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Cognitive Mechanisms Underlying Alterations in Language Function in Patients with Schizophrenia: A Narrative Review of the Evidence

*Ahmed Benaissa1**
1 University of Mostaganem (Algeria)
ahmed.benaissa@univ-mosta.dz
https://orcid.org/0000-0001-5482-0344

Abstract:

***Background**: Schizophrenia is one of the most common conditions that affects cognitive abilities and language, as it shows behavior is detached from reality, indication disturbance of cognition and language levels. **Objectives**: This study aimed to conduct a narrative review to investigate the profile of language alterations in comprehension and production and the cognitive mechanisms underlying these alterations. **Method**: A narrative review was conducted in 2024. Peer-reviewed studies published in databases related to language and neurocognition of patients with schizophrenia were selected for analysis. **Results**: Online databases were searched for key terms, and 20 articles were found. Articles were screened for inclusion and exclusion, and seven studies were included for analysis. Articles indicated that people with schizophrenia have language alterations in microstructures, especially grammatical deficits in receptive and expressive language, and macrostructures, a total deficit affecting pragmatics and linguistic context. Syntactic processing, executive functions, and theory of mind are underlying language alterations mechanisms. **Conclusion**: Language alterations include linguistic impairments at both micro- and macro-linguistic structures with syntactic processing and executive functions contributing as predictors.*

Dr. Ahmed Benaissa

Introduction:

Schizophrenia is one of the most common mental conditions for adults. According to the World Health Organization, schizophrenia affects approximately 1 in 300 people (0.32%) worldwide (WHO, 2022). Characteristic features of schizophrenia includes the separation from reality and disintegration on the emotional, linguistic, and mental levels, and it is common for people with schizophrenia to require psychological care and rehabilitation. Schizophrenia can also affect language and neurocognition. Such disturbances extend to language functions including receptive and expressive language, comprehension, and production. Specifically, literature has shown that the language and communication of patients with schizophrenia are characterized by detachment from reality, disjointed and incoherent speech, and deficits in the microstructures of language such as lexical, morphological, syntactic, and semantic, and deficits in the macrostructure of language such as pragmatism, context, and incomprehensible and ambiguous narration. Expressive and receptive language disorders in schizophrenia are described by reporting deficits in comprehension and production at the word and sentence level. (Gavilan & Garcia-Albea, 2011; Marvel, Schwartz, & Isaacs, 2004; Perlini et al., 2012; Rossell & Batty, 2008). Wernicke's aphasia shares some similar features to schizophrenia due to the presence of language production. However, this is not well documented due to the many differences in neurocognitive correlates and the nature of language disorders and dysfunctions. Schizophrenia can be diagnosed following assessment of a person's communication, due to the relative ease of assessing language production. The expressive language aspects of schizophrenia has received greater attention within research than aspects of language comprehension (Bagner, Melinder, & Barch, 2003; Kuperberg, 2010); Indicating, that people with schizophrenia have language production and fluency. However, the evidence related to comprehension or receptive language is under-researched, unlike expressive language, production, and the evaluation of discourse and speech in terms of coherence, connection to reality, and its conformity with real events, social cognition, emotions, and attribution. In addition to the interaction between neurocognitive processes and language, understanding and producing language are complex cognitive functions in the brain, and the contribution of executive and cognitive functions to understanding and producing language and communication. The study focuses on the cognitive mechanisms underlying communication and language alterations and disorders related to language comprehension and production in patients with schizophrenia. The study reviews the evidence related to the cognitive mechanisms underlying communication and

language impairment and alterations and language comprehension and production in patients with schizophrenia. Our study aimed to review the results of research related to cognitive mechanisms involved in language and communication and evidence of language alterations in comprehension and production in patients with schizophrenia.

Method:

Design:

The literature search was conducted in the following databases: ScienceDirect, PubMed, and Google Scholar. The keywords included "Language in schizophrenia", "Speech in schizophrenia", "Language processes in schizophrenia", "Neurocognition in schizophrenia". Each database was searched using the keywords. Furthermore, the reference lists of the included publications were thoroughly hand-searched and screened to discover other potentially relevant research.

