

Practitioner Review: Multilingualism and neurodevelopmental disorders – an overview of recent research and discussion of clinical implications

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Background: Language and communication skills are essential aspects of child development, which are often disrupted in children with neurodevelopmental disorders. Cutting edge research in psycholinguistics suggests that multilingualism has potential to influence social, linguistic and cognitive development. Thus, multilingualism has implications for clinical assessment, diagnostic formulation, intervention and support offered to families. We present a systematic review and synthesis of the effects of multilingualism for children with neurodevelopmental disorders and discuss clinical implications. **Methods:** We conducted systematic searches for studies on multilingualism in neurodevelopmental disorders. Keywords for neurodevelopmental disorders were based on Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition categories as follows; Intellectual Disabilities, Communication Disorders, Autism Spectrum Disorder (ASD), Attention-Deficit/Hyperactivity Disorder, Specific Learning Disorder, Motor Disorders, Other Neurodevelopmental Disorders. We included only studies based on empirical research and published in peer-reviewed journals. **Results:** Fifty studies met inclusion criteria. Thirty-eight studies explored multilingualism in Communication Disorders, 10 in ASD and two in Intellectual Disability. No studies on multilingualism in Specific Learning Disorder or Motor Disorders were identified. Studies which found a disadvantage for multilingual children with neurodevelopmental disorders were rare, and there appears little reason to assume that multilingualism has negative effects on various aspects of functioning across a range of conditions. In fact, when considering only those studies which have compared a multilingual group with developmental disorders to a monolingual group with similar disorders, the findings consistently show no adverse effects on language development or other aspects of functioning. In the case of ASD, a positive effect on communication and social functioning has been observed. **Conclusions:** There is little evidence to support the widely held view that multilingual exposure is detrimental to the linguistic or social development of individuals with neurodevelopmental disorders. However, we also note that the available pool of studies is small, and the number of methodologically high-quality studies is relatively low. We discuss implications of multilingualism for clinical management of neurodevelopmental disorders and discuss possible directions for future research.

Keywords: Multilingualism; neurodevelopmental disorders; practitioner; outcomes.

Introduction

Children with neurodevelopmental disorders often present with speech, language and communication difficulties (DSM-5; APA, 2013; see also Beitchman, Brownlie, & Wilson, 1996; Brownlie et al., 2004), ranging from anatomical differences affecting articulation in children with Down syndrome (DS; Venail, Gardiner, & Mondain, 2004) to social-communication deficits affecting pragmatic language use in children with Autism Spectrum Disorders (ASD; Rapin & Dunn, 2003). Reports in the literature demonstrate that both parents and practitioners have concerns about whether exposure to multiple languages might simply be ‘too much’ for some children who already face extensive developmental challenges (Drysdale, van der Meer, & Kagohara, 2015; Kremer-Sadlik, 2005). However, with the exception of Speech and Language Therapy services

(Kohnert, 2010), multilingualism is rarely the focus of sustained discussion in the literatures surrounding the ~~assessment and~~ management of neurodevelopmental disorders (Drysdale et al., 2015). Thus, although there may be a desire to discuss potential relative benefits and harms of maintaining use of multiple languages with a child who has a neurodevelopmental disorder, practitioners have little evidence to inform their advice. This, together with the fact that at least 50% of the world’s children are raised with two or more languages (Marian & Shook, 2012), makes the question of potential benefits and challenges of multilingualism for children with neurodevelopmental disorders not only an important research area but also one which has important implications for health, speech and language, and educational professionals who work with these children and their families (Soto & Yu, 2014; Toppelberg, Snow, & Tager-Flusberg, 1999). With this in mind, we present a systematic review of the effects of multilingualism for children with neurodevelopmental disorders, aimed at practitioners working with this population. Note that we use the term ‘multilingual’ to refer to children regularly exposed to more than one language, thus we subsume ‘bilingual’ within this definition, because in many educational, research and clinical contexts a distinction between learners of two and learners of more than two languages is not warranted. However, we will still use the term ‘bilingual’ when referring specifically to learners of two languages, as and when necessary (e.g. when we refer to children learning English and Kannada). Consistent with typical practice in the field, we use the terms ‘multilingual’ and ‘bilingual’ children in the widest possible sense, referring to individuals who are acquiring more than one language regardless of format (spoken, written, signed) and level of proficiency or context (home, school, society; c.f. definitions given by the Royal College of Speech and Language Therapists – UK (Communicating Quality, 2006, p. 268) and the European Union’s Eurobarometer (2006)). We also use the term neurodevelopmental disorder as defined in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013). We first consider the literature on multilingualism in the typically developing (TD) population as a way of providing the minimum necessary background to keep in mind when interpreting both research findings and clinical observations regarding multilingualism in neurodevelopmental disorders.

