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## Appendix

### The five compulsory steps of TBM:

#### Action

1. The so-called “voluntary” action is decided and performed by the agent’s Unconscious Mind (UM) in response to a stimulus. To this aim, the reaction paradigm that might have the best probability of success is retrieved by UM among those that are encoded in long-term memory store.
2. After a slight delay, the agent becomes aware of the ongoing action through feedback signals (somatosensory, etc.) that are conveyed to the brain as a consequence of the action performance. Thus, the agent’s Conscious Mind (CM) (more precisely: the 1st-person perspective (1PP) of CM) always lags behind UM’s activity.

#### Cognition

3. Owing to this delay, CM (i.e. 1PP) cannot know UM’s work that precedes awareness; thus, erroneously believes it has freely decided the action. Though objectively false, this belief is subjectively perceived as true, due to Free-Will (FW) illusion. It is so persistent and deeply rooted in the mind that CM (i.e. 1PP) is unwilling to abandon it.
4. The FW illusion satisfies a psychological need to secure the arousal of the Sense of Agency (SoA) and Responsibility (SoR) of the action. Both SoA and SoR inevitably lead CM (i.e. 1PP) to self-attribute reward or blame depending on action performance and outcome.
5. Both reward and blame are motivational incentives that foster learning and memory in the CM (i.e. 1PP); the updating of Knowledge will provide new information and the skill required for further action (restart from point 1).

The five compulsory steps of TBM have been subdivided into ACTION and COGNITION for the following reasons:

#### Action

First of all, UM must recognize the stimulus, then the action-decision mechanism of the “so-called voluntary” actions can be decided by imitating the experience of the preceding trial, found in Long-Term- Memory (LTM). When the perturbing stimulus is not known, imitation (I) of past experiences is impossible; so that UM’s decision must opt to a Trials-&-Errors (T-R) strategy. Action repetition at random is kept on until both the stimulus and the reaction against it are fully understood; this task is assigned to CM, i.e. the domain of the cognitive processes. Obviously, from trial to trial, the reactions will become faster and faster. The reaction will become instinctive, automatic when the learning process is on the top of the learning curve. In these conditions, the action-decision mechanism will bypass CM’s intervention.

#### Cognition

Feedback sensory signals of the action attracts the CM’s attention. So, from now on, CM believes to have freely and independently decided that action; this illusion gives rise to the Sense of Agency (SoA) and the Sense of responsibility (SoR), and induces CM to self-attribute a reward (or a punishment), depending on the degree of the action success. This step triggers LTM updating. Moreover, the pleasure and enthusiasm due to the reward are like an injection of self-confidence, thus triggering the motivation for further actions (see “associative learning”). From a statistical point of view, the more the trials will be carried out, the more wishful LTM will be updated and the more successful will be the outcomes of the future actions.