What is the frontal lobe?

The frontal lobe comprises the anterior portion of the brain and is anatomically defined by four key gyri – the superior, middle, inferior and medial frontal gyri. The prefrontal cortex forms the rostral pole of the frontal lobe and is one of the most highly developed brain regions. The frontal lobe and its regions have widespread connections throughout the brain, particularly the prefrontal cortex. Proposed functions of the prefrontal cortex are involved mainly with executive functions and higher level cognition, such as working memory, problem solving and planning. The prefrontal cortex has also been implicated as a storage site for declarative memory such as semantic and episodic knowledge. This region has reciprocal connectivity with the amygdala, and is in a position to use experience and learning to influence behavioural responses and evaluate situations. The most posterior section of the frontal lobe is the pre-central gyrus, the primary motor cortex, also surrounded by associative and supplementary motor regions.

What is the evidence for changes in the frontal lobe?

Structural changes

Moderate to high quality evidence suggests reduced grey matter in the prefrontal cortex, left orbito-frontal gyrus, left superior frontal gyrus, and bilateral medial, inferior and middle frontal gyri of people with chronic schizophrenia. People with first-episode schizophrenia also show reduced grey matter in inferior, middle and medial frontal and precentral gyri. A high risk of schizophrenia was particularly associated with reduced grey matter in inferior frontal gyrus. Moderate quality evidence suggests reduced white matter integrity in the frontal lobe of people with schizophrenia. There is also an absence of normal leftward asymmetry in the Sylvian fissure and a higher frequency of abnormal (reversed) asymmetry in the frontal lobe. High quality evidence suggests significantly greater reductions over time in frontal grey and white matter in people with schizophrenia compared to controls.

Functional changes

Moderate quality evidence suggests reduced function in the frontal lobe during memory tasks in people with schizophrenia compared to controls. During episodic memory encoding, activity is reduced in the right superior frontal gyrus and the bilateral inferior frontal gyri, and increased in the left precentral gyrus. During episodic memory retrieval, functional activity is reduced in the left inferior frontal gyrus and the left middle frontal gyrus, and increased in the left precentral gyrus and right middle frontal gyrus. During executive function tasks, people with schizophrenia show reduced activity in the middle and medial frontal gyri, and increased activity in the superior and inferior frontal gyri. Moderate to low quality evidence suggests abnormal activity (mostly increased) in dorsolateral prefrontal cortex of first-degree relatives of people with schizophrenia during cognitive control, working memory and emotional face processing tasks. Patterns of ventrolateral prefrontal cortex activity were less consistent in relatives, but showed increases during long-term memory and language processing tasks. Moderate quality evidence suggests phosphomonoester levels are decreased, and phosphodiester levels are increased in the frontal cortex of relatives of people with schizophrenia, people with a first episode of psychosis, and people with schizophrenia. N-acetylaspartate levels are decreased frontal lobe grey and white matter in first episode and chronic schizophrenia. Moderate to low quality evidence suggests glutamate/glutamine levels may be increased in the medial prefrontal cortex in the early stages of disorder. Decreases in glutamate/glutamine levels were observed in chronic schizophrenia in the dorsolateral prefrontal cortex.

For more information see the technical table

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