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Multilingualism and psychosis: a pre-registered scoping review

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Abstract

Schizophrenia impacts several cognitive systems including language. Linguistic symptoms of schizophrenia are important to understand due to the crucial role that language plays in the diagnostic and treatment process. However, the literature is heavily based on monolingual-centric research. Multilinguals demonstrate differences from monolinguals in language cognition. When someone with schizophrenia is multilingual, how do these differences interact with their symptoms? To address this question, we conducted a pre-registered PRISMA-SR scoping review to determine themes in the literature and identify gaps for future research. Four hundred and twenty records were identified from three databases in 2023. Thirty articles were included in the synthesis. We found three emergent themes: (1) the need for multilingual treatment options, (2) differences in symptomology between the L1 and L2, and (3) the impact of cultural factors on linguistic functioning. Thus, several avenues of research regarding multilingualism may be fruitful for improving linguistic and social outcomes in schizophrenia.

Highlights

- Research on the interplay between multilingualism and psychosis begins in 1959.
- A scoping review procedure was used to determine emergent themes in this literature.
- Multilingual treatment options must be implemented.
- Cultural factors impact linguistic functioning.
- Results are mixed regarding first/second language symptom differences.

1. Introduction

In January 1959, Robertson and Shamsie published "A Systematic Examination of Gibberish in a Multilingual Schizophrenic Patient" in the journal *Language and Speech.* This paper was among the first to analyze linguistic features of the speech produced by a multilingual person with schizophrenia. The results were fascinating: phonological traits of each of the speaker's languages were incorporated into his symptomatic speech. Furthermore, Robertson and Shamsie established a link between the day-to-day usage of each language and each language's impact on the phonology of his neologisms. The study's conclusions were important to researchers of both schizophrenia and language production. To the former, they indicated that the content of language in schizophrenia was rooted in real-life language experience. To the latter, they suggested that features of multiple languages were simultaneously accessible rather than compartmentalized (e.g., Kroll et al., 2015; reviewed in Palma & Titone, 2020). In this study, examining schizophrenia through the lens of multilingualism created real-world anchor points for the comparison of produced speech. In turn, examining multilingualism through the lens of schizophrenia allowed for unique insight about certain cognitive processes which are implicated in schizophrenia (Barch & Ceaser, 2012).

Thus, Robertson and Shamsie's landmark study launched a fascinating crossroads of research where schizophrenia and multilingualism or bilingualism (used here interchangeably to describe individuals who speak two or more languages) meet. In the following pre-registered scoping review, we follow suit by reviewing literature at this intersection that has been conducted since 1959 to determine emergent themes. These themes included: the challenges that multilinguals with schizophrenia face in accessing care, the expression of symptoms in multilinguals with schizophrenia, and potential avenues of treatment for multilinguals with schizophrenia. Through this review, we hope to establish a base of knowledge regarding schizophrenia and multilingualism that future researchers may use as a foundation for inquiry into this important yet understudied topic.

Schizophrenia is often characterized by the layperson using its most florid (often *positive*, Andreasen & Olsen, 1982) symptoms, such as hallucinations, delusions and disorganized behaviour. However, schizophrenia also has profound (often *negative*, Andreasen & Olsen, 1982) effects on cognitive systems including attention (Bora et al., 2017), reward/motivation (Strauss et al., 2014), and language (Kuperberg et al., 2010; Levy et al., 2010). People with schizophrenia are broadly impaired socially (Bellack et al., 1990; Degnan et al., 2018; Kurtz et al., 2015), which may be related to the language dysfunction they demonstrate (Kuperberg, 2010; Palaniyappan et al., 2023; though stigma may also contribute, Hodgins et al., 2022). The symptoms of schizophrenia are visible at several levels of linguistic analysis (Covington et al., 2005).

Related to language production, people with schizophrenia demonstrate an abnormal, often monotonous communicative delivery or prosody (Covington et al., 2005). At the lexical level, people with schizophrenia have been shown to struggle to identify words with many lexical competitors (e.g., Titone & Levy, 2004) or semantic competitors (e.g., Titone, Levy, and Holzman, 2000; see Kuperberg, 2010 for a review). Semantically, people with schizophrenia may be prone to the creation of *neologisms*, invented words with meanings that are only (initially) clear to the inventor (though when neologisms are transmitted between people, they can become regularized, especially within insular communities; Würschinger, 2021) (Covington et al., 2005; Overall & Gorham, 1988). Syntactically, some studies report the use of unclear syntactic structures, whereas others do not (Levy et al., 2010), and syntactic complexity can be used by computational models to predict schizophrenia diagnosis (Silva et al., 2023). Pragmatically, people with schizophrenia may struggle to understand irony or otherwise show signs of overly concrete interpretation of language (Bambini et al., 2016; Langdon et al., 2002).

Crucially, not every person with schizophrenia demonstrates the same language symptoms, as profiles are highly heterogenous (Oomen et al., 2022). Regardless of heterogeneity, these language symptoms are fundamental to the assessment, diagnosis and theoretical understanding of schizophrenia (DeLisi, 2001; Kuperberg, 2010; Mitchell & Crow, 2005; Sommer & Khan, 2009). Between five commonly used assessment scales for schizophrenia (PANSS, Kay et al., 1967; SAPS, Andreasen, 1984; SANS, Andreasen, 1983; BPRS, Overall & Gorham, 1988; BNSS, Kirkpatrick et al., 2011), 30 of the symptoms assessed are linguistic in nature. Table 1 presents these symptoms, recognized in clinical practice, to illustrate the breadth and depth of the impact of schizophrenia on the language system.

The prevalence of linguistic symptoms within these scales demonstrates that language and communication behaviors must be well understood to facilitate the accurate assessment of those suspected of having schizophrenia. However, the standards by which they are defined are typically based on a monolingual-centric understanding of language use. Multilinguals differ from monolinguals in language processing and production, even in their first or more dominant language (L1) (Kroll et al., 2015; Runnqvist et al., 2013; Whitford & Titone, 2012). For example, multilinguals are slower to produce full sentences than monolinguals, modulated by the frequency of the syntactic structure produced (Runnqvist et al., 2013), and they may have reduced accessibility when comprehending low frequency words (Whitford & Titone, 2012). Is this increased response latency, comparable to the symptom described in the SANS (Andreasen, 1983; item 12), taken into consideration when assessing multilinguals suspected of having schizophrenia? Would this trait of multilingual language use exaggerate or mask the symptoms of schizophrenia? Moreover, would differences in

Table 1. Linguistic symptoms included in schizophrenia assessment scales

#	Symptom	Source (Item)
1	Circumstantiality	PANSS (P2), SAPS (30), BPRS (15)
2	Tangentiality	PANSS (P2), SAPS (27), BPRS (15)
3	Loose associations	PANSS (P2), BPRS (15)
4	Derailment	SAPS (26), BPRS (15)
5	Incoherence	SAPS (28), BPRS (15)
6	Auditory hallucinations (voices)	PANSS (P3), SAPS (1,2,3)
7	Sarcasm	PANSS (P7), BPRS (6)
8	Verbal abuse	PANSS (P7), BPRS (6)
9	Reduction in facial expression	PANSS (N1), SANS (1), BNSS (9), BPRS (16)
10	Reduction in communicative gestures	PANSS (N1), SANS (3), BNSS (11), BPRS (16)
11	Disinterest in communication	PANSS (N3), BNSS (5)
12	Reduced interpersonal communication	PANSS (N3, N4), BNSS (5)
13	Poverty of speech	PANSS (N6), SANS (9), BNSS (12)
14	Poverty of content of speech	SANS (10), BNSS (13)
15	Increased response latency	SANS (12)
16	Slowed speech	PANSS (G7), BNSS (10), BPRS (18)
17	Slowed communicative gestures	PANSS (G7), BNSS (11), BPRS (18)
18	Rapid/pressured speech	SAPS (31), BNSS (10)
19	Difficult to initiate speech	PANSS (G13)
20	Difficult to control speech	PANSS (G13)
21	Distractable speech	SAPS (32)
22	Clanging	SAPS (33), BPRS (15)
23	Poor eye contact	SANS (4), BPRS (12)
24	Lack of smiling or laughing when appropriate	SANS (5), BPRS (16)
25	Laughing when inappropriate	BPRS (12)
26	Incongruous affect	SANS (6), BPRS (12)
27	Monotonous speech	SANS (7), BNSS (10)
28	Inappropriate volume of speech	BNSS (10), BPRS (12)
29	Talking to voices or self	BPRS (12)
30	Neologisms	BPRS (15)

language use among multilinguals across social experiences differentially contribute to the assessment and interpretation of schizophrenia symptoms (e.g., Titone & Tiv, 2022)?

