish.

Before presenting the annotation-quantity results, it is important to emphasize that these calculations are meant to facilitate comparisons of the collective activity of groups. They allow us to characterize the annotations of each voice part taken as a group but are not accurate reflections of, for example, how the "average alto" annotates. These figures strictly reflect the cumulative annotative practices of those singers who chose to annotate their music. The figures enable comparisons of how singers annotated as a group rather than shed light on annotation practices of individual choristers.

Results

Introduction

Through content analysis of the sheet music for two pieces that the choir had previously sung, a total of 2,684 individual score annotations were identified and analyzed using the data analysis framework. This section presents the results of the content analysis related to annotation object characteristics: general purpose, specific purpose, mode, and the voice part in which the annotations were created.

Annotation General Purpose

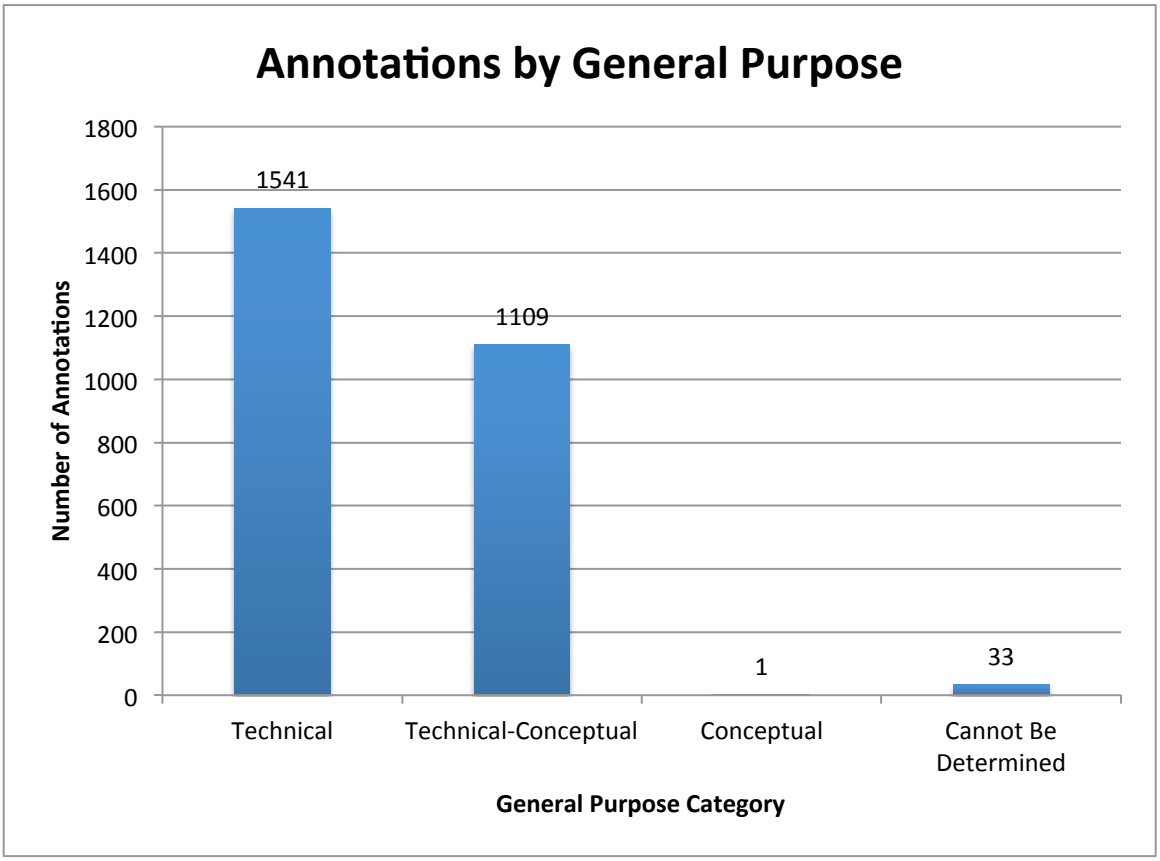

Figure 1. The distribution of score annotations among the general-purpose categories.

Each category of annotation general purpose that Winget (2008a) observed was also observed in this study, with wide variability, however. As Figure 1 illustrates, the majority (about 57%) of annotations were technical, while about 41% were technical-conceptual. Only one instance of a conceptual annotation was observed in this study, contributing 0.04% to the total. The general purpose could not be determined for about 1% of the annotations. These results appear roughly similar to Winget's (2008a) findings in that the majority of annotations were technical, the fewest annotations were conceptual, and technical-conceptual annotations were in the middle range. However, this study observed more technical-conceptual annotations as a percentage of total annotations than Winget's study (41% compared to 18%) (Winget, 2008a, p. 1886).

