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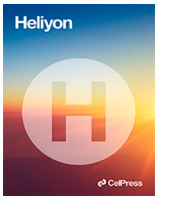

Review article

Language and communication rehabilitation in patients with schizophrenia: A narrative review

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ABSTRACT

Language impairments often appear in patients with schizophrenia and are potential targets for rehabilitation. Clinical practice and research should be intimately connected. The aim was to perform a narrative review of the assessment and intervention tools that have been used for the rehabilitation of schizophrenia patients with language and communication impairments. Two types of tools, general and specific, were developed for both purposes. General tools include the Positive and Negative Syndrome Scale for assessment, and the Integrated Psychological Therapy for intervention. The specific tools used to evaluate language and communication impairments include the Scale for the Assessment of Thought, Language and Communication, the Formal Thought Disorder scales (for caregivers and patients), and the Thought and Language Disorder scale. The most recent language-specific intervention tools include the Cognitive Pragmatic Treatment, Conecta-2, Let's talk! Multimodal Speech-Gesture training, Speech Therapy Intervention Group, and PragmaCom. These tools primarily involve psychopathology/psychiatry, psychology, linguistics, speech and language therapy, and nursing. In conclusion, a wide range of assessment and intervention tools are available for the rehabilitation of language and communication impairments associated with schizophrenia. An integrative and interdisciplinary approach should always be considered for rehabilitation of language and communication in patients with schizophrenia throughout their lifetime.

1. Introduction

Language is a basic skill in humans that facilitates communication with their environment, mainly with other humans. Communication has also been recognized by the International Communication Project as a human right which is embedded within Article 19 of the Universal Declaration of Human Rights [1]. This project highlights the importance of human communication and the significant impact of communication disabilities on every aspect of life, including positive social relationships, literacy, and employment, and the need to enable those with communication disability to fully access and participate in society [2].

1.1. Heterogeneity of language and communication impairments in schizophrenia

According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders [3], a key feature of the schizophrenia

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spectrum as well as of other psychotic disorders is disorganized speech. However, the term 'disorganized speech' remains ambiguous and is often used as a replacement of the formerly used term 'formal thought disorder' (FTD), clinically considered as 'impairments in the production of language and subjective alterations in the thought process' [4]. In fact, the term FTD was replaced by 'disorganized speech' as the latter can be object to direct observation and assessment, whereas the former can only be deduced from other deviations in overt behaviour.

From a psychopathological approach, Andreasen defined many, but not all, language impairments in her well-known and broadly disseminated Scale for the Assessment of Thought, Language, and Communication (TLC) [5,6] presently with 20 items [7]. For example, in the TLC *derailment* was defined as: 'a pattern of spontaneous speech in which the ideas slip off the track onto another one that is clearly but obliquely related, or onto one that is completely unrelated'; *tangentiality,* as 'replying to a question in an oblique, tangential, or even irrelevant manner', and *poverty of speech* as 'restriction in the amount of spontaneous speech so that replies to questions tend to be brief, concrete, and unelaborated'.

More recently, the 30-item Thought and Language Disorder scale (TALD) was developed to assess objective and subjective impairments, and the following four FTD factors were found: objective positive (16 items, including derailment, crosstalk, dissociation of thinking, and tangentiality), subjective negative (7 items, including poverty of thought, inhibited thinking, and dysfunction of thought initiative and intentionality), objective negative (with the items poverty of speech, slowed thinking, and concretism), and subjective positive (with the items pressure/rush of thought and thought interference) [8].

Indeed, a broad range of language impairments has been described in individuals with schizophrenia [4,9]. Although language is often affected in patients with schizophrenia, the impairment pattern is not homogenous among these patients. For oral language, expressive language impairments may affect verbal and non-verbal communication, such as poverty of speech content, perseveration and tangentiality, blocking, slowed verbal fluency, and lack of prosody [8,10]. Receptive language impairments include dysfunction in receptive speech ('the meanings of words, word sequences or sentences, for example in conversations, movies and radio programs, can only be grasped or understood incompletely, with effort, or not at all') [8], proverb comprehension [11], and metaphor comprehension [12].

1.2. Clinical relevance of language and communication impairments in schizophrenia

Language impairment affects communication and social interaction and may appear at the semantic level of language [13–15], but also at pre-lexical and syntactic levels [13,15,16]. However, the most obviously disordered level in schizophrenia is pragmatics [17], which means the ability to process the relationship between language and context. Pragmatic impairment may affect both language production and comprehension, and includes failures in maintaining thematic coherence and respecting the rules of conversation, and deficits in comprehending non-literal language, such as ironic or idiomatic expressions, respectively [18]. Therefore, pragmatic deficits have been suggested as a core feature of schizophrenia [18]. They are associated with different types of objective FTD, both positive (derailment; loss of associations; an increased amount of produced speech, such as logorrhoea and pressured speech; neologisms, and stilted speech) and negative (poverty of speech and slowed thinking) [8].

These language and communication impairments are potentially linked to executive deficits [19], social cognition impairments [20], and global functioning impairments [21,22]. In addition, they may be a potential marker of illness severity [23,24]; the prognosis is poor if they appear in early stages of disease [25].

Language and communication impairments have also been proposed as 'biomarkers' of schizophrenia [26,27] as they may help identify patients at risk of psychosis before its actual onset [28–31], even in the pediatric population [32]. Furthermore, some personal or environmental factors might predispose the patient to these language and communication impairments, including male gender [33], a long duration of illness [34], and the presence of social stressors [35].

Similar to the development of precise interventions for the rehabilitation of social cognition in schizophrenia, using either visual or auditive stimuli [36,37], there is an increasing awareness of the development of language and communication interventions in patients with schizophrenia. A systematic review of the importance of speech and language therapy as a rehabilitation measure for patients with schizophrenia identified 18 interventions, most of which addressed pragmatic and expressive discursive skills [38]. However, given the large variety of approaches and settings (group vs. individual, frequency, duration, method, and content of the intervention), there is no consensus on best clinical practice yet. Consequently, communication impairments are still almost absent from rehabilitative care in patients with schizophrenia [17,38,39].

