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Simulating attentional blink with a neocortical attractor model

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This study simulates attentional blink or "blink of the mind," a phenomenon where a human subject misses perception of a later expected visual pattern as two expected visual patterns are presented less than 500 milliseconds apart. With an abstract computational model of the neocortex, a cortical patch is stimulated with a sequence of patterns at varying time points. Patterns that become active attractors are considered recognized.

A neocortical patch is represented as a square matrix of hypercolumns, each containing a set of minicolumns with synaptic connections both within and across both minicolumns and hypercolumns [1]. Each minicolumn consists of locally connected layer 2/3 pyramidal cells with interacting basket and bipolar/double bouquet interneurons. All neurons are implemented using the Hodgkin-Huxley multi-compartmental cell formalism and include calcium dynamics, synaptic depression and saturating AMPA, NMDA and GABA synapses. Active patterns are encoded with global connectivity of minicolumns across hypercolumns and they inhibit each other.

Stored patterns were stimulated at sliding differential time points to create neural attractor interference measurable with synthetic electrode traces. The effect corresponded with human visual attentional blink studies. Additionally, studies on the inhibitory effect of the drug class benzodiazopine on attentional blink in human subjects were compared with neocortical simulations where an inhibitory GABA receptor conductance was increased. Simulations showed increases in the attentional blink duration, agreeing with observations in human studies. Figures 1 and 2.

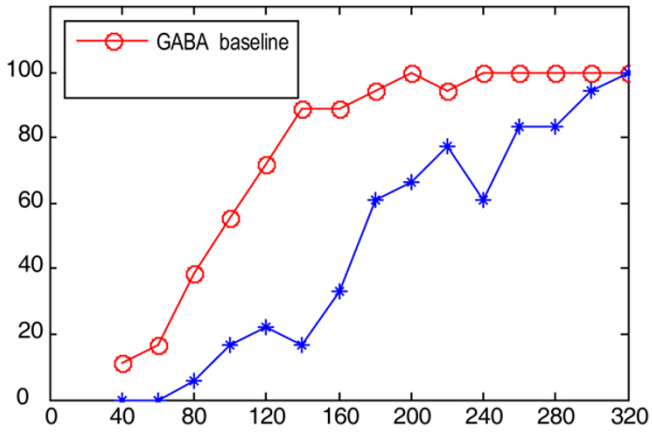

Figure 1
AB simulation with 5 of 9 stimulated minircolumns (18 trials).

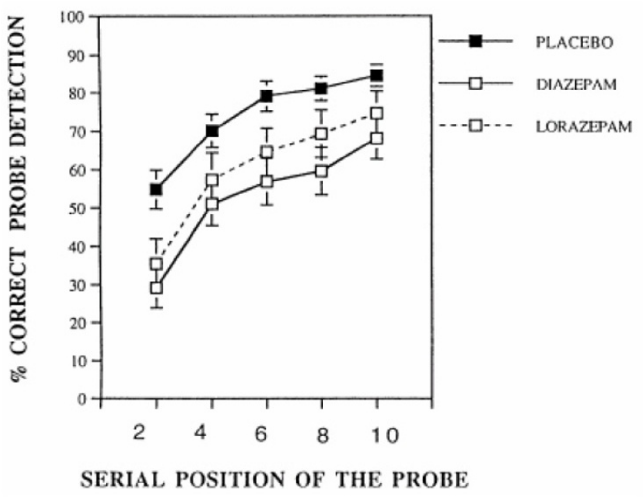

Figure 2
Human AB benzodiazepine study [2].

References

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