These questions and others like them are especially crucial given the link between migration and the development of schizophrenia (Cantor-Graae & Selten, 2005; Weiser et al., 2008). Meta-analysis of 18 studies regarding migration and schizophrenia indicated a mean weighted effect size of 2.9 (95% CI = 2.5–3.4) of the effect of first- or second-generation immigration on the increased development of schizophrenia (Cantor-Graae & Selten,

2005). There is great overlap between the populations of migrants and multilinguals (Statistics Canada, 2017). According to the 2016 Canadian Census, 76.4% of immigrants were multilingual compared to only 27.5% of Canadian-born people (Statistics Canada, 2017). In the 2021 census, Statistics Canada reported that increases in usage of non-official languages at home was driven by immigration, and that 7 in 10 of those with a non-official language L1 used an official language at home (Statistics Canada, 2022). As such, we may extrapolate that more migrants at increased risk of schizophrenia may be multilingual. It is thus important to take multilingualism into account in our understanding of the language symptoms of schizophrenia; to provide the highest standard of care to this at-risk population and to enable accurate assessment and effective treatment of symptoms. Indeed, it is often difficult to dissociate the effects of multilingualism from migration-related and cultural factors.

Investigating the intersection of schizophrenia and multilingualism may also offer insight into the cognitive organization of languages (see also Paradis, 2008). If the bilingualism literature's claim that multiple languages are activated in parallel (reviewed in Baum & Titone, 2014; Dijksta & van Heuven, 2002; Kroll & Bialystok, 2013; Kroll et al., 2015) holds true, we would expect to see symptom expression that mixes information from all languages known, as described by Robertson and Shamsie (1959). If there are systematic inconsistencies in the findings, however, this may provide evidence that certain components of language are activated in parallel while others are activated separately. Such insights offer a unique perspective on the activation of language networks in the brain, particularly given that schizophrenia is characterized by disruptions in connectivity rather than focal issues (Friston & Frith, 1995).

Language processing in the brain is distributed across several regions (Friederici & Gierhan, 2013), thus, by investigating the association between areas with disrupted connectivity and language symptoms, we may additionally better understand the flow of language through the brain. As such, incorporating populations with schizophrenia into our research on bilingualism provides a way we might tease apart some of the cognitive processes that occur in all bilingual brains. Furthermore, previous research into bilingual clinical populations (such as people with aphasia; Fabbro, 2001; Green & Abutalebi 2008; Paradis, 1977) has proven fruitful for such insights, informing theory regarding language and assessment of this condition (Paradis & Libben, 2014).

Thus, it is essential to study both neurotypical and neurodivergent populations to understand how language systems can function differently across these groups. By examining how language can become disordered in schizophrenia, we can enhance our understanding of typical language processing (Kuperberg, 2010). Moreover, comparing psycholinguistic findings between individuals with schizophrenia and neurotypical individuals may help identify which aspects of the language system are dysfunctional in schizophrenia (Levy et al., 2010), thereby contributing to a more comprehensive understanding of the disorder.

Also complicating matters is that each of a multilingual's languages are often linked with an associated culture (Grosjean, 2015; Ramírez-Esparza et al., 2020). The relationship between symptoms expressed in which language across cultural contexts can inform us on the impact of sociocultural factors on schizophrenic thought and language. This could help elucidate the connection between real-world information and the content of delusional or persecutory thought. For example, if a person with schizophrenia living under colonial rule only experiences persecutory voices in the language of colonial forces, this would provide evidence for the content of disordered thought being culturally and experientially grounded (Hadden et al., 2020). This would provide us with a better understanding of how the qualia of schizophrenic experience arise.

Thus, crucial to a cognitive and social understanding of schizophrenia, and for the study of cognition itself, is that we rigorously investigate the intersection of schizophrenia and multilingualism. Furthermore, it is beneficial to our understanding of multilingualism to probe how extant theories extend to neurodivergent populations (i.e., parallel vs. separate activation). In the following scoping review, we thus establish a base of knowledge to enable such investigations by systematically reviewing the literature regarding schizophrenia and multilingualism throughout recorded psychological history. We begin by presenting the methods used in our systematic search, which were pre-registered before data were collected and are available on the Open Science Framework website (https://osf.io/gcv6b). We then synthesize the findings of our scoping review in Section 3.4. Finally, we draw several key conclusions regarding the findings of these studies in section 4.

2. Method

2.1. Transparency

We report that our data and R script are freely available for view on an OSF repository. The searches are available at https://osf.io/76eug[1], the data are available at https://osf.io/vumq3 and the R code is available at https://osf.io/je2zp.

2.2. Procedure

We collected papers using a scoping review method (Munn et al., 2018; Tricco et al., 2018). Our scoping review protocol was created following the preferred reporting items for systematic reviews and meta-analysis protocols guideline extension for scoping reviews (Tricco et al., 2018), and then uploaded for pre-registration to the Open Science Framework website (https://osf.io/76eug). A scoping review is like a systematic review in that they both involve the systematic retrieval and analysis of published works through one or several databases (Munn et al., 2018). However, as opposed to a systematic review (which is restricted to a more specific research question), a scoping review aims to create a general overview of knowledge within a field, identify gaps in the literature and serve as a basis for future specific research (Munn et al., 2018). As such, our inclusion criteria were broad. Furthermore, the goal of the present paper is thus different from that of the single systematic review of four studies that has been conducted in this field (Erkoreka et al., 2020).

Regarding types of studies, we included peer-reviewed (case study, qualitative, quantitative and meta-analysis) studies in English published in any year, as well as peer-reviewed position pieces and reviews in English published in any year. This broad scope was to assess evidence from a variety of peer-reviewed methods and subdisciplines to gather the greatest amount of relevant information possible. Dissertations and grey literature were thus excluded. We also excluded multilingual translations or validations of testing measurements such as scales due to the lack of definite relationship

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[1]Though the links provided cannot be used by those without access to the McGill University network, the searches are provided in full and can be replicated by entering the exact same search strategy into the exact same databases.

to a confirmed multilingual population with schizophrenia. Populations must be humans who: (1) speak more than one language, and (2) have been diagnosed with a psychotic disorder (e.g., schizophrenia). We excluded people with psychosis as a symptom of other neurodegenerative disease or brain injury (e.g., Alzheimer's, traumatic brain injury) and people with psychosis as a side effect of a prescribed medication (e.g., antiepileptics), as our focus was solely on schizophrenia spectrum disorders. We included papers from any setting/context, with any interventions/exposures and outcome measurements, to create the broadest scope possible. Note that some relevant research has been published as editorial letters, however, these were not included due to lack of definitive peer review status (e.g. Saito, 2019).

As per PRISMA guidelines, we report that our search strategy was informed by consultation with a research librarian, Nikki Tummon. Three databases were used for our searches, APA PsycInfo (Ovid), Medline (Ovid) and Embase (Ovid). Studies were included from the beginning of the database registration (APA PsycInfo; 1806, Medline; 1946, Embase; 1947) until January 27, 2023. The links to the searches can be accessed at the pre-registration OSF repository (https://osf.io/76eug). Results were imported into EndNote (The EndNote Team, 2013) and de-duplicated.

Before manual screening, the 288[2] deduplicated results were automatically screened for English language and peer-review status using Metagear (Lajeunesse, 2016). From this automatic process, 36 records were removed for non-English language and 20 records were removed for not being peer reviewed journal articles. This left 232 abstracts to screen, split into 4 groups of 58. Four people (the coauthors of this paper) participated in the screening process. Each person reviewed two distinct groups of abstracts, thus, 116 abstracts per reviewer. This was counterbalanced in a "round robin" manner so that each group of abstracts was reviewed by a unique pair of people. Conflicts between reviewers were resolved by discussion and popular vote between all four researchers. No third-party tiebreaker was needed. "Maybes" that remained after popular vote were passed on to full-text screening. At the end of abstract screening, 154 records were excluded, leaving 78 full texts to screen. Full text screening resulted in the further exclusion of 47 records: 17 for a lack of explicit mention of bilingualism in subjects, 5 for a lack of explicit mention of psychosis in subjects, 1 for medication-induced psychosis, 7 for full text access issues, 1 for being a scale translation and 17 for not being peer reviewed journal articles. This resulted in the final inclusion of 30 papers (Figure 1). The small number of papers identified indicates the need for further studies in this field, hence the motivation for the present scoping review to serve as a basis for said research.

