to and download the source material for the project, as well as having access to the source recordings throughout the compositional process. ‘SoundRepository:Leeds’ can also be used to upload and submit sounds to the project, to instantly be incorporated into the audio generated. In order to encourage this activity, the process of submitting material has been simplified as much as possible. The user only has to navigate, via the map or list interface, to the intended zone, and choose ‘long’ or ‘short’, and click ‘Upload’.

5. FUTURE WORK

‘SoundExplore:Leeds’ is an application that uses recent technological developments to further engage an audience with their surroundings. By placing an emphasis on user control and exploration, as in other previously mentioned projects, ‘SoundExplore:Leeds’ facilitates this level of engagement. There are a number of ways that the application can be used to further this engagement.

Currently, the system allows for one set of audio files to be dynamically recombined, and users can submit to that set. Work has begun on expanding on this to include multiple layers of sound sets, or augmentedauralities, to be played back either simultaneously or independently. This would allow for individual users to store and collect their sounds in a set, and share that with others. Other possibilities involve the invitation of other artists to contribute an original set of sounds. ‘SoundExplore:Leeds’ also has the potential to be used as a pedagogical tool, to encourage a wider audience to participate in soundscapes and recording. With ‘SoundRepository:Leeds’ it is possible to demonstrate the way in which all of the material has been selected and processed to create the final result.

6. REFERENCES


3. PERFORMANCE MODALITIES

Performance modalities can be defined as the distinct activities that group members engage in during the course of playing a piece. These activities vary depending on the group and the context of the piece, and include a range of possibilities, from vocal performance to instrumental playing. The specific modalities chosen for a particular piece are determined by the composer, the performers, and the requirements of the piece itself.

In early rehearsals, players were able to choose between a Max/MSP or SuperCollider patch to handle recording, depending on their preference. However, the group later experienced technical difficulties reconciling these two patches and the composer took the decision to standardise the SuperCollider patch (see Figure 4a) across the group. Technologically, this emphasises the role of the composer-designer as a stakeholder in standardising interactive actions that are not seen as contributing valuable individual differences to the piece. From our observations, it can be said that what matters to the composer here was not the way in which lines were recorded, but rather the way performances differ in terms of content and vocal style.

Inardware Act 2, the sharing of sound files between group members is specified by the composer and is fundamental to the character of the piece. This modality is a preparatory technical stage specified by the composer, which requires a single player to host a shared folder on the local network, which others can then connect to as clients. This is accomplished using the native folder sharing features of the Macintosh OS X operating system. Figure 1 provides an overview of this process, where solid lines in the diagram indicate local access by the player hosting the folder and dotted lines represent players accessing the shared folder remotely over the network. It is notable that performers are not stakeholders in this process and must simply follow a predefined set of instructions, with little room for individual differences.

3.1. Hosting and Connecting to the Shared Folder

In Laptopera Act 2, the sharing of sound files between group members is specified by the composer and is fundamental to the character of the piece. This modality is a preparatory technical stage specified by the composer, which requires a single player to host a shared folder on the local network, which others can then connect to as clients. This is accomplished using the native folder sharing features of the Macintosh OS X operating system. Figure 1 provides an overview of this process, where solid lines in the diagram indicate local access by the player hosting the folder and dotted lines represent players accessing the shared folder remotely over the network. It is notable that performers are not stakeholders in this process and must simply follow a predefined set of instructions, with little room for individual differences.

3.2. Voice Recording

As stated, a key requirement of the piece is for players to vocally perform and record lines of dialogue to the previously established shared folder. Figure 1 provides an overview of this recording process. As observed during analysis, players keep a copy of the score open on screen at all times (see Figure 2a), which they refer to when choosing a line and also read aloud from during the act of recording itself. In addition, line choice also depends on other players. As stated in the technical document for the piece, a box on the player's menu may record that line (or fragments of it) again, but cannot back track to a previous line. Once a line is recorded, other players may record additional versions of existing material.

In early rehearsals, players were able to choose between a Max/MSP or SuperCollider patch to handle recording, depending on their preference. However, the group later experienced technical difficulties reconciling these two patches and the composer took the decision to standardise the SuperCollider patch (see Figure 4a) across the group. Technologically, this emphasises the role of the composer-designer as a stakeholder in standardising interactive actions that are not seen as contributing valuable individual differences to the piece. From our observations, it can be said that what matters to the composer here was not the way in which lines were recorded, but rather the way performances differ in terms of content and vocal style.

3.3. Voice Processing

BiLE practice requires members to develop their own approach to performance, where each member "is free to interpret the sound production elements of the piece" [1], representing the tacit acknowledgment that engaging in design serves as a motivation to perform. In the case of Laptopera Act 2, "sound production" refers to the way in which performers playback and process previously recorded lines from the shared folder. The type of design engaged in here is instrumental in nature and differs significantly from the composer-centred and primarily infrastructural form discussed in the previous section. Here, the performer is the key stakeholder, and the process differs from player to player according to their individual abilities and values. This does not mean that performers can design any type of instrument, as while they are free to implement the low-level details as they see fit, the patch as a whole must still conform to the basic category of a voice processing instrument, as specified by the composer.