Multilingualism in the typically developing population

A child exposed to two or more languages from early life will receive less input in each of the languages in her or his environment compared to a peer exposed to just one language. Moreover, compared to the monolingual child, the multilingual child will experience interaction between the different linguistic systems that are acquired

together. It is then not surprising that the linguistic development of multi-lingual children differs in significant ways from that of monolingual children (Gathercole, 2007; Nicoladis, 2007; Oller & Eilers, 2002; Pearson, Fernandez, & Oller, 1993). For example, it is well documented that multilingual children often possess smaller vocabularies in each of their languages when compared to their monolingual peers (Bialystok, Luk, Peets, & Yang, 2010; Junker & Stockman, 2002; Pearson et al., 1993). In addition, multilingual children often evidence a delay in the timing of the acquisition of certain aspects of morphosyntactic knowledge (e.g. the acquisition of subject-verb agreement, appropriate tense marking and negation, see Mueller Gathercole, 2006). However, these differences in vocabulary and morphosyntax are less pronounced in the multilingual child's dominant language. Moreover, differences in vocabulary size can disappear when considering conceptual or total vocabulary (Oller & Eilers, 2002). Moreover, any delays in acquisition that bilinguals might exhibit in the early years tend to disappear by late primary school age (Paradis, Genesee, & Crago, 2011). Therefore, the quantitative and qualitative differences between multilingual and monolingual language acquisition largely reflect properties of the multilinguals' environmental input (such as the lower level of exposure to each language), the inter-action of two or more linguistic systems and its age of onset, as well as the variable settings in which they are exposed to each language (Oller & Eilers, 2002) rather than cognitive, perceptual or other obstacles in the process of acquiring language. In addition, multilingual children have been found to perform equivalently (Antoniou, Gunasekera, & Wong, 2013), or, in some cases, even better than monolingual peers on measures of pragmatic conversational ability (Siegal, Iozzi, & Surian, 2009).

A growing body of evidence has shown beneficial effects of multilingualism in children in the realm of non-linguistic cognitive functioning (Adesope, Lavin, Thompson, & Ungerleider, 2010) such as performance on tests of executive control (Bialystok & Viswanathan, 2009) and theory-of-mind tasks (Goetz, 2003; Kovacs, 2009).

In summary, a large body of literature suggests that multilingual exposure gives rise to a different profile of development compared to that of the monolingual child but does not have an adverse effect on the development of language and communication skills in TD children (Paradis et al., 2011). Furthermore, there is a growing awareness that multilingualism may provide a boost in certain aspects of a child's development, such as executive control (see Bialystok & Viswanathan, 2009; Adesope et al., 2010; although also see De Bruin, Treccani, & Della Sala, 2014).

Although the relevance of research regarding multilingualism and typical development to the practitioner working with children with neurodevelopmental disorders might not be immediately apparent, we would like to highlight two main points relevant to clinical practice. Firstly, while the linguistic profile of TD multilingual children may differ from that of TD monolingual children, the underlying competence for language acquisition is clearly intact. Therefore, detection of what potentially seems to be an 'atypical' language profile is not per se cause for concern in the multilingual child. This is particularly important to have in mind as practitioners, whether working in education, health or community settings, need to make informed judgements about whether observed differences in speech-language development are part of a typical pattern of multilingual acquisition, or symptomatic of an underlying neurodevelopmental difficulty. Secondly, findings of cognitive advantages in executive functions, social cognition and improved conversational abilities in multilingual children could have important implications for populations with neurodevelopmental dis-orders given the often pervasive nature of pragmatic language, social

and cognitive impairments in these conditions. However, it remains an open question for future research whether the cognitive and conversational advantages reported in the TD multilingual population hold for children with neurodevelopmental disorders.

Multilingualism and neurodevelopmental disorders

Clinical decision-making should in principle be informed by the latest evidence available; however, this is not an easy task for practitioners given the sheer volume of published research and even more importantly, because existing research on multilingualism and neurodevelopmental disorders varies widely in terms of its aims, focus and methodology.

Firstly, conceptualization of multilingualism is highly variable and inconsistent. For example, some researchers differentiate between sequential and simultaneous bilingualism (e.g. Hambly & Fom-bonne, 2012), while others do not specify bilingualism type at all (e.g. Cheuk, Wong, & Leung, 2005). Even in the case where the cut-off for simultaneous versus sequential bilingualism is explicitly stated, there is no general consensus on exactly where it should be placed.

Secondly, choice of comparison groups also varies. Several studies have compared bilingual children with a developmental disorder with either multilingual or monolingual typically developing children, with the consequence that it is difficult to make inferences about any effects specific to multilingualism rather than to developmental disorder (Aguilar-Mediavilla, Buil-Legaz, Perez-Castello, Rigo-Carratala, & Adrover-Roig, 2014). Furthermore, while some studies have tested abilities of bilingual individuals against monolingual controls in both their first and second languages (Aguilar-Mediavilla et al., 2014; Sanz-Torrent, 2008) other studies have only provided testing in only one language (e.g. their first, Reetzke, Zou, Sheng, & Katsos, 2015; or their second language, e.g. Armon-Lotem, 2014; Ohashi et al., 2012).

