



Exploring the Cognitive Dimensions of Schizophrenia: From Aetiology to Manifestations

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Abstract

Why does Bryant, a 35-year-old man, persist in holding uncomfortable positions for prolonged periods while entertaining unfounded notions of conspiracy against him? Why does Julie, at 32, spend entire days in bed, lamenting her lack of motivation, even for her once-beloved pastime of watching TV? What drives Joe, aged 34, to climb eight flights of stairs rather than using the seemingly benign elevator he fears? And how do we explain Gerry, a 21-year-old woman, who transforms into a hyperactive, sleep-deprived dynamo at 3 am?

An answer to all these questions lead us to psychiatric and clinical diagnosis of mental health disorders such as Schizophrenia, Depression, Anxiety and Bipolar Disorder, respectively. Disorders of mind are complex manifestations of one's biological and environment.

This paper inquires about the compromised cognitive capacities of mentally ill individuals and attempts to locate their neural correlates, in essence to actually reason why individuals with a clinical diagnosis of schizophrenia often hear voices. It aims to understand the complexities associated with disorders from a bio- cognitive standpoint and argues to use the knowledge of cognitive psychology in clinical diagnosis to prevent cases of misdiagnosis and implications that follow. In simpler words, the paper attempts to understand differences in structural and functional abnormalities in brain wrt the mental disorder of schizophrenia.

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Introduction**Understanding the scope of Cognitive Psychology in Clinical Settings**

Cognitive psychology is the branch of psychology that studies mental processes such as how people think, perceive, remember and learn. The field of cognitive psychology offers much scope in clinical settings. Leveraging and shouldering on Neuroscience, in clinical settings, cognitive psychology offers an opportunity to measure brain function, accurately assessing cognition and behaviour, and linking these elements. This interdisciplinary endeavour involves sophisticated neuroimaging methods, often revealing complex and multifaceted relationships between brain activity and mental processes to reveal impairments in cognitive abilities in the field of psychopathology.

Schizophrenia

Schizophrenia as a mental health disorder, is described by its characterised oddities in the affective, behaviour and cognitive aspects of oneself. A hallmark of schizophrenia is loss of touch with reality, also referred to as Psychosis (Butcher & Mineka, 2017).

Emil Kraepelin made significant contributions to the development of the notion of schizophrenia in the late 19th century as he called it early dementia (Kraepelin, 1919). Later on, Eugen Bleuler referred to it as "schizophrenia" and highlighted the basic symptoms, or negative symptoms (Bleuler, 1950). (Schneider, 1959). These viewpoints affected the creation of categorization schemes such as the DSM and ICD, which in today's time act as major tools of diagnosis of the disorder.

Diagnostic Criteria

Schizophrenia

- A. Two (or more) of the following, each present for a significant portion of time during a 1-month period (or less if successfully treated). At least one of these must be (1), (2), or (3):
1. Delusions.
 2. Hallucinations.
 3. Disorganized speech (e.g., frequent derailment or incoherence).
 4. Grossly disorganized or catatonic behavior.
 5. Negative symptoms (i.e., diminished emotional expression or avolition).
- B. For a significant portion of the time since the onset of the disturbance, level of functioning in one or more major areas, such as work, interpersonal relations, or self-care, is markedly below the level achieved prior to the onset (or when the onset is in childhood or adolescence, there is failure to achieve expected level of interpersonal, academic, or occupational functioning).
- C. Continuous signs of the disturbance persist for at least 6 months. This 6-month period must include at least 1 month of symptoms (or less if successfully treated) that meet Criterion A (i.e., active-phase symptoms) and may include periods of prodromal or residual symptoms. During these prodromal

or residual periods, the signs of the disturbance may be manifested by only negative symptoms or by two or more symptoms listed in Criterion A present in an attenuated form (e.g., odd beliefs, unusual perceptual experiences).

