

Effect of Different Acoustic Environments on Singing Voice Performance

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Abstract

It is becoming progressively popular for artists to record their tracks in architecturally unique recording studios / home studios. For example, pop artist Billie Eilish won multiple Grammy awards in 2020, achieving something more prolific performers armed with top of the range studios, talented sound engineers and high-end equipment had not; all out of a small bedroom studio in her parents' home. (engadget, 2020) This paper provides a review of evidence-based studies of the analysis of the singing voice, identifying and critically appraising the thematic content and the research methodologies of the relevant investigations. Current research in this area is paving the way towards a better comprehension of singing performance.

Aims and Objectives

The aims and objectives of the project are as follows:

- Study relevant technology and measurement practise of the singing voice.
- Discover and investigate reliable studies relating to project for their applicability.
- Choose and analyse a selection of studies directly linked to project, presenting and comparing their findings.

Introduction

The following research investigates studies on vocal accuracy in different virtual acoustic environments. Test subjects will take part in the collection of data whereby they will sing with live foldback by various reverb levels. The singer's performance will be analysed to see if pitch / vibrato / projection is affected. The data collected will judge whether vocalists perform with greater pitch accuracy with a given amount of reverberation. It will also indicate if other singing techniques are influenced by the vocalist's acoustic perception. The studies will be compared, and conclusions drawn from the similarities in their data and results.

References

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Methodology

Each study varied their methodology slightly but the process of data collection were generally the same. Some studies used real locations to record the vocals whilst others chose virtual means such as headphone fold back or multiple surround loudspeakers as shown in Figure 1.

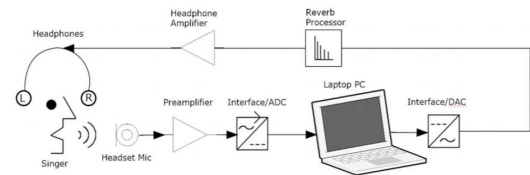


Figure 1: Recording Setup from the Barlow, Daffern, Yule and Ford 2016 Study.

Each study recorded the singing voice of a professional singing unaccompanied in a controlled environment, changing only the perceived acoustic of the vocalist. Some studies took impulse responses from real spaces to make the virtual acoustic as believable as possible by introducing early reflections.

Results

Barlow found that tempo varied by a noticeable amount, with the anechoic performance being slower by around 10%. It is suggested that the lack of reverberation resulted in a slower performance tempo as the singer needed to sustain various notes for longer to process feedback regarding pitch. In addition, the vibrato rate and depth was noticeably higher for the singer in the anechoic environment than in the reverberant space. Howard and Brereton also found a shallower spectral slope for the anechoic recordings, both suggestive of a heightened effort and increased vocal load and a resulting change in singer tone quality.

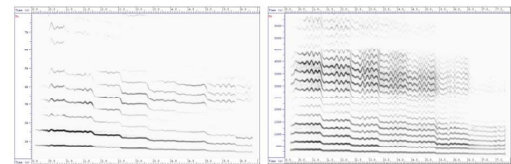


Figure 2: Spectrograms of one-octave G-major descending scale, sung by mezzo-soprano in Chapter House (left) and anechoic chamber (right) From: (Brereton and Howard, 2008)

In correspondence to the other studies, Rothman (et al) also found a considerable variation in tempo and amplitude.

Conclusion

The singers reported having to push their vocals and 'work harder' in the anechoic environment, and this was supported by the analysis of peak sound pressure levels. These observed changes seem to likely occur because singers depend on the auditory feedback provided by the acoustics of the environment in which they perform, adjusting their vocal output accordingly.