Therefore, in this Practitioner Review we aim to provide an accessible, systematic synthesis and integration of current findings on multilingualism and neurodevelopmental disorders. We would like to emphasize that in addition to considering the evidence regarding the direct impact of multilingualism on a child's specific abilities that will be provided in this review, broader factors concerning multilingualism should be considered when communicating with multilingual families. Most importantly, depriving children of exposure to the language that is primary to their parents, family and community can limit children's participation in family, educational and community activities (Lindsay, Dockrell, Desforges, Law, & Peacey, 2010). The World Health Organization International Classification of Functioning, Disability and Health (ICF, WHO, 2007) encourages the practitioner to integrate what is known about impairments of bodily function and structure, with the impact of such impairments on activity and participation in everyday life, and to consider the influence of contextual factors such as societal attitudes and personal characteristics. The ICF thus provides a framework that can be effectively used to aid the practitioner in factoring multilingualism into the clinical reasoning process (see McLeod, Verdon, Bowen work on multilingualism and speech disorders, 2013).

In summary, our aim is to provide a snapshot of the current state-of-the-art in research that would help inform the practice of relevant professions. We also aim to identify what focus the research on this topic has taken, in order to identify consistencies in the literature and gaps which still require attention in future research. By doing this, we intend to create a useful resource for an evidence-informed approach in working and researching with multilingual families with children with neurodevelopmental disorders.

Method

Medline, PsycInfo, ERIC and Scopus databases were searched for published articles on multilingualism in neurodevelopmental disorders available through to June 2015. Given that there is no universally accepted definition of ‘neurodevelopmental disorders’ we based keywords in this area on the conditions classified as such in DSM-5 (Intellectual Disabilities, Communication Disorders, ASD, Attention-Deficit/Hyperactivity Disorder (ADHD), Specific Learning Disorder, Motor Disorders, Other Neurodevelopmental Disorders).

There were no restrictions for age of participants or study sample size, apart from the fact that single-case studies were not included. Nonempirical papers and studies not published in peer-reviewed journals were not included.

Initial searches, after removing duplicates and obviously nonrelevant papers, yielded 597 studies. Four hundred and sixty-four studies were removed based on reading the abstract, and a further 82 studies were removed after full review due to not meeting one or more of the criteria described above, leaving 50 studies to be included in the review. Common reasons for exclusions were as follows: the study was nonempirical; the study sample was not relevant, for example, on closer review the sample was clinical but did not have the language status that was claimed (monolingual or multilingual), or vice versa; the study sample did not map on to the DSM diagnostic criteria for neurodevelopmental disorders; the study was a single-case study.

Findings

Summary of identified studies

Background information about each of the included studies is provided in Table S1. In this section, we present summaries of the studies arranged by neurodevelopmental disorder (also see Table S2); ASD (n = 10), Intellectual Disability (n = 2) and Communication Disorders (n = 38). No studies on multilingualism in Specific Learning Disorder, ADHD and Motor Disorders were included. Studies reporting comparisons between different groups are divided into those which compare mono- and multilingual groups with the same disorder and those which compare multilingual groups with a disorder to mono- and multilingual groups without a disorder. The former line of research is more informative about potential positive or negative influences of multilingualism on particular disorders than the latter. Comments about the methodological strengths and weaknesses of studies are also noted.

Multilingualism and communication disorders.

Twenty-nine studies have addressed the potential relevance of multilingualism for Specific Language Impairment (SLI). Eight studies had sample size (multiSLI) $N \leq 10$; 10 N between 10 and 20; five N between 21 and 40; three N between 41 and 80; and three studies $N > 80$ (Cheuk et al., 2005 $N = 326$; Salameh, Nettelbladt, Hakansson, & Gull-berg, 2002 $N = 192$; Westman, Korkman, Mickos, & Byring, 2008 $N = 81$). Seven studies investigated Stuttering with two studies having $N \leq 10$, two N between 11 and 20, and to N between 21 and 40, and one study $N = 129$. Two studies that reported on communication/phonological disorders (not more specifically defined) had sample sizes of 7 and 30. Studies on multilingualism and SLI had homogenous samples in terms of age, with the majority of studies involving children aged 6 or less, while studies on multilingualism and stuttering involved older participants and had samples with a wider age range.

Multilingualism and SLI: Multilingual (MultiSLI) versus Monolingual LI (MonoSLI):

The majority of studies indicated comparable performance between multiSLI and monoSLI groups across a number of linguistic features, including: use of correct verb forms or endings according to tense and number, persistence of immature grammatical forms, appropriate use of grammar within narratives, subject-verb agreement, correct use of the subject in a phrase or sentence and production of syntactically complex clauses (Clahsen, Rothweiler, Sterner, & Chilla, 2014; Cleave, Girolametto, Chen, & Johnson, 2010; Gutierrez-Clellen, Simon-Cereijido, & Wagner, 2008; Paradis, Crago, Genesee, & Rice, 2003; Spoel-man & Bol, 2012). In contrast, Verhoeven, Steenge, and van Balkom (2011) found an increased number of ungrammatical utterances in second language (L2) in a multiSLI sample and Cleave et al. (2010) found that a multiSLI group, when compared to monoSLI group, performed more poorly on a standardized assessment of expressive morphology and grammar.

