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To cite this article: João A. Lopes, Cristina Gomes, Célia R. Oliveira & Julian G. Elliott (2020): Research studies on dyslexia: participant inclusion and exclusion criteria, European Journal of Special Needs Education, DOI: [10.1080/08856257.2020.1732108](https://doi.org/10.1080/08856257.2020.1732108)

To link to this article: <https://doi.org/10.1080/08856257.2020.1732108>



Published online: 24 Feb 2020.



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ARTICLE



Research studies on dyslexia: participant inclusion and exclusion criteria

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ABSTRACT

Dyslexia is a term widely used to describe reading characterised by problems with the fluent and accurate letter or word recognition. Nevertheless, there is no consensus about the definition, origin, and diagnosis of dyslexia and the term is often used very differently by researchers and practitioners. In many cases, research findings are employed by clinicians in ways that are misleading and potentially counterproductive. The present study takes the form of an examination of participant samples included in studies of dyslexia ($n = 800$) over 20 years (2000–2019). The findings show that (1) researchers use a wide range of inclusion and exclusion criteria; that (2) IQ-reading achievement discrepancy is the most common inclusion criterion for dyslexia samples; (3) studies typically compare dyslexic samples to normal controls but not to other poor readers; (4) dyslexia seems to be employed as a catch-all term for poor readers in general, not as a term to define a specific type of poor reader. Finally, (5) dyslexia studies are very rarely published in educational journals.

ARTICLE HISTORY

Received 30 August 2019
Accepted 4 February 2020

KEYWORDS

Dyslexia; poor readers;
sample constitution;
inclusionary criteria;
exclusionary criteria

Since the term dyslexia was first coined by the German ophthalmologist, Rudolf Berlin, in 1887, many terms have been used to describe the difficulties that a significant proportion of people encounter in trying to decode text. Early terms included congenital word blindness (Hinshelwood 1907), visual agnosia for words, and word blindness (Orton 1925). More recently, terms commonly used include specific reading difficulties, specific learning difficulties, learning disability, specific reading retardation, unexpected reading difficulty, reading disorder, reading disability, and specific reading disability.

Dyslexia has become one of the most widely employed terms to describe reading (decoding) and spelling problems. While this term has long been prevalent in the UK, its use has proliferated across the world, particularly in the United States where dyslexia advocacy and legislation have flourished (Gabriel 2019; Ward-Loneragan and Duthie 2018). Despite its ubiquity, achieving a workable and scientifically valid definition proved difficult (Elliott and Grigorenko 2014a). What has compounded the difficulty is that there is often a gulf between understandings of the construct of dyslexia in the research literature and formal definitions put forward by practitioner and advocacy groups. This has impacted the

ability of professionals to operationalise the term for educational, clinical and even forensic practice (Knight 2018; Ryder and Norwich 2018).

For many researchers, the term dyslexia should be seen as synonymous with reading disability (i.e., a severe difficulty in decoding text) (Elliott and Grigorenko 2014a, 2014b; Protopapas and Parrila 2018; Snowling et al. 2019). Thus, Peterson and Pennington (2015) state:

“Dyslexia is mainly defined as the low end of a normal distribution of word reading ability Thus, in order to diagnose the disorder, a somewhat arbitrary cut-off must be set on a continuous variable” (p. 285).

Similarly, Seidenberg (2017) states:

Dyslexics are children (and later adults) whose reading is at the low end of a normal distribution. Reading skill results from a combination of dimensional factors (that is, ones that vary in degree), yielding a bell-shaped curve. The reading difficulties of the children in the lower tail are severe and require special attention. ‘Dyslexia’ refers to these children. Viewed this way, dyslexia is on a continuum with normal ‘reading’. All children face the same challenges in learning to read, but dyslexics have more difficulty with the essential components” (pp.156–157).