Annotation Mode

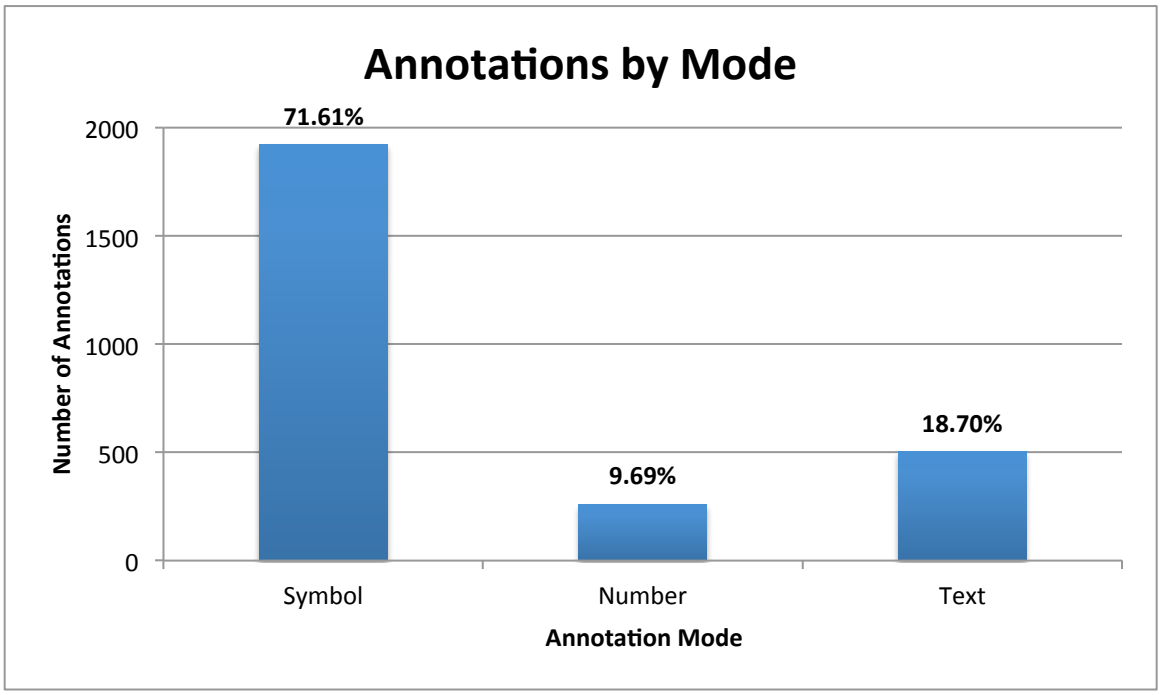

Figure 2. The distribution of score annotations among the mode categories.

Each annotation was classified as symbolic, numeric, or textual, depending on its mode of representation. As Figure 2 illustrates, approximately 71.6% of all annotations were symbolic, 18.7% were textual, and 9.7% were numeric. Textual annotations were more numerous compared to numeric annotations. The prevalence of textual annotations compared to numeric annotations could be due to the fact that instrumentalists use numbers to create annotations related to instrumental fingering techniques, while vocalists have no need for such annotations. Conversely, vocalists use text to create annotations related to singing diction, which instrumentalists likely create less frequently than vocalists. These differences between the physicality of vocal and instrumental performance could account for the prevalence of textual over numeric annotations among the choristers in this study.

The annotations have also been analyzed to determine the distribution of each

annotation mode among the three general-purpose categories, which is illustrated in Figure 3. The symbolic and textual annotations both had roughly 60% in the technical category and approximately 37% in the technical-conceptual category.[6] By contrast, the vast majority of numeric annotations were technical-conceptual (about 76%), while 24% were technical.

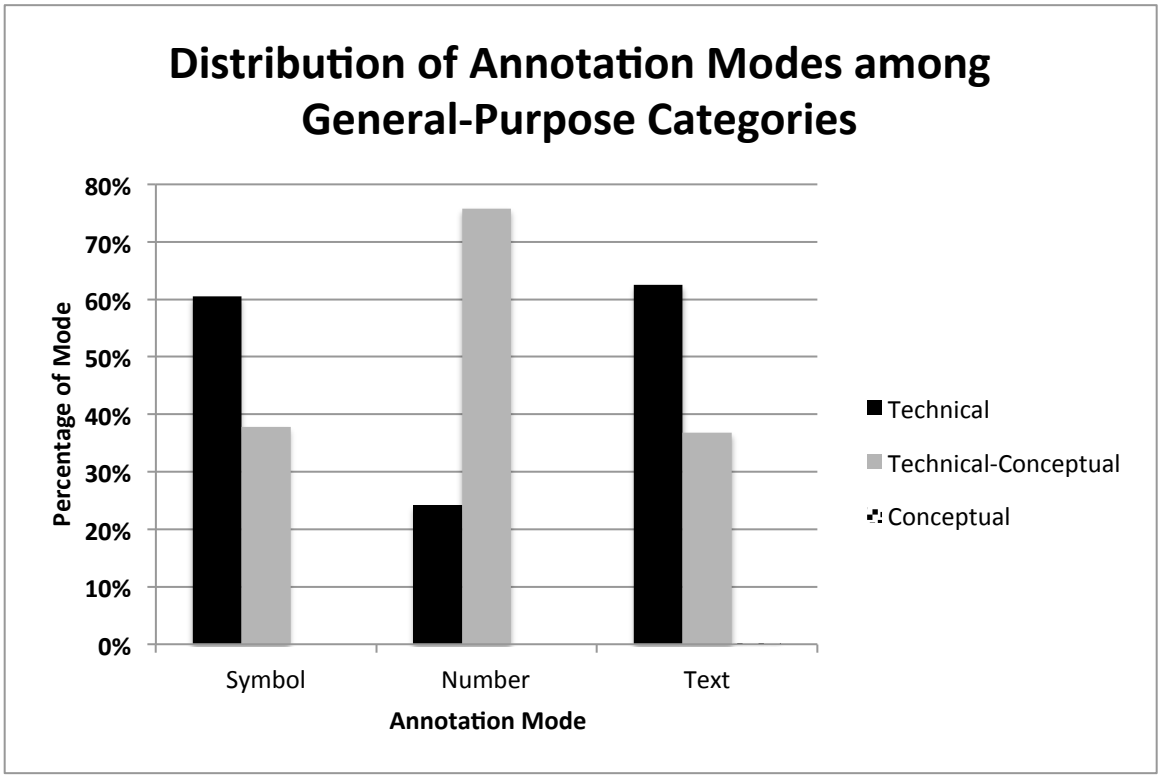

Figure 3: The distribution of annotation modes among general-purpose categories.

Further analysis of how each mode was distributed among specific-purpose categories (illustrated in Figure 4) revealed that the vast majority of numeric annotations (about 77%) were classified as timing/rhythm for specific purpose. Since timing/rhythm was considered a technical-conceptual purpose, the high percentage of numeric timing/rhythm annotations accounts for the high percentage of technical-conceptual numeric annotations. While about 77% of numeric annotations were related to timing/rhythm,

[6] The single conceptual annotation observed in this study was textual.

approximately 13% related to pitch and 10% related to navigation. Compared to the numeric annotations, no single specific-purpose category accounted for the majority of symbolic annotations. However, annotations related to timing/rhythm (about 26%) and pitch (about 25%) together accounted for more than half of the symbolic annotations. Approximately 18% of symbolic annotations related to navigation, 12% to breathing, and 8% to dynamics. Textual annotations were 22% timing/rhythm, 21% navigation, 16% breathing, 14% diction, and 13% dynamics.