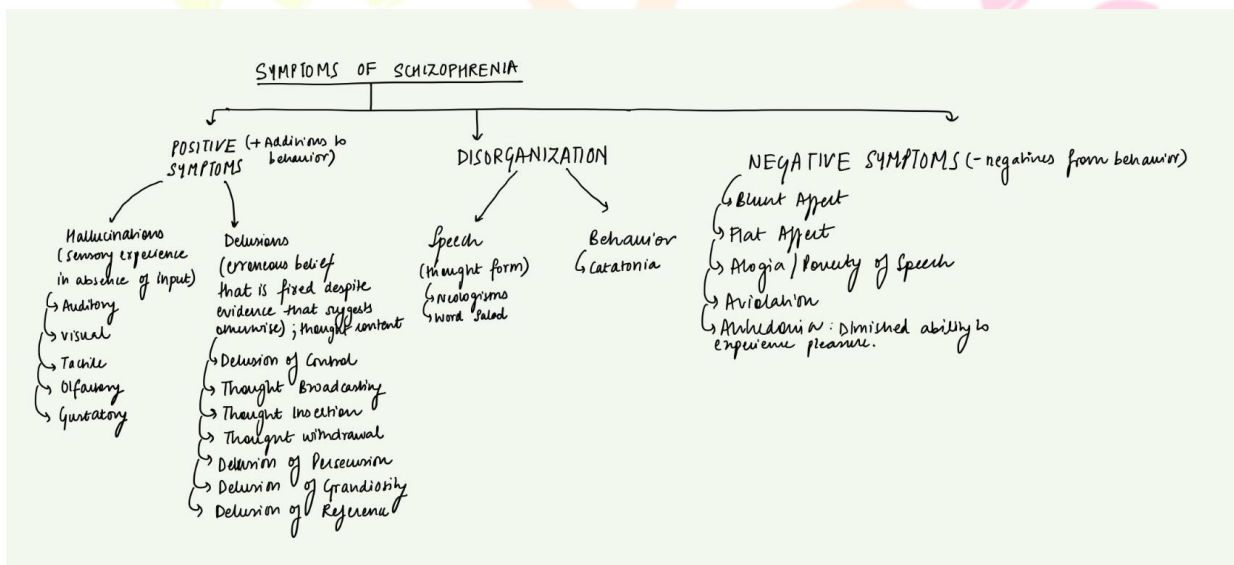
- D. Schizoaffective disorder and depressive or bipolar disorder with psychotic features have been ruled out because either (1) no major depressive or manic episodes have occurred concurrently with the active-phase symptoms, or (2) if mood episodes have occurred during active-phase symptoms, they have been present for a minority of the total duration of the active and residual periods of the illness.
- E. The disturbance is not attributable to the physiological effects of a substance (e.g., a drug of abuse, a medication) or another medical condition.
- F. If there is a history of autism spectrum disorder or a communication disorder of childhood onset, the additional diagnosis of schizophrenia is made only if prominent delusions or hallucinations, in addition to the other required symptoms of schizophrenia, are also present for at least 1 month (or less if successfully treated).

Source: Reprinted with permission from the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (Copyright 2013). American Psychiatric Association.

Source: Butcher & Mineka, 2017

Symptoms

Symptoms seen in schizophrenia can be classified as Positive Symptoms, Negative Symptoms and Disorganised Behaviour and Speech. Some researchers also classify the symptomatology of Schizophrenia as Positive, Negative and Cognitive Symptoms.



Epidemiology

According to WHO estimates, schizophrenia affects approximately 24 million people worldwide. (Mathew et. al, 2020). The lifetime risk of developing schizophrenia is approximately 0.3 to 0.7 percent, which translates to about 1 out of every 140 individuals. (DSM 5). In India, reported rates of incidence lie between 1.5/1000 to 3/1000 individuals are diagnosed with it (Gururaj et. al, 2005; Murthy & Loganathan, 2011; Mathew et al, 2020). Schizophrenia onset shows significant gender differences. The male-to-female ratio is 1.4:1, possibly due to women having a less severe form of the disorder and more depressive symptoms, while Males tend to have a more severe form of schizophrenia.

Cognitive Aetiology

Cohen's Cognitive Model of Schizophrenia.

Cohen's model is based on how context affects cognitive control. According to him, in normal human beings, the working memory correctly updates and retains contextual information (About the environment, akin to show setting, plot and characters are context in a story) essential for cognitive control. In patients with schizophrenia, Dopamine affects the dorsolateral prefrontal cortex and the medial frontal gyrus' ability to process context, which leads to impairments in cognitive control, which are characteristic of schizophrenia. Lack of cognitive control impacts attention, regulation, working memory and other domains.

Firth's Cognitive Explanation: Theory of Mind

Frith, 1992 discussed how cognitive issues are linked to schizophrenia through his cognitive neuropsychological model which identifies two critical aspects of thought-processing issues: metarepresentation i.e., difficulties in comprehension of one's own and others thoughts and emotions; and central control i.e., impaired regulation of cognitive processes and actions. These impairments in thought process and control leads to schizophrenia symptoms. He believed that a partial theory of mind is a key deficiency in schizophrenia, which is why they are unable to control and monitor their own behaviour, leading to feelings of passivity. This can help us understand the concept of auditory delusion of control i.e. The feeling of someone is putting thoughts in my head.