A data charting form was designed in Microsoft Excel (Microsoft Corporation, 2018) based on PRISMA guidelines (Tricco et al., 2018). Three researchers independently charted data and updated the form iteratively as new information was acquired. For each paper, we extracted the theme, the paper type, the aim (or hypothesis), population, the place of origin, the method used, the measures collected, the outcomes of said measures and the authors' conclusions (see Supplementary Materials, Appendices A and B). Statistical quality assessment was not conducted due to the considerable number of non-statistical results reviewed and lack of relevance to scoping review objectives; However, qualitative assessment of quality was noted during synthesis. As a review, this study was exempt from McGill University IRB approval.

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[2]There is a typo in the OSF repository: 288 is correct, not 228.

3. Results

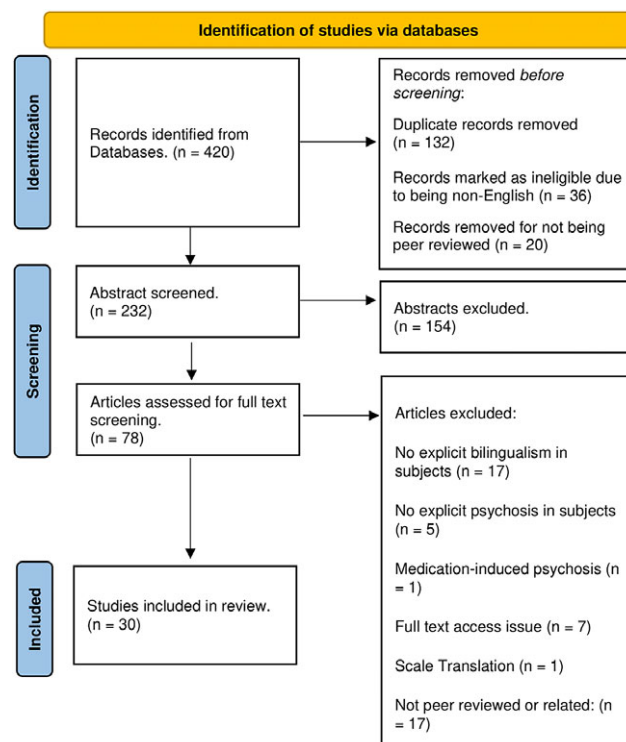## 3.1. Selection of sources of evidence

Figure 1. Selection of sources of evidence.

3.2. Characteristics of sources of evidence

Sources of evidence were characterized using the paper type, the aim/hypothesis, the population, the place of origin, the methods used and the measures collected. Sources reviewed contained 6 position pieces/reviews, 5 case studies, 6 qualitative original research papers, 15 quantitative original research papers and 1 meta-analysis. Note that some sources may be included in more than one category due to mixed methodologies, and therefore this count does not add up to 30. All non-review sources worked with populations of multilinguals with schizophrenia spectrum disorders, ranging in number between 1 and 283 per study. For a more detailed summary of source characteristics, see the chart provided in Supplementary Material, Appendix A.

3.3. Results of sources of evidence

Results of sources of evidence can be found in the results chart provided in Supplementary Material, Appendix B. Relevant results will be synthesized the following Section 3.4.

3.4. Synthesis of sources of evidence

In the following section, we synthesize the findings of our scoping review. Five main research questions regarding multilingualism and schizophrenia guided this synthesis: (1) Is symptom detectability greater when assessed or in the L1 or the L2? (2) Is symptom expression more severe when occurring in the L1 or the L2? (3) What is the relationship between lifetime language use and language of symptom expression? (4) What can be done by

practitioners to best support this population? (5) What special considerations must be taken regarding the intersection of bilingualism and cultural diversity? In this synthesis of 30 papers, we begin with the least empirical works, such as position pieces, which offer a theoretical bedrock for empirical research. Then, we work towards the most empirical works which have provided data to support or contradict these hypotheses. Section 3.4 contains the broad overview of the results of the synthesis.

3.4.1. Reviews and position pieces

This section contained the synthesis of five review papers or position pieces (Alherz et al., 2019; de Zulueta, 1984; Gerson & Schweitzer, 1972; Paradis, 2008; Zislin et al., 2002) and resulted in the emergence of four main themes. The first is the anecdotal association between more severe symptomology and language use in the L1. Gerson and Schweitzer (1972) and Zislin et al. (2002) proposed more severe symptomology in the L1 (i.e., a protective quality of the L2), whereas de Zulueta (1984) and Paradis (2008) proposed differences in L1/L2 symptomology between individuals. Of these papers, Paradis provides the most compelling argument through relation to the bilingual aphasic literature. The second emergent theme is the need for multilingual practitioners who can work with multilingual patients with psychosis in whichever language is most effective, which was proposed by Gerson and Schweitzer, and Paradis. This leads into the third emergent theme; the possibility that receiving treatment in the L2 may be more effective due to the increased lucidity that patients seem to show (de Zulueta, 1984; Paradis, 2008; Zislin et al., 2002). Finally, the fourth emergent theme is the possibility that diglossia is a neurodevelopmental insult which contributes to the development of schizophrenia, proposed by Alherz et al. (2019). Unlike its predecessors, this final theme will not re-emerge in the synthesis of other sections (drawing its validity into question), which we continue now in Section 3.4.2, *Case Studies.*

3.4.2. Case Studies

This section contains a synthesis of three papers (Lukianowicz, 1962; Sandoval et al., 2022; Wang et al., 1998) and resulted in the emergence of two major themes: The degree of symptomology presented in the L1 versus the L2, and the influence of cultural factors. However, the findings of these case reports are mixed. Wang et al. (1998) reported six case studies of multilinguals with psychosis, within which language(s) and valence of hallucinations differed based on cultural factors related to language. One should note that all cases under examination involved immigrants to the USA who spoke English as a second language. Further investigation is needed to determine if these findings remain consistent for individuals who are simultaneous bilinguals. In the Lukianowicz (1962) case studies of 14 patients, L2 hallucinations were found to be more aggressive, and could thus represent more severe symptom expression in the L2. However, compared to modern psychological science, the conclusions proposed by this paper (e.g., that there are three types of bilinguals who hallucinate) rely heavily on conjecture and assumption, and thus these conclusions may be flawed. Lukianowicz's findings are to the exception of Sandoval et al.'s (2022) patient who reported increased lucidity in his L2 and provided qualitative descriptions of his lived experience which are compelling but lack empirical evidence. In sum, the findings of the 3 case studies reviewed were inconsistent on whether symptoms are more severe in the L1 or L2. Wang et al. (1998) additionally reported the impact of cultural context on the language of symptoms, an argument which is strengthened by others' findings such as de Zulueta

et al. (2001). Next, beginning our inquiry into experimental studies, we will review qualitative studies exploring multilingualism and psychosis.

3.4.3. Qualitative Studies

While some of the studies in the present section also contained case reports of the patients who participated, they additionally include methods of qualitative data collection. Some studies reviewed contain qualitative interviews as a portion of a mixed method alongside quantitative measures; these mixed-methods studies will be included in Section 3.4.4, *Quantitative Studies.* In the present section, we reviewed 5 studies (Bersudsky et al., 2005; Hayati & Shahlaee, 2011; Hemphill, 1971; de Zulueta et al., 2001; Kung et al., 2016). In sum, the results from qualitative studies of the relationship between schizophrenia symptoms and multilingualism align with the results previously described. Once again, we find contradictory data on whether symptoms expressed in the L1 or L2 are more severe. Hemphill (1971) reported that auditory hallucinations most frequently occur in the L1, representing more severe L1 symptomology. However, this study had potential for bias due to the sociopolitical environment of apartheid South Africa in which it took place. Some of Hemphill's conclusions about the separation of the L1 and L2 (which usually represented indigenous vs. colonial languages) may be influenced by this environment. De Zulueta et al. (2001), on the other hand, reported findings that varied between participants, ranging from more severe symptomology in the L2 to symptomology expressed equally in both languages with L1-only hallucinations.

Thus, the first emergent theme from this section was the contradictory findings on symptom prevalence in the L1/L2, however, these inconsistent findings may indicate that sociolinguistic factors and diverse life experiences outside of simply L1/L2 have an impact on the expression of schizophrenia symptoms in multilinguals. This theme was echoed by Kung et al.'s (2016) thorough and well-supported findings of language-based stressors specific to bilingual Chinese Americans with schizophrenia, indicating that linguistic and cultural identity plays a role in the specific life experiences of multilinguals with schizophrenia. Additionally, Hayati and Shahlaee (2011) and Bersudsky et al. (2005) demonstrated that individuals with schizophrenia can acquire an L2, however, the lack of significance testing, small sample sizes and lack of standardized language proficiency measures draws these methods into question. Regardless of the quality of the findings of these individual studies, however, multilinguals with schizophrenia have been demonstrated in the reviewed literature at large to exist. We next turn to quantitative and mixed-methods studies which empirically investigate this population.