Continuing research on the topic should help rehabilitation services to select the most suitable tools for assessment and intervention, considering recent developments and structured procedures. With support of an accurate and comprehensive assessment for potential language impairments, targeted interventions can be planned and validated.

Unfortunately, a very limited number of reviews addresses tools that have been used for assessment and intervention of language impairments in schizophrenia. We have only found our review of assessment tools in Spanish [40], only one review of intervention tools, published in English in 2016 [38], and a mixed review of assessment and intervention studies from the speech and language therapy perspective in Spanish, where only one intervention tool was obtained [16].

Therefore, and based on the assumption that assessment and intervention in rehabilitation need to be intimately connected in clinical practice and research, the aim of this paper was to perform an updated narrative review, according to an integrated and multidisciplinary approach, of the assessment and intervention tools that have been used for the rehabilitation of language and communication impairments in patients with schizophrenia.

2. Materials and methods

The inclusion criteria for publications in this review were as follows: (i) original papers and books on assessment or intervention tools for rehabilitation of language and communication impairments and/or thought disorders in patients with schizophrenia; (ii) language of publication: English, French, German, Spanish, or Portuguese; (iii) papers published before November 2023; and (iv) full-text papers.

The extracted information is presented in Table 1, following the CONSORT schema: (i) for assessment and intervention tools, the type[1] (general/specific); (ii) for psychopathological assessment tools, the modality (oral, including verbal and non-verbal communication/written/others), method[2] (objective/subjective/mixed), structure (number of language and total number of items), and language function[3] (expressive/receptive/mixed, meaning expression, or comprehension functions); and (iii) for intervention tools, the format (individual/group), structure in phases (yes/no), length (number and frequency of sessions and duration of sessions and interventions), patients (groups, sociodemographic characteristics, and diagnosis), type of study (non-controlled study, non-randomized controlled study, randomized controlled study, and other studies) and main results after the intervention in the following domains: language and communication, neurocognition, psychopathology, psychosocial functioning, quality of life, and social cognition. Please see Table 1 and footnotes for an overview of variables and main definitions.

3. Results

3.1. Tools used for language assessment in schizophrenia

Different approaches have been used to assess the language and communication abilities of patients with schizophrenia; consequently, a broad range of scales, tests, and other assessment tools have been developed. These tools primarily involve the disciplines psychopathology, psychology, linguistics, and speech and language therapy.

3.1.1. Psychopathological approach

A total of 18 assessment tools were obtained in this approach. According to the previously established variables and definitions, they were classified using two criteria: type (general/specific) and method (objective/subjective/mixed). Three distinct groups of language assessment tools were identified [40] with five, seven, and six tools. The first two groups were general tools and differed in method, the first one being objective general language assessment tools [41–46]. The second group was consequently subjective general language assessment tools [47–54]. Finally, the third group was specific language assessment tools [5,6,8,55–57]. This third group with specific tools included four only using the objective method, one only using the subjective method and one using both methods; to improve clarity we have joined them in a single group. All the 18 tools involve the oral modality and verbal communication, meaning that no language assessment tools for non-verbal communication in schizophrenia were found from this perspective. See Table 2 for further details.

3.1.2. Additional approaches

From a psychological and linguistic perspective, there is also an extensive variety of assessment tools, including the two equivalent forms of the *Assessment Battery for Communication* (ABaCo) [58] and *Assessment of Pragmatic Abilities and Cognitive Substrates* (APACS) [59]. Satisfactory psychometric properties were obtained for both of them [58,59]. Other methods for studying and analyzing the language used in schizophrenia include automated analysis of speech, natural language processing, and machine learning [60–63].

Furthermore, research carried out from the speech and language therapy approach has also used a number of different assessment tools: i) an *ad hoc* designed battery for lexical-semantic and phonological assessments in patients with schizophrenia compared to controls (n = 48 in both groups), with tests for semantic fluency, phonological fluency, lexical ambiguity, semantic association, and phonological processing [64]; ii) the *Boston Naming Test* [33], the *Controlled Oral Word Association*, and a *Sentence Repetition test* in a single 53-year-old male case of a speech and language therapy intervention [65]; and iii) the *Montreal Assessment Communication Brief Battery* to evaluate the effect of a new group intervention on language [66].

3.2. Language intervention tools in schizophrenia

Similar to the heterogeneous situation for diagnostic tools, intervention tools for the rehabilitation of language and communication in patients with schizophrenia have also been developed using various approaches, including the perspectives of psychopathology, psychology, linguistics, speech and language therapy, and nursing. Joyal et al. (2016) reported that most of the 18 selected studies comprised pragmatic or expressive discursive skills as the only aim of therapy (or part of it); the therapeutic approach was mainly

[1] General type means 'focused on language and other domains or functions', and specific type means 'focused on language without other domains or functions', as indicated in Table 1.

[2] Objective method means 'usual clinical observation or interview', subjective method means 'interview focused on inner experiences or using a self-questionnaire', and mixed method means 'use of both methods', as indicated in Table 1.

[3] Expressive means 'expression or production function', receptive means 'comprehension function', and mixed means 'both functions', as indicated in Table 1.

Table 1
List of extracted information.