In addition to this chat functionality, players may also use the network tool to start or reset a shared clock. This process has something in common with the aforementioned modality of hosting the shared folder 3.1. in that a single player must take on the role of starting the clock when the piece begins.

4. SoCIALLY CONSTRUCTED SYSTEMS

What becomes apparent from the previous examination of performance modalities in Laptopera Act 2, is that performers systems as a whole are a complex, interlocking mix of instrumental and infrastructural software, which must be adopted in their totality in order for players to be able to successfully perform the piece. We define these here as socially constructed performance systems, where Figure 4 shows the different elements involved in such a system from the perspective of an individual performer. Such systems represent the socially negotiated needs and requirements of different stakeholders in the group, in this case consisting of standardised infrastructural aspects specified by the composer-designer, and individualised aspects contributed by each performer-designer.

There is no doubt that socially constructed systems pose a number of challenges for interaction, such as the degree to which performers are able to devote attention to each of the constituent elements, the extent to which these elements can be successfully integrated into their practice or adapted to their needs. The ease with which players can switch between different performance modalities that the system as a whole affords. In Les’ case, his instrument was tightly integrated with the sound file recorder by design, allowing newly recorded soundfiles to be selected immediately by using a button on the Wii Remote. In contrast, Ian kept a copy of the shared folder open and monitored the addition of new sounds, before choosing them from a menu. Julien also took this approach, but dragged sound files directly from the shared folder into his instrument window.
3. PERFORMANCE MODALITIES

Performance modalities can be defined as the distinct activities that group members engage in during the course of playing a piece. There are a number of ways to do so, which follow a pattern throughout, which is formalised below, we formally identify five modalities that were required to realise Laptopera Act 2 by Charles Hutchinson. Our aim was to identify the stakeholders involved in each modality, the systems developed and used in each, and the way in which these systems were adopted in their totality.

In BiLE practice, the composer is charged with the task of proposing an initial idea to the group and guiding the process of collaboration to a satisfactory end point. In the case of Laptopera, the initial idea was presented in the form of a technical document which provides instructions for performers - and a text score, which requires players to vocally perform and record lines taken from spam e-mails. A key feature of the piece is that recorded material can be accessed by all members of the group, allowing newly recorded lines to be juxtaposed with processed versions of existing material.

It is worth mentioning here that the score does not allocate specific modalities to specific performers; rather it is the case that all the modalities defined below are employed by all members of the group.

3.1. Hosting and Connecting to the Shared Folder

In Laptopera Act 2, the sharing of sound files between group members is specified by the composer and is fundamental to the character of the piece. This modality is a preparatory technical stage specified by the composer, which requires a single player to host a shared folder on the local network, which others can then connect to as clients. This is accomplished using the native folder sharing of the Macintosh OS X operating system. Figure 1 provides an overview of this process, where solid lines in the diagram indicate local access by the player hosting the shared folder and dotted lines represent access from the client to the shared folder remotely over the network. It is notable that performers are not stakeholders in this process and must simply follow a predefined set of instructions, with little room for individual differences.

3.2. Voice Recording

As stated, a key requirement of the piece is for players to vocally perform and record lines of dialogue to the previously established shared folder. Figure 1 provides an overview of this recording process. As observed during analysis, players keep a copy of the score open on screen at all times (see Figure 4b), which they refer to when choosing a line and also read aloud from during the act of recording itself. In addition, line choice also depends on other players. As stated in the technical document for the piece, once a line is recorded, other players may record other lines. As stated in the technical document for the piece, choosing a line and also read aloud from during the act of analysis, players keep a copy of the score open on screen.

In early rehearsals, players were able to choose between a Max/MSP or SuperCollider patch to handle recording, depending on their preference. However, the group later experienced technical difficulties reconciling these two patches and the composer took the decision to standardise the SuperCollider patch (see Figure 4a) across the group. Technologically, this emphasises the role of the composer-designer as a stakeholder in standardising interactions that are not seen as contributing valuable individual differences to the piece. From our observations, it can be said that what mattered to the composer here was not the way in which lines were recorded, but rather the way performances differ in terms of content and vocal style.

3.3. Voice Processing

BiLE practice requires members to develop their own approach to performance, where each member “is free to interpret the sound production elements of the piece” [1], representing the tacit acknowledgment that engaging in design serves as a motivation to perform. In the case of Laptopera Act 2, “sound production” refers to the way in which performers playback and process previously recorded lines from the shared folder. The type of design engaged in here is instrumental in nature and differs significantly from the composer-centred and primarily infrastructural form discussed in the previous section. Here, the performer is the key stakeholder, and the process differs from player to player according to their individual abilities and values. This does not mean that performers can design any type of instrument, as while they are free to implement the low-level details as they see fit, the patch as a whole must still conform to the basic category of a voice processing instrument, as specified by the composer.

What is perhaps most important to note about the voice processing modality is that individualisation occurs at the level of instrument design, not just playing style. Figure 2 shows how these voice processing instruments differ in terms of their chosen interfaces - and is illustrated by a series of still images taken from rehearsal footage - whilst Figure 4c shows the graphical user interface of one player’s instrument.

