

Examining the Relationship Between the Presence of Audio and Subjective User Experience in the Context of Virtual Reality

John Levee
Stetson University

ABSTRACT

Examining the Relationship Between the Presence of Audio and Subjective User Experience in the Context of Virtual Reality aims to establish correlation between the presence of spatialized audio during a VR experience and improved user experience in terms of increased immersion, realism, enjoyment, and perceived quality of the visual component. Through use of the HTC Vive VR headset, participants experienced four variations of a forest-themed environment, two with accompanying audio from field recordings of wind, birds, and other natural sounds. The four variations are as follows:

1. High quality visual render (with audio)
2. High quality visual render (silent)
3. Low quality visual render (with audio)
4. Low quality visual render (silent)

In general, it was found that the presence of audio caused increased feelings of immersion, realism, and enjoyment in the user; however, results were inconclusive in regards to whether or not the presence of audio caused an increase in perceived visual quality.

METHODS

1. Subjects experience each of 4 VR environments (described above) in a random order, pausing between experiences to fill out a survey.

2. Survey Questions:
- a. Please respond to these statements with a number from 1 to 10, with one being “strongly disagree” and 10 being “strongly agree”:
 - i. I was immersed in the experience.
 - ii. The experience felt realistic.
 - iii. I enjoyed the experience.
 - iv. The visuals were of high quality.
 - v. The audio was of high quality.

3. After experiencing all 4 environments, fill out another, brief survey:
- a. Please rank the experiences from best to worst, with 1 being the best and 4 being the worst, in each of the following categories:
 - i. Immersion
 - ii. Realism
 - iii. Enjoyment
 - iv. Visual Quality
 - v. Audio Quality

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IMMERSION

In the category of immersion, results were fairly consistent both immediately after experiencing environments individually and in hindsight after experiencing all four environments.

Individually

Individually, Variation 1 was rated as most immersive, followed by Variation 3. Variations 4 and 2 were ranked third and fourth respectively. From this, it can be gathered that the presence of audio resulted in increased immersion, regardless of visual quality.

However, increased visual quality only contributed to increased immersion when audio was present. Without the addition of audio, increased visual quality resulted in decreased immersion. From this, no correlation can be observed between visual quality and level of immersion.

Collectively

When reflecting upon all four environments, results were similar. Variation 1 was again rated as most immersive, followed by Variation 3. In this situation however, Variation 2 outranked Variation 4.

From this, it can be ascertained that the presence of audio resulted in increased immersion, regardless of visual quality. It can also be ascertained that increased visual quality resulted in increased immersion, but that its effects were less profound than those of the audio.

REALISM

In the category of realism, results were fairly consistent both immediately after experiencing environments individually and in hindsight after experiencing all four environments.

Individually

Individually, Variation 1 was rated as most realistic, followed by Variation 3. Variations 2 and 4 were ranked third and fourth respectively. From this, it can be gathered that the presence of audio resulted in increased realism, regardless of visual quality.

It can also be ascertained that increased visual quality resulted in increased realism, but that its effects were less profound than those of the audio.

Collectively

When reflecting upon all four environments, results were similar. In this instance however, Variation 3 was rated as most realistic, followed by Variation 1. Again, Variation 2 outranked Variation 4.

From this, it can be ascertained that the presence of audio resulted in increased realism, regardless of visual quality.

However, increased visual quality only contributed to increased realism when audio was not present. With the addition of audio, increased visual quality resulted in decreased realism. From these conflicting results, no correlation can be observed between visual quality and level of realism.

ENJOYMENT

In the category of enjoyment, results were fairly consistent both immediately after experiencing environments individually and in hindsight after experiencing all four environments.

Individually

Individually, Variation 1 was rated as most enjoyable, followed by Variation 3. Variations 2 and 4 were ranked third and fourth respectively. From this, it can be gathered that the presence of audio resulted in increased enjoyment, regardless of visual quality. It can also be ascertained that increased visual quality resulted in increased enjoyment, but that its effects were less profound than those of the audio.

Collectively

When reflecting upon all four environments, results were similar. Variation 1 was again rated as most enjoyable, followed by Variation 3. In this situation however, Variation 4 outranked Variation 2.

From this, it can be ascertained that the presence of audio resulted in increased enjoyment, regardless of visual quality. However, increased visual quality only contributed to increased enjoyment when audio was present. Without the addition of audio, increased visual quality resulted in decreased enjoyment. From these conflicting results, no correlation can be observed between visual quality and level of enjoyment.

PERCEIVED VISUAL QUALITY

In this category, it was hypothesized that the presence of audio would result in increased perceived visual quality. In other words, it was speculated that being able to hear the audio would cause subjects to perceive the visuals as being of higher quality. This was found to be the case some times, but not to a very large extent.

Individually

Individually, Variation 1 was perceived as having the highest visual quality. Unexpectedly, Variation 4 was rated second best, followed by Variation 2. Variation 3 was perceived as having the worst visual quality.

A number of conclusions can be drawn from these results. When graphics were actually of high quality, it can be seen that the presence of audio resulted in higher perceived visual quality. However, when graphics were actually of low quality, the presence of audio resulted in lower perceived audio quality. Because of this contradiction, no correlation can be confidently stated between the presence of audio and perceived visual quality.

Interestingly, subjects also ranked Variation 4 higher than Variation 2. Because of this, there is also no correlation found between the actual and perceived visual quality of the VR environments.

It should be noted that the combination of high quality visuals and audio did result in the highest perceived visual quality.

Collectively

When all four variations were considered retrospectively, Variation 1 was perceived to have the highest visual quality, followed by Variation 2. Variation 4 was ranked third, and Variation 3 was ranked last.

PERCEIVED VISUAL QUALITY (cont.)

A number of conclusions can be gathered from this data. Firstly, it can be seen that with high quality graphics, the presence of audio resulted in greater perceived visual quality in the subject. In this regard, the hypothesis was correct.

However, when the graphics were actually of lower quality, the presence of audio resulted in lesser perceived visual quality, contradicting the hypothesis. Because of these conflicting results, it cannot be confidently stated that the presence of audio has any correlation with perceived visual quality.

Unlike in other categories, visual quality had a more profound effect on the data than the presence of audio, as the two high quality renders outranked the two low quality renders.

PERCEIVED AUDIO QUALITY

There were conflicting results in this category. Both individually and collectively, the two variations with audio obviously had the greatest perceived audio quality, but their ranks differed.

Individually, Variation 1 outranked Variation 3, meaning that higher quality visuals resulted in increased perceived visual quality. In other words, when the graphics looked better, subjects thought the audio sounded better.

However, when looked at collectively, Variation 3 was ranked first, and Variation 1 was ranked second. From this, it can be ascertained that lower quality graphics resulted in greater perceived audio quality. In other words, when the graphics looked better, the subjects thought that the audio sounded worse.

Because of these contradicting results, it cannot be confidently concluded that visual quality has any effect on perceived audio quality.

CONCLUSION

Overall, it can be observed that the presence of audio has a profound effect on subjective user experience in the context of virtual reality.

It can be confidently concluded that the presence of audio has strong correlation with increased immersion, realism, and enjoyment, regardless of the visual quality of the VR environment.

Results are conflicting however, when examining perceived visual quality. This study is unable to find correlation one way or the other between the presence of audio and perceived visual quality, as results were conflicting. It is also unable to conclude that the quality of the visuals has any effect on the perceived audio quality.

Further research should be done to verify these findings, as this sort of study is new in the context of VR, although similar studies in the context of film have been done, with conflicting results.

Further, a psychological study could attempt to ascertain the reason for these findings.