

Biochemical theory of schizophrenia: the dopamine hypothesis

(= an excess of the neurotransmitter dopamine). Attention has focused on the brain's neurotransmitter systems. Neurotransmitters are the chemical messengers that allow brain cells to communicate with each other. The human brain makes use of several hundred different neurotransmitters, but the most important as far as schizophrenia is concerned is dopamine.

The dopamine hypothesis suggests that schizophrenia results from over-activity in the brain dopamine systems. Evidence from this theory comes from 3 main sources:

- Post-mortems on schizophrenics shows unusually high levels of dopamine, esp. in the limbic system (Iversen, 1979)
- Antipsychotic drugs (for example chlorpromazine) work by binding to the dopamine receptor sites.
- High doses of amphetamines and L-dopa (used to treat Parkinson's) enhance the activity of dopamine and sometimes produce symptoms similar to psychomotor disorders seen in certain types of schizophrenia. Dopamine-containing neurones are concentrated in the basal ganglia and frontal cortex (concerned with the initiation and control of movements) and degeneration of the dopamine system produces Parkinson's.

Evaluation: There is strong evidence that dopamine is central to the action of anti-psychotic drugs but only weak evidence of abnormal dopamine metabolism. PET scans gives a way to study dopamine receptor binding in the brain of living patients, but the evidence is very inconclusive and more needs to be done (**Gelder et al. 1989**). Even if schizophrenics have a higher level of dopamine, it might be a result rather than the cause of the illness. But even if dopamine is the causative factor, it is perhaps indirect because abnormal family circumstances might give rise to high levels of dopamine, which, in turn, trigger the symptoms (Lloyd et al. 1984)

Even though there is strong evidence that dopamine is central to the action of anti-psychotic drugs, there is also evidence that dopamine metabolism in schizophrenia is weak (*see Gross 45-51, esp. table 30.1 and 30.2 on neurons and neurotransmitters*). Generally, it must be questioned whether a higher level of dopamine is the cause or the effect.

- **Frith and Cahill, (1995)** worked with correlational data and said that brain abnormalities are to be expected in severe cognitive and affective abnormalities, but the fact that brain differences can be observed in some people it does not give an answer to why not all develop schizophrenia.
- **Carlsson and Carlsson (1990)** claim that schizophrenia involves an imbalance between dopamine neurones originating in the midbrain and glutamate neurones in

the cortex might lead to excess in dopamine, and such excess is known to produce psychosis. But is the high level of dopamine the cause or the effect of the psychosis? The picture is complicated, because anti-psychotic medicine also brings about long-term changes to dopamine receptors.

In its simplest form, the dopamine hypothesis of schizophrenia proposes that symptoms arise because of over-activity within the dopamine system. Two pieces of evidence support this idea. One is that all antipsychotic drugs tend to lessen the activity in the dopamine system by blocking one particular type of dopamine receptor known as the D 2 receptor. All drugs with D 2 blocking effects tend to improve the symptoms of schizophrenia (Seeman 1980). Conversely, drugs that boost dopamine function, like amphetamine or L-Dopa, tend to make schizophrenic illnesses worse, or to bring out symptoms closely resembling those seen in schizophrenia in otherwise healthy people.

These observations provide circumstantial, yet there is consistent, evidence that dopamine is implicated in schizophrenia. Since the theory was first formulated by **Snyder(1976)**, many studies have examined these issues in more detail. For example, researchers have used PET to measure the number of dopamine receptors in the brains of people with schizophrenia, when alive and after death (post-mortem). Although several studies have provided evidence of dopamine over-activity (Reynolds, 1989), some have failed to do so. The picture is complicated by the fact that antipsychotic medicines also bring about long-term changes to dopamine receptors. A handful of studies have overcome this problem by recruiting subjects who have never taken drugs. Wong et al (1986), for example, examined drug-free patients and showed a two-to three-fold increase in the number of dopamine receptors in several brain regions.

Although the dopamine hypothesis has gained some support from research, many important questions remain. At the moment, we cannot easily explain how abnormalities in the dopamine system lead to differing symptoms of schizophrenia. The fact that the illness is characterised by periods of disturbance interspersed with episodes of normality also presents a problem for the dopamine hypothesis. It is probably unlikely that a disorder as varied as schizophrenia could arise from an abnormality of just one neurotransmitter. Researchers are currently exploring how dopamine interacts with other neurotransmitters in the brain, such as serotonin and glutamate. However, there can be little doubt that dopamine will be involved when the precise role of neurotransmitters in schizophrenia is eventually clarified.