Inclusion and exclusion criteria:

Studies related to speech and language in schizophrenia in production and comprehension and the neurocognitive mechanisms involved. All studies on receptive and expressive language in schizophrenia and its major and minor levels: lexical, morphological, syntactic, semantic, pragmatic, and discourse, published up to August 2024, were included. Studies were included according to the following criteria: Studies were included according to the following criteria: (a) being an original paper published in a peer-reviewed journal, (b) being an English language paper, (c) recruited and reported data for adults with schizophrenia, (d) reported findings from speech and language in schizophrenia. Articles not meeting these criteria were excluded from the analysis. Articles that did not have inclusion criteria were excluded

Results:

The search yielded 20 articles after the initial screening of titles and abstracts. Articles without inclusion criteria and with no language and cognition in patients with schizophrenia content and also reviews were excluded. In figure 1, the stages of the search, screening and inclusion process. Eight articles in total were included in the final review. Table 1 summarizes the results of the articles included in the review. Sample sizes did not vary significantly between the included studies, with between 30 and 55 people with schizophrenia. All studies focused on studying micro and macro structures of language by assessing the metaphorical or expressive language, or one or more of these aspects. There were insufficient studies in the field of language and neurocognition among patients with schizophrenia.

Figure 1: Flow diagram showing the Search, inclusion, and screening process

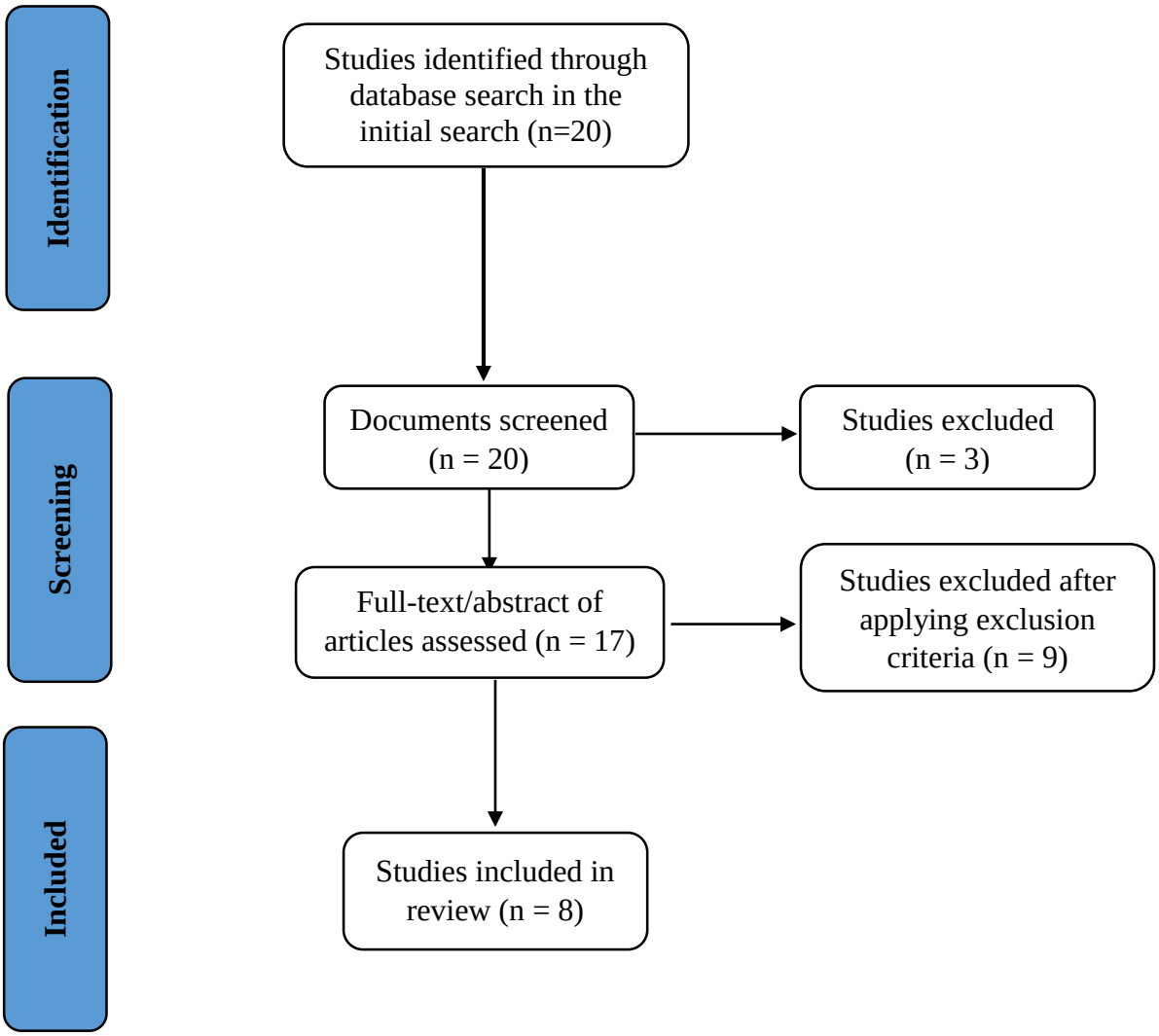

Table 1: Language and cognition studies in patients with schizophrenia

Reference (Year)	Study objectives	Study population	Outcome measurements	Main Findings	Study country
Martínez et al. (2024)	Investigating oral language production and the cognitive mechanisms underlying verbal communication alterations in patients with schizophrenia	Thirty five patients with schizophrenia Thirty five patients with Wernicke's aphasia (Mean age 42.66)	Semantic Image Matching Test Homonymous Image Identification Test Oral Denomination Test of Images Picture Arrangement Test	Patient with schizophrenia show deficits in lexical concept formation and markedly irregular and empty oral speech with speech errors and neologisms.	Cuba and Colombia
Tan & Rossell (2019)	To investigate whether performance on language tasks contributes to symptoms of formal thought disorder independently of neurocognitive functions in patients with schizophrenia.	Fifty-four patients with schizophrenia (Mean age = 43.35)	**Symptom assessment:** Scale for the Assessment of Thought, Language and Communication **Neurocognitive assessment:** the MATRICS Consensus Cognitive Battery, Delis-Kaplan Executive Function System Colour-Word Interference Test **Language assessment:** synonym identification task, Sentential Pairs and Meanings Task	Syntactic processing contributes significantly to the severity of formal thought disorder, independent of neurocognition. A specific relationship exists between language comprehension impairment and formal thought disorder.	Australia