Attentional Deficit Model

Early work done in the field of attention by Broadbent, 1971 encouraged research which suggested the inability to filter out irrelevant information leads to cognitive overload, perceptual distortions and difficulty in responding to the environmental stimuli. Frith, 1979, called this the attention-deficit theory. Beech, 1989 supported this by stating that lack of inhibition control is present in people with schizophrenia. Hemsley, 1996 extended this approach and suggested that symptoms of schizophrenia results from A. Impairment in automatic assessment of input B. Breakdown of relationship between memory and sensory input. According to this theory, Hallucinations result from overload; One's own thoughts becomes indistinguishable from external input; and as a result delusions occur when one tries to understand the external and internal stimuli. This model was able to explain positive symptoms of schizophrenia. He also suggested that, negative symptoms therefore emerge as a coping strategies to deal with the sensory overload.

Cognitive Model of Delusions

The idea that delusional beliefs in schizophrenia are wholly different from regular thoughts is called into question by the theory put forth by Bentall and associates, 2001. Rather, it implies that delusions are only severe forms of mental processes that vary from typical cognitive systems to the odd. They claim that a significant discrepancy between one's ideal and real self is experienced by many people with schizophrenia, which leads to a negative self-perception. This disparity can cause depression, and people may use this as a psychological defence strategy to blame others for their flaws when life circumstances provoke them. Furthermore connected to the formation and upkeep of persecutory beliefs in schizophrenia include externalising explaining techniques, self-esteem, familial dynamics, and attachment problems.

Impaired Cognitive Capacities in Schizophrenia

The breadth and diversity of symptoms associated with schizophrenia pose a challenge to the development of cognitive models. However, in a sense it also calls for attention to affected cognition as nearly every cognitive domain is impacted: motor activity (catatonia), emotional expression (flat affect), perception (hallucinations), inferential thinking (delusions), fluency of thought and speech (alogia), ability to initiate and complete goal-oriented behaviour (avolition), and ability to seek out and experience emotional gratification (anhedonia). The centrality of cognitive deficits is to the extent where schizophrenia is seen as a neuropsychological impairment (Bowie & Harvey, 2006; Blanchard & Neale, 1994).

The technological advancements in the field of brain imaging techniques have equipped us with abilities to gather a deeper understanding of the structural and functional abnormalities in the brain.

Some characteristics of the cognitive impairment experienced by individuals with schizophrenia are explained as follows.

- Progressive nature of the impairment :** Researchers suggest that some impairments are present before disease onset ((Davidson et al 1999; Cornblatt et al 1999), moderate and severe decline of cognitive ability are detectable at the time of the first episode and post that (Bilder et al, 2000; Bowie and Harvey 2000; Saykin et al 1994), post which usually cognitive deterioration to stabilises during middle adulthood (Rund 1998). However, about age 65, a possible secondary decline phase begins.
- Generalised versus Specific:** One ongoing debate in the field has been about the generalised versus specific localised impairments. This debate is due to an unclear, observable neuropsychological stamp of the disorder.
- Severity:** Cognitive deficits of schizophrenia are often on a sliding scale of severity ranging from moderate to severe impairment, (Bilder et. al, 2000) on almost all aspects of cognition (Butcher & Mineka, 2017).

	Normal	Mild	Moderate	Psychotic Disorder — less severe	Psychotic Disorder — more severe
Emotions	Laughing at a joke or crying at a funeral.	Slightly restricted range of emotions, such as not responding to a joke or sad story.	Greater restrictions in emotions or odd emotional content for a situation, such as getting upset for little reason.	Intense restrictions in mood or intense anger at a coworker for innocuous behaviors such as not responding immediately to an email.	No mood changes whatsoever or extreme inappropriate affect such as laughing for no reason or sobbing loudly during a happy story.
Cognitions	Ability to organize thoughts and sentences and communicate well.	Slight oddities of thinking, such as belief that a dead relative is in the room.	Greater oddities of thinking, such as a belief that one's life resembles segments on a television news program, or some difficulty forming clear thoughts.	Delusional or very odd beliefs that seem possible, such as belief that a coworker is deliberately poisoning one's lunch, or greater difficulty forming clear thoughts.	Delusional or extremely odd beliefs that seem impossible, such as a belief that one is being abducted by aliens, or complete inability to form clear thoughts.
Behaviors	Working and interacting with others appropriately.	Slightly peculiar behaviors such as failing to wash or brush one's teeth for a couple of days.	Greater peculiarity of behavior, such as avoiding all television shows because of possible resemblance to one's life or failing to wash for 1-2 weeks.	Intense peculiarity of behavior, such as refusing to go to work for several weeks due to fear of being harmed or great difficulty caring for oneself.	Extremely peculiar behavior such as hearing voices, running wild down a street, not moving at all for hours, or loss of interest in caring for oneself.