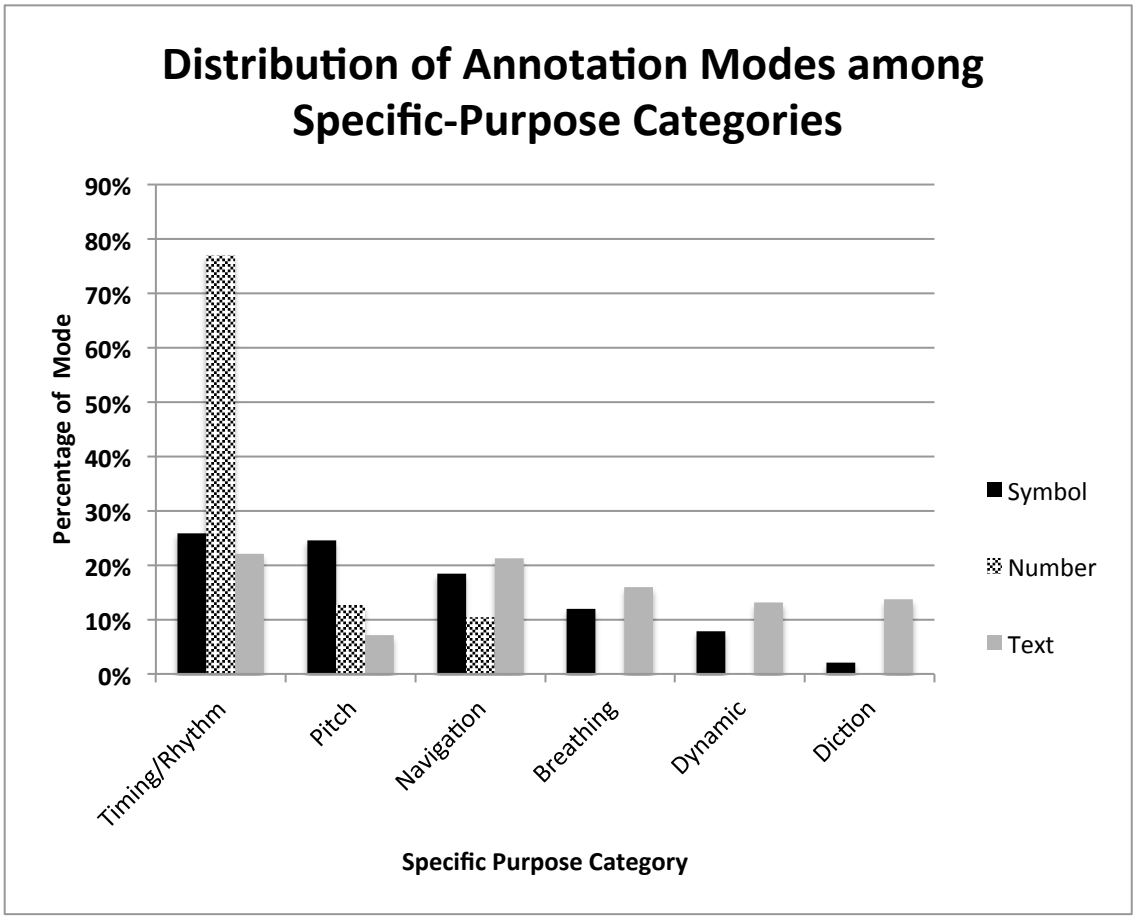

Figure 4. The distribution of annotation modes among specific-purpose categories.

Annotation Specific Purpose

Eleven specific-purpose categories were observed among the annotations analyzed for this study. Although no single category accounted for the majority of annotations,

approximately one-third of all annotations related to timing/rhythm, one-fifth related to pitch, and one-fifth related to navigation. Figure 5 illustrates the five specific-purpose categories that were observed most frequently among the annotations. The other six categories observed in the study, along with the percentage of total annotations they accounted for, were as follows: diction (4.06%), representational context (3.20%), attentive (3.06%), cannot be determined (1.34%), informational context (0.07%), and emotive (0.04%).