Psychopathological assessment and intervention tools	Type • General: focused on language with other domains or functions • Specific: focused on language without other domains or functions
Psychopathological assessment tools	Modality • Oral: verbal/non-verbal communication • Written • Others Method • Objective: usual clinical observation or interview • Subjective: interview focused on inner experiences or using a self-questionnaire • Mixed: use of both methods Structure • Number of language items • Total number of items Language function • Expressive: addresses expression or production function • Receptive: addresses comprehension function • Mixed: addresses both functions
Intervention tools	Format • Individual • Group Structure in phases • Yes • No Length • Number of sessions • Duration of one session • Frequency of sessions • Duration of intervention Patients • Groups • Sociodemographic characteristics: n, sex distribution, mean age, age range • Diagnosis Type of study • Non-controlled study • Non-randomized controlled study • Randomized controlled study • Other studies Domains of results after intervention • Language and communication • Neurocognition • Psychopathology • Psychosocial functioning • Quality of life • Social cognition

variants of operant conditioning [38]. Furthermore, although evidence tended to show that certain areas of language are treatable through therapy, it was difficult to state which type of approach should be implemented to best treat which language impairment in schizophrenia [38]. In our review, similar to how we approached the literature on language assessment tools, language intervention tools were classified according to variable type into general and specific tools.

3.2.1. General interventions on language

Among all the tools that might be included in this section, we have considered three criteria: efficacy, dissemination, and association with brain changes. Two general interventions on language have been selected. The first one is the *Integrated Psychological Therapy* (IPT), developed at the University of Bern, Switzerland [67,68]. It is an effective and worldwide disseminated program that aims to address both cognitive training and therapy for social deficits, with language ability representing a transition position between cognitive and social impairments [67,68]. In particular, the verbal communication and social skills subprograms focus on communication and social interaction; the remaining ones (cognitive differentiation, social perception, and interpersonal problem solving) also target various impairments in lexical-semantic and pragmatic levels of language. The minimum period of intervention with the whole program is six months [67,68].

The second one is *REHACOP*. It is a structured program targeting five different cognitive domains: attention, processing speed, memory, language, and executive functioning; more recently, three additional domains were added: activities of daily living, social cognition and relational abilities, and psychoeducation [69,70]. The intervention was based on paper-pencil tasks, using the principles of restoration, compensation, and optimization. The setting of the program allows both, the individual and the group administration (between 5 and 8 patients per group). The minimum period of intervention with the original five domains is three months.

In both programs, the level of cognitive effort and demand of exercises gradually increased, and practice in real life context is

Table 2
General and specific psychopathological assessment tools of language in individuals with schizophrenia.

Author(s) and year	Tool name	Type	Method	Structure[a]	Language function
Overall and Gorham, 1962 [41]	Brief Psychiatric Rating Scale (BPRS)	General	Objective	Across the different versions: 1/16, 1/18, 1/24	Expressive
Bobon et al., 1986 [42]; Bobon and Woggon, 1986 [43]	AMDP system	General	Objective	13/100	Expressive
Andreasen, 1984 [44]	Scale for the Assessment of Positive Symptoms (SAPS)	General	Objective	9/34	Expressive
Andreasen, 1984 [45]	Scale for the Assessment of Negative Symptoms (SANS)	General	Objective	5/25	Expressive
Kay et al., 1987 [46]	Positive and Negative Syndrome Scale (PANSS)	General	Objective	4/30	Expressive - Receptive
Süllwold, 1986 [54]	Frankfurt Complaint Questionnaire, FCQ (*Frankfurter Beschwerde Frageboben*, FBF)	General	Subjective	10/98	Expressive - Receptive
Huber, 1986 [48]; Gross et al., 1987 [49]	Bonn Scale for the Assessment of Basic Symptoms (BSABS)	General	Subjective	2/100	Expressive - Receptive
Vargas and Jimeno, 2002 [53]	ESEA (*Evaluacion Subjetiva de Errores Atencionales*)	General	Subjective	3/13	Expressive - Receptive
Schultze-Lutter et al., 2007 [51]	Schizophrenia Proneness Instrument, Adult version (SPI-A)	General	Subjective	2/35 (+21 optional items)	Expressive - Receptive
Schultze-Lutter et al., 2012 [52]	Schizophrenia Proneness Instrument, Child and Youth version (SPI-CY)	General	Subjective	2/49 (+3 optional items)	Expressive - Receptive
Dollfus et al., 2016 [47]	Self-Evaluating of Negative Symptoms (SNS)	General	Subjective	4/20	Expressive
Pienkos and Sass, 2017 [50]	Examination of Anomalous World Experience (EAWE)	General	Subjective	1/6 domains; language domain: 10 subtypes	Expressive - Receptive
Andreasen, 1979 [5–7]	Thought, Language and Communication scale (TLC)	Specific	Objective	20 items	Expressive
Marengo et al., 1986 [55]	Bizarre-Idiosyncratic Thinking (BIT), Comprehensive Index of Positive Thought Disorder	Specific	Objective	5 categories and 11 subcategories	Expressive
Chen et al., 1996 [56]	Clinical Language Disorder Rating Scale (CLANG)	Specific	Objective	17 items	Expressive
Barrera et al., 2008 [57]	Formal Thought Disorder Scale for carers (FTD-c)	Specific	Objective	33 items	Expressive (Receptive)[b]
Barrera et al., 2008 [57]	Formal Thought Disorder Scale for patients (FTD-p)	Specific	Subjective	29 items	Expressive (Receptive)[b]
Kircher et al., 2014 [8]	Thought and Language Disorder scale (TALD)	Specific	Objective Subjective	30 items	Expressive - Receptive

Note.
[a] For general assessment tools, language items/total items; for specific assessment tools, number of items or categories.
[b] Mostly expressive language function.

promoted.

3.2.2. *Specific interventions on language*

In terms of specific interventions on language, to our knowledge one of the first initiatives was the *program of communication skills* for individuals with schizophrenia, that was designed for educational purposes, and presented in a national conference [71]. The intervention was structured into four modules containing a total of 16 sessions: presentation, skills of approaching others, skills of relating with others, and assertiveness [71]. The program enabled the acquisition and use of communication skills in a group of young patients (18–25 years) compared with a group receiving broader cognitive interventions; however, limited information about the methodology and results in language assessment is provided [72]. Therefore, we could not include it properly in our review.

