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Presentation Abstract

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Title:	Dynamic gating in multi-modular neural networks using random connections
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Presentation Time:	Monday, Nov 15, 2010, 8:00 AM - 9:00 AM
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Abstract:	You hear a phone ringing - do you pick up? The answer to this question depends on your current situation: are you home? is the ringing a part of the movie you are watching? In general, the response to many of the sensory stimuli we encounter in everyday life depends on the context, which in general is determined by some of the features of the perceived external environment, and by our inner mental state. Our actions, our disposition to behavior and the features of the environment that we attend, can change rapidly (e.g. when our spouse says he/she is answering the phone, we can ignore the following phone rings). We studied a general model of a multi-modular attractor neural network that can dynamically re-route the interactions between different modules. In particular we assumed that each module represents one feature of a complex context and we required that the attractor state of

one or more modules determines which of the other modules should guide the response of the network. The remaining modules should be ignored (gated). As the state of the modules can rapidly change, the set of gated modules can also quickly adapt to different contexts (dynamic gating). Since the network must ignore all possible states of the non-relevant modules, there is a combinatorial explosion of the number of conditions that should be simultaneously imposed. Building on previous work [Rigotti et al. 2010], we introduce a population of randomly connected neurons (RCNs) which receive fixed random input from all modules and project plastic connections back to them. This population mediates the interactions between different modules. The large repertoire of response properties generated by random
connectivity (mixed selectivity to the states of multiple modules) allows the network to implement all the desired context dependent transitions with a number of RCNs that grows only polynomially with the number of modules. Since both lesion and imaging studies implicate prefrontal cortex in tasks that require flexible context switching, we believe that our model may provide important insight to understand the interaction between this area and the rest of the brain in context-dependent tasks.

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GATING

PREFRONTAL CORTEX

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