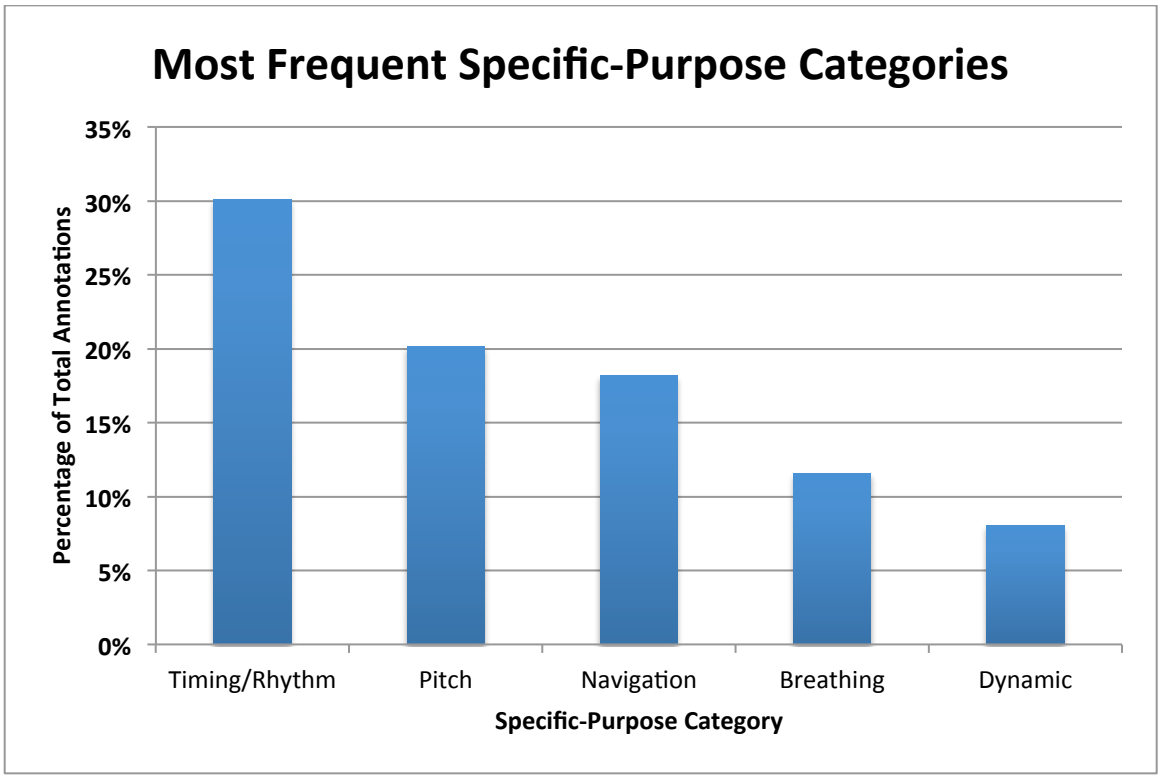

Figure 5. These five specific-purpose categories were observed most frequently in the study.

Comparison of Voice Parts

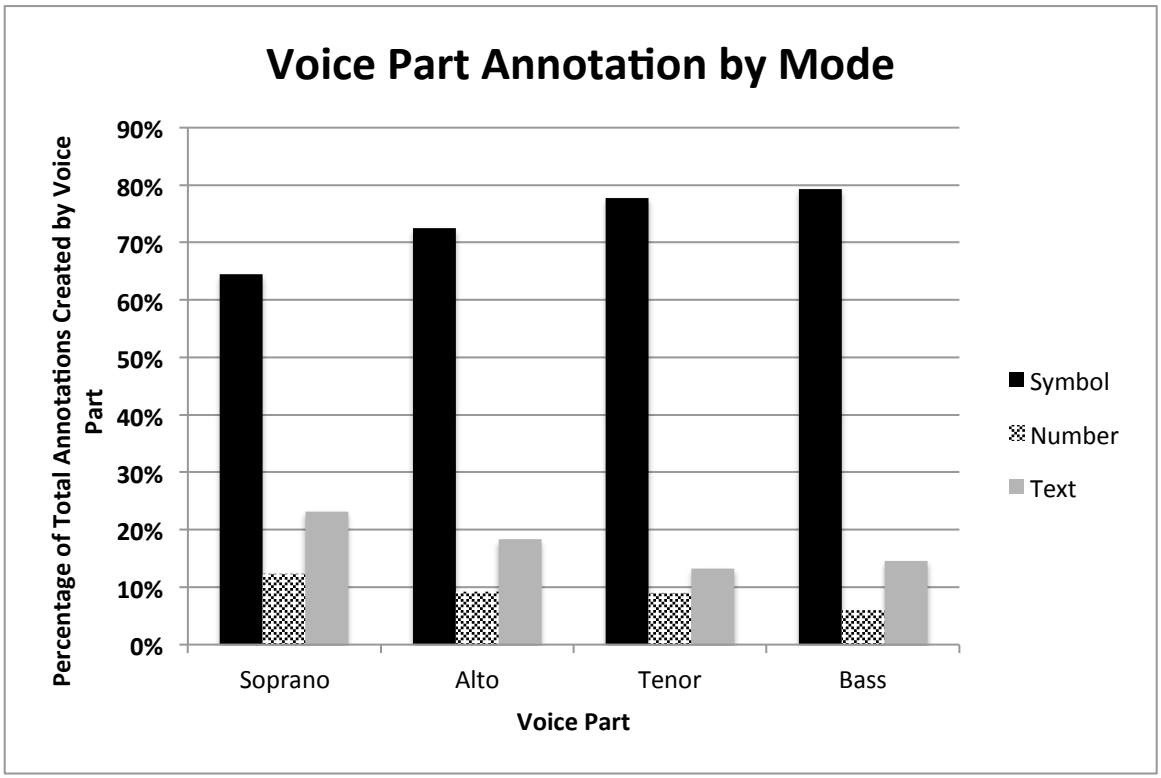

Figure 6. Distribution of each voice part's annotations among the three annotation modes.

Each voice part's annotations were analyzed to see how its annotations were distributed among the three modes of annotation: symbol, number, and text. Figure 6 illustrates the distribution of each voice part's annotations among the three modes. The majority (64%-79%) of annotations created by each voice part were symbolic, while 13%-23% were textual, and 6%-12% were numeric.