Within the United States, the notion that dyslexia is manifested by an ‘unexpected’ problem with reading has been widely put forward as a means to differentiate between dyslexic and other poor readers (Stanovich 2005; Elliott and Nicholson 2016; Vellutino et al. 2004). Here, it is suggested that reading problems may be expected for some children (the poor readers, or the ‘garden-variety poor readers’ in the words of Stanovich (1988), but not for others (the dyslexics) (Christo 2015; Ferrer et al. 2010). The notion of unexpectedness is at the origin of the IQ-discrepancy model of specific learning disabilities (Beaujean et al. 2018). According to this perspective, reading problems are unexpected when the individual has a normal or above normal IQ. Shaywitz (2003) suggests that unexpectedness is revealed by an uneven cognitive profile in which a decoding weakness is typically surrounded by a ‘sea of strengths’ (p. 58), not usually found in other poor readers. These may include high functioning with respects to reasoning, problem-solving, critical thinking, vocabulary, comprehension and general knowledge.

While such an account might appeal to those with such strengths, there is little evidence that the reading difficulties of others with flatter profiles are inherently different in respect of appropriate intervention or prognosis (Fletcher et al. 2013). Furthermore, socially disadvantaged children with reading disabilities are likely to experience particularly acute problems with general knowledge, comprehension, and vocabulary, often attributable to reduced access to the life opportunities that could compensate for their lack of access to the written word (Kodan and Akyol 2018; Lee and Kim 2015). Reduced vocabulary will hinder the child’s ability to decode unknown printed words, particularly where these are partially decoded or irregularly spelt and, as a result, further hinder the development of the child’s phonological recoding skills (Lawrence et al. 2018; Tunmer and Greaney 2010).

Given the flaws of the IQ discrepancy model (Fletcher et al. 2007; Gresham and Vellutino 2010; Stuebing et al. 2009), it is unsurprising that this model is now generally agreed to be inappropriate for diagnosing dyslexia. Thus, the 5th edition of the Diagnostic and Statistical Manual (DSM-V), produced by the American Psychiatric Association (APA) (2013), dispensed with such an approach for identifying learning disabilities in reading

and other academic areas. Similarly, major dyslexia advocacy groups, such as the International Dyslexia Association and the British Dyslexia Association, contend that dyslexia features across the intellectual spectrum. Interestingly, however, despite this, the discrepancy model continues to be used by some practitioners and researchers (Machek and Nelson 2007; O'Donnell and Miller 2011).

An alternative way to identify an unexpected problem with reading is to examine the intractability of the condition for a given individual following provision with high-quality, evidence-based intervention over time (Fletcher et al. 2018). By definition, such a determination could not take place at an early age, or before several years of intense intervention had taken place. While this conception is increasingly popular for determining eligibility for special education in the United States, it is very rarely employed as a means of selecting participants for dyslexia research studies.

A particular difficulty exists where dyslexia researchers draw upon a pool of poor readers as participants for their studies (e.g., in cognitive science, neuroscience, genetics, or education), but apply subsequent findings solely to a dyslexic subgroup. For example, if, as is often the case, one were to recruit those reading at or below the 15th centile on a standardised reading test for a study of various cognitive processes (e.g., working memory), it would be invidious to subsequently claim that, should the observed mean performance be below that of a comparator group of normal readers, such processes could be considered to be markers of dyslexia, and thus these could then be employed to differentiate dyslexic individuals from other poor readers. However, such circular-definition practices are common (Elliott and Grigorenko 2014a).

Constitution of participant samples in studies of dyslexia

It is often unclear in dyslexia studies whether the use of this term applies to all struggling decoders, or to a subset that can be differentiated from other poor readers. Where there is a suggestion that the latter case applies, criteria for making this distinction are rarely made explicit (Lopes et al. 2016). Nergård-Nilssen and Eklund (2018), for example, recently developed an instrument, *'The Norwegian screening test for dyslexia'*, that was designed to detect dyslexia in upper secondary school students. Participants in the development of the instrument were divided into non-impaired and impaired reading groups through a self-report questionnaire. Of the 38 'impaired' students, twelve were diagnosed with dyslexia. However, the authors do not report who diagnosed the students and simply note that: 'Unfortunately, we do not have access to their test protocols or test reports' (p. 4). Thus, the reader cannot scrutinise how participants diagnosed with dyslexia actually differed from other participants who self-reported reading problems. Furthermore, results were presented for the 'impaired' and for the 'non-impaired' group, but not for the subsequently identified specific group of dyslexics.

