



Weill Cornell Medicine

Arousal Units: A Framework for Measuring and Tracking Levels of Consciousness During Recovery

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Background & Unmet Need

- Each year, millions of patients experience unconsciousness across a range of care settings, including the ICU, operating room, postoperative care unit (PACU), and emergency medical services
- Current consciousness assessments, such as behavioral diagnostic scales, neuroimaging, or EEG, are assessed sporadically, limiting their precision due to the dynamic nature of consciousness
- Moreover, implementation of these methods cannot feasibly capture the temporal resolution needed to track transitions between states of consciousness
- As a result, critical care decisions are often made without objective data about potential recovery; for instance, a study in several Canadian Trauma centers found that 70% of ICU deaths are related to life support withdrawal, with 65% occurring within 72 hours due to uncertainty in prognosis¹
- **Unmet Need:** Objective and quantitative methods for measuring and tracking consciousness levels

Technology Overview

- **The Technology:** "Arousal Units" (AU), a biomarker for quantitative assessment and monitoring of consciousness levels using EEG
- AUs are repeated, temporally discrete cortical patterns that link to behavioral and breathing changes
- These cortical patterns consist of interactions between three spectral variables: fractional gamma, delta, and gamma power that can be sequentially identified within specific windows
- **PoC Data:** Arousal indices reflected arousal levels and predicted dominant motor movements in mice during recovery from hypoglycemic coma (accuracy of ~89%, sensitivity of ~75%) and brain injury (accuracy of ~87%, sensitivity ~76%)
- Arousal indices also reflected arousal levels in human patients, including neonates and older patients emerging from anesthesia

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Diany Paola Calderon
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Sijia Gao

Patents:

[US Application Filed](#)

Publications:

[Gao et al. Proc Natl Acad Sci USA. 2025.](#)

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Cornell Reference:

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¹Turgeon et al. CMAJ. 2011.

AU: Arousal Unit; DOC: Disorder of Consciousness

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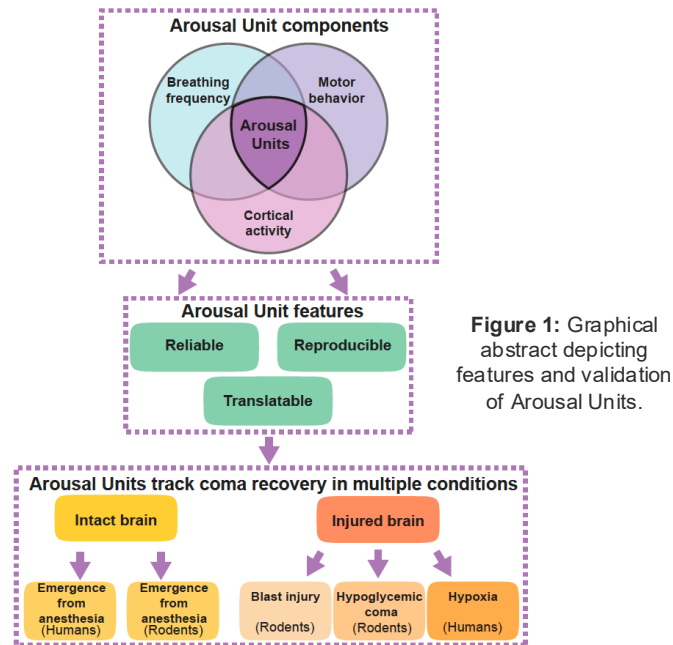
Technology Applications

- Real-time monitoring of consciousness levels for patients recovering from anesthesia, a disorder of consciousness (DOC), or brain injury
- Prognosing recovery trajectory in patients with long-term DOC to predict patient outcomes and inform treatment decisions
- Assessing treatment efficacy for DOC patients
- Remote assessment of patient consciousness

Technology Advantages

- AUs can measure the transition from one state of consciousness to another
- Provides objective and quantitative measurements
- Continuous monitoring capability versus sporadic behavioral assessments
- Applicable across multiple conditions and causes of consciousness disorders
- Can be used remotely on telemedicine platforms