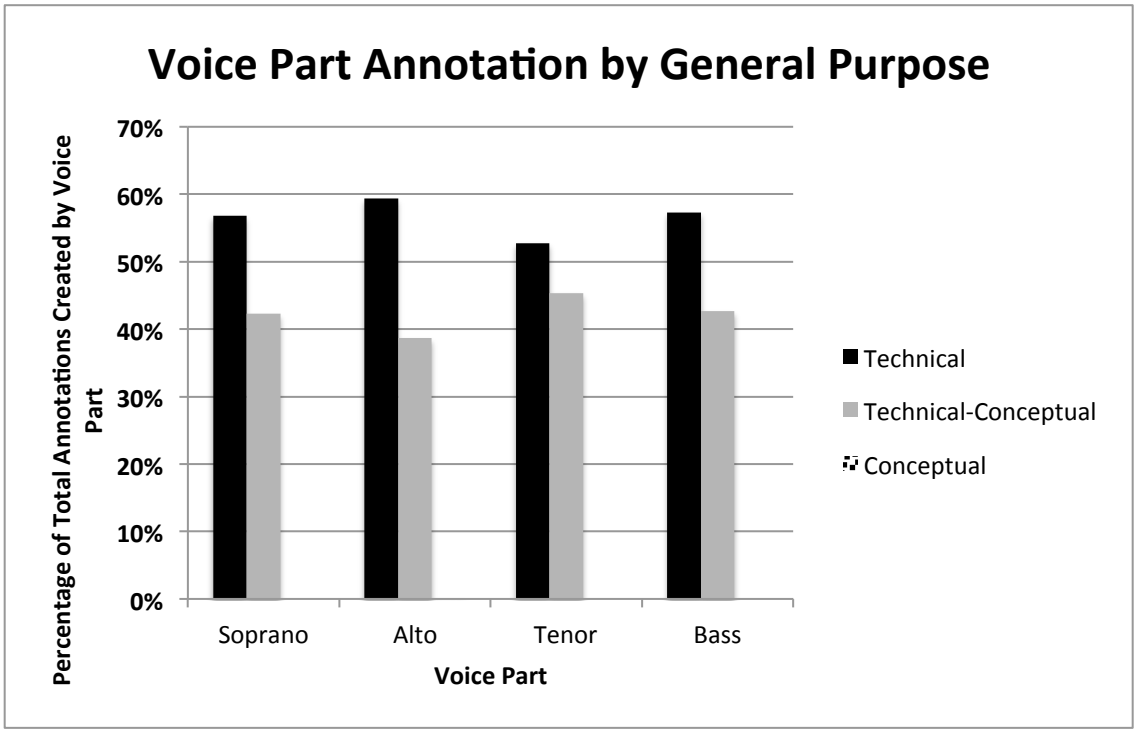

Figure 7. Distribution of each voice part's annotations among the three annotation general purposes.

Each voice part's annotations were also analyzed to determine the distribution of its annotations among the three categories of general purpose: technical, technical-conceptual, and conceptual. As Figure 7 illustrates, most of each voice part's annotations (from 53%-59%) were technical, while 39%-45% were technical-conceptual. Only one conceptual annotation was observed during the study, and it was created in the alto line.

Annotation Quantity

First, when comparing how the choir's annotated copies of music were distributed among the four voice parts (seen in Figure 8), sopranos and altos appear to have been more likely to annotate their music compared to tenors and basses. Sopranos accounted for 30.4% of the choir's annotated copies, altos for 36.1%, tenors for 13.3%, and basses for 20.3%. However, the distribution of the choir's total annotations among the voice parts provides insight into how many annotations each voice part actually created (see

Figure 9). Most singers who decided to annotate were sopranos or altos, and, as one would reasonably infer, these sections produced most of the annotations observed in this study. Sopranos contributed 32.6% of the choir's total annotations, altos contributed 39.3%, tenors 12.1%, and basses 16.1%. It is interesting to note that although about 20% of annotators came from the bass section (see Figure 8), a smaller percentage of the choir's annotations were attributed to the bass section (about 16%). This disparity suggests that the bass section did not create as many annotations in their music as the number of bass annotators would suggest.

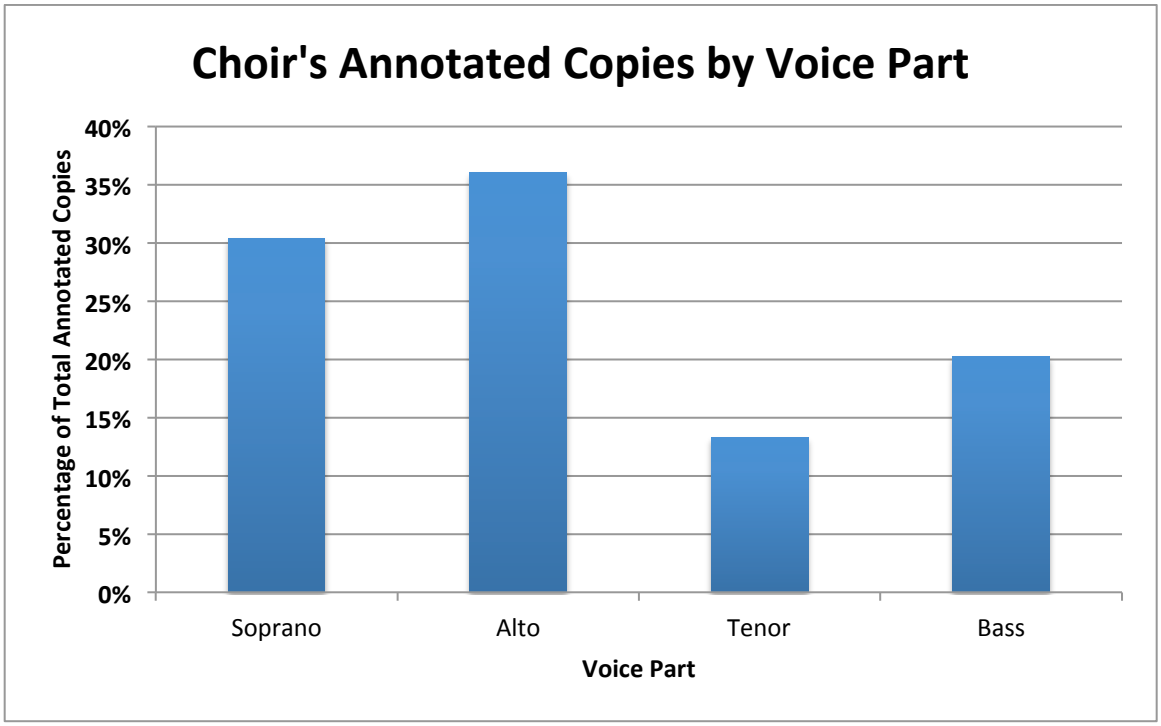

Figure 8. This graph illustrates how the copies of music that contained annotations were distributed among the four voice parts.

