# Short-term memory for pain: A transcranial magnetic stimulation study

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## Background

Sensory working memory (WM) can be characterised as temporarily representing a stimulus when it is no longer perceptually present, for example, to retain stimulus properties including intensity and duration.

Under a sensory recruitment model, the neural regions underlying WM for tactile inputs to the skin surface have been identified as those that also subserve initial tactile encoding and detection –notably, the primary (SI) and secondary (SII) somatosensory cortices[1,2,3]. Both these regions have also been implicated in the encoding of nociceptive inputs[3] and, in facilitating intensity and location discrimination of painful stimulation[4,5]. However, no study has investigated the extent to which these neural substrates underlying non-painful touch are involved in WM for painful touch.

## Aim

Using single-pulse transcranial magnetic stimulation (spTMS) we will determine the causal and temporal contributions of neural regions (i.e. SI & SII) in WM for painful compared to non-painful stimulation.

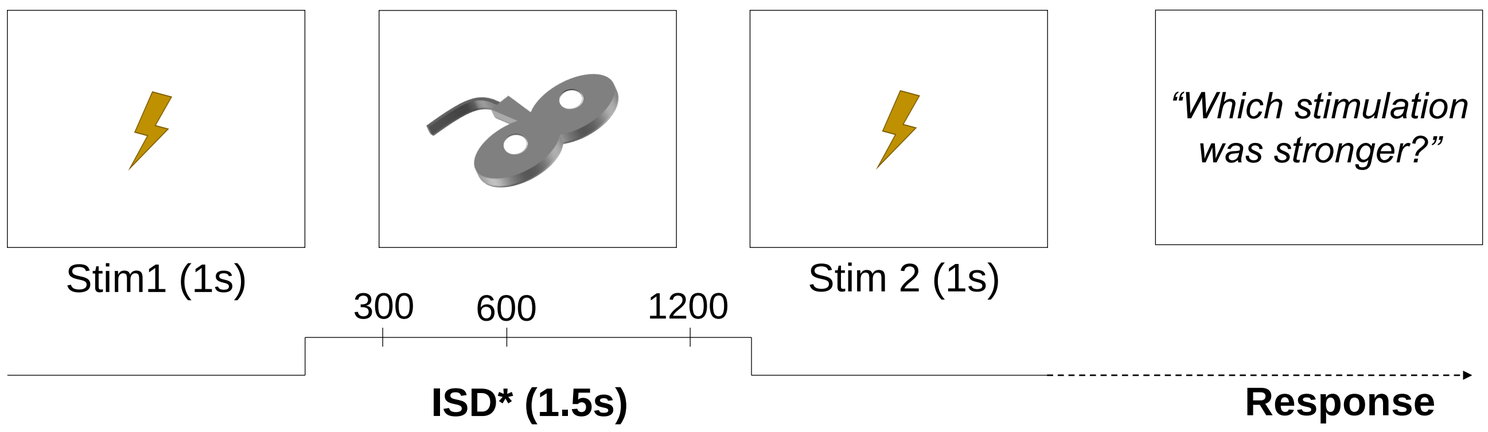
## Method

### Electro-tactile simulation

Painful or non-painful (between-subjects design) transcutaneous electrical stimulation delivered to the left index finger through two stainless steal electrode rings.

### Experimental Task

2-alternative forced choice delayed discrimination task requiring participants to identify which of 2 stimulations was greatest in intensity.

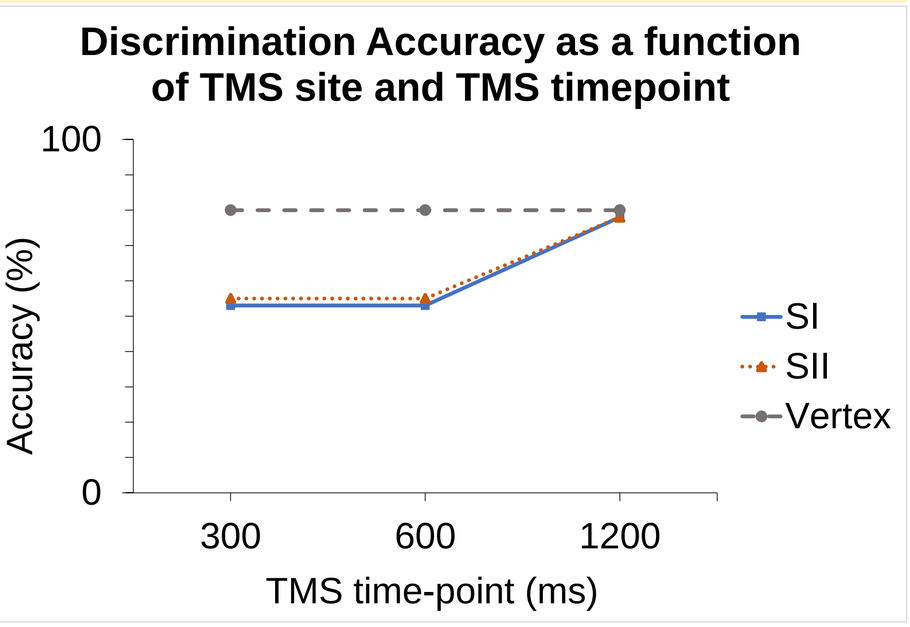



* ISD: During an interstimulus WM delay, inhibitory sp-TMS will be delivered to either contralateral SI or SII or, a control site (vertex) at one of three time points: 300, 600 or 1200 ms.