Tan et al. (2016)	Investigating oral language comprehension and receptive language processing of words and sentences in patients with schizophrenia	Fifty-seven patients with schizophrenia (Mean age = 43.40).	**Language tasks:** Lexical recognition of words. Word meaning attribution (synonym). Sentence comprehension	Receptive language deficits at the grammatical level. Significant deficits in sentence comprehension to process deep structure which have been strongly associated with formal thought disorder. Relationship between some aspects of language comprehension and speech production and formal thought disorder.	Australia
Buck & Penn (2015)	Examining lexical properties and their association with cognitive variables.	forty two schizophrenic patients Forty eight healthy controls (Mean age = 42.50).	Narrative of Emotions Task Interview Lexical Software Emotion Perception Theory of Mind Attributional Style Social Functioning Role Functioning Psychiatric Symptoms.	Significant differences in the number of words per sentence between patients with schizophrenia and healthy controls. Language difficulties associated with schizophrenia include impaired social cognition and real-world performance.	Australia

Perlini et al. (2012)	Investigating linguistic abilities in macro- and microstructures Assessing grammatical comprehension skills in patients with schizophrenia.	Thirty schizophrenic patients (Mean age = 39.70)	Narrative production: microlinguistic analysis, macrolinguistic analysis, Analysis of informative content, Analysis of textual organization. Syntactic comprehension.	Language disorder in macro and micro structures. Language deficit in speech rate, discourse coherence and grammatical comprehension.	Italy
Walenski et al. (2010)	Investigating language and morphology in patients with schizophrenia.	Forty three patients with schizophrenia. Forty two healthy controls (Mean age = 35.30).	Past tense production task.	Patients with schizophrenia showed language impairments in morphology and syntax and impaired performance in regular and novels tenses. Scores of thought disorders predicted their performance in producing regular and novels tenses.	USA
Tavano et al. (2008)	Investigating the syntactic and pragmatic components of expressive and receptive verbal abilities in patients with schizophrenia.	Thirty seven patients with schizophrenia. Thirty seven healthy controls. (Mean age = 39.73).	Narrative measures: story-telling task Conversational measures: semistructured conversational template. Syntactic comprehension measures: computer-based Syntactic comprehension test. Pragmatic comprehension measures: test of	Patients with schizophrenia showed lower word production and fluency in narrative and conversation. They also had less grammatical diversity and grammatical and pragmatic deficits.	Italy

