

## Visual vs. Auditory vs. Tactile: A Comparison of P300 Brain-Computer Interfaces using Different Modalities in a Case-Study with a Locked-In Syndrome Patient

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Locked-In Syndrome (LIS) has been described as a condition of almost complete or even total paralysis of the human muscular system, therefore severely affecting the ability of interacting with the outside world (Bauer, Gerstenbrand, & Rimpl, 1979). Brain-Computer Interfaces (BCIs) have emerged as a promising possibility for LIS patients to maintain a certain level of activity, e.g. via enabling them to engage artistically via “Brain Painting” and thus improving quality of life (Holz, Botrel, Kaufmann, & Kübler, 2015).

However, “Brain Painting” and various other BCI approaches rely on visual stimulation, in case of “Brain Painting” on visual flashes evoking an electroencephalographic event-related response called P300. Since loss of vision has been pointed out as a limiting factor in various LIS cases, alternative BCIs have been developed, for example using auditory or tactile stimuli to elicit P300 responses (Riccio, Mattia, Simione, Olivetti, & Cincotti, 2012). Halder, Käthner and Kübler (2016) could show successful use of an auditory P300 BCI in paralyzed patients, but BCI research regarding potential LIS end-users remains scarce (Kübler, Müller, & Guan, 2017).

This contribution aims to further explore P300 BCI use in LIS patients by comparing visual, auditory and tactile P300 BCI approaches in a single-case-study. Performance was best using the visual P300 BCI, but auditory and tactile paradigms were well received by the patient as alternatives should a loss of vision occur in the future. More sessions are planned to examine long-term development of BCI home use and possible training effects.

Keywords / Descriptors:

- Locked-In Syndrome (LIS)
- P300 Brain-Computer Interfaces (BCI)
- Modality Differences (Visual vs. Auditory vs. Tactile)