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Reverberation Effects on Mental Wellbeing

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Abstract:

Music usually serves as a regulator for personal emotions and mental wellbeing. However, there exists few current research on how specific aspects of music production would affect perceived wellbeing. Therefore, this study seeks to find out how deep reverberation affects the perceived wellbeing by evaluating immediate affective response. Although earlier works have established the relationship between music and mental wellbeing in certain aspects, few have evaluated the effects of reverberation on affective response alone. To bridge this gap, this study employs an experimental survey design, which involves participants listening to melodically identical music extracts with different levels of reverb, then filling out a survey containing self-assessments of their affect response based on twenty emotion state items of the Positive and Negative Affect Schedule (PANAS) scale. Therefore, this study will attempt to reveal whether variations in the level of reverberation (wet-dry mix) result in differences in affect response, providing future research directions for spatial audio and music psychology.

Keywords: Reverberation; Affective response; Music psychology.

1. Introduction

Recent research has indicated that people tend to use music as a tool to increase or reduce arousal, to regulate their mood, and to increase their emotional wellbeing [1,2]. In addition, intentional use of music has been found to be useful in terms of increasing subjective wellbeing, such as reducing anxiety and increasing mood [3,4]. Yet despite the fact that earlier research findings already highlight a general link between music and mental wellbeing, there is little research to date that is about whether particular music-production techniques would lead to effects on mental wellbeing, as opposed to mere music exposure [11]. Reverberation, or otherwise reverb for short, is one such music-production technique that may influence the experienced mental wellbeing of listeners [12].

In the work of Schäfer et al., music is frequently used for purposes that go beyond pure entertainment, such as personal awareness and emotion regulation [1]. On the other hand, assessments such as the Warwick-Edinburgh Mental Wellbeing Scale (warrior, enthusiasm, keeping hope up) define wellbeing with regard to positive psychological functioning [5]. Similarly, the framework of the Positive and Negative Affect Schedule (PANAS) measures the impact of short-term emotions, serving as a useful tool for studies that measure the immediate effects of stimuli [6-8,

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13]. These studies of psychological functioning can be used together as a possible method for this paper, enabling the positive and negative effects of reverb on the listener to be quantified cleanly.

Previous research on reverb has attempted to address some of the implications of reverb on the human brain [9]. An example of this is a study conducted by Picou et al. to determine whether moderate reverberation would affect self-reported fatigue. The findings were that reverb did not significantly influence self-reported fatigue, but prolonged listening did [10]. Although this finding seems to undermine the impact of reverb, it exposes certain limitations of the existing literature. The research conducted by Picou was focused on moderate environmental reverb, instead of the deliberate use of reverb, such as wet-dry mix adjustment. Additionally, the research by Picou explored speech-listening within a classroom rather than technical decisions in music production. Thus, the existing studies on reverb examine the effects of spatial environment on self-reported fatigue, but do not consider the impact of the deliberate application of reverb on perceived feelings of comfort, fatigue, irritation, and other emotions of listeners.

To address this gap, the research question that this study will focus on is exploring reverb as a controllable music production parameter instead of an uncontrollable environmntal condition. Firstly, this study examines the wet-dry mix of reverb as a deliberate technical decision in music production instead of in classroom settings. Secondly, the study evaluates perceived mental wellbeing through the PANAS framework to provide a structured assessment for affective responses of the listeners. Finally, the study expands on the research related to music psychology by investigating multiple individual psychological responses that are categorized into positive and negative affects, such as irritable, ashamed, and excited.

2. Methodology

2.1 Research Design

This research uses an experimental survey design to investigate the influences of various reverb wet-dry mixes on the affective response of an individual. The independent variable (the wet-dry mix of reverb) was defined as three categories; 0% (no reverb); 50% (moderate reverb), and 100% (full reverb). The twenty items categorized into two response types, positive affect (PA) and negative affect (NA) of the PANAS framework, were the dependent variable (self-reported affective response).