			metaphor and idiom comprehension.	Patients with schizophrenia had grammatical abilities in receptive language.	
Marini et al. (2008)	Assessment of micro and macro language abilities, the impact of language processing, and neuropsychological predictions of language performance in patients with schizophrenia	twenty-nine schizophrenic patients forty eight healthy controls (Mean age = 43.4)	**Neuropsychological assessment:** the Mini Mental State Examination, language (Phonological Verbal Fluency; Categorical Verbal Fluency), verbal memory, visual memory (Immediate Visual Memory), and logical reasoning, the Copy of the Rey–Osterrieth Complex Figure Test, Wisconsin Card Sorting Test, psychomotor speed, attention, Trail Making Test **Assessment of narrative abilities:** Three stories with the help of a single picture stimulus and two cartoon stories each containing six pictures.	Total language deficit in macro structures and relative in microstructures. Deficits in attention and executive function are predictors of language impairment.	Italy

Martínez et al. (2024) investigated the cognitive mechanisms contributing to speech and verbal behaviors in patients with schizophrenia compared to Wernicke's aphasia, and aimed to identify mechanisms contributing to alterations in oral communication disorders. Semantic matching tests of pictures, identification of similar pictures, and verbal naming of pictures and picture stories were administered to 35 people with schizophrenia. The study concluded that communication disorders amongst people with schizophrenia are not related to

neurolinguistic changes. Unlike for patients with Wernicke's aphasia, which results from neurological changes, and that language and communication disorders in schizophrenia are not linguistic feature. The results indicated that patients with schizophrenia might be affected by changes in the formation and classification of abstract concepts. In contrast with Wernicke's aphasia, patients with schizophrenia did not produce paraphasias and the neologisms and the invention of new words, but not phonological and grammatical paraphasias. Difficulties in forming and processing lexical concepts, intellectual distortions, and disorganized, vague, and disconnected speech are consequences of the disorder of formal thought.

Tan & Rossell (2019) examined whether language comprehension impairment had a significant effect on the severity of formal thought disorder independent of neurocognitive impairment by examining the relationship between formal thought disorder and language comprehension of single words and sentences. 54 patients with schizophrenia were assessed on tasks of language comprehension, executive functions, and symptoms of formal thought disorder. The study found that sentence-level grammatical task accuracy significantly predicted severity of positive formal thought disorder symptoms, and word-level language processing did not significantly predict severity of positive formal thought disorder symptoms after controlling for neurocognitive functions. The results suggest that language specific impairments in grammatical function occur concurrently with neurocognitive deficits in the mechanisms of some formal thought disorder symptoms. The grammatical impairment appreciation of deep structure may contribute to some of the differences in speech patterns seen for some patients with schizophrenia. Semantic sentence processing and single-word semantic processing did not contribute to the severity of positive formal thought disorder symptoms.

Tan et al. (2016) described the profile of receptive oral language processing and aspects of word and sentence language comprehension and their relationship to symptoms of formal thought disorder in patients with schizophrenia by examining the role of lexical processing and the attribution of meaning to words and sentences and the relationship between comprehension and production. Word and sentence comprehension, Lexical recognition, and synonym identification tasks were administered to fifty-seven patients with schizophrenia compared with healthy controls. The study found that lexical recognition and synonym recognition for patients with schizophrenia did not differ significantly compared to people without schizophrenia, with rapid responses in high-level word recognition and similar error rates in the synonym and lexical recognition tasks.

In a sentence comprehension task, patients with schizophrenia had increased syntactic errors when changing sentence structure, which was associated with increased severity of symptoms of positive formal thought disorder. These results indicate the impairment of grammatical processing in receptive language when changing structures and grammatical manipulation for patients with schizophrenia and its association with symptoms of formal thought disorder. The defect in oral language is related to grammatical structures and not lexical processing with no difficulties in assigning meanings to individual words and finding synonyms based on phonological similarity.

