# Towards the Influence of Space & Environment on a Musical Performance

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**Abstract:** Within Environmental Psychology, our surroundings have been widely acknowledged to influence human behaviour. However, research has yet to establish an adequate scholarly discourse surrounding the impact of one's environment on musical performance, highlighting a large gap in current understanding. In this paper, I outline the methodology and early findings of an ongoing Ph.D. research project. The project investigates performance behaviour in three environments: firstly, the physical environment; secondly, a simulated representation of the environment within a recording studio, and, thirdly, the environment and acoustical characteristics of the studio itself. The method used expands upon previous research by Sato (2011), Brereton (2011), and Ueno (2010) into the effects of room acoustics on musical performance.
The study has indicated that performances are affected by the emotional influences of an environment in addition to its acoustical characteristics. This research offers composers, performers, and studio engineers a greater understanding of the interrelationship between performer and environment, encouraging the use of physical and simulated spaces as a performance tool. Increased attention to the role of space upon performance meets the need for a better understanding within environmental psychology of how environments are experienced and perceived aurally.
**Keywords:** Music Performance, Audio Recording, Environmental Psychology, Performance Analysis.

**Context**

A musical performance is influenced by the environment in which it takes place. The acoustical identity, situation, the performer's emotional connection to, and the cultural significance of the space are examples of environmental attributes that impact on a performance. At present, interest into the effects of the surrounding environment on a musical performance has focused mainly on the acoustical characteristics of the space, wherein reverberation is most frequently investigated. A number of studies have placed musicians in simulated acoustic environments within anechoic chambers to explore the effects of different types and durations of reverberation on a musical performance, and also how the performance and playing are affected when the reverberation is completely removed. Sato, Kamekawa, and Marui (2011), Brereton, Murphy, and Howard (2011), Ueno, Kato, and Kawai (2010), and Woszczyk & Martens (2008) have all explored the effects of various acoustical characteristics on a musical performance within simulated environments. What these studies have not included, however, is the influence of the real-world, physical environments, of which the simulations are modelled on, and how they influence a musical performance. This raises the question: How does an environment impact a musical performance beyond its acoustical characteristics? The purpose of this paper is to demonstrate a practical research method developed to answer this question and to explore the early results achieved in the experiments.

In addition to music performance studies, this research takes an interdisciplinary approach through the perspective of environmental psychology. By applying research methods and analysis used in environmental psychology, the influence of environment and the significance of space on a musical performance can be investigated in ways that are yet to be achieved. Within the field of environmental psychology, there is a strong emphasis on how we perceive and experience our surroundings. There is, however, a lack of research into the way an environment is perceived and experienced aurally. Publications in music and acoustics have, however, briefly attended to the perception of the sound characteristics of spaces (LaBelle 2010; Blesser & Salter 2007; Toop 2001), but the emotional and psychological effects of environmental sound require further investigation that can be achieved through methods in environmental psychology.

The inclusion of a psychological perspective brings attention to the social norms and learned behaviour encouraged by certain environments. Barker's 'Behaviour-Settings Theory (BST)' (1968) explains the relationship between person and environment, and how associated behavioural traits become a standard within those places and situations. Both the physical and social aspects of an environment are required to suggest a behaviour setting (Scott 2005: 297), and suggest that inhabitants conform to an environment's implied behavioural constraints. BST is often applied to environmental perception, wherein previously learned behaviour and actions are expected within certain places. This study suggests that Behaviour-Settings Theory can also be applied to the venue for musical performance or space where any musical activity is taking place. For example, a musician's previous experience within a concert hall environment may encourage greater focus on delivering an accurate recital, but it may also coax a sense of nervousness due to the formal performance expectations. We can propose that the musician's perceptions of the environment, whether positive or negative, are likely to be influenced by their previous experiences that will shape how they interact with the space (Paine 2007: 372).