2.2 Participants

Between April 13th and 14th, 2026, the researcher recruited participants via WeChat to fill out an online survey. On April 15th, 17 respondents filled out the survey. Since the participant sample was only recruited based on the social relations of the researcher, there was inevitably some bias in the sample of participants. Most of the participants were 16 and 17 years old, with the ages of the participants ranging from 15 to 28 years. The majority of the participants identified as female, the rest as male. The backgrounds of the participants were Chinese, Korean, Austrian, American, and New Zealand. None of the participants had hearing problems or disabilities. The participants had to sign the user agreement of informed consent in the first part of the survey.

2.3 Audio Samples

The audio sample used in this study was derived from the MIDI file Twinkle-Little-Star (Long Version), which was downloaded from the online MIDI repository BitMidi (https://bitmidi.com/twinkle-little-star-long-version-mid). The file was then imported into Ableton Live 12 Suite on macOS. After importing, the MIDI section was manually trimmed by the researcher so that the excerpt was approximately two minutes in duration. The final excerpt length was 127 seconds. A reverb preset named “Small Room” from the Ableton Live library was applied to three copies of the same music excerpt, with different levels of wet-dry mix. The three copies with varying reverb settings were then exported separately. All default parameters of the reverb preset were kept unchanged except for the wet-dry mix, which was altered to produce three different samples with the following reverb conditions (Condition A: 0% wet (no reverb), Condition B: 50% wet (moderate reverb), Condition C: 100% wet (full reverb)).

There were no additional processing or application of other irrelevant effects. This ensured that the wet-dry mix of the chosen reverb preset was the only manipulated variable, allowing the comparison of its effects on affective response to be controlled.

2.4 Procedure

The experiment was conducted through an online Microsoft Forms survey. The survey is composed of three sections: informed consent, demographic information, and the listening tasks with three self-reported PANAS assessments. Participants were required to complete the experiment with headphones or earphones to ensure a consistent auditory experience. However, because the participants completed the survey independently, the listening environment was not controlled. All participants listened to the three audio samples in a fixed sequence, from 0% to 50% to 100% reverb. After listening to each excerpt, they completed a 20-item PANAS assessment. Positive Affect: Interested, Excited, Strong, Enthusiastic, Proud, Alert, Inspired, Determined, Attentive, and Active. Negative Affect: Distressed, Upset, Guilty, Scared, Hostile, Irritable, Ashamed, Nervous, Jittery, and Afraid. Each item was scored on a five-point Likert scale, where 1 = Very slightly or not at all, 2 = A little, 3 = Moderately, 4 = Quite a bit, and 5 = Extremely. The PANAS framework served as a self-reported measure of participants' subjective emotional responses after listening to each excerpt. The same 20 items were repeated for each of the three reverb conditions. Because participants were not explicitly informed whether they could pause the audio sample or replay it, the playback behavior was not controlled.

2.5 Data Processing and Statistical Analysis

All responses scoring on the PANAS assessment were numerically coded from 1 to 5 according to the official Likert scale conversion. The 20 assessed items were categorized into Positive Affect (PA) and Negative Affect (NA), with 10 items coded as PA and the other 10 as NA. The PA and NA scores of each participant were calculated as the average score of the 10 items in their corresponding categories. The mean values and standard deviations of PA and NA for each of the reverb conditions across the 17 participants were then computed. Because all participants listened to the same three audio samples, a repeated measures ANOVA test was conducted to see whether positive and negative affect scores differed across the reverb conditions.

3. Results

3.1 Evaluation Metrics

Positive Affect (PA) and Negative Affect (NA) scores yielded values from 1 to 5 as they were calculated as the mean of the ten corresponding items, which were also scored from 1 to 5. The mean (M) and standard deviation (SD) were calculated for each reverb condition. A one-way repeated ANOVA test was conducted separately for PA and NA to assess differences across different conditions.

3.2 Descriptive Statistics

Table 1 summarizes the mean and standard deviation of PA and NA scores across the three-reverb wet-dry conditions.

Table 1. Descriptive statistics for positive and negative affect across reverb conditions.

Condition	PA (M)	PA (SD)	NA (M)	NA (SD)
0% Reverb	2.21	0.72	1.49	0.49
50% Reverb	1.90	0.62	1.37	0.55
100% Reverb	1.76	0.77	1.56	0.69

For positive affect, mean scores were 2.21 (SD = 0.72) for the 0% condition, 1.90 (SD = 0.62) for the 50% condition, and 1.76 (SD = 0.77) for the 100% condition. For negative affect, mean scores were 1.49 (SD = 0.49) for the 0% condition, 1.37 (SD = 0.55) for the 50% condition, and 1.56 (SD = 0.69) for the 100% condition.

