



NeuroPop

Weapons Grade Sound Design

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White Paper: NeuroPop – Sound Design, Multimedia Consultation, Technology Applications

Overview:

NeuroPop uses basic research findings in neuroscience and psychology and applies it to real-world media applications. Using data from studies on the human brain, NeuroPop has developed proprietary soft technology called Neurosensory Algorithms (NSA). NSAs are used to change any type of sound into brain modifying tools called "structured sounds." Structured sounds are able to modulate how the brain carries out complex tasks such as emotional response, attentional shifts, memory formation, and sleep control. These brain changing structured sounds can be used in any multimedia platform that uses sound.

NSA-driven Effects

NSA technology has been successfully used to date in several basic areas:

- Virtual motion
- Directing attention and increasing memory
- Changing emotional responses
- Shifting arousal
- Inducing physiological responses

Virtual Motion: By using NSAs based on how the brain figures out where a sound or image is located in space, we can mix a soundtrack or musical piece to place specific sounds almost anywhere in 3-D space, without use of surround sound systems.

Directing attention and memory: NSAs can be used to place structured sounds at particular points in a multimedia piece to increase or decrease a person's attention. By very careful placement of such structured sounds, this change in attention can actually increase a person's ability to remember material or distract them away from it.

Changing emotional responses: Just as music can be considered an emotional "language," structured sound can be used to evoke highly specific emotional responses from listeners. NSAs exist which elicit fear, relaxation, physical arousal, tension or deep meditative states, among others.

Shifting arousal: Arousal applies to a complex interaction between psychological and physiological states. NSAs can strongly modulate arousal at many levels and have been demonstrated to cover a wide range of states from making a listener fall asleep to inducing "fight or flight" near-panic.

Inducing physiological responses: Sound is well known to act on preconscious regions of the brain, including those areas responsible for control of physiological responses such as changes in heart rate, respiration, pupillary dilation and even complex behaviors such as sleep. Clinical testing has demonstrated that NeuroPop's NSAs when mixed into the proper audio media can affect all of these. Applications can range from helping reduce physiological stress by reducing heart rate to inducing sleep in insomniacs.

Sample Applications

NSAs are not sounds or computer programs - they are software formulas that can be applied to almost anything that uses sounds. This allows us to work in a wide variety of media. As NSAs are placed in the final mix, they do not interfere with the composition or creativity of the pieces involved. NSAs have been applied to:

- Recorded music
- Live music
- Video and film soundtracks
- Installation and sound art
- Computer/video games and immersive environments
- Instructional multimedia presentations
- Health and wellness

Recorded music: NSAs and structured sounds have been widely used in a number of recorded music CDs, including NeuroPop's own "Overload: The Sonic Intoxicant" which received wide press coverage and positive responses from such diverse places as Wired, Tone Magazine, Der Spiegel and many others. Furthermore, by mixing emotional and arousal modifying NSAs into musical pieces, it has been demonstrated that music can be used as a carrier for signals to the listeners brain to induce behaviors from focusing on a task at hand to letting them fall asleep without drugs.

Live music: Since NSAs are algorithms that can be run in real time on any computer or mixing devices that can handle plug-ins, they can be used to put live performances over the top. NeuroPop NSAs have been used in live performances in venues in New York City and Los Angeles and can in fact be used in almost any venue with stereo speakers and a computer-compatible mixing board.

Video and film soundtracks: NeuroPop has worked with video and film artists and producers to create soundtracks that completely change and enhance the audience's emotional response by allowing the director to create an "emotional soundtrack." The director merely indicates what response they would like from their audience at what point in the film/video, and by use of the appropriate eliciting structured sound, their audience will react as desired.

Installation and sound art: NSAs and structured sound have been used by sound artists to help create installation and sound art in galleries and museums around the world. By using subtle arousal-inducing NSAs, structured sounds have helped enhance visitors' experience of the

physical aspects of the art pieces and increased the amount of time they spend viewing them. The judicious use of sensory localization NSAs also allows artists to create pieces that have larger-than-life impact, even if the piece or gallery is relatively small.

Computer/video games and immersive environments: Immersive virtual environments such as those in first person shooter games owe much of their sense of "presence" on the quality of the sounds presented. By using NSA structured sounds, not only can users get extremely enhanced experiences of the environment, but they can also be driven to highly personal physical and psychological responses. Localization NSAs can put the footsteps or voice of a friend or foe behind the player's head, not just somewhere on the screen based on nearby speaker placements. Arousal NSAs can make a player feel anxious when entering a challenging region or even physically ill if they are taking virtual damage. In virtual simulation environments, attention and memory shifting NSAs can be used to highlight specific areas that may require immediate action or future development.

Instructional multimedia presentations: NSAs and structured sounds do not require complicated backdrops to be effective. Simple Powerpoint presentations or online learning software can be significantly enhanced by using NSAs to increase attention and focus or using structured sounds that can direct eye movements to a specific point on a screen. Use of such NSAs could improve retention of subject matter and keep their attention from wandering away from critical points, all without additional work on the part of the presenter.

Health and wellness: NSAs have been demonstrated to be able to directly affect physiological as well as emotional states. The potential benefits of applying NSAs to music and sonic environments in clinics, hospitals or even home environments are tremendous. Our sleep-inducing NSAs are currently undergoing clinical testing in New England and California and are showing 80% effectiveness in reducing time to enter sleep and increasing the duration of uninterrupted sleep. This application alone could benefit millions of people who suffer from sleep disorders or are in stressful environments such as postoperative ICUs.

Neurosensory Algorithms (NSAs): The Science Behind Structured Sound

Neurosensory Algorithms are NeuroPop's unique technology. NSAs are digitally designed acoustic modulators that can stimulate regions of the human brain responsible for processing sensory localization, attention, memory, and emotional or physiological state. NSAs are derived from best frequency and best temporal neural response characteristics of sound-sensitive and auditory processing regions of the brain. These regions have been partially mapped by studies using such diverse techniques as behavioral psychophysics tests, electroencephalography (EEG), neural imaging by Positron Emission Tomography (PET) and functional Magnetic Resonance Imaging (fMRI). The unique feature of NSAs is their derivations from overlap of sound sensitive areas of the brain with regions of the brain involved in specific emotional, attentional states, and physiological responses. By using NSAs to change an existing soundtrack, we use sound in the same way that radio uses a carrier wave - to get the specific features of the sound to affect the listener's brain in a controlled fashion.

How do you get NSAs into your piece?

NSAs are constructed using high-end sound editing and composition software, and use sample acquisition, granular synthesis, subtractive synthesis, and a variety of temporal modulators to generate basic structured sounds. In order to select the proper NSAs to utilize, NeuroPop works closely with the original materials creator or director to assess the responses that are desired, and analyze the features of the basic material. Features taken into account include overall structure of the basic presentation (e.g., for music, tonalities, stylings, instrumentation, tempi, duration, etc.), audience demographics, and desired psychophysical effects. Once the structured sounds are constructed, they are integrated into existing soundtracks during the final mix. An additional multiband mastering process, though not required, is often employed to intensify the NSAs without altering perceived quality of a presentation.

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