Supporting Data / Figures



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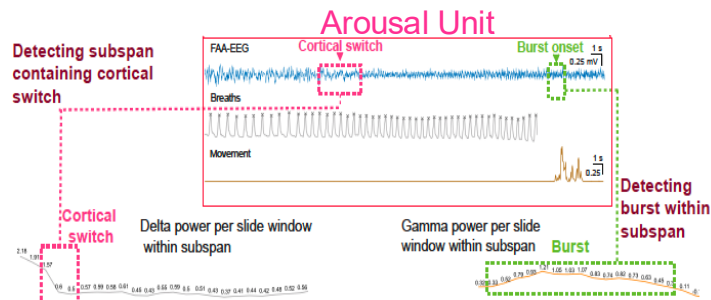
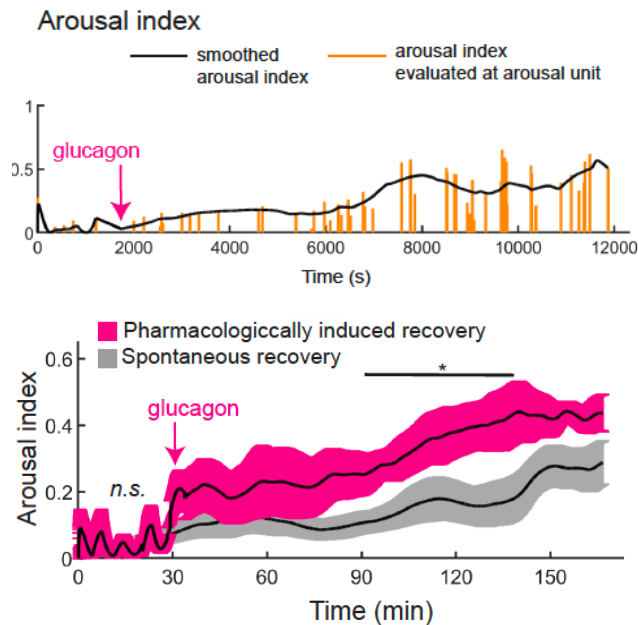


Figure 2: Top left: Arousal Units represent a pattern of increased breathing frequency aligned to a cortical switch, which precedes a movement. Within these EEG spans, a peak in total gamma power or gamma burst directly links to the movement **Top right:** Arousal index in mice recovering from a hypoglycemic coma **Bottom right:** The Arousal index in a model of hypoglycemic coma reflects differences in to pharmacologically-induced recovery vs spontaneous recovery.



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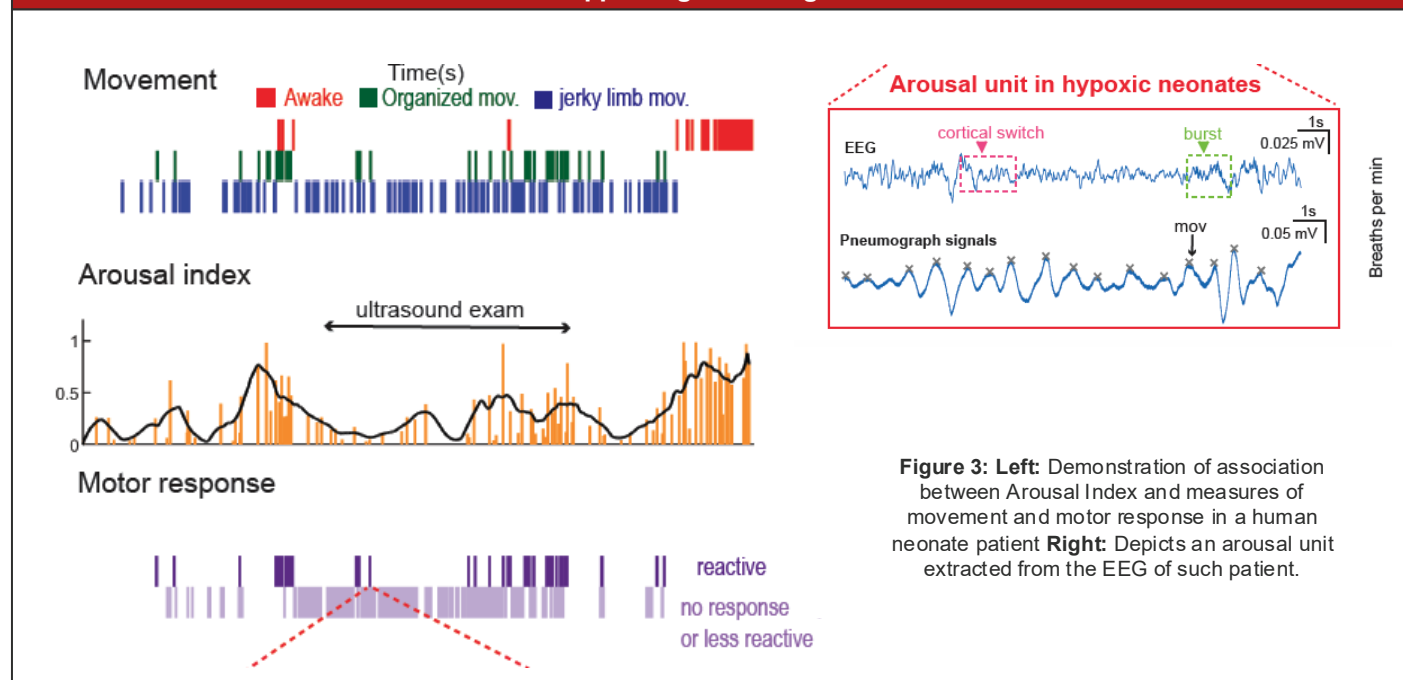


Figure 3: Left: Demonstration of association between Arousal Index and measures of movement and motor response in a human neonate patient Right: Depicts an arousal unit extracted from the EEG of such patient.

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