Comparable performance between multi- and mono-SLI groups was also observed on psycholinguistic and cognitive functioning tasks such as nonword repetition and digit span (Thordardottir & Brandeker, 2013; Ziethe, Eysholdt, & Doellinger, 2013). Mixed findings were observed for sentence repetition (a task thought to reflect more morphosyntax and lexical phonology than semantics or prosody), with Thordardottir and Brandeker (2013), and Ziethe et al. (2013) finding no differences between multi and monoSLI groups and Westman et al. (2008) reporting poorer performance of multiSLI when compared to monoSLI group.

In terms of lexical and other aspects of language functioning, two studies observed more limited vocabularies (Thordardottir & Brandeker, 2013; Westman et al., 2008), and three studies found lower scores on general or composite language abilities measures in multiSLI versus monoSLI group (Cheuk et al., 2005; Crutchley, Botting, & ContiRamsden, 1997; Verhoeven, Steenge, van Weerdenburg, & van Balkom, 2011). However, other studies have found that multiSLI did not perform worse than monoSLI children on general language measures (Thordardottir & Brandeker, 2013; West-man et al., 2008).

Notes on methodology: All studies reported matching groups on at least chronological age (CA). Most provided information on how bilingualism was assessed (apart from Westman et al., 2008) and defined the type of bilingualism in their sample (apart from Verhoeven, Steenge, van Weerdenburg, et al., 2011; Verhoeven, Steenge,

& van Balkom, 2011). Although not reported for all studies, effect sizes for all comparisons were medium to large.

Multilingual SLI versus typically developing groups: When compared to multiTD groups, multiSLI groups tend to show worse performance on psycholinguistic tasks thought to underpin language and reading abilities including phonological aware-ness, memory including phonological memory indexed by nonword repetition and verbal working memory measured via digit recall task, rapid automatic naming, auditory attention and letter identification (Aguilar-Mediavilla et al., 2014; Engel de Abreu, Cruz-Santos, & Puglisi, 2014; Girbau & Schwartz, 2008). However, when compared to monoTD groups, multiSLI children showed poorer performance only on a digit recall task (index of verbal working memory; Engel de Abreu et al., 2014) but not for nonword repetition (index of working memory), sentence repetition, working memory (counting task), visuospatial working memory, interference suppression, selective attention and nonverbal IQ (Crutchley et al., 1997; Engel de Abreu et al., 2014; Thordardottir & Brandeker, 2013).

Most studies found that multiSLI groups, when compared to monoTD groups, performed worse on measures of linguistic features (Crutchley et al., 1997; Engel de Abreu et al., 2014; Spoelman & Bol, 2012; Verhoeven, Steenge, van Weerdenburg, et al., 2011; Verhoeven, Steenge, & van Balkom, 2011). However, findings were mixed when they were compared to multiTD groups, with an equal number of studies reporting poorer performance on measures of linguistic features including use of correct verb forms or endings according to tense and number, and persistence of immature grammatical forms, and number of grammatical errors produced (Blom & Paradis, 2012; Rothweiler, Chilla, & Babur, 2010; Sanz-Torrent, 2008) and conversely, no differences on these types of measures (Clahsen et al., 2014; Gutierrez-Clellen, Simon-Cereijido, & Erickson Leone, 2009; Verhoeven, Steenge, van Weerdenburg, et al., 2011; Verhoeven, Steenge, & van Balkom, 2011).

For other language measures including narrative microstructure/macrostructure, general or composite language scores, semantic fluency and receptive/ expressive language scales, multiSLI groups performed more poorly than multiTD groups (Aguilar-Mediavilla et al., 2014; Cheuk et al., 2005; Squires et al., 2014; Verhoeven, Steenge, van Weerdenburg, et al., 2011; Verhoeven, Steenge, & van Balkom, 2011). More detailed analysis suggests that for simultaneous multilinguals, multilingualism status has the effect of depressing general language scores to the same extent in SLI and TD groups (Korkman et al., 2012). Relationships between vocabulary size, word frequency and verb accuracy, and influence of the features of the child's home language on accuracy of verb forms in L2, were equivalent in multiSLI and multiTD groups (Blom & Paradis, 2015). It is interesting to note that Salameh, Hakansson, and Nettelbladt (2004) observed that the development of grammatical structures in Arabic as first (L1) and Swedish as second (L2) language proceeded in the same way across multiTD and multiSLI groups; however, the pace of development was slower in the latter group.

