Transcranial Infrared Laser Stimulation Improves Rule-Based Category Learning

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Transcranial Infrared Laser Stimulation

- **Previous Research**
  - Novel, non-invasive form of Low-Level Light Therapy (LLLT)
  - LLLT: modulation of biological functions red/near-infrared light\(^1\)
  - Primary mechanism of action appears to be photobiomodulation of mitochondrial cytochrome oxidase\(^2\)
  - Cytochrome oxidase catalyzes oxygen consumption in cellular respiration for metabolic energy (ATP) production & primary photoacceptor of red to near-infrared light energy\(^3\)

- **Beneficial effects shown in humans:**
  - Improved neurological outcome after ischemic stroke & TBI\(^4\)
  - Improved outcomes for patients with major depression & anxiety
  - Improved performance on standard neuropsychological measure of executive function\(^5\)
  - Improved sustained attention & short-term memory retrieval performance\(^6\)
  - Improved outcomes for patients with major depression & anxiety
  - Photobiomodulation of primary neurons functionally inactivated by toxins: role of cytochrome c oxidase.\(^7\)

- **TILS session** lasted 8 minutes, administered in 8 one-minute treatments.
- Sessions alternated between **lower right lateral and upper right lateral areas of the forehead, targeting lateral prefrontal cortex**.
- The **Laser Treatment group** received full treatment.
- The **Placebo Treatment group** receive placebo treatment consisting of:
  - Brief 5 s of treatment followed by 55 s of no treatment (1/12\(^{th}\) of cumulative light energy density) in each session
  - Otherwise identical procedures to the Laser Treatment group

- **Rule-Based**
  - Multichannel NIRS probes for prefrontal imaging
  - Increase of cortical activities in PVT
  - Increase of cortical activities in DMS

- **Information-Integration**