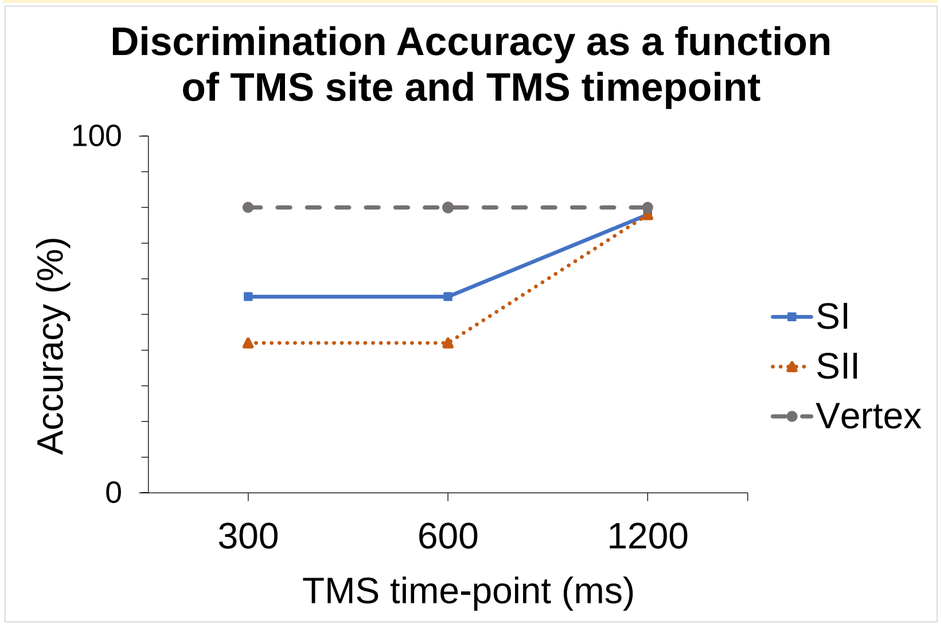
## Expected Results

We predict spTMS over SI and SII but, not vertex, will reduce discrimination accuracy however, this effect will differ as a function of stimulation type (painful vs. non-painful) and TMS time-point (300, 600 or 1200 ms).

### Non-Pain Condition:




### Pain Condition:




- spTMS over SII at early delay (300 & 600 ms) will more greatly impair task performance in the painful than non-painful group due to fundamentality of SII in pain encoding over and above SI.

- No influence of spTMS over all 3 neural targets when administered at late delay (1200 ms), in line with the notion that later stage WM depends upon representation in higher-order executive networks[6].

## References

1. Harris, J. A., Miniussi, C., Harris, I. M., & Diamond, M. E. (2002). Transient storage of a tactile memory trace in primary somatosensory cortex. *Journal of Neuroscience*, *22*(19), 8720-8725. https://doi.org/10.1523/JNEUROSCI.22-1908720.2002
2. Katus, T., Grubert, A., & Eimer, M. (2015). Electrophysiological evidence for a sensory recruitment model of somatosensory working memory. *Cerebral Cortex*, *25*(12), 4697-4703. doi:10.1093/cercor/bhu153
3. Apkarian, A. V., Bushnell, M. C., Treede, R. D., & Zubieta, J. K. (2005). Human brain mechanisms of pain perception and regulation in health and disease. *European journal of pain*, *9*(4), 463-484. https://doi.org/10.1016/j.ejpain.2004.11.001
4. Oshiro, Y., Quevedo, A. S., McHaffie, J. G., Kraft, R. A., & Coghill, R. C. (2009). Brain mechanisms supporting discrimination of sensory features of pain: a new model. *Journal of Neuroscience*, *29*(47), 14924-14931. https://doi.org/10.1523/JNEUROSCI.5538-08.2009
5. Lockwood, P. L., Iannetti, G. D., & Haggard, P. (2013). Transcranial magnetic stimulation over human secondary somatosensory cortex disrupts perception of pain intensity. *cortex*, *49*(8), 2201-2209. https://doi.org/10.1016/j.cortex.2012.10.006
6. Romo, R., & de Lafuente, V. (2013). Conversion of sensory signals into perceptual decisions. *Progress in neurobiology*, *103*, 41-75. https://doi.org/10.1016/j.pneurobio.2012.03.007