As may be expected, comparisons between multiSLI and monoTD groups on lexical or general language measures including receptive and expressive vocabulary, general vocabulary, general/composite language scales, and word reading tended to show poorer performance by the multiSLI when compared to monoTD group (Crutchley et al., 1997; Engel de Abreu et al., 2014; Thordardottir & Brandeker, 2013). However, Kapantzoglou, Restrepo, and

Thompson (2011) reported that multiSLI children were able to engage in novel word learning/production in a similar way to monoTD peers in a dynamic assessment context.

Notes on methodology: The majority of studies reported matching groups on at least CA (apart from Rothweiler et al., 2010; Salameh et al., 2004; Sanz-Torrent, 2008). Most provided information on how bilingualism was assessed (apart from Aguilar-Mediavilla et al., 2014; Engel de Abreu et al., 2014; Crutchley et al., 1997; Sanz-Torrent, 2008) and defined the type of bilingualism in their sample (apart from Aguilar-Mediavilla et al., 2014; Crutchley et al., 1997; Girbau & Schwartz, 2008; Sanz-Torrent, 2008). Effect sizes for comparisons were reported in most but not all studies and ranged from small to large.

Multilingualism and stuttering: Howell, Davis, and Williams (2009) found no difference in stuttering onset and educational achievement between bi- and monolingual stutterers. However, simultaneous bilingual stutterers had slower recovery rate than sequential bilingual and monolingual stutterers. Jayaram (1983) found that although bilingual (English-Kannada) stutterers stuttered more on the nasal sounds, both mono- and bilingual stutterers were equally dysfluent on voiceless consonants (especially on voiceless fricatives). Lim, Lincoln, Chan, and Onslow (2008) explored the severity and type of stuttering in English and Mandarin and whether the potential difference is influenced by language dominance and found that balanced bilingual stutterers had lower percentage of syllables stuttered and lower perceived stuttering severity scores than English dominant and Mandarin dominant stutterers. Nwokah (1988) compared stuttering in L1 and L2 and found no difference in reading and spontaneous speech (but individuals were more likely to stutter in one of their languages). Roberts (2002) found that while dominant bilingual stutterers were more dysfluent and spoke more slowly in L2 during spontaneous monologues, balanced bilingual stutterers had similar profiles of difficulties in both languages; however, there were no differences in language patterns between balanced and dominant bilingual stutterers during a reading aloud task. Schafer and Robb (2012) found that bilingual stutterers tend to stutter less in L1 than L2, and stutter more on content compared to function words in L1 (but have an equal profile in L2).

Notes on methodology: Howell et al. (2009) matched groups on CA and developmental level and although matching was not specifically reported in Jayaram's (1983) study, there was no significant difference in terms of CA. Howell et al. provided information on how bilingualism was assessed but Jayaram did not. Both studies tested in both L1 and L2.

Multilingualism and other communication disorders: Multilingual phonological disorder versus multilingual TD: Yavas (2010) explored the development of English two-member consonant clusters at the onset of the word, where the first consonant is /s/ (e.g. the development of the pronunciation of words such as 'stop' and 'skate'). No differences between Spanish-English bilingual children with phonological disorders and bilingual typically developing children were found.

Multilingualism and ASD.

Multilingual (multiASD) versus monolingual ASD (monoASD):

Studies of multilingual children with ASD have focussed on lexical, grammatical and communicative development, with no included studies reporting results for cognitive skills. Three studies had sample size

(multiASD) N of 10 or less; three N between 11 and 20; four N between 21 and 40. Apart from a study by Baron-Cohen and Staunton (1994) that encompassed a relatively wide age range (4–16 years), other studies had more homogenous and younger samples (all ≤ 60.78 months). All studies have found either no difference or superior performance of multilingual children with ASD when compared to monolingual children.

In terms of early communicative development, comparisons showed either no significant differences between mono- and multiASD groups for early gesture, babbling and vocalization, age at first word/phrase and overarching communication skills ratings (Hambly & Fombonne, 2012; Ohashi et al., 2012; Reetzke et al., 2015; Valicenti-McDermott et al., 2012) or superior performance of multiASD group for babbling and proto-imperative gesture use (e.g. pointing; Valicenti-McDermott et al., 2012).

Similarly, no significant differences were observed for receptive total vocabulary, general receptive language, expressive vocabulary and general expressive language (Hambly & Fombonne, 2012; Ohashi et al., 2012; Petersen, Marinova-Todd, & Miranda, 2012; Valicenti-McDermott et al., 2012). Better performance for multiASD was found for a measure of expressive total vocabulary (Petersen et al., 2012).

Measures of social interaction, social reciprocity, pragmatic language and interpersonal skills were not found to be different between mono- and multiASD populations (Hambly & Fombonne, 2014; Ohashi et al., 2012; Reetzke et al., 2015). Hambly and Fombonne (2012) found that although there were no differences in terms of early language milestones between simultaneous and sequential bilinguals with ASD, simultaneous bilinguals had better interpersonal skills (measured by VABS-II Interpersonal subdomain scale). Finally, Valicenti-McDermott et al. (2012) found that multiASD group performed better on certain aspects of pretend play when compared to monoASD group.