Reviews of studies with adults have shown that highly diverse criteria are often employed (e.g., Rice and Brooks 2004). A similar difficulty seems to apply in studies conducted with children and youth. For instance, several studies with dyslexic individuals report that participants have a diagnosis of dyslexia but offer no further specifications (e.g., Stagg, Eaton, and Sjoblom 2018; Sjoblom, Eaton, and Stagg 2016), while other studies mainly detect dyslexic students by their low performance on one or more reading tests (e.g., Diamanti et al. 2018; Breadmore and Carroll 2016). In other cases, the terms

'dyslexics' and 'poor readers' seem to be taken as equivalents or are taken as synonymous, but, somewhat puzzlingly, some differentiation between dyslexia and poor reading is still suggested (e.g., Uno et al. 2009).

Other issues might affect the composition of samples of dyslexic subjects. For instance, even where studies present clear criteria, these are highly variable across different studies. Moreover, even for a specific study, children included in the same group, based on the same selection criteria, may present considerable phenotypic variations. Within-disorder variations, however, are discarded when groups are statistically compared (Peters and Ansari 2019).

More than three decades ago, Ellis and Large (1987) considered that bringing together children of different ages, with different backgrounds and taught in different ways, would not enable the identification of a putative average reader. These authors stated that either the group is entirely homogeneous (which hardly happens), or the individual pattern is obscured by the group average. The group average does not represent the performance of the individual and does not permit group generalisations for the individual. Lyon and Moats (1997) also highlighted the limitations and challenges of sampling strategies and study designs in reading intervention research. These included sample heterogeneity and vague inclusion criteria, poorly defined interventions, inadequate control groups, inadequate intervention and transfer effects, poorly controlled teacher effects, low fidelity of programme implementation by teachers, and inadequate measurement practices.

Much has been done in the last decades in the area of reading research and dyslexia and the design of studies has become progressively more sophisticated (see, for instance, Aravena et al. 2016; Tilanus, Segers, and Verhoeven 2019a, 2019b). Approaches that have sought single-factor explanations of reading disability/dyslexia fail to address the complexities involved, and it is now understood that multiple deficit model approach is required (e.g., Pennington 2006; Kauffman 2004; Ring and Black 2018). In this respect, '... a multiple-deficit model proposes that the development of any complex cognitive behaviour, such as reading, is the outcome of multiple levels of interacting factors that may be protective or increase risk of a disorder' (Ring and Black, p. 2). That approach must acknowledge that the aetiology of the problem is multifactorial, that comorbidity is the rule, not the exception, and that the distribution of the disorder is often continuous, not discrete (therefore, cut-off points are usually arbitrary). Moreover, longitudinal and training studies, are essential to map the course of the disorder and to identify the factors that can mediate or moderate its development (Lyon and Moats 1997; Diamanti et al. 2018; Snowling et al. 2019; Tong et al. 2017).

Ensuring the appropriate selection of participants for studies of reading disability presents several methodological challenges. Researchers must recognise and acknowledge these challenges.

The present study

It appears that the term 'dyslexia' is understood very differently by researchers, which leads to a lack of consistency and clarity in the make-up of participant groupings for dyslexia research studies. While this difficulty has been shown for adult studies, albeit more than fifteen years ago (Rice and Brooks 2004), the picture for children and young people is unclear. Accordingly, the main goal of this study was to identify the nature of participants included in studies of dyslexia since 2000. Specifically, we sought:

- (a) To identify selection criteria in studies of dyslexia, and to assess the degree of homogeneity of the criteria used for the selection of samples;
- (b) To compare the selection criteria for samples of struggling readers (other than 'dyslexics') with selection criteria for samples of identified dyslexics;
- (c) To identify the contexts from within which samples of dyslexics were collected;
- (d) To identify the professional characteristics of groups involved in the diagnosis of participants for studies on dyslexia.
- (e) To review the characteristics of the scientific journals that publish studies on dyslexia.

Method

Sample

Eight hundred journal articles involving dyslexia were analysed.¹ In 764 of these, we found samples of either 'dyslexics only' or samples that contrasted 'dyslexics' and 'normal readers', or some other subjects (e.g., speech and language impaired). Seven studies included samples of 'dyslexics' that were contrasted with samples of other struggling readers and with normal controls.