3.4. Sound File Playback

In addition to the vocal material, the score also calls for players to select and play sounds taken from Stockhausen’s Studi II. These are required at the beginning of the piece, but may also be interspersed throughout. Although approaches to sound file playback are not as highly individualised as in the voice processing modality, the process is still approached in a number of different ways, with players accessing sounds from the OS X finder (Les), from the recorder patch (Shelley), or integrating them into their custom designed instrument patches (Julian and Iain).

3.5. Posting to Chat and Starting the Clock

In this modality, players make use of a network tool, written in SuperCollider. The tool itself can be seen in sections e. and f. of Figure 4. In BiLE practice in general, chat is primarily used to announce technical problems or to check when all players are ready to begin playing. The chat function of this tool plays a special coordinating role in Laptopera Act 2, where it is used to announce codes, which give the section and line number of recently recorded lines, in the same way they are referred to in the score. This allows players to track their position within the piece at any given time.

In addition to this chat functionality, players may also use the network tool to start or reset a shared clock. This process has something in common with the aforementioned modality of hosting the shared folder 3.1, in that a single player must take on the role of starting the clock when the piece begins.

It is notable within this modality that use of the network tool is not specified explicitly by the composer or by performers but is instead emergent in nature, in that it forms part of the existing practice of the ensemble.

4. SOCIALLY CONSTRUCTED SYSTEMS

What becomes apparent from the previous examination of performance modalities in Laptopera Act 2 is that performers systems as a whole are a complex, interlocking mix of instrumental and infrastructural software, which must be adopted in their totality in order for players to be able to successfully perform the piece. We define these here as socially constructed performance systems, where Figure 4 shows the different elements involved in such a system from the perspective of an individual performer. Such systems represent the socially negotiated needs and requirements of different stakeholders in the group, in this case consisting of standardised infrastructural aspects specified by the composer-designer, and individualised aspects contributed by each performer-designer.

There is no doubt that socially constructed systems pose a number of challenges for interaction, such as the degree to which performers are able to devote attention to each of the constituent elements, the extent to which these elements can be successfully integrated into their practice or adapted to their needs and the ease with which players can switch between different performance modalities that the system as a whole affords. In Les’ case, his instrument was tightly integrated with the sound file recorder by design, allowing newly recorded soundfiles to be selected immediately by using a button on the Wii Remote. In contrast, Iain kept a copy of the shared folder open and monitored the addition of new sounds, before choosing them from a menu. Julian also took the approach, but dragged sound files directly from the shared folder into his instrument window.
6. REFERENCES


5. CONCLUSIONS

In the course of this paper, we have presented an ethno-graphic study of performance modalities in BILE’s laptop opera Act 2, identifying the stakeholders involved in each modality and considering how multiple modalities manifest themselves as socially constructed performance systems. Our investigation shows that whilst traditional roles of composer and performer are present within BILE practice, the consensus driven nature of the group produces a dynamic set of orientations, which do not strictly define players’ sole activities. Instead, interaction is perhaps best understood with reference to hybrid roles such as a) the composer-performer, reflecting the fact that the member who conceives of a piece is also involved in playing b) the composer-designer, reflecting the need for composers to design infrastructures which aid realisation of the piece by simplifying interaction, and c) the performer-designer, reflecting the fact that performers are required to design instruments which stand apart from each other. As these latter two roles show, design inheres within both composition and performance, but in service of different sociotechnical functions, representing the need for standardisation of particular modalities, whilst allowing for indviduation in others. In addition, other modalities can be described as emergent, due to their reliance on tools or standardisation of particular modalities, whilst allowing for sociotechnical functions, representing the need for stan-

2. RELATED WORK

2.1. Musical Structure representation

There are a few works that evaluate effective methods to memorize musical scores scientifically. Most of these methods for memorizing musical scores are based on theories derived from the experience of professional players. For example, Bernstein [2] insists that non-conscious memory is weak and may fail to provide the answer to a simple question like “What was the next note?” Therefore the backup memory based on conscious memory, when players are conscious of a musical structure as shown in Figure 1 and recognize the modulation point, is important. Accordingly, how to aid learners to commit musical structure to their conscious memory is a key point in the design of our proposed system.

Synder [3] describes the process of memorizing a song, which is investigated from the view points of cognitive psychology and information theory. Specifically, it is necessary for players to analyze the musical structure, and it is especially important for them to be conscious of the different points of two similar phrases. In our research, we develop a system that prevents the learner from memorizing ambiguously by presenting different points among similar phrases on musical scores, thus helping the learner to memorize musical scores correctly.

3. DESIGN

As mentioned in Section 2, it is important to be conscious of the musical structure of a musical score and the different points among similar phrases. Musical structure is composed of multiple musical layers from abstracted layer to detailed layer as shown in Figure 1. The learner requires the abstracted layers to check brieﬁx overview of the song. In contrast, the learner requires the detailed layers to check the momentary states of a song, which are rhythm, pitch, and musical techniques. Because the necessary layer is dependent on the ability or the interest of