3.4.4. Quantitative Studies

In the present section, we review 16 quantitative or mixed methods studies which investigate the intersection of multilingualism and schizophrenia (For greater detail, see also Supplementary Material, Appendix C.). A variety of paradigms from several cognitive science disciplines were employed, including the linguistic analysis of transcribed structured interviews and the statistical analysis of the association between language usage and symptom expression. The schizophrenia symptoms included in these studies (non-exhaustively) included auditory hallucinations (Hadden et al., 2020), thought disorder (Milun et al., 1980) and lexical markers (Smirnova et al., 2015). However, quality of these studies varied, see Supplementary Material, Appendix C for greater detail about each

study in this section, including discussion of the potential for bias or low-quality evidence.

In these 16 studies, 4 main themes emerged. The first theme was the association between lifetime language usage and the language(s) that schizophrenia symptoms are expressed in (Hadden et al., 2020; Robertson & Shamsie, 1959). Two studies of 16 reported a concordance between lifetime patterns of language usage (related to cultural-linguistic identity) and the language(s) (or components of language, e.g. phonology) in which linguistic symptoms of schizophrenia (including disorganized speech and auditory hallucinations) were expressed: Language symptoms reflected real-life language usage. In particular, Hadden and colleagues provided methodologically sound empirical evidence with a larger number of participants for such a specialized population (N = 37). Thus, these findings are especially salient for demonstrating the relationship between lifetime language usage and language of symptom expression.

The second theme was the importance of sociocultural factors in the expression of schizophrenia symptoms and related concerns in multilinguals (Hadden et al., 2020; Gilmer et al., 2009; Haasen et al., 2000; Khawaja et al., 2013; Malgady & Constantino, 1998; Price & Cuellar, 1981; Stolk et al., 2015). In the cited studies, findings regarding schizophrenia symptoms, diagnosis and prevalence varied between language groups in a manner inextricable from the cultural identities associated with said groups. This indicates a need for cultural awareness and sensitivity when conducting research with and providing treatment to multilinguals with schizophrenia. See Supplementary Material, Appendix C or Section 4 for greater detail.

The third theme was the need for multilingual and multicultural care practitioners (Haasen et al., 2000; Khawaja et al., 2013; Stuart et al., 1996) to assess multilinguals with schizophrenia accurately and equitably. The fourth theme that emerged once more was the difference between symptom severity when expressed or measured in the L1/L2, in which results were again mixed (Grand et al., 1977; Hadden et al., 2020; Milun et al., 1980; Malgady & Constantino, 1998; Price & Cuellar, 1981; Smirnova et al., 2015; Seeman, 2016). See Section 4 for greater detail. This inconsistency as well as the substantial proportion of underpowered studies suggests that further quantitative research with powerful experimental designs ought to be conducted to further investigate these research questions. For a detailed narrative synthesis of the studies overviewed in Section 3.4.4, see Supplementary Material, Appendix C. Additionally, one study by Lutz et al. (2021) demonstrated that migrants with schizophrenia in psychiatric hospitals benefitted from intensive L2 training in a specialized language ward, demonstrating that L2+ acquisition is intact in patients with schizophrenia. We now turn to the final portion of the synthesis. This section, 3.4.5, will cover in detail the single meta-analysis of four studies that has been conducted in this domain.

3.4.5. Meta-analyses

Importantly for the field, Erkoreka et al. (2020) conducted a meta-analysis in Spain to determine whether there was quality evidence of if bilingual patients with schizophrenia are more symptomatic in the L1 or the L2. This meta-analysis included only four studies with a total of 283 patients. The authors included studies with standardized assessment scores, from which they extracted effect sizes and, using these data, created both a fixed effects model to control for different sample sizes and a random effects model to interpret as additional information. These models indicated that there is low

quality evidence that symptoms are stronger in the L1. This evidence was found to be low quality due to risk of bias, heterogeneity and low sample sizes paired with large confidence intervals. These models found that the probability of detecting more symptoms in the L1 is 16–19%. Based on these findings, the authors proposed that different language networks for the L1 and L2 as well as more effortful processing in the L2 could result in lesser symptomology expressed in the L2.

This conclusion, especially regarding more effortful processing, is reflected in the literature reviewed to this point. However, we have also reviewed findings which challenge the concept of a separation of the language networks altogether in multilinguals with schizophrenia, such as the multilingual symptoms reported by Hadden et al. (2020) and Robertson and Shamsie (1959). Furthermore, the bilingualism literature consistently reports that multiple languages are activated in parallel (reviewed in Baum & Titone, 2014; Dijkstra & van Heuven, 2002; Kroll & Bialystok, 2013; Kroll et al., 2015). As such, Erkoreka et al.'s proposal of separate language networks impacting L2 symptomology is controversial.

As the quality of evidence found in this meta-analysis is low overall, further studies should be conducted which improve upon the weaknesses identified by Erkoreka et al. (2020). Furthermore, this meta-analysis only included four empirical studies and therefore fails to capture the entire breadth of this interdisciplinary literature. Thus, the present scoping review adds value to this meta-analysis by reviewing the findings of several papers that could not be meta-analyzed due to methodology. This is important for establishing the state of the literature holistically to provide interested parties with a complete image of the research to this point.

4. Summary of evidence

In section 3.4, we synthesized the findings of 30 studies from three databases regarding schizophrenia and multilingualism. Four main themes emerged throughout this synthesis. The first emergent theme was the need for multilingual medical and social service practitioners who can (1) assess patients in as many of their spoken languages as possible to capture the most accurate picture of symptomology and (2) provide treatment in whichever language leads to the most fruitful outcomes. Multilingual treatment options are necessary (and often preferred, Khawaja et al., 2013) for multilinguals with schizophrenia, especially those with limited proficiency in the national language. Stuart et al. found evidence for higher rates of antipsychotic use in limited English proficiency bilinguals paired with lower rates of psychotherapy, potentially indicating that the lack of access to first-language psychotherapy for those with low national language proficiency was being supplemented by medication (Stuart et al., 1996). It is also possible that the acculturation stressors (Khawaja et al., 2013) associated with having limited English proficiency in an English-speaking country contributed to an increase in symptoms warranting antipsychotics. Khawaja et al. found that approximately 50% of culturally and linguistically diverse patients, including those with schizophrenia, relied exclusively on bilingual practitioners (Khawaja et al., 2013). Timely access to psychiatric treatment is an important predictor of outcomes in schizophrenia (Bird et al., 2010). When multilinguals with schizophrenia are disadvantaged by limited proficiency in the national or regional language, this may prove a barrier to receiving timely and adequate care, resulting in poorer outcomes or service disengagement (see Maraj et al., 2023).

The second emergent theme is that therapy in the L2 *may* be fruitful when patients demonstrate lesser degrees of emotionality or thought disorder in the L2 (see the non-schizophrenia literature, e.g. Jończyk et al., 2016; Ortigosa-Beltrán et al., 2023; Pavlenko, 2012). Some researchers reviewed here have proposed that in some patients with schizophrenia, emotional access and/or thought disorder is reduced in the L2, resulting in greater stability and lucidity (de Zulueta, 2001; Gerson & Schweitzer, 1972; Paradis, 2008; Sandoval et al., 2022). This is interesting due to its conflict with theories of bilingualism that posit a shared semantic system between the L1 and L2 (Ameel et al., 2009; Francis, 2020). As the semantic system is known to be abnormal in patients with schizophrenia (Kumar & Debruille, 2004; Salavera et al., 2013) this may represent a way bilinguals with schizophrenia differ from bilinguals without the condition. However, it is also possible that this phenomenon can be entirely attributed to the reduced emotionality in the L2 demonstrated in other populations, and that L2 decreases in thought disorder are related to the lesser degree of stress on cognitive systems when in a calmer state. In regard to this phenomenon, Sandoval et al.'s patient reported "I know my English [L2] isn't perfect, so it takes me an extra effort to think about the things I want to say to my clinicians…it's like I can encapsulate the psychosis with my broken English…But when I speak Spanish, my thoughts are more fluid and harder to stop…" (Sandoval et al., 2022). Based on these anecdotal reports, many authors proposed L2 learning or therapy in the L2 as a fruitful treatment avenue for people with schizophrenia. It is important to note that this treatment should not be conducted at the expense of multilingual care options (i.e., L2-only support), as discussed in the preceding paragraph. Further research is needed to experimentally prove out this proposal, as so far it has remained theoretical. Furthermore, less severe symptom expression (the basis of this claim) was not always detected in studies, as we now discuss.