Procedure

An analytical grid was developed to examine the following features of each journal article:

- (a) Title of the article;
- (b) Article publication year;
- (c) Journal in which the article was published;
- (d) Number of identified dyslexic participants in the sample;
- (e) Contexts of sample collection;
- (f) Criteria for sample selection;
- (g) Test battery for sample selection;
- (h) The professional categories of groups involved in the diagnosis of participants for studies on dyslexia.

Studies involving samples of identified dyslexic participants were retrieved from the Elsevier SCOPUS database of more than 16,500 peer-reviewed journals. Journal articles were searched using the keywords Dyslexia or Dyslexics. The search was limited to Article in the Document Type field. From the whole set of articles retrieved from SCOPUS, the 40 most cited articles each year from 2000 through 2019 were retained for additional analysis.

We analysed empirical studies in the database that involved (a) samples of identified dyslexic participants and samples of normal readers, (b) samples including both identified dyslexic participants and struggling readers not identified as dyslexic, and (c) samples of dyslexic readers only. Studies of (a) struggling readers who were not held to be dyslexic and (b) non-empirical studies (e.g., systematic reviews, meta-analyses, editorials, and commentaries) were excluded.

Data analysis

Both qualitative and quantitative methods were used for data analysis. Qualitative content analysis was used initially (Cho and Lee 2014) to elicit general categories, and this was followed by categorical content analysis. According to Patton (2015), this kind of analysis makes use of objective and systematic procedures that allow the researcher to make logical deductions from the selected data corpus.

Qualitative analysis was followed by quantitative analysis of the data whereby the frequency of each of the identified categories was calculated. Low frequency (below 5%) and/or a lack of conceptual relevance were identified as criteria for eliminating some categories. Only one study was excluded on this basis.

For each of the final categories, the percentage of inter-observer agreement (two judges were used) was calculated by dividing the number of agreements by the total number of answers. Cohen's Kappa was not used because it was considered highly unlikely that raters would provide random answers given that the rating system referred to the presence or absence of a specific category (e.g., medical sciences, neurosciences, psychology, education). Rater disagreements were discussed and reviewed by both raters. When an agreement was not subsequently achieved, a third rater was called upon to assist. For an initial exercise involving 200 studies, the inter-rater agreement varied between 94% and 97% with a mean agreement of 95.8%. For this reason, it was decided that further analysis of this kind was not required.

Results

Criteria for the selection of samples

Inclusionary criteria: Table 1 shows the frequencies of inclusion criteria used by researchers for sample selection.

What becomes most apparent from Table 1 is that the criteria used to select dyslexic participants are stricter than the criteria used to select normal readers (the widely used control group). Also, there is only a very small number of studies with samples of poor readers other than people diagnosed as having dyslexia.

The battery of tests employed typically included cognitive (usually IQ) and reading tests. The WPPSI-R, the WISC-R, the WAIS and the Raven scales are by far the most

Table 1. Inclusionary criteria in sample selection: frequency and type (N = 800 studies).

	Criteria				
	A formal diagnosis of dyslexia	Results in a battery of tests ^c	School records of learning problems	IQ	No information
Dyslexic (800 ^a – 100%)	315 ^b (39%)	596 (75%)	20 (3%)	498 (62%)	18 (2%)
Normal readers (738 – 92%)	-	487 (66%)	14 (2%)	370 (50%)	76 (10%)
Struggling readers (7–0.9%)	-	4 (57%)	-	5 (71%)	0

^aNumber of studies including dyslexic readers; ^b Number of studies in which 'dyslexics' receive a formal diagnosis;

Note: categories are not mutually exclusive. A particular participant within the dyslexic group, for instance, might have received a formal diagnosis of dyslexia, might have undertaken several tests, and might have a school record of learning problems.

commonly used cognitive measures. The Stanford-Binet, the Woodcock-Johnson Test of Cognitive Abilities, The Primary Test of Cognitive Skills, or the KBIT Test (Kaufman Brief Intelligence Test) were less frequently used measures in the 800 studies that were reviewed. Reading tests comprised a range of standardised measures such as the Woodcock-Johnson Educational Battery, the Reading and Spelling subtests of the Wide Range Achievement Test, the Alouette's standardised reading test, or the Hong-Kong Test of Reading and Writing (HKY-SpLD), in addition to various non-standardised measures.

