Unconstrained and constrained embodied interaction with audiovisual feedback during vocal performance

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ABSTRACT

This paper presents the work on unconstrained and constrained embodied interaction with live audiovisual processing parameters during singing. Building upon the concept of affordance and embodiment and adopting a User-Centred Design approach, two case studies were realised. The first case study in a context where a performer is free to move and interact with the MyoSpat interactive system for live sound processing parameters (unconstrained interaction); and, the second in a performative situation where the musician is limited by a played instrument or interface (constrained interaction). The interaction design solution proposed in the two case studies was welcomed by the performers; its potential and limitation allowed invited the exploration of new gestures-sound relationships.

INTRODUCTION

Performers demonstrate a high level of interactivity afforded by the ability to physically control musical nuance of the instrument. Similar self-evident interactivity is necessary when using interfaces for performance and production. While this is essential, it is not always the case since current technology might not establish such a level of interactivity and direct interaction with sound. In designing modes of interaction with an interface, various factors should be considered: performance's genre, instruments, available sensing technology, required computational power, and the interface's affordances (Tanaka et al., 2012). It is the latter aspect that is particularly relevant to this work. Godøy (2010) demonstrates that music can invite certain gestures that are often encouraged by sound's timbral and dynamic qualities, the *affordance of musical sound*. In their study, Caramiaux et al. (2011) concluded that gestures can be evoked by the sound's causality. Although these *sound-tracing* studies identify important information about gesture-sound relationships, they did not consider the potential bias of the gesture tracking device's affordance on the sound-tracing exercise. Tanaka et al. (2012) explored gestural affordance with sound in relation to different devices, concluding that the combination of input devices and output feedback leads to the construction of highly sophisticated affordances, which require an equally complex construct of affordance. To reduce this complexity, I refer to the idea described by (Leman, 2007), that interfaces and modes of interactions should put the user in an ideal position where the interface itself disappears. It is necessary to specify that here the word "disappear" does not aim to promote the idea of an invisible system, but it refers to the interaction between the human and the machine (Dourish, 2001). Thus, the musician's and the audience's perception should not focus on the mechanics of interaction. Nevertheless, *"a musical communicative channel should be established that is catalysed by the modes of interaction, but not hindered by them"* (Tanaka and Knapp, 2002). Interaction design is, therefore, a vital aspect of attaining musical satisfaction. Body movements during performance enhance the music experience, and the embodiment of the interaction with sound plays an important role to *"facilitate the encoding of expressive gestures into sounds, and the decoding of sounds into expressive gestures"* (Leman and Maes, 2015). Building on the concept of affordance of musical sound, and principles of embodiment and natural interaction, in this paper, I present modes of interaction with sonic and visual in two different contexts reflecting the constraints posed by the technology during music performance.

UNCONSTRAINED AND CONSTRAINED EMBODIED INTERACTION

This paper proposes modes of embodied interaction in singing performance in two contexts: unconstrained and constrained. In the former, the performer is free to move the body freely; and in the latter, the performer's movements are restricted by an instrument or interface. For this research, it was realised a custom interactive system named MyoSpat (Di Donato et al., 2017).

Modes of interaction and MyoSpat were informed by research conducted adopting a User-Centred Design

(UCD) approach (Norman and Draper, 1986). The UCD cycle included a first phase of an in-depth review of body movements during the singing and the iterative work with the performers, which then led to defining the interaction design, the realisation of MyoSpat, the performance of *VoicErutseG* by Vittoriana De Amicis, and the composition and performance of *Music Gesture Beatbox* by Grace Savage.

Case Study 1: Unconstrained Interaction

In the first case study, I explored modes of interaction in a situation in which the singer can move her whole body freely, without any technological constraint. This is defined as unconstrained interaction. In this context, Vittoriana De Amicis, performed *VoicErutseG* (Figure 1) (De Amicis and Di Donato, 2015a; De Amicis and Di Donato, 2015b) a performance with no restriction of movement, if not the choreographic indications of the already composed music. *VoicErutseG* explores the possibility of extending existing works in the vocal solo repertoire through gesture-controlled sound spatialisation, paying careful attention not to disrupt the choreographic aspects and required vocal techniques of the original works. The performance aimed to inform and demonstrate the implementation of a natural and embodied interaction design for controlling the spatial position of the vocal sound, considering factors that might interfere with aspects of the performance and the concentration of the performer. Taking into account all aims and considerations, the interaction design consisted in a pointing gesture to establish the spatial position of the sound in the listening area (see video performance[1]).

