Music in 12-Point Panoramic Space

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Tones in music differ from each other in pitch (highness, lowness), loudness, and quality or timbre. Another dimension in which tones can differ is spatial location. Space has been used occasionally for musical aesthetic purposes in past centuries. However, until the advent of recent technology, space has been more difficult to manipulate than other attributes of tones like pitch and intensity. Multichannel audio sources under computer control, coupled with multichannel amplifiers and speakers provide a mechanism for changing the location of a sound. This technology is typically used to stream music along different spatial pathways, or to develop three-dimensional effects.

The present demonstration of 12-point panoramic chromatic music exploits a different principle of spatial music than what has gone before. Here, 12 audio speakers are distributed at equal intervals around a circumference. To each speaker is assigned one tone of the chromatic scale. Every time that tone is notated in the music it is presented at that location. In this way, the pitch structure of the music is correlated with structure in audio space. The replication of the structure in space and pitch can potentially serve to emphasize that structure and can potentially heighten the aesthetic effect. In addition to capitalizing on well-established musical structures such as tonality, the circular array of speakers can create new aesthetic effects. For example, rapid sequencing from speaker to speaker can create illusory motion.

To explore the effects of 12-point Panoramic Chromatic music, in the Arts-Netlantic presentation studio, several classical musical pieces available as computer MIDI files were decomposed in such a way that all tones of one chroma (e.g., all C's, or all C#'s) were directed out of the same speaker. Thus, all C's emanated from one speaker, and all C#'s from the speaker to its right, and all D's from its right and so on to the B which emanated from the left of the original "C" speaker.

Previous psychoacoustic research conducted by A. J. Cohen and colleagues used a similar set-up within a sound-attenuated testing booth in the Department of Psychology at the University of Prince Edward Island. Cohen, Lamothe, MacIsaacs, Fleming, & Lamoureux (2001) and Cohen, Lamothe, Doucette, & Monthony (2002) determined the listener's accuracy of identifying locations in space and their ability to determine whether the illusory auditory motion of two consecutive tones/speakers was clockwise or counterclockwise. The systematic pattern of results supports the assumption that listeners under the present realistic listening conditions are also able to localize the source of the 12 audio speakers as they were in the less naturalistic testing booth. Cohen and Lamothe (2001) also observed that a number of listeners could hear sounds only from behind them. For those listeners, the differentiation of the locations for spatial audio would be limited, if this front-back confusion remains under the more musical and realistic conditions.

The demonstration with 12 audio speakers under independent control was first established at the University of Waterloo, Department of Psychology, by A. J. Cohen in 1977. Several renditions have since followed, including a wearable headband of 12 speakers run by a Commodore 64 in the 1980's. In December, 2003, Coralie Vincent, tested the concept of presenting real music through the 12-point panoramic audio space, under the direction of A. J. Cohen. Three selections by Bach, Shostakovich & Debussy were used. Subsequently, with assistance of Robert Drew, a contemporary work for flute by Richard Gibson of the University of Moncton was employed using MIDI files created by Dale Sorenson. This Gibson piece *Rossignol* seems to illustrate well the new aesthetic dimensions of the 12-point panoramic sound.

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The support of the Arts-Netlantic Project by the Canadian Culture Online Program is gratefully acknowledged. Annabel J. Cohen conceived of the idea of assigning pitch to location over 25 years ago. Only through Arts-Netlantic has it been possible to fully realize this idea by bringing together high end audio equipment from Digidesign Pro-Tools, PSB Speakers, with willing and able technicians: Coralie Vincent, Robert Drew, Shawn McCormack, and Jeff Porter. Coralie implemented the idea using her degree in audio engineering to advantage. Robert Drew assisted in adapting MIDI files for presentation. Shawn McCormack and Jeff Porter facilitated the implementation of the PSB speaker configuration and NAD amplifiers. Dale Sorenson kindly provided access to the MIDI notation files of the piece by Richard Gibson. Richard Gibson is also thanked for allowing the performance of his piece in this setting. Help with graphic was provided by Danny Ledwell. The Department of Psychology at UPEI is acknowledged for its support of diversity for which the 12-point Chromatic Panoramic sound is an apt metaphor of multiplicity forming a unified whole.

NOTE

[1]Popular and classical music offer enormous stylistic variety from a repertoire of just 12 tones. These 12 tones divide the octave into 12 equal units, known as semitones. Each semitone represents a frequency ratio of one-twelfth of an octave. The 12 successive semitones, commonly referred to as C, C#, D, D#, E, F, F#, G, G#, A, A#, B, make up the chromatic scale. Much music typically relies on only a subset of 7 tones from the chromatic scale. The most common of these 7-note subsets is the major scale, familiar as *doh, re, me fa, sol, la, ti, doh*. The distance between the successive tones in the major scale is 2, 2, 1, 2, 2, 2, 1 semitones. Within a piece of music, the tones of the scale are used with unequal probabilities. In other words some tones are used more often than others. This unequal weighting of the tones leads to expectations on the part of the listener about what tone is to be presented next. Predictable characteristics of music, such as frequent sounding of a particular note, enable the mental establishment of a reference structure for the musical piece. The establishment of a central reference tone in music is referred to as tonality. Tonality can arise through the presence of a variety of cues, be it repetition of a central tone, high intensity of a particular tone, or learned cues such as the a relation like *ti doh* which has come to signify the structural significance of the final note, *doh*.

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