The third emergent theme addressed whether schizophrenia symptoms are more severe or detectable when expressed or assessed in the L1 or L2. In other clinical bilingual populations such as bilinguals with aphasia, different patterns of symptom expression and recovery can be observed in different languages (Fabbro, 2001; Paradis, 1977). Robertson and Shamsie (1959) and Hadden et al. (2020) supported the concept that lifetime language usage is associated with the language that schizophrenia symptoms are expressed in. However, the data regarding whether symptoms are more pronounced when expressed or assessed in the L1 or L2 are mixed. Erkoreka et al. (2020) reported in a meta-analysis of 4 studies that there was low quality evidence demonstrating a 16–19% greater chance to detect symptoms in the L1 than the L2. In studies employing the BPRS, one study ($N = 10$) detected greater symptomology in the L2 (Grand et al., 1977), and two studies ($N = 77$) detected greater symptomology in the L1 (Malgady & Constantino, 1998; Price et al., 1981). One case study ($N = 1$) and one quantitative study (schizophrenic $N = 10$) reported a decrease in thought disorder in the L2 (Milun et al., 1980; Sandoval et al., 2022). In contrast, another case study reported decreased delusions in the L1 for one participant (de Zulueta et al., 2001). However, in this case, the L1 was not the participant's dominant language (i.e., he was reverse-dominant), and thus may be more cognitively similar to the L2 as measured in other studies.

Across studies, reports were mixed on whether auditory hallucinations were more likely to occur in the L1 or the L2. Furthermore, the severity of hallucinations in the L1 or L2 varied: Some studies, such as Lukianowicz (1962) and Hadden et al. (2020) provided qualitative reports of greater hostility in L2 hallucinations,

which Hadden et al. associated with the dominance of the English language (the L2 in such cases) and English-speaking society in the United Kingdom. In the case where L1 hallucinations were found to be hostile, this was often associated with L1-only hallucinations (de Zulueta et al., 2001; Sandoval et al., 2022), though not exclusively (Hadden et al., 2020). Thus, while the data are mixed, they seem to indicate that individual differences play a major role in the relationship between symptom severity and detectability in the L1 and L2. More research is necessary, including research which incorporates studies of reading as well as verbal language processing, as people with schizophrenia are additionally known to demonstrate differences in reading processes (Whitford et al., 2018, 2023), as are multilinguals (Palma & Titone, 2020).

As these examples show, variables related to culture, language history and illness history may account for individual differences in symptom expression in the L1 and L2 of multilinguals with schizophrenia. This fourth emergent theme aligns well with recent efforts to situate multilingualism research socioecologically (De Bot et al., 2007; Douglas Fir Group, 2016; Hernández-Rivera et al., 2022; Titone & Tiv, 2022, 2023; Tiv et al., 2022). Broadly, people with schizophrenia face negative psychosocial outcomes (Bellack et al., 1990; Medalia & Saperstein, 2013), negative vocational outcomes (Bouwmans et al., 2015; Marwaha & Johnson, 2004; Lin et al., 2022) and significant experiences of stigma (Degnan et al., 2021; Morgades-Bamba et al., 2019; Valery & Prouteau, 2020). These domains and others all may be impacted by the cognitive, social and cultural correlates of multilingualism.

For example, experiences of mental health stigma may be amplified by other stigmatized identities, such as being an L2 speaker of the national language (Birney et al., 2019). The issues that multilinguals with schizophrenia (especially those with limited proficiency in the national language) face in treatment are not uniquely about being multilingual: There are cultural and ethnic factors which contribute to treatment issues such as diagnostic disparities (Haasen et al., 2000) and medication adherence (Gilmer et al., 2009). On the topic of diagnostic disparities, it is worth noting that one study found no significant difference in SAPS ratings among bilingual Latinos, monolingual English-speaking Latinos and monolingual Euro-Americans (Diaz et al., 2009). Thus, the small amount of research concerning inconsistencies in diagnosis in multilinguals also showed inconclusive results.

As such, findings seem to indicate that there is not a "one size fits all" approach to quantifying schizophrenia symptoms in multilinguals, but rather a complex interplay of medical and social factors that contribute to symptom expression. This finding is emblematic of schizophrenia, which is a complex and nuanced experience that evades capture within a coherent model (Barch et al., 2022).

4.1. Limitations

One limitation of this work is that research investigating the intersection of multilingualism and schizophrenia is scant and requires further contribution using appropriate methodologies. The total number of studies identified in this scoping review was small ($N = 30$) and the vast majority were non-experimental in nature. Additionally, many studies with experimental designs lacked appropriate statistical significance testing. This represents a major limitation of our findings. Furthermore, this scoping review was limited by not reviewing dissertations, grey literature and non-English literature. Additionally, its findings are only up to date until January 2023 when this is a rapidly emerging field of literature, with new publications already extant at the time of manuscript

writing (e.g., Maraj et al., 2023). These limitations should be addressed by updated research into this topic in the future.

5. Conclusions

This scoping review identified several studies with highly relevant and impactful findings on the issue of multilingualism and schizophrenia. However, the overall landscape of the field indicates that this topic has been neglected within schizophrenia research. Consequently, we call for further (ideally experimental) research with hypotheses concerning the five findings listed in Section 4.1. It is our hope that this scoping review provides a solid base for such research to build on now that the general shape of the field has been established. Future empirical studies should aim to address the topics of interest identified in Section 4.1 while also improving on the methodologies used to draw more definitive conclusions, especially regarding the implications of multilingualism on schizophrenia symptom expression and the potential benefit of L2 therapy.

References

Alherz, M., Almusawi, H., & Barry, D. S. (2019). Diglossia in the etiology of schizophrenia: A hypothesis. *The Journal of Nervous and Mental Disease*, **207** (11), 987–992. 10.1097/nmd.0000000000001067

Ameel, E., Malt, B. C., Storms, G., & Van Assche, F. (2009). Semantic convergence in the bilingual lexicon. *Journal of memory and language*, **60** (2), 270–290. 10.1016/j.jml.2008.10.001

Andreasen, N. C. (1983). *Scale for the assessment of negative symptoms (SANS)*. University of Iowa.

Andreasen, N. C. (1984). *Scale for the assessment of positive symptoms (SAPS)*. University of Iowa.

Andreasen, N. C., & Olsen, S. (1982). Negative v. positive schizophrenia: Definition and validation. *Archives of General Psychiatry*, **39**, 789–794. 10.1001/archpsyc.1982.04290070025006

Bambini, V., Arcara, G., Bechi, M., Buonocore, M., Cavallaro, R., & Bosia, M. (2016). The communicative impairment as a core feature of schizophrenia: Frequency of pragmatic deficit, cognitive substrates, and relation with quality of life. *Comprehensive Psychiatry*, **71**, 106–120. 10.1016/j.comppsych. 2016.08.012

Bannister, D., & Fransella, F. (1966). A grid test of schizophrenic thought disorder. *British Journal of Social and Clinical Psychology*, **5**(2), 95–102. 10.1111/j.2044-8260.1966.tb00961.x

Barch, D. M., & Ceaser, A. (2012). Cognition in schizophrenia: core psychological and neural mechanisms. *Trends in cognitive sciences*, **16**(1), 27–34. https://doi.org/10.1016/j.tics.2011.11.015

Barber, L., Reniers, R. & Upthegrove, R. (2021). A review of functional and structural neuroimaging studies to investigate the inner speech model of auditory verbal hallucinations in schizophrenia. *Translational Psychiatry*, **11**, 582. 10.1038/s41398-021-01670-7

Barch, D. M., Karcher, N., & Moran, E. (2022). Reinventing schizophrenia – Embracing complexity and complication. *Schizophrenia Research*, **242**, 7–11. 10.1016/j.schres.2021.11.037

Baum, S., & Titone, D. (2014). Moving toward a neuroplasticity view of bilingualism, executive control, and aging. *Applied Psycholinguistics*, **35**(5), 857–894. 10.1017/S0142716414000174

Bellack, A. S., Morrison, R. L., Wixted, J. T., & Mueser, K. T. (1990). An analysis of social competence in schizophrenia. *British Journal of Psychiatry*, **156**, 809–818. 10.1192/bjp.156.6.809

Bersudsky, Y., Fine, J., Gorjaltsan, I., Chen, O., & Walters, J. (2005). Schizophrenia and second language acquisition. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, **29**(4), 535–542. 10.1016/j.pnpbp.2005.01.004

Bird, V., Premkumar, P., Kendall, T., Whittington, C., Mitchell, J., & Kuipers, E. (2010). Early intervention services, cognitive-behavioural therapy and family intervention in early psychosis: Systematic review. *British Journal of Psychiatry*, **197**(5), 350–356. 10.1192/bjp.bp.109.074526

Birney, M. E., Rabinovich, A., Morton, T. A., Heath, H., & Ashcroft, S. (2019). When speaking English is not enough: The consequences of language-based stigma for non-native speakers. *Journal of Language and Social Psychology*, **39** (1), 67–86. 10.1177/0261927x19883906

Bora, E., Binnur Akdede, B., & Alptekin, K. (2017). Neurocognitive impairment in deficit and non-deficit schizophrenia: A meta-analysis. *Psychological Medicine* **47**(14), 2401–2413. 10.1017/S0033291717000952

Bouwmans, C., de Sonneville, C., Mulder, C. L., & Hakkaart-van Roijen, L. (2015). Employment and the associated impact on quality of life in people diagnosed with schizophrenia. *Neuropsychiatric Disease and Treatment*, **11**, 2125–2142. 10.2147/NDT.S83546

Cantor-Graae, E., & Selten, J.-P. (2005). Schizophrenia and migration: A meta-analysis and review. *American Journal of Psychiatry*, **162**(1), 12–24. 10.1176/appi.ajp.162.1.12.