Buck & Penn (2015) examined lexical differences to characterize the cognitive features of speech disorders present for patients with schizophrenia. The lexical characterize of emotion narratives in patients with schizophrenia were compared with and the cognitive domains predicted by these lexical characterize were examined. Emotional narrative and social cognition were assessed in 42 patients with schizophrenia and the association between social characteristics of narrative and cognition was assessed. Patients with schizophrenia had an increased use of pronouns and personal pronouns in narratives, which suggests impairments in theory of mind, social cognition, and attribution. Since pronoun use involves using representations of other people's minds, increased use of negative emotional words was associated with impairments in theory of mind and attributional biases. Words in a sentence were a strong predictor of real-world functional outcome. The tendency to use more complex sentences when emotionally narrative may be related to performance in occupational and social settings. These results suggest that linguistic features can serve as sensitive and specific indicators of the diagnostic status of schizophrenia and that increased use of the pronoun in emotional narratives is associated with poor social cognition.

Perlini et al. (2012) investigated micro- and macro-linguistic abilities and grammatical comprehension skills in patients with schizophrenia. 30 patients with schizophrenia were assessed on a storytelling task and a grammatical comprehension task. The study found difficulty in producing narratives, as production was at a low rate of speech flow, grammatical errors, and less grammatical complexity. This indicates a defect in the microstructures of the language and a deficit in the macro-structures, including a lack of coherence of the discourse, a pragmatic weakness, and a defect in grammatical understanding.

Walenski et al. (2010) investigated language at the morphological level for patients with schizophrenia by assessing past tense forms of regular, irregular, and novel verbs and the correlation of the degrees of thought disorder in patients with the production of past tense. Past tense production tasks were administered to 43

patients with schizophrenia. The study found that patients with schizophrenia showed deficits in producing past tenses for regular and novel verbs compared to irregular verbs. Patients with schizophrenia were found to have impaired grammatical and morphological processing, syntactic abnormalities, and an association between thought disturbance and the production of regular and novel past tense forms.

Tavano et al. (2008) examined the grammatical and pragmatic components of expressive and receptive verbal abilities in patients with schizophrenia and analyzed the production of elicited narratives and grammatical and pragmatic receptive abilities. The study discovered that schizophrenia patients had severe impairments and declines in syntactic diversity and speech fluency indicators, as well as lower access to syntactic structures, indicating impairment. Patients with schizophrenia take longer to organize speech, produce fewer words, have poor grammar, word repetition, and poor lexical variety. This is due to poor mind-reading ability. People with schizophrenia show difficulties in repeating complex syntactic sentences, syntactic understanding, metaphor understanding, and idiom understanding. This involves pragmatic difficulties, with understanding metaphors and idiomatic expressions being linked to errors in grammatical understanding, i.e. the fewer grammatical errors the more pragmatically appropriate explanations can be provided. Processing metaphors and idiomatic expressions involves not only pragmatic reasoning in choosing between two alternative meanings of an expression, but also syntactic abilities.

Marini et al. (2008) investigate the analysis of micro and macrolinguistic abilities and their neuropsychological correlates and description of language impairment at the lexical, morphological and pragmatic levels and the extent to which impairment of cognitive neurological processes is related to language impairment amongst patients with schizophrenia. The finding described language impairment at the lexical, morphological, and pragmatic levels and the extent to which impairment of cognitive neurological processes is related to language impairment in schizophrenia patients through the description of a picture story, animation, and performance on executive function tasks. The results indicated a mild deficit in processing the small structures of the language and a severe deficit in the large linguistic dimension of processing. The speech of patients with schizophrenia was characterized by verbosity, the production of a greater number of words, and semantic grammatical errors, and its association with executive functions and lexical-semantic errors were associated with difficulties in global reasoning and sequencing. In the major linguistic processing dimension, the production of narratives by patients with schizophrenia was less informative and informed, and

empty, semantically disorganized, less coherent, ambiguous, and vague discourse was associated with executive deficits. The variance in discourse coherence errors was explained by the performance of executive function tasks. This shows that selective and executive attention deficits and inhibitory processing are associated with difficulties in planning conceptual messages and, at the lexical level, with selective attention problems in the semantic selection process at the level of the argument. The results indicate that the slight deficit at the microlinguistic level of processing results from the processing deficit at the macrolinguistic level.

