Executive control / Cognitive control

A key component in modern theories of mental functioning is the executive control system. Humans plan and carry out many complex tasks; some of which can be carried out automatically but many of which seem to require higher-level control (processes such as planning, abstract thinking, learning rules, or inhibiting appropriate actions). Since human beings mental resources are limited it is hypothesized that in order to make efficient use of them there must be a co-ordinating system.

Originally, theories of an executive system came about via observation of patients who had suffered damage to frontal regions of their brain. These patients seemed to perform normally on many laboratory-based tasks of memory, language and intelligence, but performed poorly on everyday tasks (such as planning a visit to the shops).

Norman and Shallice's (1986) influential model proposes two interacting systems of cognitive control:**contention scheduling**, and the **supervisory attentional system**.

At the lower level is the **contention scheduling system (CS)**. Contention scheduling is for well-learned, habitual tasks which are performed automatically (unconsciously). Independent modular neural structures, called schemata,

control these actions. Contention scheduling controls the selection of schemata through a decentralised process (i.e. there isn't normally a higher-level bit that decides which schemata is selected for a particular task) process of competitive and cooperative activation of schemata by sensory input, and input of other schemata. A specific schemata becomes active, and its corresponding action or cognitive operation is performed, when its activation threshold is reached.

Above the level of the contention scheduling system is the **supervisory attentional system (SAS)**. The SAS doesn't have to be engaged for simple tasks which can be performed automatically, instead it is needed for:

1. Tasks that involve

planning or decision making.

2. Tasks that involve error correction or troubleshooting.
3. Situations where responses are not well-learned or contain novel sequences of actions.
4. Dangerous or technically difficult situations.
5. Situations which require the overcoming of a strong habitual response or resisting temptation.

The SAS does not control actions directly, but instead modulates the activation thresholds of particular schemata - this way it can cause a bias towards or

away from particular schemata. Shallice (1988) says that the experience of willed volition is equivalent to this biasing of schema activation thresholds.

Below is a simplified diagram of how the SAS and CS systems are thought to interact:

How executive

control relates to hypnosis

A key goal of many hypnosis researchers is to tie theories of hypnosis in with mainstream theories of human psychological functioning. Hilgard was one of the first to discuss hypnosis with reference to control systems, and he believed that *"any satisfactory theory of hypnosis should also be a theory bearing on psychology at large"* (Hilgard, 1991). Modern theories discuss the ability of hypnotised individuals to shift and divide attention: as such, an understanding of how hypnosis and suggestion affect the functioning of the executive control system is fundamental to a full theoretical understanding of hypnosis. See the **theories** page for information on how modern theorists have

tried to explain hypnosis using concepts from cognitive neuroscience.

Key readings in cognitive control

Miller, E. K., Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. Annual Review of Neuroscience, 24, 167-202.

Norman, W., Shallice, T. (1986). Attention to action. In: Davidson, R. J., Schwartz, G. E., Shapiro, D. (Eds). Consciousness and self-regulation: Advances in research and theory, vol 4. New York: Plenum, p 1-18.