A comparison of characteristics and post-intervention results of seven specific interventions for language is presented in Table 3. These interventions have been developed in different languages and countries: an individual speech and language therapy intervention in USA [65], Cognitive-Pragmatic Treatment (CPT) in Italy [73], Conecta-2 in Chile [74], Let's talk! in Portugal [75], Multimodal Speech Gesture (MSG) training in Germany [76], the Speech Therapy Intervention Group (STIG) in Brazil [66], and the PragmaCom in Italy [39].

3.2.2.1. Speech and language therapy intervention. The first intervention was individually designed by a speech and language therapist for the aforementioned clinical case [65]. Two phases of speech and language therapies were implemented. In Phase 1, reducing the patient's anxiety and increasing his awareness of his communication systematically progressed through eight stages, from an active non-verbal participation to providing personal factual information. Relaxation exercises were also performed. In phase 2, to increase language productivity and awareness of social communication skills, a hierarchy consisting of two stages was followed: first, engaging in shared tasks that required verbal interaction and second, engaging in factual conversations. Specific objectives included to sit

Table 3
Results of specific interventions on language in patients with schizophrenia.

Tool name (Author(s) and year)	Setting Length	Participants	Type of study	Results after intervention	Comments
– Clegg et al., 2007 [65]	individual Two sequential phases with the same general objectives. Phase 1: 15 sessions (45 min each), once a week, 15 weeks. Phase 2: 10 sessions (45 min each), once a week, 10 weeks.	A 53-year-old male inpatient with a paranoid schizophrenia and concurrent depressive episode. Main impairments: severe poverty of speech, anxiety when talking, social phobia, and increasing withdrawal isolation.	Non-controlled	**LC:** Improvement in the Improvement in the mean length of utterance (score = 3.4 vs 8.5) and written short self-description (unable to complete vs able to complete). Unchanged score in Attitude to Communication scale (both scores = 15). **PP.** Improvements in the Visual Analogue Self-Esteem Scale ($z = -2.41$; $p < 0.05$), and the Communication Anxiety Scale (score = 22 vs 8 or 9).	Phase 1: Reducing individual's anxiety and increasing his awareness of his communication. Phase 2: Increasing language productivity and awareness of social communication skills. The author points at the difficulty of measuring small changes in communicative behavior at a conversational level.
Cognitive Pragmatic Treatment (CPT) Bosco et al., 2016 [73]	group 20 sessions (approximately 90 min each) twice a week, 10 weeks	Individuals with schizophrenia (no age limits), (n = 17; males, 58.8 %; mean age, 41.7 years; range, 29–61 years)	Non-controlled	LC. *Post-treatment.* Significant improvements in performance at post-training compared to pre-training on both comprehension ($t = 5.239$; $p < 0.0001$) and production tasks ($t = 4.143$; $p < 0.001$) of the ABaCo. 3-month *follow-up*. Improvements compared to pre-training on both comprehension ($t = 4.039$; $p < 0.001$) and production tasks ($t = 4.040$; $p < 0.001$). Considering *comprehension and production tasks together,* significant improvements on the Linguistic, Extralinguistic, and Paralinguistic ABaCo scales both at post-training ($t = 3.817$, $p = 0.002$; $t = 5.138$, $p < 0.0001$, and $t = 3.152$, $p = 0.006$ respectively) and at 3 months ($3.908 < t < 4.869$; $0.0001 < p < 0.002$). ABaCo context scale, slightly significant improvements on both comparisons ($t = 2.063$, $p = 0.056$, and $t = 1.871$, $p < 0.08$). NC and SC. Significant differences at post-training only in the Aachener Aphasic Test ($t = 2.74$; $p = 0.02$).	ABaCo assesses a wide range of pragmatic phenomena, such as direct and indirect speech acts, irony, and deceit, expressed through different communication modalities, i.e., linguistic, extralinguistic, paralinguistic, social appropriateness and adequacy to the context.
Conecta-2 Figueroa et al., 2019b [74]	group 32 sessions (90 min each) twice a week, 16 weeks. Structure: executive and cognitive functions; social cognition (both 8 sessions); pragmalinguistics and communicative efficacy (16 sessions)	Individuals with schizophrenia (>18 years), first episode of psychosis (n = 10; males, 70.0 %; range, 18–24 years)	Non-controlled	**LC.** Improvements in 9/10 individuals in the pragmatic-communicative abilities assessed with the screening language, psychosis, and intersubjectivity (LEPSI), mainly in paraverbal aspects, theory of mind and social cognition, interactional coherence, global pragmalinguistic organization, and coherence	The authors consider that communication ability trainings were performed during the entire program, as well as training in executive and superior cognitive functions and social cognition.

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Table 3 (*continued*)