Chernigovskaya, T. V., Balonov, L. J., & Deglin, V. L. (1983). Bilingualism and functional brain asymmetry. *Brain and Language*, **20**, 195–216. 10.1016/0093-934x(83)90042-1

Covington, M. A., He, C., Brown, C., Naci, L., McClain, J. T., Fjordbak, B. S., Semple, J., & Brown, J. (2005). Schizophrenia and the structure of language: The linguist's view. *Schizophrenia Research*, **77**(1), 85–98. 10.1016/j. schres.2005.01.016

De Bot, K., Lowie, W., & Verspoor, M. (2007). A dynamic systems theory approach to second language acquisition. *Bilingualism: Language and Cognition*, **10**(1), 7–21. 10.1017/S1366728906002732

de Zulueta, F. I. (1984). The implications of bilingualism in the study and treatment of psychiatric disorders: A review. *Psychological Medicine*, **14**(3), 541–557. 10.1017/s0033291700015154

de Zulueta, F. I., Gene-Cos, N., & Grachev, S. (2001). Differential psychotic symptomatology in polygot patients: Case reports and their implications. *British Journal of Medical Psychology*, **74** 277–292. 10.1348/000711201160966

Degnan, A., Berry, K., Sweet, D., Abel, K., Crossley, N., & Edge, D. (2018). Social networks and symptomatic and functional outcomes in schizophrenia: A systematic review and meta-analysis. *Social Psychiatry and Psychiatric Epidemiology*, **53**(9), 873–888. 10.1007/s00127-018-1552-8

Degnan, A., Berry, K., Humphrey, C., & Bucci, S. (2021). The relationship between stigma and subjective quality of life in psychosis: A systematic review and meta-analysis. *Clinical Psychology Review*, **85**, 102003. 10.1016/j. cpr.2021.102003

DeLisi L. E. (2001). Speech disorder in schizophrenia: Review of the literature and exploration of its relation to the uniquely human capacity for language. *Schizophrenia Bulletin*, **27**(3), 481–496. 10.1093/oxfordjournals.schbul.a006889

Diaz, E., Miskemen, T., Vega, W. A., Gara, M., Wilson, D. R., Lesser, I., Escamilla, M., Neighbors, H. W., Arndt, S., & Strakowski, S. (2009). Inconsistencies in diagnosis and symptoms among bilingual and English speaking Latinos and Euro-Americans. *Psychiatric Services*, **60**, 1379–1382. 10.1176/ps.2009.60.10.1379

Dijkstra, T., & van Heuven, W. J. B. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition*, **5**(3), 175–197. 10.1017/s1366728902003012

Douglas Fir Group. (2016). A transdisciplinary framework for SLA in a multilingual world. *The Modern Language Journal*, **100**(S1), 19–47. 10.1111/modl.12301

Erkoreka, L., **Ozamiz-Etxebarria, N.**, **Ruiz, O.**, & **Ballesteros, J.** (2020). Assessment of psychiatric symptomatology in bilingual psychotic patients: A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, **17**(11). https://doi.org/10.3390/ijerph17114137

Fabbro, F. (2001). The bilingual brain: Bilingual aphasia. *Brain and Language*, **79**(2), 201–210. https://doi.org/10.1006/brln.2001.2480

Francis, W. S. (2020). Shared core meanings and shared associations in bilingual semantic memory: Evidence from research on implicit memory. *International Journal of Bilingualism*, **24**(3), 464–477. https://doi.org/10.1177/1367006918814375

Friederici, A. D., & **Gierhan, S. M.** (2013). The language network. *Current opinion in neurobiology*, **23**(2), 250–254. https://doi.org/10.1016/j.conb.2012.10.002

Friston, K. J., & **Frith, C. D.** (1995). Schizophrenia: a disconnection syndrome. *Clinical Neuroscience*, **3**(2), 89–97.

Gerson, A., & **Schweitzer, D. A.** (1972). Linguistic regression of the multilingual psychotic. *Perspectives in Psychiatric Care*, **10**(5), 236–237. https://doi.org/10.1111/j.1744-6163.1972.tb00781.x

Gilmer, T. P., **Ojeda, V. D.**, **Barrio, C.**, **Fuentes, D.**, **Garcia, P.**, **Lanouette, N. M.**, & **Lee, K. C.** (2009). Adherence to antipsychotics among Latinos and Asians with schizophrenia and limited English proficiency. *Psychiatric Services*, **60**, 175–182. https://doi.org/10.1176/ps.2009.60.2.175

Grand, S., **Marcos, L. R.**, **Freedman, N.**, & **Barroso, F.** (1977). Relation of psychopathology and bilingualism to kinesic aspects of interview behavior in schizophrenia. *Journal of Abnormal Psychology*, **86**(5), 492–500. https://doi.org/10.1037//0021-843x.86.5.492

Green, D. W., & **Abutalebi, J.** (2008). Understanding the link between bilingual aphasia and language control. *Journal of Neurolinguistics*, **21**(6), 558–576.

Grosjean, F. (2015). Bicultural bilinguals. *International Journal of Multilingualism*, **19**(5), 572–586. https://doi.org/10.1177/1367006914526297

Haasen, C., **Yagdiran, O.**, **Mass, R.**, & **Krausz, M.** (2000). Potential for misdiagnosis among Turkish migrants with psychotic disorders: A clinical controlled study in Germany. *Acta Psychiatrica Scandinavica*, **101**(2), 125–129. https://doi.org/10.1034/j.1600-0447.2000.90065.x

Hadden, L. M., **Alderson-Day, B.**, **Jackson, M.**, **Fernyhough, C.**, & **Bentall, R. P.** (2020). The auditory-verbal hallucinations of Welsh-English bilingual people. *Psychology and Psychotherapy*, **93**(1), 122–133. https://doi.org/10.1111/papt.12234

Hayati, A., & **Shahlaee, K.** (2011). On the Relationship between Mind and Language: Teaching English Vocabulary to Schizophrenics. *Psychology*, **2**(05), 416.

Hemphill, R. E. (1971). Auditory hallucinations in polyglots. *South African Medical Journal*, **45**, 1391–1394.

Hernández-Rivera, E., **Gullifer, J. W.**, & **Titone, D.** (2022). Socioecological and psycholinguistic approaches to multilingual health literacy. *Translational Issues in Psychological Science*, **8**(2), 197. https://psycnet.apa.org/doi/10.1037/tps0000325

Hodgins, V., **O'Driscoll, G.**, & **Titone, D.** (2022). The impact of neurotypical cognition on communication deficits attributed to pathologized people: schizophrenia as a case study. *Applied Psycholinguistics*, **44**(3), 330–342. https://doi.org/10.1017/s0142716422000340

Jończyk, R., **Boutonnet, B.**, **Musiał, K.**, **Hoemann, K.**, & **Thierry, G.** (2016). The bilingual brain turns a blind eye to negative statements in the second language. *Cognitive, Affective & Behavioral Neuroscience*, **16**(3), 527–540. https://doi.org/10.3758/s13415-016-0411-x

Kay, S. R., **Fiszbein, A.**, & **Opler, L. A.** (1967). The positive and negative syndrome scale (PANSS) for schizophrenia. *Schizophrenia Bulletin*, **13**(2). https://doi.org/10.1093/schbul/13.2.261

Khawaja, N. G., **McCarthy, R.**, **Braddock, V.**, & **Dunne, M.** (2013). Characteristics of culturally and linguistically diverse mental health clients. *Advances in Mental Health*, **11**(2), 172–187. https://doi.org/10.5172/jamh.2013.11.2.172

Kirkpatrick, B., **Strauss, G. P.**, **Nguyen, L.**, **Fischer, B. A.**, **Daniel, D. G.**, **Cienfuegos, A.**, & **Marder, S. R.** (2011). The brief negative symptom scale: Psychometric properties. *Schizophrenia Bulletin*, **37**(2), 300–305. https://doi.org/10.1093/schbul/sbq059

Kroll, J. F., & **Bialystok, E.** (2013). Understanding the consequences of bilingualism for language processing and cognition. *Journal of Cognitive Psychology (Hove)*, **25**(5). https://doi.org/10.1080/20445911.2013.799170

Kroll, J. F., **Dussias, P. E.**, **Bice, K.**, & **Perrotti, L.** (2015). Bilingualism, mind, and brain. *Annual Review of Linguistics*, **1**, 377–394. https://doi.org/10.1146/annurev-linguist-030514-124937

Kumar, N., & **Debruille, J. B.** (2004). Semantics and N400: Insights for schizophrenia. *Journal of Psychiatry and Neuroscience*, **29**(2), 89–98.