Notes on methodology: All studies matched individuals MultiASD with other groups on at least CA. The majority provided information on how bilingual-ism was assessed (apart from Petersen et al., 2012), defined type of bilingualism (except Valicenti-McDermott et al., 2012) and tested in L2 if not in both languages (except Reetzke et al., 2015 which tested in L1). Only studies by Ohashi et al. (2012) and Petersen et al. (2012) have provided effect sizes for comparisons, small in the case of Ohashi and large in the case of Petersen.

Multilingual ASD versus multilingual TD: Baron-Cohen and Staunton (1994) found that, when compared to their non-ASD TD siblings, a significantly higher proportion of multiASD children who were brought up in England and whose mothers were not English acquired a non-native accent in English. The study provided information on matching (CA) bilingualism assessment but did not define type of bilingualism.

Multilingualism and intellectual disabilities.

Only two studies were identified, with DS as the only condition studied in this category, with sample sizes of 12 (Cleave, Kay-Raining Bird, Trudeau, & Sutton, 2014) and eight (Bird et al., 2005) multilingual children with DS (mean age = 12.5 and 7 years respectively). There were no differences between MultiDS and MonoDS groups on a syntactic boot-strapping task (used as an index of bilingual learning; Cleave et al., 2014; large effect size), nor

on measures of language abilities including expressive and receptive vocabulary, total vocabulary, mean length of utterance and use of correct word endings (Bird et al., 2005; effect size not provided for comparison between multiDS and monoDS group). Groups were matched on mental age/developmental level, information on how multilingualism was assessed was provided, type of multilingualism was defined and language testing was conducted in L2.

Perceptions about and experiences with raising a child with clinical disorder as multilingual. Three qualitative studies examined perceptions and beliefs of immigrant families related to multilingualism and their experiences with professionals in relation to the issue of multilingualism in ASD (Jegatheesan, 2011; Kay-Raining Bird, Lamond, & Holden, 2012; Yu, 2013) and one in communication disorders (Perez,

2000). In all the four studies, parents reported both positive views about multilingualism (increased ability for a child to integrate better in different aspects of social life, cultural importance and increased job opportunities) but also expressed concerns (lack of services/support and whether children would be able to learn two languages). Parents also high-lighted issues in terms of receiving adequate support from professionals, in particular being advised that use of more than one language at home is harmful for their children's development.

Discussion

Below we will briefly summarize existing findings before we consider the methodological limitations of the current literature, clinical implications and future research directions.

Current findings

Since SLI is a condition manifesting mainly in the development of language ability, it is probably not surprising that more than half of the identified studies have explored the role of multilingualism in this group. Studies that have provided comparisons between multiSLI and multiTD samples yielded inconsistent results, with almost equal numbers of studies suggesting either negative, or neither positive nor negative impacts of multilingualism on language performance. However, as will be dis-cussed in more detail below, these studies cannot uniquely identify the contribution of multilingualism to language performance beyond any effects of SLI itself. Twelve studies have compared multiSLI and monoSLI groups and the majority of them (nine studies) found no group differences on various aspects of language functioning.

Ten studies have explored the potential impact of multilingualism on various aspects of functioning in children with ASD, such as language and communication skills and social abilities. The studies found no difference between multiASD and monoASD groups and in some cases superior performance of the multiASD group.

Other neurodevelopmental disorders were much less studied. Two studies investigated the impact of multilingualism on Intellectual Disabilities (both DS). Although eight studies have explored effects of multilingualism on Communication Disorders other than SLI (seven focusing on stuttering and one on exploring

mothers' perceptions about language development in their multilingually exposed children with communication disorders), only two studies have provided comparisons between multilingual and monolingual groups with a disorder (stutterers). Therefore, it is difficult to draw firm conclusions and future work will need to focus more on these conditions.

Research into multilingualism in neurodevelopmental conditions: current limitations and future directions

Limitations. Studies identified in this systematic review in general provided matching between groups; however, the majority have matched groups on just CA. Matching mono- and multilingual groups with developmental disorders on the level of symptom severity is potentially desirable. However, we also question the usefulness of matching in cases where multilingualism may interact with the presentation of the developmental disorder (e.g. if multilingualism boosts sociopragmatic skill, matching monoASD and multiASD children on symptom severity may mask the beneficial effect of multilingualism, given that sociopragmatic deficits are core ASD symptoms). An alternative method is to consider these variables as covariates and also to adopt individual differences perspective and within subject designs supported by sophisticated statistical approaches such as model based cluster analysis. In addition, future research should investigate whether large, population based sampling with multilingualism as a predictive variable is a better approach.