Tool name (Author(s) and year)	Setting Length	Participants	Type of study	Results after intervention	Comments
				of the structural organization (50–70 % of improvements). **SC.** Improvements in emotional attribution assessed with the Eyes Test in 7/10 individuals (increase in total scores ≥4 points).	
Let's talk! Melo et al., 2019 [75]	group 18 sessions (30–60 min each), three days a week, 6 weeks	Individuals with schizophrenia (no age limits) admitted to a rehabilitation unit showing psychosocial and personal dysfunction as assessed with the Personal and Social Performance scale	Single-case experimental design (proposal)	A clinical research project of therapeutic occupation activities on conversation and social interaction is proposed. Selected assessment tools are: i) Personal and Social Performance scale (socially useful activities, including work and study, b) personal and social relationships, c) selfcare, and d) disturbing and aggressive behaviors). ii) Scale for Interpersonal Behavior (expression of negative feelings, expression of positive feelings, expression and management of personal limitations, and taking initiative). Items of this scale have been categorized into personal resilience, mood equilibrium, motivation, self-esteem, personal autonomy.	The authors hypothesize that therapeutic occupation activities promote, prevent, empower, and recover individuals' social skills and appropriate verbal and nonverbal behaviors.
Multimodal Speech-Gesture (MSG) training Riedl et al., 2020 [76]	Individual	30 individuals with schizophrenia and 30 healthy controls (18–60 years), randomly allocated to wait-training group (n = 20), and training-follow up group (n = 10). So far, 18 patients completed the entire training (males, 77.8 %; range, 23–62 years).	Randomized controlled study (in course)	Intended variables: behavioral data including speech- gesture matching and working memory performance; neural data including neural activation in the whole brain and regions of interest; social data including communication skills (as measured by an ad-hoc questionnaire for relatives, social functioning, quality of life; psychopathology).	Pilot study aimed at investigating the behavioral and neural effects of this new speech-gesture-training program for patients with schizophrenia. Outcome measures are pre-post-fMRI and standardized psychological questionnaires.
Speech Therapy Intervention Group (STIG) dos Santos et al., 2021 [66]	group 24 sessions (60 min each), twice a week, 12 weeks	Individuals with schizophrenia (19–59 years). Experimental group (n = 9; males, 35.7 %; 40–59 years, 71.4 %). Control group (n = 5; males, 20.0 %; 40–59 years, 80.0 %)	Non-randomized controlled study	**LC.** Significant improvements were found in the experimental group compared with the control group in the following variables of the Montreal Assessment Communication Brief Battery: conversational discourse, narrative discourse, metaphor interpretation, interpretation of speech acts, verbal fluency, semantic judgment, emotional prosody productions and reading.	The authors suggest that the lack of significant improvement in writing might indicate that writing requires more time in the learning process.

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Table 3 (*continued*)

Tool name (Author(s) and year)	Setting Length	Participants	Type of study	Results after intervention	Comments
PragmaCom Bambini et al., 2022 [39]	group 13 sessions (40 min each), once a week, 13 weeks	Individuals with schizophrenia (18–65 years). Experimental group (n = 15; males, 53.3 %; mean age, 40.9 years). Control group (n = 15; males, 73.3 %; mean age, 44.0 years).	Randomized controlled study	**LC.** *Post-treatment.* Significant improvements in the experimental group compared with the control group in global pragmatics (APACS Total, F (1,21) = 5.4, p = 0.03); ability to comprehend metaphors (PMM Total score, F (1,21) = 8.94, p = 0.007). 3-month *follow-up.* Significant improvements in the experimental group compared with the control group in the APACS. Total (F (1,20) = 8.40, p = 0.008), PMM (F (1,20) = 6.56, p = 0.01), **NC and PP.** Significant improvement in abstract thinking at *post-treatment* (PANSS N5, F (1,21) = 8.1, p = 0.01) but not at 3-month *follow-up*. **PF and QLS.** Significant improvement in daily functioning as measured with the QLS (F (1,20) = 5.45, p = 0.03).	**Post-treatment effect sizes**. *PragmaCom group*, large effect size for the PMM total score (d = 0.77), small-to-moderate effects in the APACS total, PANSS N5, and QLS (0.26, 0.24, and 0.27 respectively). *Active control group*, small-to-moderate effect size for the PMM total score (d = 0.30), negligible for the other measures (d = 0.07, 0.04, and 0.09 for the APACS total, PANSS N5 and QLS total scores, respectively).

Note. ABaCo, Assessment Battery for Communication; APACS, Assessment of Pragmatic Abilities and Cognitive Substrates test; PANSS, Positive and Negative Syndrome Scale; PMM, Physical and Mental Metaphors; QLS, Quality of Life Scale. Domains of results: LC, language and communication; NC, neurocognition; PP, psychopathology; PF, psychosocial functioning; QL, quality of life; and SC, social cognition.

comfortably in the speech and language therapy sessions in phase 1, and to establish and maintain eye contact in communicative situations; some objectives were considered in both phases. For instance, to address poverty of speech and poverty of content of speech, non-committal or unspecific words were identified (like 'possibly' and 'sometimes' in phase 1, and a core vocabulary of words to describe patient's feelings, like 'relaxed' or 'overwhelmed' was constructed and practiced. The intervention was partially successful [65].

3.2.2.2. Communicative-pragmatic treatment (CPT). The second, CPT, consists of 20 sessions held in small groups led by a psychologist [73]. Each session deals with one particular aspect of communication and mainly concentrates on the different expressive modalities of communication, that is, linguistic, extralinguistic, paralinguistic, social appropriateness, and conversational abilities. Some rehabilitation sessions also address other issues related to communicative ability, such as awareness, theory of mind, and planning [73]. The main objectives of CPT are to help the individual create new meanings and share them with others, and to understand the speaker's intended meaning beyond the literal meaning of utterance. Context is a key element in communication [73]. Therefore, the relevant contents of the program are inferential processes from literal utterances to intended meanings, appearing in indirect speech acts and deceitful and ironic statements. Several techniques and materials were used in the program, including role-play and video clips showing different communication scenes.

3.2.2.3. Conecta-2. The third specific language intervention, *Conecta-2*, is a 32-session training program that promotes communication skills and social cognition among individuals with schizophrenia [74]. It has been applied in the following phases: 1) a diagnostic assessment, including self-assessment, speech analysis, and questionnaire for the therapist; 2) a workshop for executive and superior cognitive functions, social cognition, pragmalinguistics, and communicative efficacy; and 3) an assessment using the eye test and screening language, psychosis, and intersubjectivity (LEPSI), which were also developed by this research group in clinical linguistics [74]. In relation to language and communication, the contents of the program included linguistic aspects, that is, routines and strategies for communication and interaction, facial and corporal expression, different types of interpersonal distances (intimate, personal, and social distances), and an analysis of various situations that require communication. Group discussions, handouts, presentations, and video scenes were used in the program [74].