Source: Paul, 2002

Executive Functioning

Executive functions encompass a wide range of cognitive processes that produce purposeful, goal-directed behaviour. Executive functioning is understood as the brain faculty that underlies the human faculty of acting and thinking as a reaction to one's external environment as well as internal states and goals. (Orellana & Slachevsky, 2013)

Luria's research is a pioneer in the research of Executive Functioning. These components are also verified by Diamond, 2012 proposes three core components of executive functioning are Attention, Working Memory and Cognitive Flexibility.

Attention

Is often associated with the limbic and reticular activation system. This system can also be understood as Inhibition, which includes response inhibition (self-control, resisting temptations, and avoiding impulsive actions) and interference control (selective attention and cognitive inhibition).

Even before they experience their first psychotic episode, people with a genetic predisposition to schizophrenia struggle to focus (Cornblatt et al 1985). Consistency is found in research stating that schizophrenic individuals show a general attentional deficiency (Javed & Akhouri, 2020) wherein some studies suggest that negative symptoms are inversely related to attentional deficits. Deficits in executive attention, specifically, are associated with negative symptoms in schizophrenia, according to the Attention Network Test. Attention to irrelevant cues is also associated with experience of positive symptoms such as delusions and hallucinations (Corlett et. al, 2007; Gray, 1998). Corlett et. al, 2007 stated that delusions may result from the formation of associations between irrelevant or unrelated events. Positive symptoms are linked to the failure of source monitoring process (Johnson et. al, 1993), hypothesised as a result of attentional impairments.

Besides a general deficiency, We also look at different functions of attention, such as selection, sustained attention, and inhibitory control. (Galaverna et. al, 2012). Selective attention deals with how we perform when confronted with conflicting signals such as Stroop Effect tests. It involves choosing certain signals for deeper processing while blocking others from accessing the same level of processing Stirling, 2006 suggested that patients take twice as long in Stroop tasks, which indicates difficulties in attention, however Some studies indicate that it remains intact for visual tasks. (Strauss & Alpha, 1992)

Sustained attention refers to the ability to stay attentive and vigilant over a set period i.e., an ability to focus and concentrate for longer durations. However, a recent argument by Carter and others suggests that the attention deficits in schizophrenic patients may be linked to difficulties in regulating brain activity in response to transient changes rather than a deficit in sustained attention itself.

Individuals with schizophrenia often experience difficulties in auditory information processing, particularly in a phenomenon called sensory gating. This process involves the brain's response to paired auditory clicks (P50 responses). In healthy individuals, the response to the second click is weaker, demonstrating sensory gating. However, many people with schizophrenia show "poor P50 suppression," with responses to the second click nearly as strong as the first. This impaired sensory gating is associated with the disorder (Heinrichs, 2001; Potter et al., 2006). They also report difficulties in shifting attention between different tasks or goals (Jazbec et. al, 2007); challenges in inhibiting impulsive responses (Barch et. al, 1999); problems with spatial orientation in attention tasks (Posner et. al, 1988); and issues in detecting and recognizing signals or important information within a given context called signal detection (Servan- Schreiber D et. al, 1996).

The effect of schizophrenia on divided attention is disputed. Some have reported that patients show greater loss of performance than healthy controls when moving from single tasks to dual tasks, and others have reported that performance loss is similar in both groups or even that patients perform the dual task better than either task on its own (Allen, 1982). (González-Andrade et. al, 2021)

In addition to showing deficits in attention, studies also report that Individuals with schizophrenia exhibit higher cortical activity than those without the condition when engaged in less challenging attention tasks. However, when it comes to more demanding attention tasks, individuals with schizophrenia display lower cortical activity compared to those without the condition (Karch et al., 2009).