The influence of different environments on performance is evident throughout musical history; musical styles, compositions, and cultural and social scenarios in which performance takes place have all evolved alongside building trends. As music performance and exposure to multiple cultural styles is now immediately available without a set geographical location, we must question whether or not the significance of certain environments is still affective in modern music performance practice. Has music performance become separate from the environment in which it is taking place? Mueke & Zach (2007) suggest that "while the listener can hear the same harmonies that are used in architecture in the music, there is little connection between music and its architectural space" (Mueke & Zach 2007: 255). However, in regard to the progression of music creation and performance, it may now be lacking from the impact of environmental significance; effectively, "music has been geometrized and lost its connection to the material" (Mueke & Zach 2007: 255-256).

This paper collectively analyses the influence of acoustical characteristics of space on a musician's playing (quantitative), and also explores the emotional and psychological impact of a surrounding environment on a musician's performance experience (qualitative) (see: figure 1).

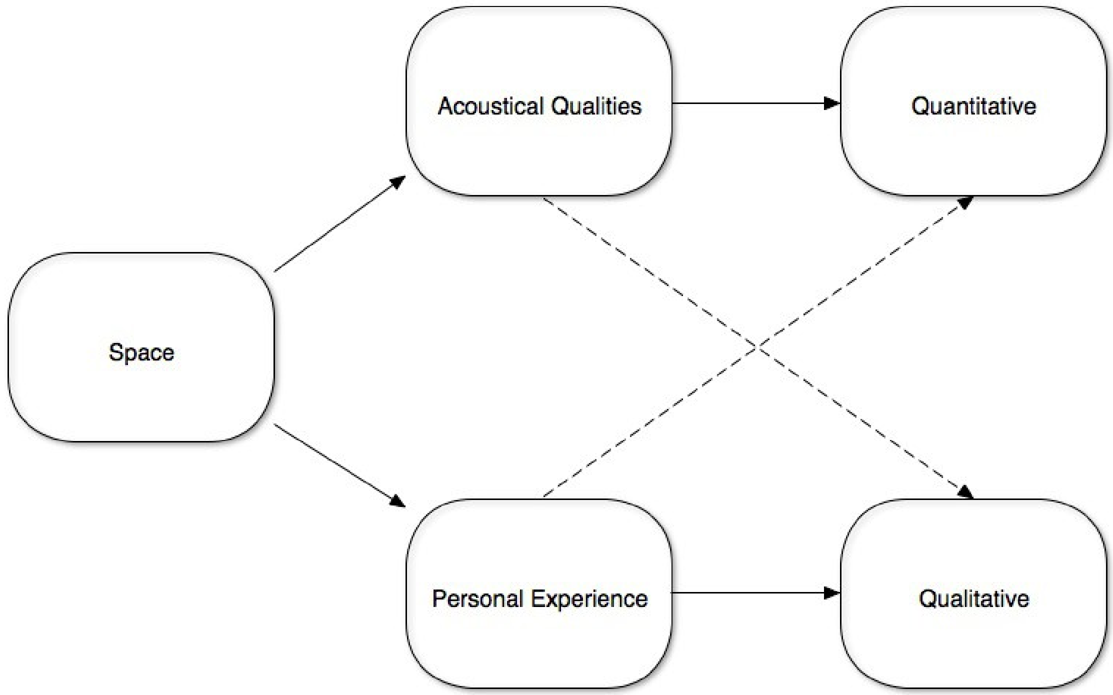


**Figure I.** Quantitative and qualitative approaches within this research.

## Methods and Materials: The 'Three-Stage Method'

In order to investigate the emotional and psychological influence of an environment on a musical performance in greater depth, the following experimental practical test has been created. The test combines repeated musical performances across multiple real-world locations and digitally simulated emulations of the same spaces through convolution reverberation. This not only reveals the effects of a space's acoustic identity on a musical performance, but also suggests the emotional and perceptive impact of physically being in the real-world environment. Physical movements and gestures are an important element of musical expression within performance (Davidson 2014: 183), and by witnessing the process of performance allows for investigation into how the different environments have an effect on the musician's movement.

The test requires a musician to perform three chosen musical excerpts within a variety of real-world environments. It is suggested that the participant chooses pieces that he/she can play with accuracy and has well-rehearsed. It is also suggested that of the three excerpts played, one is of a moderately fast tempo, one is of a moderately relaxed tempo and the third is to include a very wide dynamic range. These specifications allow for easy analysis of the influence of the environment on tempo, dynamics and articulation, but do not restrict the musician to unfamiliar repertoire.