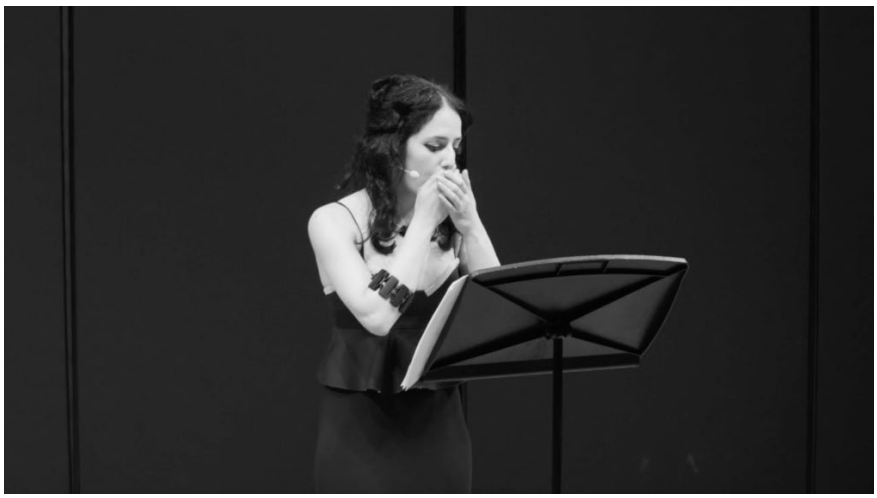

Figure 1 Vittoriana De Amicis performing VoiceErutseG.

Case Study 2: Constrained Interaction

In the second case study, the interaction design is realised in a context where the movements of the performers were partially constrained by a musical instrument or interface during the performance. I defined this constrained interaction. This mode of interaction was explored in a real-world scenario through the work of Grace Savage, who composed and performed *Music Gesture Beatbox* using MyoSpat and a loop-station (Savage and Di Donato, 2016). Technological constraints were determined by the use of a hand-held microphone and a loop-station, and the MyoSpat interactive audiovisual system. In addition to performative aspects, the interaction design was realised taking into account the musicians' creative process of composing and performing. The interaction design consisted in the (i) pointing gesture to control sound spatialisation parameters and lighting effects, (ii) the rising hand gesture to process the voice with a band-pass filter and video colour filtering (Figure 2), (iii) the throwing gesture to generate visual feedback and sound spatialisation trajectories, and (iv) the beat gestures speed to control the speed in which videos were played (see video performance[2]). These gestures were drafted and used by Savage in *Music Gesture Beatbox* to address issues that arise when composing a piece around technological constraints, and the need of freedom to explore and embody audiovisual processes.

[1] *VoicErutseG* video: https://www.youtube.com/playlist?list=PL60BfNS9JlwuSitKCKrYVRhcXsW6gbG5g

[2] *Music Gesture Beatbox* video: https://youtu.be/DRFqCXpvfW0

Figure 2 Grace Savage performing Music Gesture Beatbox.

RESULTS AND CONCLUSION

The work presented in this paper aimed at the creation of modes of interaction that would result in embodied vocal performance, and that would not disrupt the execution of the performance nor the creative process that led to its realisation. Main findings from observations and post-interviews with performers showed that designing interactions that allow freedom of movement in the control sound processing parameters, can support the use of a system in any context, regardless choreography elements imposed by a score. Thus, it allows performers to focus on the performance rather than learning the use of an interactive system. The use of a constrained interaction design coupled with a sophisticated technological ecosystem, required a bigger effort from the performer and reduced the number of choreographic possibilities. However, it was observed that this was not a major issue; Savage took advantage of the required learning curve, during which she builds a *"habituated mental model of its constraints"* (Magnusson, 2010), and found the virtuosity within the interaction design and technological constraints.
In the future, the interaction design in a constrained and unconstrained context will be explored in relation to the idea of Human-Sound Interaction (Di Donato et al., 2020), which focuses on our diversity in perceiving sound, its affordances, and consequently how this affects our interaction with live audiovisual processes.

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