Discussion:

This narrative review investigated and provides of an account of the context of research into the cognitive mechanisms and underlying language associated for patients with schizophrenia, focusing on both language comprehension and production in patients with schizophrenia. The reviewed literature states that people with schizophrenia exhibit numerous language alterations. The review included 8 studies and the results agreed on language deficits at the grammatical level and the macrostructures of the language. The language profile of patients with schizophrenia was characterized by poor coherence of discourse, empty and disorganized speech, less fluency in narrative and conversational speech tasks, and expressive language with reduced grammatical diversity. Evidence suggests that syntactic processing contributes to the prediction of alterations in receptive and expressive language. Language disorders are associated with impairments in social cognition, theory of mind, lexical concept formation, and poor pragmatic inferential processing abilities, as well as deficits in executive and attentional functions. The studies reviewed as part of the narrative review indicate that there is a significant deficit at the grammatical level, with lesser effects at the lexical, semantic, and phonological levels, with results showing that patients with schizophrenia had poorer performance in grammatical and morphological structures in sentences. The studies have reported deficits in syntactic comprehension and production related to receptive and expressive language, grammatical processing, and microstructural language. People with schizophrenia suffer from linguistic alterations that appear in grammatical deficits in the microstructures of the language and the deficit in pragmatics, verbal narrative, disorganized and empty speech, and the generation of new words in the macrostructures of the language is related to indicators of formal thought disorder. Patients with schizophrenia had more difficulty with the macrostructure of language than in the microstructure of language. At the pragmatic level, there were difficulties in reasoning and a deficit in referential coherence. The deficit in the macrostructure likely affects language at the microstructure level. Formal

thought disorder is a language profile that affects the speech production of schizophrenia patients and is characterized by disorganized, incoherent, and empty speech due to disorganized thought and detachment from reality. Grammatical processing contributes to the severity of formal thought disorder. The weak appreciation of the deep structure of the sentence has an impact on the emergence of symptoms of formal thought disorder and impaired grammatical processing is a mechanism contributing to symptoms of formal thought disorder without generalizing to all functions of language. Some evidence has shown that the symptoms of formal thought disorder are associated with a significant language deficit in sentence comprehension and processing of the sentence and deep structures. On the other hand, there is evidence of a relationship between some aspects of language comprehension and speech production and formal thought disorder. In addition, grammatical errors increased with the severity of the symptoms of formal thought disorder and the deficit in attributing sentence meaning and poor appreciation of linguistic context were associated with the symptoms of formal thought disorder. The articles reviewed showed insufficient evidence to report significant neural changes as a mechanism involved in language alterations from functional magnetic resonance imaging evidence, but there was an influence of neurocognitive processes including grammatical and pragmatic processing, executive functions, concept formation, and theory of mind. The cognitive dimension is also expected to contribute to explaining linguistic changes in schizophrenia, similar to grammatical and pragmatic processing. Impaired attention, working memory, and problem-solving are likely to be contributing factors to the effects on language alterations.

Conclusion:

Language alterations in the speech of schizophrenic patients are evident and significant. The findings of the reviewed evidence showed language impairment at the level of micro and macro structures of speech and discourse through narrative and conversational speech tasks. The linguistic profile of the schizophrenic includes grammatical errors at the microstructural level and a total deficit in pragmatic skills and discourse context at the macrostructural level. Fewer errors and language disorders in the word and sentence at the lexical, semantic, and phonological levels compared to the morphological and syntactic levels. On the other hand, evidence has shown that grammatical processing, grammatical comprehension skills, and formal thought disorders contribute to predicting receptive and expressive language functions. There is no evidence that functional neurological changes contribute to language and communication in patients with schizophrenia, which is under investigation. Speech in

schizophrenia patients and the mechanisms underlying changes in language and communication functions need further investigation, as well as clinical and experimental contributions to verify the factors influencing the language process and schizophrenia and contribute to rehabilitation programs.

Recommendations:

Schizophrenia patients exhibit language impairments affecting both micro and macro language structures due to cognitive deficits. Therefore, standardized assessment procedures are required for clinical diagnosis screening, and investigation of linguistic and cognitive assessment.

Strengthening the role of speech and language therapists and cognitive rehabilitation in the field of mental illness to improve the quality of life of patients with schizophrenia, psychosis, and Alzheimer's.

Reliance on cognitive assessment in cognitive rehabilitation and language therapy

Longitudinal studies to investigate language alterations, taking into account pharmacological treatment.

Investigation of anatomical and neuroimaging studies to determine the correlation between neural regions and language abilities.

Design of language therapy programs for patients with schizophrenia.

Comparison of linguistic and cognitive symptoms in patients with schizophrenia, aphasia, and Alzheimer's disease in diagnosis and treatment.

Conflict of interest:

The author declares that he has no conflict of interest.

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