 DOI: 10.3217/978-3-85125-962-9-76

Shared Brain Activity During the Creative Process and Dance Performance of LiveWire

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Introduction: LiveWire is an art-science performance that integrates research, training, and outreach at the nexus of the arts (music/dance) and neuroscience. The five sections of the musical score are inspired by neuroscience concepts, from the unconscious sub-routines that underlie our habits to the dynamism of thought: this is reflected in the choreography, which evolves from more constrained movements to structured improvisation. Shared brain activity from two dancers was acquired in real-time using mobile brain-body imaging (MoBI) technology and incorporated into the aesthetics of the performance through lighting and projections. This art-science project was designed to investigate intra- and inter-brain communication dynamics and networks during a series of rehearsals and public performances.

Material, Methods, and Results: Over the span of five months, two professional dancers were recorded simultaneously via 32 channel electroencephalography (EEG) at 1000Hz, motion sensors (128Hz), and video cameras (30fps). EEG data was denoised using a signal processing pipeline that included an adaptive scheme to remove eye movement artifacts [1], artifact subspace reconstruction (ASR) [2], and independent component analysis (ICA). Task related ICs were clustered using a k-means algorithm with a centroid number (k) computed by the Calinski-Harabasz algorithm [3]. Clusters were visualized in the MNI MRI template and analyzed to yield brain-to-brain communication networks between the dancers (See Fig. 1). Such networks indicate shared neural synchrony, estimated via bispectrum, following methods in [4] and functional connectivity, estimated via generalized partial directed coherence (gPDC) as in [5].

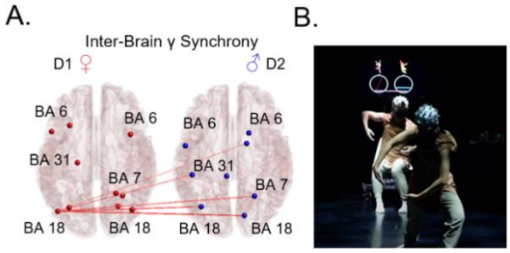

Figure 1. Section three ('Internal Model of Reality') of the LiveWire performance at the Midtown Arts & Theater Center Houston (MATCH), held on 01/21/22. A) Five most significant average inter-brain neural synchrony connections across this section in the gamma frequency band showing synchrony between conscious and alert subjects mainly connecting in the occipital lobes. The brain on the left represents female dancer 1 (D1) and the right for male dancer 2 (D2), with both containing their respective dipole coordinates in shared Brodmann Areas (BA). B) A still frame of the dancers as they perform this section.

Discussion: Our study demonstrates the use of MoBI technology to study the social brain in action in artistic contexts. Cluster analysis of ICs, neural synchrony, and functional connectivity of denoised EEG uncovered Brodmann areas related to movement planning and execution, visual processing, and proprioception and how their activations relate to each other within and across brains. Notably, when looking at bispectrum estimates in time across the performance, higher levels of neural synchrony were observed when the two dancers interacted with each other.

Significance: The integration of art, science, and MoBI technology in natural settings allow us to address questions of societal impact, e.g., neural dynamics of social interaction and the neural basis of creativity.

Acknowledgments: NSF IUCRC BRAIN UH (#2137255); NEA Res Lab Rice U; IUCRC BRAIN Tec de MTY

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