

Differential modular dynamics in marmoset cortex during conscious and unconscious states

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Consciousness is the state of wakefulness and awareness characterised by the ability to sense and respond to stimuli. In recent years, our understanding of the mechanisms underlying consciousness has been greatly improved by the study of unconsciousness with general anaesthetics. While much of this work has focused on the cellular effects of anaesthesia, several recent studies have used functional magnetic resonance imaging (fMRI) to investigate whole-brain, network-level changes linked to these cellular effects. The dynamics of whole-brain states have been shown to differ between periods of consciousness and unconsciousness, with a smaller repertoire of brain states observed during unconsciousness, and fewer transitions between these states (Barttfeld et al, PNAS, 2015). These whole-brain analyses have been invaluable for characterising the systems-level bases of consciousness, providing evidence for theoretical accounts of conscious experience. This approach, however, does not consider the modular configurations (and reconfigurations) that constitute these whole-brain states, and that have been linked to cognition (Bassett et al, PNAS, 2011; Braun et al, PNAS, 2015). We quantified these modular dynamics during wakeful rest and anaesthesia-induced unconsciousness, using resting state fMRI with the common marmoset (*Callithrix jacchus*; Hori et al, Cereb Cortex, 2020). We found that the awake condition was characterised by more coordinated reconfiguration of a smaller number of modules, and by greater stability among whole-brain networks derived from these modules. Conversely, the anaesthetised condition was characterised by the more haphazard reconfiguration of a larger number of modules and a decrease in network integrity. Our findings are consistent with the hypothesis that unconsciousness results from the fragmentation of whole-brain networks, and that the coordinated reconfiguration of modular structure is a marker of cognitive engagement in the conscious state.