Research findings consistently demonstrate the difference in the attentional capacities of schizophrenic patients from normal controls in parts of the brain such as the particularly in regions considered to constitute an attentional network including the dorsolateral prefrontal cortex (DLPFC), the insula, the anterior cingulate gyrus (ACG), the amygdala, hippocampus, ventral striatum, thalamus and cerebellum (Liddle, et al. 2006). Research Studies use multiple assessment procedures such as the Continuous Performance Test (CPT) combining visual and auditory stimuli, evaluating participants' ability to respond to targets while ignoring distractors. The Trail Making Test (TMT) focuses on connecting letters and numbers in sequence swiftly. The Wisconsin Card Sorting Test (WCST) measures cognitive flexibility in adapting to

changing rules. The Stroop Colour Word Test (SCWT) assesses interference by challenging participants to identify ink colour instead of reading the colour name.

Memory

Is the unit that receives, stores, and analyses information (posterior neocortex); which Diamond, 2012 also includes the concept of Working memory.

Memory studies in Schizophrenia have tried to understand three processes, Encoding, Recognition and Recollection. While some report impaired encoding to be more pronounced (Lee & Park, 2005) , others report recognition and retrieval to be more pronounced. Individuals with schizophrenia exhibit intact shallow encoding, they struggle with deep encoding of information. Recognition paradigms also demonstrate impairments wherein familiarity remains unimpaired when item-specific encoding is employed, but it is severely impaired when a relational encoding strategy is necessary. Recollection is significantly impaired regardless of encoding processes. (Ragland et al, 1982).

Cohen, 1988 suggests significant impairments in measures of short term memory, and therefore, Goldman-Takic's neuropsychological model of schizophrenia relates memory dysfunction to the formal thought disorder characterised by failure to retain ideas, reported in schizophrenia. However, Individuals with schizophrenia may exhibit more pronounced retrieval deficits when actively recalling declarative information from long-term memory compared to short-term memory tasks like digit span. Hemsley, 1993 suggested that the breakdown between memory and perception results in difficulty in recall in schizophrenia.

Working Memory

The working memory, as its name suggests, is a slate which actively works on the information without its transfer to long-term memory. (Bowie and Harvey, 2006). Baddeley, 1986 suggested a model for working memory consisting of three components. The supervisory system is the central executive, which coordinates with various subsystems. The phonological loop, which controls linguistic and auditory information, and the visuospatial sketchpad, which controls visual and spatial data, are two examples of "slave systems". More recently, Repovs and Baddeley (2006) introduced the episodic buffer, a fourth element, to the model. Information from working memory, long-term memory, and other sources is integrated by the episodic buffer.(Kebir & Tabbane, 2007).

Schizophrenic patients have poorer test scores than healthy controls at a statistically significant level on tasks analysing phonological working memory such as Consonant Trigram Test, Digit Span Forwards and Backwards, DSDT versions, Verbal paired associate learning tests to name a few, as revealed in a metaanalysis conducted by Forbes et. al, 2008.

Patients diagnosed with Schizophrenia also have statistically significant impairments in visuospatial working memory analysed by tasks such as Tests of Pattern Recognition, Spatial Span Backwards and Forward, Immediate Visual Recall Learning Tests to name a few, as found in a meta analysis study by Forbes et. al, 2008. Meta Analytic study by Lee & Park, 2005 demonstrated deficits more consistently reported for visuospatial tasks than verbal working memory tasks.

Research has claimed that verbal working memory is a core deficit in schizophrenia. (Gold et al. 1997; Heinrichs & Zakzanis, 1998). In a meta-analysis study by Heinrichs & Zakzanis, 1998, they found fewer studies reporting performance on non verbal memory tasks. When they engage in tasks of working memory, patients with schizophrenia show less prefrontal brain activity compared to healthy controls (Cannon et al., 2005).

Cognitive Flexibility

Cognitive flexibility is defined as an ability to adapt to changing rules or categories. It is a unit that plans, organises, and regulates behaviour and cognition and is usually associated with frontal lobes. Diamond, 2012 includes creative thinking, viewing situations from multiple perspectives, and adaptability in response to changing circumstances in this part of executive functioning. Judgement, Planning, decision making, problem solving, reasoning also are cognitive skills that are part of executive functioning. (Suchy, 2009)