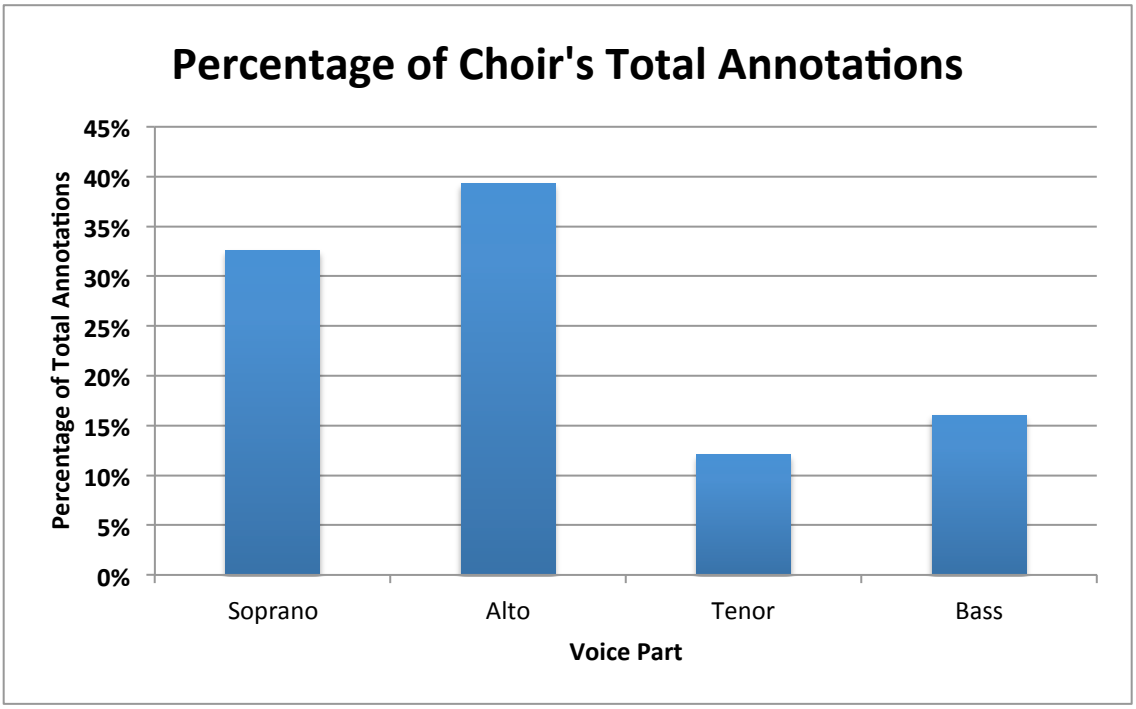

Figure 9. This graph illustrates how the choir's annotations were distributed among the four voice parts.

Similarly, when comparing average annotations per bar (illustrated in Figure 10), the bass section annotated at the lowest rate among the four voice parts, suggesting that the basses who chose to annotate did not create as many annotations in their music compared to the other voice parts. The average rate of annotation among singers who annotated their music was 0.24 annotations per bar. The graph in Figure 10 illustrates that the soprano and alto sections annotated more heavily than this average rate, while the tenor section annotated at approximately the average rate, and the bass section annotated its music below the average rate.

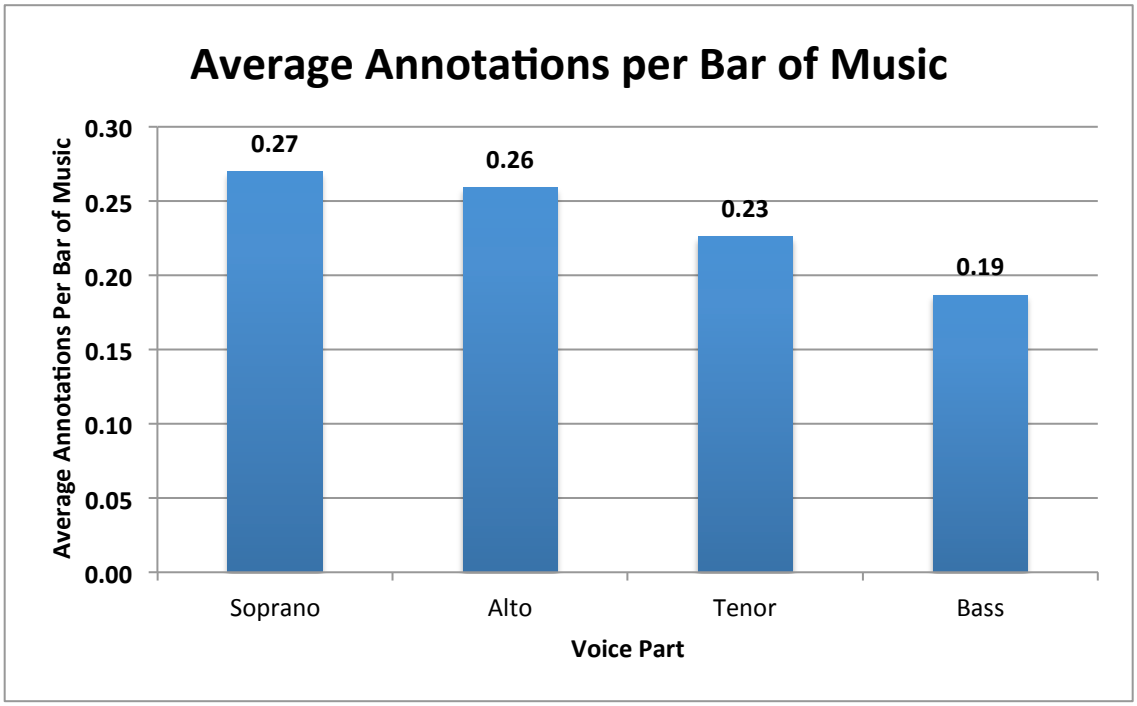

Figure 10. This graph illustrates how heavily each voice part collectively annotated its scores. This calculation included only those singers who created annotations in their scores.

