# EDITORIAL

# Dopamine and Hypnosis

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Given the identification of specific brain functions and psychiatric disorders with the activity of specific neurotransmitter systems, it is reasonable to hypothesize that certain neurotransmitter systems might be especially involved in hypnosis and hypnotic phenomena. Such an approach has proven fruitful in sleep research, for example with Hobson's demonstration of a shift from a predominance of noradrenergic activity during wakefulness to cholinergic activity in sleep, especially REM sleep (1). The dopamine system is a particularly likely candidate for hypnosis. Spiegel and King (2) demonstrated a robust correlation between measured hypnotizability and levels of homovanillic acid, a dopamine metabolite, in the cerebrospinal fluid. The correlation was robust, about .6, meaning that about one-third of the variance in hypnotizability was accounted for by the levels of this dopamine metabolite. This study was based on Pribram and McGuinness' (3) work on activation and arousal. This theory implicated dopamine in activation, which increases circuit redundancy and focusing, versus arousal, which decreases circuit redundancy, deploys attention more broadly, and is noradrenergic. This early model fits well with current models of attention. In it, the anterior attentional system involves activation and focusing of attention, and is localized to the anterior cingulate and right frontal cortex. These areas are rich in dopaminergic neurons. The posterior attentional system, localized in anterior portions of the occipital cortex, is related to arousal and is noradrenergically mediated.

The idea is that hypnosis is activation without arousal, a form of alertness or consciousness but with less sympathetic activation. This would be consistent with the adrenergic role in vigilance, and the fact that the posterior visual system is strongly innervated by norepinephrine pathways, including the pulvinar and superior colliculus. There is weaker noradrenergic innervation of more ventral pattern recognition pathways. In the anterior attention system, the alerting component increases the speed of response selection but allows for a lower quality of information (4). This is information processing with a reduction in vigilance, or critique of the information processed. Clark is cited by Posner and Peterson (5) as showing that manipulation of norepinephrine levels pharmacologically had specific effects on attention shifting. Posner and colleagues (6) found that patients with right parietal lesions were especially affected by the omission of a warning signal, while those with left parietal lesions were not. These noradrenergic pathways arise in the locus coeruleus and are right-lateralized. Posner and Peterson (5) postulate that activation of norepinephrine works through this posterior attention system.

An analogy might be drawn between the function of the anterior attentional system's responsiveness to lower quality cues with less warning and hypnotic

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Accepted November 9, 2002

suggestibility, a kind of responsiveness to cues regardless of their incongruity. Could we think of the kind of social input that forces the individual to increase orienting, likewise forces them into a noradrenergic mode of interaction, heightening stress and its related health consequences, whereas a supportive hypnotic input is one that allows the person to decrease vigilance and shift more into a mode of target detection alerting--more of the dopaminergic and/or cholinergic mode. Thus, the idea is that selective activation of the anterior attention system in hypnosis would constitute activation without vigilance, with a relative suppression of noradrenergic input and perhaps, therefore, output. Furthermore, our recent observation of a correlation between hypnotizability and CSF HVA further implicates specific involvement of the frontal lobes where the majority of dopaminergic pathways exist, followed by the basal ganglia. It is particularly interesting that the anterior cingulate gyrus is rich in dopaminergic neurons (7), providing converging evidence that the hypnotic state, which involves both arousal and focusing, may be associated with activation of the anterior cingulate gyrus. This is consistent with PET studies showing involvement of the anterior cingulate during hypnotic analgesia (8-11).

There has been little in the way of pharmacological challenge studies linking hypnosis and specific neurotransmitter pathways. Early studies showed that the amphetamine and LSD, which stimulate dopamine release, enhance hypnotic responsiveness. However, the interpretation of these findings is constrained by the fact that these drugs also affect the norepinephrine and serotonin systems. Nonetheless, there seems to be converging evidence from brain functional imaging research that the dopamine system may play an important role in hypnosis and hypnotic phenomena.

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