The physical environments are then simulated by gathering impulse responses of the space during each recording exercise (see: Figure 2). A convolution reverberation effect is created from an impulse response to later be used in a recording studio environment (see: Figure 3). Similarly to studies previously mentioned, the effects of a space's acoustic characteristics such as reverberation, early reflections and resonance on the participant can be analysed in a controlled environment. By repeating the performance test in a recording studio environment with a convolution reverb effect responding in real-time offers a comparable musical and acoustical space that exists separately from the physical environment. Similar to the experiments carried out by Sato, Kamekawa, and Marui (2011), Brereton, Murphy, and Howard (2011), Ueno, Kato, and Kawai (2010), the simulation can also be 'turned off', offering a recording free of effects for more accurate analysis.


**Figure II.** Impulse Response (IR) captured in large music hall (Location C)


**Figure III.** Real-time convolution reverberation effect generated with IR.

The performance test is repeated for a third and final time within the recording studio environment without the addition of simulated space, leaving only the minimal attributes of an acoustically dry room. It is in this situation that the participant experiences the least environmental influence in terms of acoustical response to their performance. The recording studio space used included a small and highly absorbent booth, which presented no noticeable amount of reverberation or resonance. The Three-Stage Method provides recordings of the same performance in three different instances: real-world; simulated; and, acoustically dry, which can then be easily analysed and compared (see Figure 4), providing quantitative and measurable data. Following on from the performance and recording exercises, the participants completed an informal interview that aims to reveal personal accounts during the experiment with regard to how each environment was experienced. The interview stage following the recording and performance experiment provides qualitative data that is unavailable through observation and analysis (Holmes & Holmes 2012: 74).

**Limitations**

The method developed for this research project has a number of limitations. When compared to previous studies towards the effects of acoustical characteristics on a musical performance, this method does not employ multiple speaker playback systems. The convolution reverberation effects used in this method do, however, simulate the acoustical characteristics of the chosen performance spaces to where they respond musically similar to the actual space for the purpose of analysis. The sense of realism within the simulations is also questionable, due to the immediacy of a returning signal to the participating musician via headphones, which has been described as distracting when trying to play with accuracy.

**Process and Findings**

The first experimental test was accomplished with a single electric guitarist across four locations chosen specifically for the purpose of the test, and acts as a pre-run experiment in testing the Three-Stage Method as an effective methodology. The participant performed on a professionally custom built guitar through a close-mic'd VOX AC30H2L 50th Anniversary amp/cab combo. The physical locations used, of which impulse responses were gathered via transient bursts for simulation, consist of: a large church hall (Location A), a small church hall (Location B), a large music hall (Location C), and a small concert hall (Location D). Each location used in the experiment often accommodates musical performances of varying styles, all possessing different acoustic characteristics to which the participant was responsive. The performances and impulse responses were captured with two AKG C214 cardioid microphones in a stereo XY configuration. The preamp/interface was an M-Audio Profire 2626 into a Macbook Pro running Logic Pro 9.

