**Alexander Toschev**

Industrial Artificial Intelligence, Higher Institute of Information Technologies and Information Systems of Kazan Federal University. sanchis @gmail.com

**Max Talanov**

PhD, Industrial Artificial Intelligence, Higher Institute of Information Technologies and Information Systems of Kazan Federal University. max.talanov@gmail.com

**Computational emotional thinking model.**

**Keywords**

AI; Machine Cognition; Machine Thinking; Thinking Model; Computational Emotions; Neuromodulation;

**Emotional computing system management**

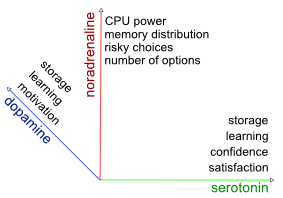
We have failed to find any cognitive architecture that take in account neuro-scientific nature of emotional processes in brain. We used Lovheim – “Cube of emotions” [1] as model for objective brain response on emotional stimulus and created neuromodulator to computing system parameter mapping. Roughly we could state that noradrenaline influences overall speed of thinking process, dopamine and serotonin - reward processing and learning.

Figure 1. [Computing system parameters mapping].

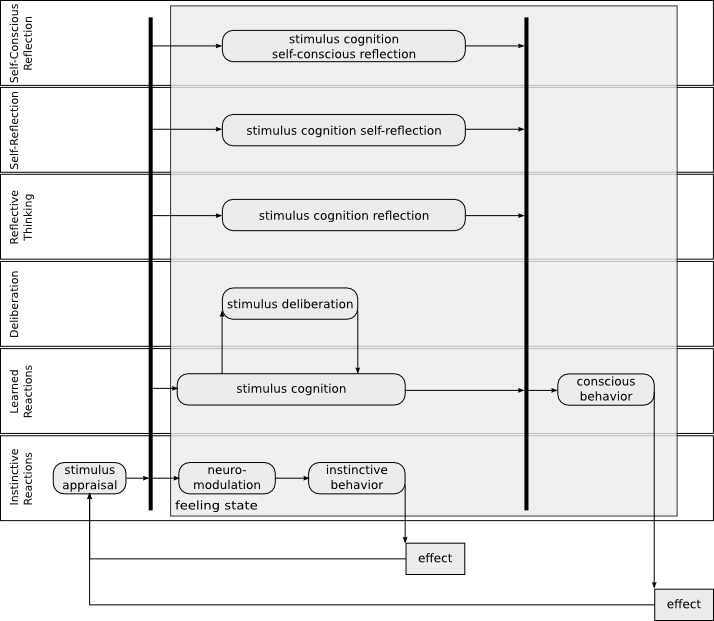
**Generic: CPU power** (computing processes distribution or load balancing) is influenced by noradrenaline the higher is noradrenaline more computing processes should be concentrated on current activity. **Working memory** (short term) distribution is influenced by noradrenaline as neurotransmitter regulating attention. Learning is impacted by serotonin and dopamine: dopamine plays major role in activation of previously remembered patterns and serotonin in pattern generation. **Storage management** (long term memory) is influenced both by serotonin and dopamine, higher concentrations of both neurotransmitters the better action is remembered(less probability to forget).

**Decision making[R]: Confidence and satisfaction** of the system is directly influenced by serotonin. System is more **motivated** under influence of dopamine. System tends to choose **risky actions** under impact of noradrenaline. Noradrenaline makes system use less **number of options** in width and depth to be processed during reasoning. For example: system is in fear state. Dopamine impacts system at half strength. This makes system choose actions highlighted with high rewards (safest). High noradrenaline in rage state causes system to think as quick as possible taking in account as less as possible number of options, implementing first action:"fight or flight" reaction.

**Emotions objective and subjective.**

Objective brain work is described as neuromodulation process with base of three neuromodulatory systems: Nor-adrenaline, Dopamine,Serotonin.

Subjective emotions perception is described via Plutchik[2] approach as main psychological model. We modeled Plutchik feedback loops (appraisal and translation of sensory information into action) in 6 thinking levels described by Marvin Minsky “The emotion machine”[3]: Inbound stimulus is been processed via spinal cord, hypothalamus, amygdala that triggers nuromodulation[4]. Neuromodulation  triggers the emotional state via neuromodulatory systems: nor-adrenaline, dopamine, serotonin[4; 5]. Instinctive behavior is processed on instinctive reactions layer that usually is not involved in conscious actions. Result of behavior actions is effect state that influences the system again as stimulus. This second stimulus is been apprised on instinctive reactions layer and triggers neuromodulation again. Neuromodulation in it's turn switches emotional state second time. Stimulus cognition actions are done in the emotional state under influence of neuromodulation. Stimulus cognition could involve deliberation, further reflection, sef-reflection self-conscious processing and emotional state switch. Conscious behavior is activated as the result of stimulus cognition.



**References**