Kung, W. (2016). Tangible needs and external stressors faced by Chinese American families with a member having schizophrenia. *Social Work Research*, **40**(1), 53–63. https://doi.org/10.1093/swr/svv047

Kuperberg, G. R. (2010). Language in schizophrenia part 1: An introduction. *Language and Linguistics Compass*, **4**(8), 576–589. https://doi.org/10.1111/j.1749-818X.2010.00216.x

Kurtz, M. M., **Mueser, K. T.**, **Thime, W. R.**, **Corbera, S.**, & **Wexler, B. E.** (2015). Social skills training and computer-assisted cognitive remediation in schizophrenia. *Schizophrenia Researcg*, **162**(1–3), 35–41. https://doi.org/10.1016/j.schres.2015.01.020

Lajeunesse, M. J. (2016). Facilitating systematic reviews, data extraction, and meta-analysis with the metagear package for R. *Methods in Ecology and Evolution*, **7**, 323–330. https://doi.org/10.1111/2041-210X.12472

Langdon, R., **Coltheart, M.**, **Ward, P. B.**, & **Catts, S. V.** (2002). Disturbed communication in schizophrenia: The role of poor pragmatics and poor mind-reading. *Psychological Medicine*, **32**(7), 1273–1284. https://doi.org/10.1017/S0033291702006396

Levy, D. L., **Coleman, M. J.**, **Sung, H.**, **Ji, F.**, **Matthysse, S.**, **Mendell, N. R.**, & **Titone, D.** (2010). The genetic basis of thought disorder and language and communication disturbances in schizophrenia. *Journal of Neurolinguistics*, **23**(3), 176. https://doi.org/10.1016/j.jneuroling.2009.08.003

Lin, D., **Kim, H.**, **Wada, K.**, **Aboumrad, M.**, **Powell, E.**, **Zwain, G.**, **Benson, C.**, & **Near, A. M.** (2022). Unemployment, homelessness, and other societal outcomes in patients with schizophrenia: A real-world retrospective cohort study of the United States Veterans Health Administration database: Societal burden of schizophrenia among US veterans. *BMC Psychiatry*, **22**(1), 458. https://doi.org/10.1186/s12888-022-04022-x

Lukianowicz, N. (1962). Auditory hallucinations in polyglot subjects. *Psychiatria et Neurologia (Basel)*, **143**, 274–294. https://doi.org/10.1159/000131132

Lutz, M., **Streb, J.**, **Titze, L.**, **Busselmann, M.**, **Riemat, N.**, **Pruter-Schwarte, C.**, & **Dudeck, M.** (2021). Migrants with schizophrenia in forensic psychiatric hospitals benefit from high-intensity second language programs. *Frontiers in Psychiatry*, **12**, 711836. https://doi.org/10.3389/fpsyt.2021.711836

Malgady, R. G., & **Constantino, G.** (1998). Symptom severity in bilingual Hispanics as a function of clinician ethnicity and language of interview. *Psychological Assessment*, **10**, 120–127. https://psycnet.apa.org/doi/10.1037/1040-3590.10.2.120

Maraj, A., **Ferrari, M.**, **MacDonald, K.**, **Peters, M.**, **Joober, R.**, **Shah, J. L.**, & **Iyer, S. N.** (2023). Engaging with care in an early intervention for psychosis program: The role of language, communication, and culture. *Transcultural Psychiatry*, https://doi.org/10.1177/1363461523116706

Marwaha, S., & **Johnson, S.** (2004). Schizophrenia and employment – A review. *Social Psychiatry and Psychiatric Epidemiology*, **39**(5), 337–349. https://doi.org/10.1007/s00127-004-0762-4

McGuire, P. K., **Silbersweig, D. A.**, **Wright, I.**, **Murray, R. M.**, **Frackowiak, R. S.**, & **Frith, C. D.** (1996). The neural correlates of inner speech and auditory verbal imagery in schizophrenia: Relationship to auditory verbal hallucinations. *British Journal of Psychiatry*, **169**(2), 148–159. https://doi.org/10.1192/bjp.169.2.148

Medalia, A., & **Saperstein, A. M.** (2013). Does cognitive remediation for schizophrenia improve functional outcomes? *Current Opinion in Psychiatry*, **26**(2), 151–157. 10.1097/YCO.0b013e32835dcbd4

Microsoft Corporation. (2018). *Microsoft Excel*.

Milun, M., **Daneel, M. H.**, **Smart, D.**, & **Beumont, P. J. V.** (1980). Language medium and schizophrenic thought disorder. *South African Medical Journal*, **57**, 996–997.

Mitchell, R. L., & **Crow, T. J.** (2005). Right hemisphere language functions and schizophrenia: The forgotten hemisphere?. *Brain*, **128**(5), 963–978. https://doi.org/10.1093/brain/awh466

Morgades-Bamba, C. I., **Fuster-Ruizdeapodaca, M. J.**, & **Molero, F.** (2019). Internalized stigma and its impact on schizophrenia quality of life. *Psychology, Health & Medicine*, **24**(8), 992–1004. https://doi.org/10.1080/13548506.2019.1612076

Munn, Z., **Peters, M. D. J.**, **Stern, C.**, **Tufanaru, C.**, **McArthur, A.**, & **Aromataris, E.** (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, **18**(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Oomen, P. P., **de Boer, J. N.**, **Brederoo, S. G.**, **Voppel, A. E.**, **Brand, B. A.**, **Wijnen, F. N. K.**, & **Sommer, I. E. C.** (2022). Characterizing speech heterogeneity in schizophrenia-spectrum disorders. *Journal of Psychopathology and Clinical Science*, **131**(2), 172–181. https://doi.org/10.1037/abn0000736

Ortigosa-Beltrán, I., **Jaén, I.**, & **García-Palacios, A.** (2023). Processing negative autobiographical memories in a foreign language. *Frontiers in Psychology*, **14**, 1133915. https://doi.org/10.3389/fpsyg.2023.1133915

Overall, J. E., & **Gorham, D. R.** (1988). The brief psychiatric rating scale (BPRS): Recent developments in ascertainment and scaling. *Psychopharmacology Bulletin*, **24**(1), 97–99.

Palaniyappan, L., **Homan, P.**, & **Alonso-Sanchez, M. F.** (2023). Language network dysfunction and formal thought disorder in schizophrenia. *Schizophrenia Bulletin*, **49**(2), 486–497. https://doi.org/10.1093/schbul/sbac159

Palma, P., & **Titone, D.** (2020). Bilingual lexical access and reading. In R. R. Heredia & A. B. Cieślicka (Eds.), *Bilingual lexical ambiguity resolution* (pp. 159–183). Cambridge University Press. https://doi.org/10.1017/9781316535967.008

Paradis, M. (1977). Bilingualism and aphasia. In *Studies in neurolinguistics* (pp. 65–121). Academic Press. https://doi.org/10.1016/B978-0-12-746303-2.50008-7

Paradis, M. (2008). Bilingualism and neuropsychiatric disorders. *Journal of Neurolinguistics*, **21**(3), 199–230. https://doi.org/10.1016/j.jneuroling.2007.09.002

Paradis, M., & **Libben, G.** (2014). *The assessment of bilingual aphasia*. Psychology Press. https://doi.org/10.4324/9781315802138

Pavlenko A. (2012). Affective processing in bilingual speakers: disembodied cognition?. *International Journal of Psychology: Journal International de Psychologie*, **47**(6), 405–428. https://doi.org/10.1080/00207594.2012.743665