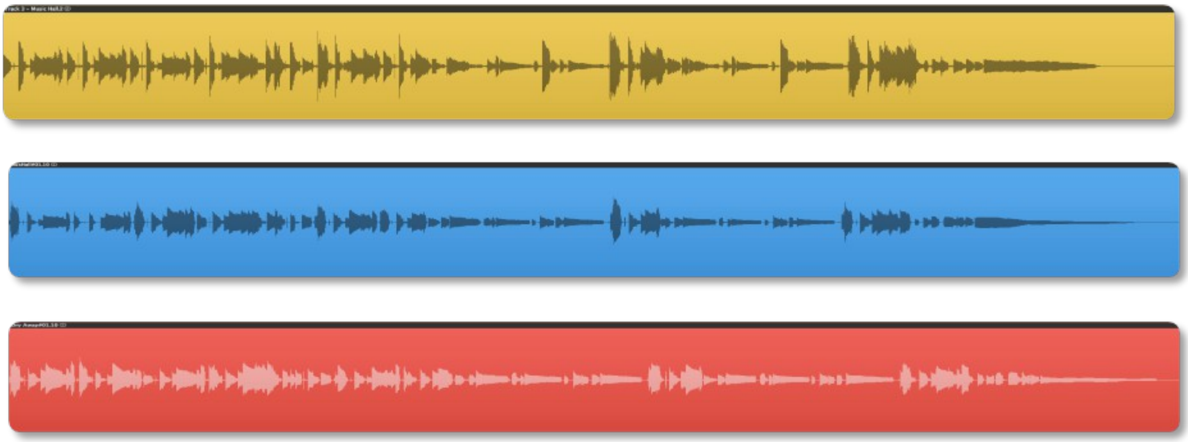

**Figure IV.** Comparing performances of the same piece in the real-world environment (yellow), the simulated environment (blue), and, the dry recording studio (red).

Following completion of the three-stage performance and recording experiment, the recorded material is categorised by piece performed and environment/simulated environment. For example, the first excerpt performed in Location A, B, C & D, in Simulated Location A, B, C & D and in Dry Recording Studio. This allowed for variations in performance elements such as tempo, dynamics and articulation to be compared between each environment and simulated environment with ease. The use of a close mic recording technique during all of the performances afforded an accurate visual representation of the audio capture within recording software. This offers the ability to turn off the simulated space and compare waveforms (see: Figure 4), indicating variations in dynamic range and musical pauses. The participating musician included in the experiment showed little emotional connection to the various recording environments, but did indicate attributes of learned behaviour in all of spaces used. For example, in both of the church hall environments, the participant's voice was lowered and playing in between takes was reduced.

## Discussion

The experimental test method presented in this study aims to demonstrate the wider influence of environment on a musical performance. The method extends upon existing studies, emphasising the psychological and emotional influence of performing within specific environments. Ongoing research using this method indicates that a musician's perception of and emotional attachment to an environment is an influential factor that impacts on playing and performance in a number of ways. For example, the participant's awareness of the social norms and expected behaviour within the large church hall (Location A) encouraged a subtle approach to their performance, feeling obliged to play with less aggression, even on the highly dynamic excerpt. It is important to re-assert that the player did not follow the religious belief system that is promoted within any of the buildings included in this experiment, but responded to the social norms of how to conduct oneself in the church setting. The large amount of reverberation that accompanied any musical notes played within Location A became a negative distraction to the participant when trying to execute an accurate performance, but the participant found the enveloping acoustic characteristics supportive of experimentation within the performance.

The experimental test has shown that a musician's physical environment is an influential factor over musical performance. This is evident across all three 'environments' within the experiment: the physical space, the simulated space and the acoustically dry space. The physical spaces that accommodated the musical performances during this experiment transmitted a sense of identity to the participant, who in turn demonstrated clear indications of learned behaviour/BST and the desire to experiment with the acoustic identity of the various environments. In the large music hall (Location C), for example, the expectations of how to behave in a formal gathering space were conflicted with the excitement of performing within a large hall with a complimentary and highly musical acoustic response. When performing within the recording studio environment and being able to hear the simulated space of Location C in real-time through headphones, the participant continues to use the reverberation of the space as a creative tool within the performance, but lacks the reservation encouraged by the formal surroundings of the physical space or the excitement of playing within such a large and acoustically vibrant space. The participant is able to use the sound of the space effectively and expressively without the direct influence of learned behaviour. As a contrast to this, when the simulated space is removed from the studio recording, the recital of the chosen excerpts is much more precise. It can be suggested that the expectancy and past experience of a recording studio environment demands an accurate performance. The studio recordings of all three excerpts without any convolution reverberation during recording appear static in comparison, and significantly lacking in musical expression.

In response to the musical performances taking place within the physical environments throughout this study, the space becomes an active factor in the performance; shaping the music heard not only in regard to acoustic intervention, but also the emotional and psychological experience of the participating musician. Although the convolution reverb effects afforded the musician with similar musical characteristics to the physical spaces they emulated, the psychological and emotional responses did not all reoccur. This study, supported by the findings of the Three-Stage Method, draws attention to the impact of emotional and psychological influence of the surrounding environment on a musical performance. Research into the emotional and psychological influences of environment and space on a musical performance will continue as part of this project to include a larger number of participating musicians.

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