3.2.2.4. Let's talk!. The fourth specific language intervention is *Let's talk!* (or *Vamos conversar!* in the original language), the research project having been published [75]. It aims to improve communication and conversation skills and increases the potential to generalize

conversational skills [75]. It covered 18 sessions and six conversation areas: 1) observing, listening to others, and non-verbal communication; 2) active listening and listening comments; 3) talking about a topic (initiating and maintaining a conversation); 4) ending a conversation; 5) talking on the phone; and 6) talking to a stranger (or an unfamiliar person). The program was implemented with a minimum of four participants and conducted by a clinical nurse, a specialist in the program, and members of the research group [75]. Modeling, reinforcement, corrective feedback, and homework are techniques used in the program.

3.2.2.5. Multimodal Speech Gesture (MSG) training. The fifth intervention, *MSG training*, with eight sessions, was developed with a focus on the main communication problems of individuals diagnosed with schizophrenia, including "concretism" (i.e., the inability to interpret abstract meanings considering the context) and problems associated with non-verbal communication, especially gestures accompanying abstract speech [76]. The program, published as research project, consists of eight sessions applied in an individual setting. Exercises with increasing complexity (first perceptual, productive, and free productive tasks) are executed by the patient who is accompanied by an examiner [76]. Materials include information about non-verbal communication and videos using stimuli with three modalities (bimodal, visual, and auditive) and two types of concreteness (concrete and abstract). For the feasibility of application to daily life, the participant was invited to perform homework exercises with a person he/she was in regular close contact with [76].

3.2.2.6. Speech Therapy Intervention Group (STIG). The sixth intervention, the *STIG,* is a 24-session group program designed to stimulate communicative behavior and linguistic processes in individuals with schizophrenia [66]. It consists of storytelling activities (discourse), games of semantic relations and lexical evocation (lexicon semantics), singing and dramatization of scenes (prosody), and metaphor games and indirect speech (pragmatic), focusing on participants' interests and current and daily themes. It is divided into seven phases: 1) initiation of the project's bond and agreement; 2) stimulation of free discourse, attention, and concentration; 3) narrative discourse work; 4) work with the lexicon and semantic categories; 5) stimulation of the understanding and production of linguistic and emotional prosody; 6) promotion of language use in different contexts (pragmatics); 7) development of reading and writing; and 8) review of concepts and general evaluation of the group [66]. The main contents of the program are: conversational discourse, narrative discourse, metaphor interpretation, interpretation of speech acts, verbal fluency, semantic judgement, emotional prosody prodcutions, reading, and writing.

3.2.2.7. PragmaCom. Finally, the most novel treatment on the pragmatics of communication, *PragmaCom*, consists of 13 sessions and addresses communicative-pragmatic skills based on the model of communication proposed by Grice [39]. This model assumes that, in communicative settings, speakers cooperate by adhering to a set of conversational maxims regarding the quality, amount, and manner of the information to provide; this also serves to accommodate the interlocutor's behavior and to infer implicit meanings. PragmaCom guides participants in the analysis of communicative mismatches that arise from the violation of these maxims to prompt reasoning about the pragmatic mechanisms at play. PragmaCom includes two types of 4-phase exercises: (i) those focused on comprehension and addressing the understanding of figurative language (metaphors, idioms, and proverbs); (ii) those focused on the production and application of maxims governing the quantity and relevance of information provided in speech. The phases are: 1) the detection of a communicative mismatch presented in a story context and deriving either from a failure in understanding a figurative expression or from an inappropriate discourse; 2) the reconstruction of the pragmatic mechanisms that were violated in the story and that are needed to understand the figurative expression or to produce appropriate speech; 3) the generalization to other contexts; and 4) the creation of new contexts by using the restored rule or expression. The complexity level of the exercises is adapted to the cognitive load of the patient.

4. Discussion

4.1. Language assessment tools for rehabilitation in schizophrenia

A broad variety of language and neurocognitive assessments were obtained in the 11 selected papers of a mixed review from the speech and language therapy perspective [16]. The TLC was the most frequent tool, other assessments were the Communication Disturbances Index, the Montreal Communication Evaluation Battery, verbal fluency tasks and discourse assessment [16]. Moreover, comparing with our previous review on psychopathological assessment of language in schizophrenia [40], we now present in a single table the structure and language function of the 16 collected scales, plus the tools of Schultze-Lutter et al. [51,52].

Across the selected psychopathological tools, the nature and extension of language items vary notably, that is, from the two items of the Bonn Scale for the Assessment of Basic Symptoms and Schizophrenia Proneness Instrument, Adult version (disturbance of receptive speech[4] and disturbance of expressive speech[5]) [51], to the 33 items of the Formal Thought Disorder Scale for caregivers [57]. This scale is the only one to be applied to caregivers and includes the statement: "It is hard to understand what she/he is trying to say" [57]. It is noteworthy that the reviewed language tools using the subjective method (BSABS, ESEA, SPI-A, SPI-CY, EAWE, and TALD) should be applied by a trained clinician, usually psychiatrist or psychologist. Interestingly, none of the tools in this review was designed to determine the presence or absence of FTD in patients. The factor structure of the FTD and its dimensional nature may account for this

[4] A disturbance in understanding verbal stimuli that are either read (visually presented) or heard (orally presented).
[5] A self-experienced difficulty in verbal expression with a problem of producing inadequate words.

drawback [4,8].