Adaptability

Pantelis et al. (2002) used an intradimensional (ID)/extradimensional (ED) task from the Cambridge Neuropsychological Test Automated Battery to evaluate the cognitive flexibility of patients in the categories of mild, moderate to severe, and chronic patients. In this task, which assesses discrimination and reversal learning, participants are required to modify their answers in accordance with predetermined guidelines designating figures as "correct" or "incorrect." Patients initially need to learn how to change their replies within a single feature category (the ID shift). Subsequent phases (known as the ED shift) need responses to be given to a variety of feature categories; for instance, reacting to coloured shapes instead of linear figures. He reported that first-episode schizophrenic patients show some success in shifting between categories (ED). However, moderately severe schizophrenic patients often struggle with the ED category shift due to a tendency to persevere. Patients with chronic schizophrenia tend to fail in both ID and ED shifting. Chronic or first-episode schizophrenic patients also exhibit difficulty inhibiting taught responses on the Wisconsin Card Sorting Test (Eisenberg and Berma, 2010), which can result in perseverative errors; this finding supports the nature of diminished ability of cognitive flexibility, which is also progressive in nature. This type of inflexibility is correlated with highly with occupational difficulties (Lysaker et al, 1995; Bowie & Harvey, 2006)

Problem Solving and Planning

A popular neuropsychological task for assessing planning and problem-solving abilities in people with a range of clinical problems, such as schizophrenia and ADHD, is the Tower of London (TOL) test. Rearranging coloured balls on pegs to fit a target configuration is the task at hand. One must adhere to certain guidelines, such as moving only one ball at a time and avoiding putting larger balls on smaller ones. The challenge grows increasingly difficult as players go through successive levels. Research consistently shows that people with schizophrenia typically do poorly on the TOL test, demonstrating deficiencies in planning abilities that may have an impact on daily functioning (Kaller et al., 2011; Balzan & Delfabbro, 2013).

Decision Making (DCM)

DMC is a four-dimensional notion that consists of the following: (1) comprehension of the information revealed; (2) appreciation of a specific situation; (3) reasoning related to that knowledge; and (4) ability to articulate a decision (Appelbaum & Roth, 1982). According to a study by Moser et al., 2002 suggested that there were no significant impairments observed on any of the MacArthur Competence Assessment Tool for Clinical Research (MacCAT-CR) subscales by people exhibiting positive symptoms of schizophrenia, however individuals exhibiting negative and disordered symptoms demonstrated a decreased ability to make decisions (DMC). Jeste et. al, 2006 concluded that a large proportion of individuals diagnosed with schizophrenia have significant impairment in decision making. This finding was corroborated by another experimental study which used the Iowa Gambling Task. It entails selecting two favourable (C, D) and two unfavourable (A, B) cards from four decks. The goal of the game is to maximise gains over several attempts. Evidence of varying degrees of

quality indicates that people with schizophrenia typically do badly on this test, selecting more cards from the unfavourable decks (A and B) and fewer from the favourable deck (D). Although less favourable deck C was chosen by them than by controls, the difference was not statistically significant. (NeuRA,2022)

Creativity

An interesting finding is the relationship between schizophrenia and creativity. Creativity is understood as novel, original, useful, effective ideas with possess some sort of utility. Although schizophrenic patients show creativity in terms of originality in terms of their neologisms and While there exist notable instances of exceptionally talented individuals who may have been diagnosed with schizophrenia (such as Vincent Van Gogh and John Nash), A meta analysis conducted by revealed that creativity has a negative relationship with schizophrenia, however a positive link between creativity and psychoticism or positive schizotypy was reported. (Acar et. al, 2018).

Many researchers have found impairment in almost most of the components of executive functioning. This is often referred to as **Dysexecutive syndrome**. The disruption of frontal lobe control on behaviour.

General Intelligence

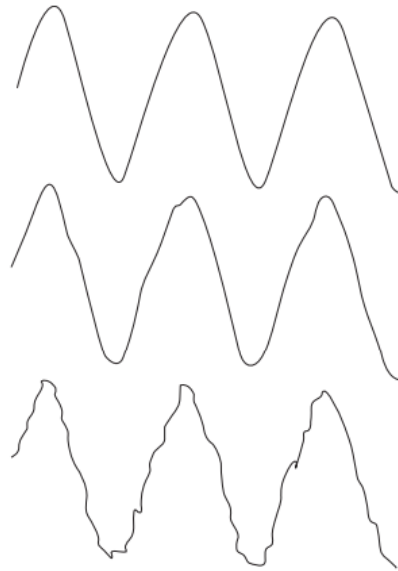
When compared to the general population, patients with schizophrenia typically have lower Intelligence Quotient (IQ) scores, and this difference is evident even prior to the start of psychosis. Low IQ is also considered a risk factor for developing schizophrenia (Butcher & Mineka, 2017). People with schizophrenia spectrum disorders have lower nonverbal reasoning skills and overall IQs. Inadequate performance on assessments of processing speed, like the Wechsler Intelligence Scale for Children's Coding subtest, can identify individuals who will go on to develop schizophrenia spectrum illnesses from those who won't. (Reichenberg et al., 2006; Sorensen et al., 2006; Seidman et al., 2006; Wilk et al., 2005).

