# Chen Institute Retreat 2023

**Presenter:** Isabelle Rosenthal

**Poster title:** The temporal binding window between ICMS and vision depends on biological relevance of visual stimuli

**Abstract:** It is established that intra-cortical microstimulation (ICMS) of primary somatosensory cortex (S1) can elicit a variety of artificial tactile sensations in human patients, but there has been little work on how the brain processes this non-naturalistic input in multisensory contexts. Understanding the timing necessary for visual and ICMS stimuli to feel simultaneous (the temporal binding window) is essential for creating a successful closed-loop brain-computer interface (BCI) for people with spinal cord injury. Here, a tetraplegic patient implanted with microelectrode arrays (Blackrock Microsystems) in S1 received single-channel ICMS (60 or 100 μA) while observing visual cues, and assessed the relative timing of vision and elicited tactile sensations. Visual and ICMS stimuli were delivered either simultaneously or at an offset from one another (150 or 300ms). Visual events were either abstract (a dot moving to the end of a line) or realistic (a robotic arm tapping a first-person-perspective human arm) and were presented using virtual reality. Task performance was equal across conditions and was not affected by learning over time. In both conditions, single-channel ICMS lagged behind visual cues perceptually. In the realistic condition, stimuli were perceived as maximally synchronous when vision occurred ~100ms later than ICMS. In the abstract condition, this temporal offset was less pronounced but still present. Additionally, the patient was more likely to perceive an order to the stimuli (vision before ICMS or ICMS before vision) in the abstract condition, whereas in the realistic condition the patient was more likely to perceive the stimuli as synchronous. This effect suggests that a more biologically relevant visual scene results in a larger temporal binding window between visual cues and ICMS, such that the brain can better integrate ICMS as part of a causal, multisensory environment.