In terms of participants' age, most language assessment tools usually apply to adults and eventually to adolescents, with the exception of the SPI-CY [52]. TLC has been used in a wide age range of patients, from 9-year-old healthy children with parents with schizophrenia to 97-year-old patients with chronic schizophrenia [77,78]. Rater training, often supported by assessment manuals, is required for the application of most of these tools, including the specific language assessment tools TLC, Clinical Language Disorder Rating Scale, Thought and Language Disorder scale, and Bizarre-Idiosyncratic Thinking [5,8,55,56].

To our knowledge, all except two of the reviewed tools [50,53] have been validated in at least one language (mainly English) in various publications [79,80]. TLC is considered the clinical gold standard [81] and is a highly disseminated scale worldwide [24, 82–84]. The Thought and Language Disorder scale has also been validated in some languages [8,85] and is the only specific language assessment tool that covers both mixed methods (objective and subjective) and mixed language functions (expressive and receptive functions).

Various language assessment tools for patients with schizophrenia have been developed from the psychopathological, psychological, linguistic, and speech and language therapy approaches. All of them, regardless of the method used, were applied to verbal communication, and the expressive language function. These assessment tools seem to target complementary aspects of language impairments in schizophrenia, and consequently could be used simultaneously in the same patient in order to get a more accurate and comprehensive assessment of his/her language and communication impairments.

4.2. Language intervention tools for rehabilitation in schizophrenia

A previous review on speech and language therapies to improve pragmatics and discourse skills in patients with schizophrenia obtained 18 studies up to 2012 [38]. Researchers mainly used an individual setting and the following therapeutic approaches: operant conditioning, metacomprehension (explicit training on communication skills) or metalearning, and cognitive remediation. The authors pointed at the difficulty of comparing the efficiency of the therapies on language or speech skills due to the wide variety of certain methodological aspects (therapy settings, length and intensity of interventions, speech and language abilities that are trained …). Therefore, it remained unclear which ones should be implemented to treat language impairments in schizophrenia [38].

However, and similar to the assessment tools, in our review the mainly new developments for language intervention in patients with schizophrenia are classified in two groups, general and specific tools. This distinction might help to organize their implementation in rehabilitation services both for clinical practice and research. In addition, we classify the results of the specific tools into five different domains and show two follow-up studies (please see Table 3).

Setting and length are also shown in Table 3. In contrast to the previous study [38], most of the reviewed language interventions used a group setting, included the two general interventions, IPT and REHACOP, the latter also admitting an individual setting [67–70]. In the review by Joyal et al. (2016), the interventions differed greatly in the number of sessions (8–32 sessions), frequency (1–5 sessions/week), and length of intervention (2–25 sessions); the majority had 12–25 sessions, took place twice a week, and lasted 10–16 weeks.

In addition to the two-phases individual intervention of 2007 [65], new specific interventions have been developed in recent years, most of them with 13–24 sessions and again mostly taking place twice a week [66,73,74,76], and lasting 10–16 weeks [39,66,73]. MSG was the shortest program [73] and Conecta-2 the longest [74], although it also included therapy for other domains. Interestingly, most of them addressed not only language production but also language comprehension [39,66,73,74,76], as did four previously reviewed interventions that had not shown significant improvements [38].

Some differences concerning the aim, content and characteristics of the reviewed specific tools should be mentioned, in order to help the clinician, after an accurate and precise assessment, to choose the most appropriate intervention for the patient. Although all of them address pragmatics, Let's talk is specially oriented to learning and training communication skills in different contexts −including talking to a stranger−, and its selected assessment tools only cover psychosocial functioning [75]. The individual intervention of Clegg et al. [65] targeted pragmatics, but also semantics, and reducing anxiety in verbal situations. Moreover, the CPT and PragmaCom have been specifically designed to address pragmatics, including both verbal and non-verbal language [39,73].

Also addressing pragmatics, MSG training is the only language intervention that targeted oral, non-verbal communication (gestures) [76]; however, some interventions included non-verbal components, such as tone of voice [66,73,74]. Conecta-2 is the only language intervention that involved other major trainings (executive and cognitive functions and social cognition) [74]. Various materials, including videos and newspapers, may be used in the PragmaCom and CPT interventions [39,73]. Some interventions target specific aspects of language, e.g., telephonic conversations in CPT and STIG [66,73], narrative discourse and written language (both reading and writing) in STIG [66].

There were participants' age restrictions of up to 60–65 years in three of the analyzed interventions [39,66,76]. A certain training for clinicians, often supported by intervention manuals, is required for the application of most language intervention tools, including the general tools IPT and REHACOP [67–70], and the specific tools CPT and PragmaCom [39,73].

Similar to the previous review, there is also a variety of assessments and outcomes which make difficult to compare the different interventions. Some of these differences appear in language levels, usually including pragmatics and eventually other dimensions, production and comprehension tasks, written language, neurocognitive assessment, psychopathology, social cognition, psychosocial functioning, quality of life and follow-up.

In terms of efficacy, the evidence of improvement in neurocognition, including language, is high for the two presented general interventions, IPT and REHACOP, the first in a meta-analysis covering 1601 patients from 12 countries [86], the latter having been also recently associated with higher gray matter volume and cortical thickness of right temporal regions in patients with schizophrenia

[87].

Concerning the specific interventions, the evidence is encouraging, yet limited. Some challenges from the previous review have been addressed, including therapies specifically targeted to pragmatics (CPT and PragmaCom), to verbal or gesture comprehension (CPT, Conecta-2, MSG, STIG, and PragmaCom), effects on quality of life (PragmaCom), symptom severity and follow-up studies (CPT and PragmaCom for both). For example, significant improvements have been obtained in the comprehension of metaphors, idioms or proverbs with CPT, STIG and Pragmacom, even at 3-month follow-up [39,73].