Perception and Sensory Integration

Patients with schizophrenia have a difficult time working through a conceptual framework to understand ambiguous stimuli (Haut et. al, 1996), which indicates difficulties in perception and semantic processing. Schizophrenia patients show significant abnormalities in early visual and auditory processing. Between 54 and 86 percent of individuals with schizophrenia as compared to 8 percent people, have abnormalities related to their ability to track their eyes and have trouble with smooth-pursuit eye movement, which is the ability to follow moving objects like a pendulum. (Cornblatt et al., 2008; Levy et al., 2010).

The top pattern is the target, the middle pattern is a record of normal tracking, and the lowest pattern is the kind of abnormal record produced by some patients with schizophrenia.

(Figure from Levy et al. (1993). Eye tracking dysfunction and schizophrenia: A critical perspective. *Schizophrenia Bulletin*, 19(3), 461-536. Used with permission of Oxford University Press.)



Source: Butcher & Mineka, 2017

Patients experience difficulty in sensory situations that demand the integration of multiple elements, abnormal activation patterns have been observed in individuals with schizophrenia, highlighting difficulties in processing complex stimuli (Gur, 2010). Recent studies utilising virtual reality (VR) reveal that individuals with schizophrenia have difficulty in processing sensory information. Research by Ku et al, 2003 indicates that these patients exhibit difficulties in integrating visual and auditory stimuli effectively. Furthermore, Ku, Kim, and Kim, 2004 demonstrates impaired multimodal integration and working memory in schizophrenia patients, as they struggled to react to and remember complex multimodal stimuli.

Effects of Cognitive Impairments in Everyday Life

Impairments in cognitive functions pose serious difficulties in everyday living, which makes the disorder extremely distressing to the individual. For example, difficulties in attention in holding conversations, integrating with the community, comprehending essential instructions, reading and watching TV are difficult. (Green 1996; Green et al. 2000; Javed & Akhouri, 2020). Further, Executive dysfunction impedes their ability to carry out intricate daily tasks like going shopping, utilising public transportation, or organising a staff meeting in a professional setting (Tuburski et. al, 2021). Additionally, It offers difficulties in self-care, social, interpersonal, communal, and occupational functions (Lysaker et al 1995; Velligan et al 2000; McGurk et al 2003; Evans et al 2004; Bowie & Harvey, 2006). Cognitive Flexibility also predicts therapy outcomes for patients.

Structural Abnormalities

The structural abnormalities associated with Schizophrenia can be revealed by the use of brain imaging techniques such as MRI, fMRI. For the scope of the paper, these two techniques have been chosen, the former to provide insight into structural abnormalities, while the latter provides insight into functional correlates in the brain.

Magnetic Resonance Imaging

1. **Increased Volume of Cerebrospinal Fluid (CSF):** Individuals with schizophrenia often exhibit increased cerebrospinal fluid (CSF) volume, indicating enlarged brain ventricles and reduction in brain tissue. (Sadeghi et al., 2022). MRI scans reveal about 3 percent reduction in whole brain volume relative to that in controls (Hulshoff Pol & Kahn, 2008)
1. **Decreased Volume of White and Gray Matter:** Schizophrenia patients typically display reduced volumes of both white and gray matter in various brain regions. White matter abnormalities suggest disrupted connectivity, while grey matter reductions can affect cognitive and sensory processing (Sadeghi et al., 2022). A meta-analysis by Picó-Pérez et al. (2022) reported gray matter volume reductions in various brain areas, including the inferior, middle, and superior frontal gyri, temporal gyri, parahippocampal gyri, insulae, cingulate cortex, thalami, and caudate nuclei.
2. Patients with schizophrenia who experience psychosis may have larger Sylvian fissures and cingulum sulci, along with concomitant volume loss in the planum temporale, insula, and cingulum (Lee et al., 2016; Faria et al., 2021).
3. **Hippocampal and Anterior Cingulate Abnormalities:** A multimodal longitudinal cohort study led by Akira Sawa found reductions in hippocampal volumes and glutathione (GSH) levels in the anterior cingulate cortex (Yang et al., 2022).

