



Audio Benchmark

Marco Polo is a unique concept in audio. The utility was designed to measure a player's performance when using various audio output devices (speakers, headphones, etc.) Test results permit comparisons among these audio output devices.

Marco Polo, an apropos play on the old swimming pool game, was designed from the ground up to mimic the sound environment provided in today's typical first-person-shooter games. Every effort was made to ensure that the audio in Marco Polo was exactly the same as a player would encounter in similar games.

Audio

The audio in Marco Polo uses Microsoft's DirectSound API, the OpenAL sound API and Creative Labs' EAX API. It is presented in a 3D first-person environment. The environment is designed to convey immediate familiarity to any gamer. While video was not part of this initiative, care was taken to provide a pleasing, quality video look. The player enters a military training facility with empty buildings and equipment situated around the complex. The player can change a number of options, e.g., match keyboard keys and mouse behavior to desired settings.

Goal

The player is placed into the 3D scene. A snippet of a target sound is played and the player must locate the target sound somewhere within that scene, using only its audio signature. Several sample levels are presented, in order to familiarize the player with the controls and general feel of the application.

The actual test presents the target sound and adds auditory complexities that make locating or localizing the target more difficult. Competing sounds, called maskers, are present in the scene. In addition, advanced audio concepts are used to simulate audio occlusions, etc. The player is set free in the scene to locate the identified target. The time it takes to locate the target is recorded.

Players complete various tests using one set of audio equipment and then another set. Data from these two sets are then compared.

Research

Once the Marco Polo game and the protocol were developed, Etymotic Research recruited 30 gamers from around the world as testers. These gamers were not given specifics beyond being told that they would be taking part in a research project related to 3D audio in games. Gamers were not promised an incentive for taking part in the project. A complex protocol was developed to assure that several possible pitfalls were avoided. For example, one concern was the potential of a learning effect. Repeated exposure to any measure has some degree of learning effect.

Each tester completed four rounds of testing. Each round consisted of 36 different audio challenges. The order was randomized to reduce the effects of learning on the results. Testers completed the protocol over the course of six to eight weeks. Round one of Marco Polo was completed with the tester's own equipment; round two was completed a few days later using Etymotic earphones. Following round two, testers were instructed not to play Marco Polo for one month, but were encouraged to use the Etymotic earphones with any audio device or application they desired during that time. Since testers were already familiar with their own equipment, this requirement was meant to help determine the effect of acclimation to the Etymotic earphones. After a month the testers completed round three using the Etymotic earphones and round four a few days later using their own equipment.

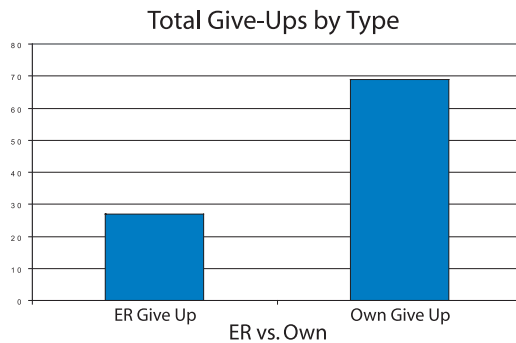


Research Continued

An additional group of players was enlisted for a repeat of the four rounds but with counterbalanced order: Etymotic earphones first, their system second and third, Etymotic earphones fourth. The results of this new group were the same and are combined in the graph below.

Results

The data showed that testers improved their scores in the second round (using Etymotic earphones) and then improved again in the third round (also using Etymotic earphones). In the fourth round, scores did not improve using their own equipment; however, scores in round four were slightly better than in round one (also using their own equipment), presumably due to a learning effect with Marco Polo.



The testers who used high-end earphones had the best scores; testers who completed Marco Polo using stereo speakers had the poorest performance. Surround sound and average headphones were in between. No category did better overall than the Etymotic earphones. The average improvement was greater than 36%. An interesting observation was the number of times testers gave up. That is, they couldn't find the target and chose to skip on to the next one. Testers using their own equipment could not find the target at all 69 times. In contrast, the same testers could not find the target 27 times when using Etymotic earphones. On the improvement extreme, one tester saw a 129% improvement in his performance. Only two testers scored better with their own equipment, but the difference was small.

Discussion

Etymotic technology provides at least two key benefits. The first is frequency response, the second is sound isolation. Etymotic earphones have higher accuracy than most earphones. A flatter frequency response means better sound quality. Enhanced bass in many headsets used for music can have an adverse effect on gaming audio.

The results of these experiments provided objective confirmation of the earlier subjective reports that "I do much better with my Ety earphones." As shown in the figure, twenty three of the twenty six subjects (players) did significantly better (20% to 129% faster to target). Because of the large number of conditions, players and repeats, the results are statistically significant at better than the 99.99% confidence level (i.e., a repeat would give the same answer 9999 times out of 10,000).

Conclusions

It was found from both the objective data and the subjective comments that quality matters when it comes to audio. Marco Polo proved to be a useful audio training tool. During test development, skill levels of gamers were revealed by the difficulty of finding targets with only audio cues. Experienced gamers entered a scene and waited for a moment, listening for cues; whereas, novice gamers entered a scene and almost immediately headed off in a direction. In the absence of visual cues, testers commented that the application taught them to listen more closely to their environment, which translated to better play in their own games. Non-experienced gamers generally improved over the course of playing, which indicates that Marco Polo could be an excellent training aid.