The study design differed: There are two completed controlled studies involving up to 30 patients with both STIG and PragmaCom, the latter being a randomized study [39,66], one controlled study still in progress with the MSG training [76], two uncontrolled studies with a maximum of 17 patients [73,74], a single-case intervention [65], and a single-case research project [75]. However, encouraging results have already been obtained at two timeframes: post-intervention [39,65,66,73,74], and at the 3-month follow-up [39,88]. Generalization of the trained skills to daily functioning according to the Quality of Life Scale has been observed with PragmaCom [39], and more recently with MSG [89].

Moreover, in a single 39-year-old male case trained with CPT, the authors obtained improvements not only in communication according to the ABaCo but also in functional magnetic resonance imaging, with stronger activation in frontal and superior temporal gyri [88]. This was consistent with other neurobiological changes associated with cognitive remediation [90], the general intervention REHACOP [87], and the specific intervention MSG when 29 patients with schizophrenia spectrum disorder were compared with 17 control subjects [89]. Indeed, pragmatic and discourse skills can be improved through therapy in patients with schizophrenia [38]. The clinical relevance of language rehabilitation is high not only for individuals with schizophrenia but also for those with first-episode psychosis [91] or at clinical high-risk of psychosis [92].

In summary, various language intervention tools for patients with schizophrenia have been developed from the psychopathological, psychological, linguistic, speech and language therapy, and nursing approaches. Similar to the assessment tools, these intervention tools might target complementary aspects of language impairments in schizophrenia. Consequently they could be used, simultaneously or not, in the same patient, in order to get a better rehabilitation of their language and communication impairments. Based on the study design and main results in language, psychosocial functioning, quality of life and brain changes, it is suggested that the most promising specific language interventions are PragmaCom, CPT, MSG and STIG [39,66,73,76] followed by Conecta-2, and the individual speech and language therapy [65,74]. Evidence of efficacy of Let's talk! is still lacking, as presently only the research project has been published [75].

4.3. Recommendations for language and communication rehabilitation

Based on the present review, we recommend the following.

A. General recommendations, mainly addressed to the service's coordinator and, generally, to all staff members.
   1. Plan language rehabilitation carefully for both clinical practice and research. Check the use of general language assessment and intervention tools and additional related assessments and interventions, such as cognitive and social cognition rehabilitation. Determine a few general objectives and available common resources of language rehabilitation for the entire service.
   2. Identify the most qualified staff members to improve patients' language and communication impairments and their potential training needs. Psychiatrists, psychologists, social workers, nurses, and other professionals are elements of psychiatric rehabilitation services with the expected areas of expertise [93]. Given the complex nature of language, speech and language therapists must join rehabilitation teams [15–17,38,64]; clinical linguists may provide valuable insights [60,63]. Consequently, an interdisciplinary perspective is essential for rehabilitation of language and communication in patients with schizophrenia.
   3. Rehabilitation of language and communication requires an integrative perspective, including the patient, relatives, caregivers, healthcare professionals, social networks … All these key players may ultimately contribute not only to improve the language and communication impairments of patients at the time of intervention but also to its generalization and transference to ordinary life, and to its maintenance.
   4. The patient's relatives and caregivers are essential stakeholders. Therefore, they can monitor the patient's language abilities [57] and be instructed on the best way to communicate with the patient.

B. Specific recommendations, mainly addressed to staff members specifically addressing language rehabilitation.
   5. When selecting and using language assessment and intervention tools, consider different types, methods, language functions, and language levels, particularly pragmatics and semantics. You may also contribute to translation, adaptation, and research of the different tools in different settings. As usual in rehabilitation, try to enhance patients' motivation and active participation using significant materials in different formats (videos, audio, etc.), if possible.
   6. An accurate and comprehensive assessment procedure is essential for the design, maintenance, and improvement of an accurate treatment plan or intervention. Set potential priorities and steps in the language rehabilitation process. We recommend using validated tools in the individual's language and, if possible, the TLC [5,6] or the Thought and Language Disorder scale [8]. Ideally, other validated tools that gather additional information, such as the two Formal Thought Disorder scales (for patients and caregivers), can also be used.
   7. We also recommend training and applying one of the present specific interventions on language: PragmaCom, CPT, STIG, MSG, Conecta-2, and individual speech and language therapy [39,65,66,73,74,76]. Let's talk! may also be indicated [75].

8. Keep the patient's lifespan in mind. Owing to the possibility of early language and communication impairments in schizophrenia [91], and the potential changes associated with aging and neurocognitive disorders [94–96], short- and long-term follow-up studies from childhood or adolescence to senior adults are necessary.

However, new assessment and intervention tools for language and communication impairments associated with schizophrenia may be designed in the future using technology and telemedicine, and therefore developing "telerehabilitation" [97]. This innovative approach might be also applied to the existing tools, therefore contributing to the already existing telepsychiatry, telepsychology, telenursery, teleclinical care, and telespeech therapy.

4.4. Limitations, strengths, and future research avenues

This study has two limitations: (i) the narrative character of the review, and (ii) the limited literature on the topic, in particular for the effectiveness of the newest intervention tools in patients with schizophrenia compared with healthy controls. However, the potential strengths of our research are (i) the inclusion of tools developed using different approaches and languages; and (ii) the established recommendations for language and communication rehabilitation derived from the review. More research is needed to: (i) accurate assess potential language and communication impairments in schizophrenia patients; (ii) study the association of these impairments with clinical, neurocognitive, biological, and functional variables; and (iii) establish the strengths, indications, and short- and long-term efficacy of interventions for rehabilitation of language and communication in schizophrenia. Finally, more work should also be done for translating and adapting these tools in different languages and countries.

5. Conclusions

We conclude that: i) there is currently a wide range of assessment and intervention tools that cover various language and communication impairments in schizophrenia; ii) the rehabilitation of language and communication requires an integrative and interdisciplinary approach, and should always be considered in patients with schizophrenia throughout their lifetime; and iii) further research on the assessment and intervention tools for the rehabilitation of language and communication in patients with schizophrenia is needed.

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Natalia Jimen: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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