Researchers have been inconsistent in how they define, conceptualize and assess multilingualism and also in terms of whether they test language functioning of bilingual individuals in both their first and second language or just one of these (usually their second language). Also, although several studies have included children with first languages that differ significantly in terms of their complexity and relatedness to second language (or the dominant language of the community), these children were considered as a single (multilingual) group, not allowing to explore whether the consequences of multilingual exposure differ based on the similarities or differences between first and second language. Furthermore, a number of studies have compared multilingual individuals with a clinical condition with either multi- or monolingual TD individuals. At the risk of stating the obvious, we highlight that studies which compare multilinguals and monolinguals who have the same developmental disorder are far more informative about the role that multilingualism may play in populations with the disorder. All of these issues necessarily limit our ability to compare findings across studies, and future work will need to explore these limitations in order to increase the generalizability of findings and ensure that any differences that are detected are indeed a consequence of multilingual exposure and not due to extraneous variables.

Apart from rare exceptions (e.g. Valicenti-McDermott et al., 2012 reporting on the effects of multilingual exposure on different aspects of play in children with ASD), research to-date has almost exclusively focused on exploring linguistic outcomes of multi-lingual exposure despite the fact that that multilingualism influences communication development more generally as well as the development of social cognition and executive functions.

On a more general note, it is important to highlight that the overwhelming majority of studies remain descriptive in nature and future research will need to employ longitudinal designs which investigate the extent to which

variability in early language exposure might influence development of particular skills and the abilities of individuals under investigation. Such longitudinal work is necessary to identify the mechanisms through which multilingual experience gives rise to positive and/or negative effects on developmental conditions. This research will need to consider multilingualism as a multidimensional construct and explore how specific dimensions of multilingual experience are related to each other, and to language, cognitive and social outcomes, in both normative and atypical development. The assessment of multilingualism will have to combine the self-reported proficiency in both languages, multilingual history and the pattern of language usage via already developed and validated questionnaires such as the Language and Social Background Questionnaire (Luk & Bialystok, 2013), the Language History Questionnaire (Li, Sepanski, & Zhao, 2006) or the Language Experience and Proficiency Questionnaire (Marian, Blumenfeld, & Kaushanskaya, 2007), to name just a few, and objective testing.

Furthermore, research reviewed here has only focused on how multilingual exposure influences child's development directly, not taking into account the indirect contribution that multilingualism can have through parental responsiveness and practices. Given also that parents of multilingual children may have only recent acquisition and limited use of the non-native language, language-use choices might have important effects on the interaction behaviours of multilingual parents and their children. Parents opting to use a non-native/nondominant language with their child may struggle to be effectively responsive to their child's interests and attentional foci and sensitive in the timing of their contributions, with the cognitive load associated with use of a nondominant language (Bialystok, 2009) and tip-of-the-tongue experiences (Gollan & Acenas, 2004) plausibly introducing greater than usual time-lapse between child behaviour and caregiver response. Nondominant language use may impact upon parent ability to access and include language which falls appropriately within the child's zone of proximal development (i.e. well-matched to the child's own receptive level, and scaffolding their growing expressive skills, without stretching far beyond the child's reach nor remaining too close to the child's own level; Vygotsky, 1978). Proposals such as these remain to be tested, and any developmental implications of parental non-native language use also remain to be shown; however, potential clinical implications in the light of current clinical practices are very important.

Finally, it is possible that in some cases, and especially in cases of disorders which include difficulties with speech and language, there may be selection biases, with multilingual children being under-represented in clinically diagnosed samples (e.g. see Stow & Dodd, 2005, for the case of bilingual children with speech disorders) and only those multilingual children who present with more severe symptomatology might be consistently referred for diagnosis. On the other hand, multilingual children are also at risk of overdiagnosis, that is, false-positive referrals, especially when a child presents with a delay compared to monolingual peers or with a non-monolingual pattern of development. Lack of expertise of the clinician and/or lack of resources necessary, and/or over-referral as a preferred error compared to under-referral, may contribute to over-diagnoses of disorders in bilingual children (Winter, 1999). As none of the articles identified and included in this review were epidemiological studies, this issue has implications for the interpretation of all the studies we reviewed, and it highlights the need for epidemiological studies in the future.

Clinical implications

Studies which found a disadvantage for multilingual children with developmental conditions were rare in our review, and there appears little reason to assume that multilingualism has negative effects on various aspects of functioning across a range of neurodevelopmental disorders and conditions. In fact, when restricting our attention to those studies that have compared a multilingual group with developmental disorders to a monolingual group with similar disorders, the findings show no systematic adverse effects on language development or other aspects of functioning. On the contrary, in the case of ASD, a positive effect on communication and social functioning has been observed; however, further replication of these findings in larger samples is needed.