3.3 Inferential Analysis

A one-way repeated measures analysis of variance (ANOVA) was conducted to evaluate the effect of reverb condition on positive affect (PA). The analysis indicated a statistically significant effect of condition ($F(2, 32) = 6.02$, $p = .006$, $\eta^2p = .273$). A separate ANOVA was conducted to explore whether the condition disparity had an effect on negative affect, where the analysis did not indicate a statistically significant effect of condition ($F(2, 32) = 3.12$, $p = .058$, $\eta^2p = .163$).

3.4 Summary of Statistical Outcomes

The repeated measures analysis of variance results showed that although the reverb condition produced a statistically significant difference in positive affect scores, it did not reveal a significant difference in negative affect scores at a statistically significant level.

4. Discussion

This study explored how the wet-dry mix of reverb influences listeners' immediate reactions in terms of short-term affective response through utilizing the PANAS framework. The current study indicated that different wet-dry settings resulted in statistically significant positive affect (PA) differences but no significant difference in negative affect (NA). In other words, reverberation effects are more obvious and quantifiable to produce short-term positive affect than negative affect.

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While most literature in music psychology has explored the general exposure to music, this study contributes to existing literature through exploring how a single domain, or parameter, of music elicits a measurable effect in mood. Amid alike literature, Picou's study has treated reverb as a part of the listening environment, while this paper isolates the idea of reverb as a deliberate production parameter in music. The findings of the study manifests how positive affect is a significant outcome when measured under exposure to music with various degrees of reverb, which aligns with the findings of other studies of acoustics regarding the effect of spatial properties of sound on the clarity, immersion, and engagement of the listener.

However, there are also a few methodological limitations that should be noted. Firstly, the listening conditions under which each participant completed the experiment were not controlled. All respondents accessed the survey independently on their devices remotely and were not informed to avoid noisy environments. This may have hindered the quality of responses since the direct effect of listening to the audio samples may have been influenced by their respective external environments. The originally distinguishable difference in reverb among the three audio samples could have been overridden by the background noise. Secondly, playback actions were not controlled. The experiment did not prohibit any participants from pausing the clips or replaying them. This might have influenced the internal validity of the study by generating anomalies in the dataset because some respondents could have rated higher or lower in items simply because they listened to the samples repeatedly. Repeated exposure to the track may have also caused habituation that downplays the true effect of the tracks.

Despite these limitations, this study still provides preliminary findings on the effect of reverb levels on the perceived mental wellbeing of listeners, particularly in positive affective responses. This implies that the impact of spatial design in music production affects listeners beyond musical aesthetic Ness.

5. Conclusion

In this research, the effect of various reverb levels in music production on the immediate affective response of music listeners was evaluated against the PANAS well-being assessment. The audio samples used in the study were only varied in the wet-dry levels of reverb, with all other musical aspects of the audio samples held constant. This allowed the study to isolate reverb as the independent variable throughout the course of the experiment. The results of the study show that differences in wet-dry reverb conditions resulted in statistically significant changes in positive affect, but not negative affect.

The findings address the research gap in previous research as they demonstrate that specific music production parameters have an impact on short-term affective responses, as opposed to just general exposure to music. Findings indicate that the effects of reverb on positive affect are clear, while the effects on negative affect were not similarly quantifiable.

Based on these results, future research could aim to control more experimental variables through measures such as controlling the listening environment and playback behavior, and randomizing the sequence in which the audio samples were played. Furthermore, using a larger and more diverse sample of participants in future studies would enhance the generalizability of the results. Other reverb parameters, including decay time, pre-delay, and diffusion, can also be studied in future research.

In conclusion, this research highlights how spatial choices in sound design can have quantifiable effects on the perceived wellbeing of listeners. However, the limitations of the study, including a small sample size, suggest that the findings are not definitive and thus should not be extrapolated to a wide population. Future research can amend this by targeting a larger and more diverse sample group using the same reproducible method.

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