Discussion

This discussion is divided into three sections. The first section presents problematic issues that surfaced when Winget's data analysis framework was applied to the context of this study. These critiques present opportunities to revise the framework for future score annotation studies. Second, the researcher presents what should have been done differently in this study in order to improve the quality of the research design and the validity of the results. The final section suggests areas of inquiry that could be explored in future studies to learn more about score annotations.

Assessment of the Data Analysis Framework

Overall, the data analysis framework used in Winget's study (2006) of score annotation among instrumental ensembles was used successfully to conduct a (primarily) quantitative content analysis of a large choir's score annotations. Although this

framework allowed the researcher to quantify content such as annotation mode (symbolic, numeric, or textual) and specific purpose (e.g., pitch or dynamics), the classification of annotations according to "general purpose" (either technical, technical-conceptual, or conceptual) was developed in the specific context of Winget's data and may not be appropriate for use in other contexts. Although this framework has not been developed to the point where it could serve as a universal framework for score annotation analysis, it is a valuable starting point and could certainly be revised to become a powerful tool that could be widely used for quantitative content analysis of music score annotations. In order to produce such a framework, more researchers would need to use Winget's framework in a variety of contexts to assess its utility and suggest revisions. It is possible that a widely applicable and accepted quantitative analysis framework for music score annotations could emerge from this process of assessment and revision. On the other hand, qualitative content analysis of music scores will likely need to proceed according to frameworks designed specifically for the context of a particular study and its research questions.

In the following paragraphs the researcher presents aspects of the data analysis framework that present potential opportunities for revision.

Annotation mode classification and units of analysis. According to the data analysis framework from Winget's study, each annotation should be classified according to its mode of representation in one of three categories: symbol, text or number. According to Winget's description of the framework, these categories are mutually exclusive (Winget, 2006; Winget, 2008a). However, it was observed during this study (as well as in the researcher's personal experience as a musician) that choristers sometimes mix modes of representation to convey a single concept. For example, a singer may want

to indicate that she should not breathe between two particular notes in the score. She may draw a slur between the two notes as well as write "N.B." (commonly used for "no breath") above the slur. This annotation combines two modes of representation (symbol and text) to express the same concept (i.e., not breathing between the notes). Although these markings convey the same idea and could be viewed as one conceptual unit, there is no way to indicate a combination of modes in the data analysis framework. The researcher then faces the question of how to define an annotation as a unit of analysis: should an annotation be defined physically by mode or conceptually by the specific purpose it expresses? The researcher in this study decided to define the unit of analysis physically based on the mode of representation. So in the case of the "no breath" annotation described above, this annotation would actually be recorded as two annotations using the data analysis framework. The slur would be considered a symbolic annotation and the "N.B." a separate textual annotation, although they express the same idea and could be viewed as the same conceptual unit.

Defining an annotation according to mutually exclusive categories of physical representation is problematic because it does not accurately reflect the way musicians conceptualize annotations. Musicians may mix modes of representation to express a single concept, but the framework currently does not allow researchers to record annotations that utilize multiple modes. If the unit of analysis is going to reflect how musicians actually conceptualize annotations, then the unit should be defined conceptually rather than physically. A revision to the framework would allow annotations to be recorded as conceptual units that sometimes combine different physical components. Annotation mode is highly valuable data for characterizing annotations, but the way it is currently instantiated in the data analysis framework requires that the unit of

analysis be defined physically, causing annotations to lose their integrity as cohesive conceptual units, which is how musicians tend to think of them, rather than as individual physical components.

The timing/rhythm category. The data analysis framework allows an annotation to be classified according to its "specific purpose," or the particular concept it expresses. Specific-purpose categories include concepts such as dynamics and pitch. However, the timing/rhythm category, in the researcher's opinion, is actually a problematic conflation of two distinct concepts: tempo and rhythm. If the timing/rhythm category were instead replaced by separate tempo and rhythm categories, then classification at a higher level of granularity would be possible and would provide more nuanced insight into the specific purpose of musicians' annotations.

Tempo refers to the speed of the beat in music performance, while rhythm refers to the relationship between notes with respect to time. Just as a melodic interval is the relationship between notes in terms of pitch, rhythm is the relationship of a given sequence of notes with respect to time. Thus, certain notes are longer in duration relative to other notes while certain notes are shorter in duration relative to others, and these relationships create different rhythms in the music. A particular rhythm can be played at various tempos, faster or slower. The relationship with respect to time (i.e., the rhythm) between the notes remains constant, while it is the speed at which the notes are executed that changes. Tempo (the speed of the beat) adjusts the rate of note execution, but the rhythmic relationship among the notes remains constant.

Within the data analysis framework, tempo should be classified as technical-conceptual in terms of general purpose because it is dependent on performance context and can vary from moment to moment according to the conductor's and the ensemble's

sense of time. However, "rhythm" should be classified as purely technical in general purpose because it indicates precisely when musicians should take physical action to execute the notes. Rhythm is therefore closely related to the physicality of music making that Winget says defines technical annotations.

As the framework currently stands, an annotation is classified as timing/rhythm if it relates to either tempo or rhythm, and there is no way to distinguish between these types of annotations. It is recommended that future iterations of the framework distinguish between rhythm (technical) and tempo (technical-conceptual), since making this distinction would provide richer, more nuanced data in future studies.

Improvements to the Research Design

Triangulation. Future iterations of this study should not employ score content analysis as the only method but should instead complement content analysis with other data collection points, such as observations or interviews. Triangulating data sources in this way allows the results from one method to be compared against results from other methods, and if the results support each other, then the study's findings have greater validity. Wildemuth has noted the particular importance of triangulation when using documents and artifacts as data sources, writing:

> [w]hile it has some advantages, this data collection approach is rarely used alone; it is more often used to provide a different perspective on a particular phenomenon. In this way, findings from multiple data sources can be used to draw more valid conclusions about the phenomenon of interest (2009, p. 164).