However, despite this, qualitative studies exploring experiences of parents of children with ASD in relation to the issue of multilingualism found that parents were being advised by professionals that use of more than one language at home is harmful for their children's development (Jegatheesan, 2011; Kay-Raining Bird et al., 2012; Yu, 2013). The families studied, however, report the benefits of multilingualism to their children in terms of participation in religious, community and family life. It is also important to emphasize that in a study that investigated the perceptions of 863 nurses involved in language screening of bilingual children, Nayeb, Wallby, Westerlund, Salameh, and Sarkadi (2014) found that nurses reported lack of training and lack of confidence in developmental norms for bilingual children. A clear clinical implication therefore, is that assumptions about the potential difficulties (and benefits) of multilingualism for individuals with developmental disorders should be challenged within communities of professional practice. There is little systematic research on this topic; however, and for health and educational purposes, multilingualism is often considered from an instrumental perspective, for example, information about the 'home language' is used to assess whether an interpreter is needed in clinic, to assess 'EAL' (English as an Additional Language) teaching capacity, or to meet organizational data collection requirements. A broader perspective, taking a relational view of language could help to improve professional practice in this area.

Issues around multilingualism can also be viewed within the wider context of ensuring culturally appropriate services, which are essential in the provision of effective and equitable assessment and support (Bhui, Warfa, Edonya, McKenzie, & Bhugra, 2007; Hernandez, Nesman, Mowery, Acevedo-Polakovich, & Callejas, 2015; Suzuki & Ponterotto, 2007). This is particularly relevant when considering the wellbeing of ethnic minority communities, whose languages may not enjoy similar status to the languages of the majority culture. Practitioners therefore should be aware that language use can be considered a social and political issue, as much as it can be considered a personal issue.

One framework which can support practitioners working at the complex interface of disability, cultural sensitivity and multilingualism, is the WHO-ICF model (referred to in the introduction). The 'contextual' aspect of WHO-ICF invites consideration of individual characteristics which are not related to the health condition itself but which may affect individual functioning. This includes languages alongside other relevant characteristics such as race, gender, age and religion. In addition, the United Nations Convention on the Rights of the Child (CRC) states that human rights are for all children and particularly mentions both language and disability as characteristics which should not be used as a basis for discrimination and denial of rights (Article 2). Rights to culture, language and religion are enshrined as rights for all children (Article 30) and all children have rights to media and appropriate books in an accessible language (Article 17).

In our view, many policies and practices ‘default’ towards mono-language use simply through a lack of consideration of a multilingual perspective. Such default assumptions could unfold in different ways depending on priorities; for example, families may restrict the learning of the majority culture’s language to promote the home language, while professionals may advise restricting the child’s first language in favour of the language used in schools. The human rights/sociocultural context perspective, together with the present review’s findings of no evidence of a developmental disadvantage associated with multilingualism, therefore have implications for public policy.

We therefore recommend that consideration of multilingualism should be incorporated into public policy relevant to children with neurodevelopmental disability, especially with reference to education and health. The precise details of such policy will vary according to profession, country, community etc. However, public policy should challenge the mono-lingual default, and encourage assessment of multi-lingual children to include discussion with key informants (e.g. the child if s/he is able, parents, siblings, teacher) about the child’s language history and the contexts in which different languages are present in everyday life. We also recommend that public policies reinforce the fact that there is no clinical, linguistic, or cognitive evidence to support routine recommendation of mono-language use for children with neurodevelopmental disorders who are from multilingual backgrounds.

Conclusions

In this paper, we have systematically reviewed and synthesized available evidence on the effects of multilingualism on children with various neurodevelopmental disorders. We have observed that there is little evidence to support the widely held view that multilingual exposure is detrimental to the linguistic or social development of individuals with these conditions. However, we also note that the available pool of studies is small and the proportion of methodologically high quality studies is not high. Finally, we discussed the implications for clinical practice and encourage practitioners to consider multilingualism within the broader context of a child’s personal and social development.

Supporting information

Additional Supporting Information may be found in the online version of this article:

Table S1. Characteristics of the studies.

Table S2. Study findings.

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Key Points

Key practitioner message

- Fifty studies exist on multilingualism in the context of neurodevelopmental disorders. The majority of studies have concentrated on Communication Disorders (38) and Autism Spectrum Disorder (10).
- The findings show no systematic negative effects of multilingualism on language development, or other aspects of functioning in children with neurodevelopmental disorders.
- Clinical or educational assessment for multilingual children who have neurodevelopmental disorders should include discussion with key informants about the child's language(s) history and the contexts in which different languages are present in everyday life.
- Practitioners should discuss with families the potential negative outcomes of restricting multilanguage exposure/use on participation and access to human rights.
- There is no evidence to support recommendation of mono-language use for children with neurodevelopmental disorders who are from multilingual backgrounds.

Areas for future research

- Consistency between studies in terms of conceptualization and assessment of multilingualism is needed.
- Choice of control group and matching criteria needs to be theoretically grounded to ensure that any differences that are detected are indeed a consequence of multilingual exposure and not due to extraneous variables.
- The majority of current research is descriptive in nature. The field needs longitudinal studies which investigate the potential influence of variability in early language exposure on later cognitive and linguistic development.
- Further work is needed to identify the mechanisms through which multilingual experiences give rise to positive and/or negative effects on neurodevelopmental disorders.
- Qualitative research is needed in order to further understand the lived experience of multilingual children and families.
- Future research will need to take into account the indirect contribution that multilingualism may have through parental responsiveness and practices.

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