Functional Magnetic Resonance Imaging

Functional magnetic resonance imaging (fMRI) studies in patients with schizophrenia have revealed a range of structural abnormalities in brain activation patterns during various tasks.

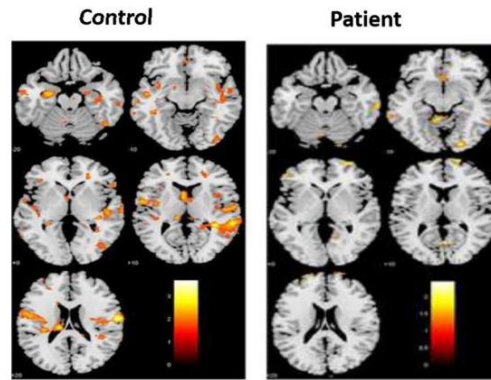
Memory. Patients with schizophrenia consistently show decreased activation in the dorsolateral prefrontal cortex during tasks related to working memory and cognitive problem solving. This has been associated with the severity of negative symptoms in patients (van Veelen et al., 2010).

Social Cognition and Emotional Processing. In tasks involving social and emotional situations, patients with schizophrenia exhibit hypoactivation in various brain regions, including the right occipital cortex, right fusiform gyrus, amygdala, hippocampus, and anterior cingulate cortex (Li et al., 2010; Anticevic et al., 2012; Taylor et al., 2012). In a study involving negative threat words, patients with schizophrenia showed hyperactivation in the angular gyrus, middle/inferior temporal gyrus, and the amygdala, especially in response to words that elicited more excitement or hostility. This was one of the rare instances of hyperactivation observed in patients with schizophrenia (Dar et al., 2021).

Attention. A meta-analysis by Picó-Pérez et al. (2022) noted decreases in activation in the dorsomedial prefrontal cortex, supplementary motor area, and right inferior frontal gyrus during cognitive tasks, particularly those related to attention and vigilance. These deficits were observed across multiple studies, emphasising their consistency in patients with schizophrenia. During the Stroop task, patients with schizophrenia showed failure of deactivation in the medial frontal cortex, indicating default mode network dysfunction (Salgado-Pineda et al., 2021).

Resting State fMRI

Finding abnormalities in cerebral functional connectivity connected to cognitive functions and medical problems can be advantageously accomplished by resting-state functional resonance imaging (rs-fMRI). Because rs-fMRI doesn't require inputs like task-based fMRI does, standardisation is easier. As can be noticed, that patients have much less brain activity as compared to controls.



Source: Gur & Gur, 2010

Cognitive models

Neuroanatomical Models postulate that disorders of Executive functioning can be located in specific brain regions and circuits. (Orellana & Slachevsky, 2013)

The Connectionist model of schizophrenia

Deficits in executive functioning, memory, and attention may be related to changes in brain connections between cortical and subcortical networks, for example, the heteromodal association cortex. Therefore, given the limited scope of the paper, the following models have been proposed by different authors which leads an insight into how impairment in neural networks lead to cognitive impairments, leading to manifestations of symptoms (Pantelis et al, 2002; Schmitt et al., 2011).

One such hypothesis is **Schizophrenia as a disruption of the fronto-striato-thalamic system**. According to this model, schizophrenia is associated with alterations in the prefrontal cortex, basal ganglia, and thalamus, impacting executive functions (Pantelis et al., 2002). Dysfunction in three key frontosubcortical circuits - the Dorsolateral Prefrontal cortex, Orbito Frontal Cortex, and Anterior Cingulate Cortex - may underlie cognitive and behavioural control deficits. Reduced blood flow to the prefrontal cortex has been linked to negative symptoms. (Orellana & Slachevsky, 2013)

Conclusion

This flowchart captures the essence of the entire term paper. It explains the Aetiology of Schizophrenia for a cognitive lens. At the same time, the paper also attempted to understand the impact of schizophrenia on cognitive abilities. We can conclude that executive dysfunction in terms of memory, attention and cognitive flexibility, along with other facets of general intelligence, leads to schizophrenia symptoms. Impairment in memory, attention and cognition also result as a symptom of schizophrenia. Therefore, the paper allows us to understand how compromised cognitive abilities act both as a cause and an effect of the disorder. Therefore, they serve as helpful in diagnosing schizophrenia.

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