Price, C. S., & **Cuellar, I.** (1981). Effects of language and related variables on the expression of psychopathology in Mexican American psychiatric patients. *Hispanic Journal of Behavioural Science*, **3**, 143–160. https://doi.org/10.1177/073998638100300203

Ramírez-Esparza, N., **García-Sierra, A.**, & **Jiang, S.** (2020). The current standing of bilingualism in today's globalized world: A socio-ecological perspective. *Current Opinion in Psychology*, **32**, 124–128. https://doi.org/10.1016/j.copsyc.2019.06.038

Robertson, J. P. S., & **Shamsie, S. J.** (1959). A systematic examination of Gibberish in a multilingual schizophrenic patient. *Language and Speech*, **2**, 1–8. https://doi.org/10.1177/002383095900200102

Runnqvist, E., **Gollan, T. H.**, **Costa, A.**, & **Ferreira, V. S.** (2013). A disadvantage in bilingual sentence production modulated by syntactic frequency and similarity across languages. *Cognition*, **129**(2), 256–263. https://doi.org/10.1016/j.cognition.2013.07.008

Saito, S. (2019). Acute psychosis in a polyglot: Linguistic regression to the mother tongue and restoration. *Asian Journal of Psychiatry*, **43**, 91–92. https://doi.org/10.1016/j.ajp.2019.05.025

Salavera, C., **Puyuelo, M.**, **Antoñanzas, J. L.**, & **Teruel, P.** (2013). Semantics, pragmatics, and formal thought disorders in people with schizophrenia. *Neuropsychiatric Disease and Treatment*, 177–183. https://doi.org/10.2147/ndt.s38676

Sandoval, L. R., **Stone, L.**, **Guimond, S.**, **Lawler, A.**, **Keshavan, M. S.**, & **Stone, W. S.** (2022). Encapsulating psychosis with a second language: A clinical case. *Schizophrenia Research*, **248**, 363–365. https://doi.org/10.1016/j.schres.2021.11.001

Seeman, M. V. (2016). Bilingualism and schizophrenia. *World Journal of Psychiatry*, **6**(2), 192–198. https://doi.org/10.5498/wjp.v6.i2.192

Silva, A. M., **Limongi, R.**, **MacKinley, M.**, **Ford, S. D.**, **Alonso-Sánchez, M. F.**, & **Palaniyappan, L.** (2023). Syntactic complexity of spoken language in the

diagnosis of schizophrenia: A probabilistic Bayes network model. *Schizophrenia Research*, **259**, 88–96. https://doi.org/10.1016/j.schres.2022.06.011

Smirnova, D., **Walters, J.**, **Fine, J.**, **Muchnik-Rozanov, Y.**, **Paz, M.**, **Lerner, V.**, **Belmaker, R. H.**, & **Bersudsky, Y.** (2015). Second language as a compensatory resource for maintaining verbal fluency in bilingual immigrants with schizophrenia. *Neuropsychologia*, **75**, 597–606. https://doi.org/10.1016/j.neuropsychologia.2015.06.037

Sommer, I. E. C., & **Kahn, R. S.** (2009). *Language lateralization and psychosis*. Cambridge University Press. https://doi.org/10.1017/CBO9780511576744

Statistics Canada. (2017). *Linguistic integration of immigrants and official language populations in Canada*. Government of Canada.

Statistics Canada. (2022). *While English and French are still the main languages spoken in Canada, the country's linguistic diversity continues to grow. (11-001-X)*. Government of Canada.

Stolk, Y., **Sevar, K.**, **Tran, N.**, **Mancuso, S. G.**, **Chopra, P.**, & **Castle, D.** (2015). A comparative study of the economic and social functioning of Vietnamese-Australians with low English proficiency living with psychotic illness. *International Journal of Social Psychiatry*, **61**(4), 319–329. https://doi.org/10.1177/0020764014543710

Strauss, G. P., **Waltz, J. A.**, & **Gold, J. M.** (2014). A review of reward processing and motivational impairment in schizophrenia. *Schizophrenia Bulletin*, **40**(Suppl 2), S107–S116. https://doi.org/10.1093/schbul/sbt197

Stuart, G. W., **Minas, I. H.**, **Klimidis, S.**, & **O'Connell, S.** (1996). English language ability and mental health service utilisation: A census. *Australia and New Zealand Journal of Psychiatry*, **30**, 270–277. https://doi.org/10.3109/00048679609076105

The EndNote Team. (2013). *EndNote 20*.

Titone, D., & **Levy, D. L.** (2004). Lexical competition and spoken word identification in schizophrenia. *Schizophrenia Research*, **68**(1), 75–85. https://doi.org/10.1016/S0920-9964(03)00212-3

Titone, D. A., & **Tiv, M.** (2022). Rethinking multilingual experience through a systems framework of bilingualism. *Bilingualism: Language and Cognition*, **26**(1), 1–16. https://psycnet.apa.org/doi/10.1017/S1366728921001127

Titone, D. A., & **Tiv, M.** (2023). Rethinking multilingual experience through a systems framework of bilingualism: Response to commentaries. *Bilingualism: Language and Cognition*, **26**(1), 247–251. https://doi.org/10.1017/S1366728922000785

Titone, D., **Levy, D. L.**, & **Holzman, P. S.** (2000). Contextual insensitivity in schizophrenic language processing: evidence from lexical ambiguity. *Journal of Abnormal Psychology*, **109**(4), 761. https://doi.org/10.1037//0021-843x.109.4.761

Tiv, M., **Kutlu, E.**, **Gullifer, J. W.**, **Feng, R. Y.**, **Doucerain, M. M.**, & **Titone, D. A.** (2022). Bridging interpersonal and ecological dynamics of cognition through a systems framework of bilingualism. *Journal of Experimental Psychology: General*, **151**(9) https://psycnet.apa.org/doi/10.1037/xge0001174

Tricco, A. C., **Lillie, E.**, **Zarin, W.**, **O'Brien, K. K.**, **Colquhoun, H.**, **Levac, D.**, **Moher, D.**, **Peters, M. D. J.**, **Horsley, T.**, **Weeks, L.**, **Hempel, S.**, **Akl, E. A.**, **Chang, C.**, **McGowan, J.**, **Stewart, L.**, **Hartling, L.**, **Aldcroft, A.**, **Wilson, M. G.**, **Garritty, C.**, … **Straus, S. E.** (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, **169**(7), 467–473. https://doi.org/10.7326/M18-0850

Valery, K. M., & **Prouteau, A.** (2020). Schizophrenia stigma in mental health professionals and associated factors: A systematic review. *Psychiatry Research*, **290**, 113068. https://doi.org/10.1016/j.psychres.2020.113068

Wang, J. H., **Morales, O.**, & **Hsu, L. K.** (1998). Auditory hallucinations in bilingual immigrants. *The Journal of Nervous and Mental Disease*, **186**(8), 501–503. https://doi.org/10.1097/00005053-199808000-00009

Weiser, M., **Werbeloff, N.**, **Vishna, T.**, **Yoffe, R.**, **Lubin, G.**, **Shmushkevitch, M.**, & **Davidson, M.** (2008). Elaboration on immigration and risk for schizophrenia. *Psychological Medicine*, **38**(8), 1113–1119. https://doi.org/10.1017/S003329170700205X

Whitford, V., & **Titone, D.** (2012). Second-language experience modulates first-and second-language word frequency effects: Evidence from eye movement measures of natural paragraph reading. *Psychonomic Bulletin & Review*, **19**, 73–80. https://doi.org/10.3758/s13423-011-0179-5

Whitford, V., **O'Driscoll, G. A.**, & **Titone, D.** (2018). Reading deficits in schizophrenia and their relationship to developmental dyslexia: A review. *Schizophrenia Research*, **193**, 11–22. https://doi.org/10.1016/j.schres.2017.06.049

Whitford, V., **Byers, N.**, **O'Driscoll, G. A.**, & **Titone, D.** (2023). Eye movements and the perceptual span in disordered reading: A comparison of schizophrenia and dyslexia. *Schizophrenia Research: Cognition*, **34**, 100289. https://doi.org/10.1016/j.scog.2023.100289

Würschinger, Q. (2021). Social networks of lexical innovation. Investigating the social dynamics of diffusion of neologisms on twitter. *Frontiers in Artificial Intelligence*, **4**, 648583. https://doi.org/10.3389/frai.2021.648583

Zislin, J., **Kuperman, V.**, & **Durst, R.** (2002). The generation of psychosis: A pragmatic approach. *Medical Hypotheses*, **58**(1), 9–10. https://doi.org/10.1054/mehy.2001.1392