In the context of this study, interviews with choristers could have been used to validate the content analysis of score annotations. One of the problems with using content analysis in isolation was that the researcher had to do a significant amount of subjective interpretation in order to assign a specific purpose to each annotation. However, the

specific purpose of an annotation was not always clear to the researcher just from examining the score. If the researcher had been able to interview individual choristers in order to clarify the purpose of these ambiguous annotations, the validity of the results would have been enhanced. Gathering qualitative data from interviews and rehearsal observations also would have allowed this study to engage in richer data analysis by providing access to some of the meaning and explanation underlying the score annotation phenomena that were observed in the content analysis. Without triangulation from qualitative data sources, the findings of this study were confined mostly to the quantitative, descriptive realm.

Intercoder agreement and reliability. The limited time and resources available for conducting this research study resulted in the use of only one coder (i.e., the researcher) to identify and classify all the score annotations using the data analysis framework. However, future iterations of this study should provide for at least two researchers to code the annotations and should measure intercoder agreement to determine the reliability of the results of the content analysis. As Spurgin and Wildemuth explain:

> [Quantitative] Content analysis strives for objectivity and replicability. Thus employing more than one coder is essential to demonstrate that your results are not skewed by a single coder's subjective judgments and bias. Given the same content, coding scheme, and training, any coder's work should result in the same data. High measures of intercoder agreement indicate the reliability of the results of the coding process (Lombard, Snyder-Duch, & Bracken, 2002 as cited in Spurgin & Wildemuth, 2009, p. 301).

Although in this study the researcher took measures such as periodically reviewing Winget's code definitions and reviewing the coding in an effort to ensure consistent application of the data analysis framework, this study did rely upon only one researcher's

understanding of the framework and therefore the coding was subjective and there was no measure of reliability.

Assessing intercoder agreement in future studies applies not only to how code definitions are applied but also to how coders identify the unit of analysis. According to Spurgin and Wildemuth, "It is important to demonstrate that your recording unit can be identified reliably... If there is little agreement, you will need to clarify the definition of your recording unit. A strong content analysis study will report on the intercoder agreement on recording unit identification, when appropriate (2009, p. 299-300). Ensuring that the unit of analysis is reliably identified will be especially important for future studies since it is recommended that annotations be defined conceptually rather than physically in the future (see "Annotation Mode Classification and Units of Analysis" above).

Suggestions for Future Studies

This section suggests ideas for future studies that would contribute to knowledge in the area of music score annotation.

The effect of the conductor on an ensemble's score annotations. A conductor coordinates the forces of an ensemble in order to realize his or her interpretation of a piece of music. The conductor's vision and direction are clearly a source of ensemble coordination. Therefore, it would be interesting to determine the effect of the conductor on the annotations an ensemble creates in order to measure how many ensemble annotations could be attributed to the conductor's instruction. Such a study could observe ensemble rehearsals to note directions the conductor gives the ensemble and then examine the ensemble's scores for evidence of these directions. The

study could also compare the conductor's score annotations with those of the ensemble to observe similarities and differences.

Different types of annotators. This study examined the score annotations of a large community-based choir. However, choirs that vary by ensemble type (e.g., a 100-voice community choir or a 16-voice chamber choir) and skill level (professional, student, or amateur) could be studied and compared in order to assess the impact of these different factors on the musicians' annotation behaviors.

In addition to studying ensemble musicians, it would also be interesting to study the annotations that solo musicians create during private practice and score study in order to compare these private annotations with those that the musician creates during ensemble rehearsals. Similarly, a researcher could examine the score annotations created by non-performing music scholars, such as historians and theorists, to determine how and why they annotate music scores.

The effect of a musician's perception of a piece's difficulty on the number of annotations the musician creates in the piece. As noted in "Data Analysis" in the Methodology section of this paper, the difficulty level of a piece of music appeared to have a direct correlation with the number of musicians who chose to annotate the piece. Intuitively, one would infer that if a musician perceives a piece as easy to perform, then he or she will create fewer annotations in the piece, since annotations are connected to the cognitive processes of understanding and performing a piece of music. However, it would be valuable to see whether this intuition is supported by appropriate research.

Music traditions other than Western classical music. Although study of score annotation thus far seems to have confined itself mostly to classically trained musicians performing Western classical music, it would be excellent to study other music traditions

that use written symbolic representation of music in order to see whether and how these musicians annotate their written music, the character of these annotations, and the purposes these annotations serve. It would, for example, be interesting to compare score annotations of Western classical ensembles with those of jazz ensembles that use improvisational methods of performance.

Conclusion

This study completed a content analysis in order to characterize the score annotations created by a 100-voice choir during ensemble rehearsals in their copies of two choral works. The content analysis reviewed 158 copies of sheet music and used a coding frame developed by a previous study (Winget 2006) to characterize 2,684 individual annotations according to their mode of representation, specific purpose, and general purpose. As a result of the content analysis, the study found that (a) in terms of annotation mode, most of the choir's annotations were symbolic, while the fewest were numeric; (b) in terms of general purpose, most of the choir's annotations were technical, while the fewest were conceptual; (c) eleven specific purposes were observed in the choir's annotations; the most frequently observed specific purpose was timing/rhythm and the least frequently observed was emotive; (d) the choir created 2,684 annotations and annotated its music at an average rate of 0.24 annotations per bar; (e) most of the choir's annotations were created in the soprano and alto parts; and (f) the soprano and alto parts were annotated above the average rate of 0.24, and the tenor and bass parts were annotated below this average rate.

In addition to the content analysis results, this research also produced a critical evaluation of the coding frame that was used in the study. It was concluded that this

coding frame, which was developed in the context of instrumental ensembles, could be used effectively to conduct quantitative content analysis of score annotations in other contexts. However, the coding frame would not be appropriate for qualitative content analysis in other contexts, since its thematic codes are difficult to apply outside their original context. The evaluation of the coding frame also resulted in suggestions for improving the frame for future applications. Finally, the researcher also provided suggestions to improve the research design of future studies as well as ideas for future research in the area of score annotations.

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