Exclusionary criteria: [Table 2](#) shows the frequencies of exclusionary criteria used by researchers for sample selection.

Sensory deficits (hearing, vision), and comorbidities (e.g., ADHD, emotional disorders, mental illness, neurological disorders), are by far the most common exclusionary criteria. However, in some studies, conditions such as ADHD (attention-deficit hyperactivity disorder), are used as inclusionary criteria because the researchers intended to study subjects with comorbid dyslexia and ADHD. A significant number of studies refer that the language employed in the education system might not be an individual's first language. In such cases, the subject should be excluded. English is the language of the vast majority of the participants (most frequently in UK or US settings) although there are also many studies in Finnish, Norwegian, Chinese, French, Hebrew, German, Dutch, and Italian, and only a few in Spanish, Portuguese or Arabic, amongst others.

Contexts

[Table 3](#) shows the frequencies of the contexts where samples were collected.

Professionals

[Table 4](#) shows the frequencies of the professional groups that select/diagnose participants for studies on dyslexia.

It is important to note that in almost three-quarters of the studies, the researchers took responsibility for identifying whether participants were deemed to be dyslexic.

Research methodology

The results show that 98% (n = 744) of the studies represent basic research (e.g., genetic studies, spatial and temporal attention in developmental dyslexia, neuroanatomical

Table 2. Exclusionary criteria in sample selection: frequency and type (N = 800 studies).

	Criteria					
	Sensory deficits	Comorbidity	Other problems	Lack of educational opportunities	IQ	Not first language
Dyslexic (800 – 100%)	226 (28%)	283 (35%)	78 (10%)	62 (8%)	33 (41%)	122 (15%)
Normal readers (738 – 92%)	162 (22%)	192 (26%)	60 (8%)	42 (6%)	28 (4%)	116 (16%)
Struggling readers (7–0.8%)	3 (43%)	7 (100%)	-	1 (14%)	2 (29%)	4 (57%)

Note: categories are not mutually exclusive.

Table 3. Frequencies of the contexts in sample selection (N = 800 studies).

	Clinical	Community	Re-used	No information
Dyslexic (800 – 100%)	252 (28%)	391 (28%)	77 (28%)	112 (28%)
Normal readers (738 – 92%)	28 (4%)	445 (60%)	64 (9%)	146 (20%)
Struggling readers (7–0.8%)	2 (29%)	6 (86%)	-	1 (14%)

Note: Categories are not mutually exclusive.

The most noticeable fact in Table 3 is that a large number of studies provide no information about the locations where samples were collected. It is also important to note that, in 28 studies, normal readers were recruited in clinical settings.

Table 4. Professional groups that provide the classification/diagnosis.

	Researcher	Unspecified professional in clinical or community context ^a	Psychologist	Others	No information
Dyslexic (800 – 100%)	529 (66%)	184 (23%)	65 (8%)	236 (30%)	45 (6%)
Normal readers (738 – 92%)	457 (62%)	133 (18%)	4 (0.5%)	42 (6%)	43 (6%)
Struggling readers (7–0.8%)	6 (86%)		-		1 (14%)

Note: Categories are not mutually exclusive

studies) and that only 2% (n = 8) represent applied research, aimed to address pedagogical issues (e.g., classroom paired learning, music training to improve phonological awareness and reading skills, sublexical training with rhythmic background).

Journals that publish studies on dyslexia

The data provide evidence that empirical studies of dyslexia are most commonly found in neuroscience journals (43%), followed by psychology journals (24%), medical sciences journals (14%), interdisciplinary journals (19%) and education journals (6%). Taken together, journals in the domains of neuroscience (a domain close to the medical sciences) and medical sciences publish more than half the studies. Perhaps the most striking finding is that education journals published a mere 5% of the studies in this field.

Sample size in studies on dyslexia

The results show that studies about dyslexia typically use small samples. Almost 50% of the studies (n = 398); contained 1–50 participants; 25% (n = 202) had 50–100 participants; 21% (n = 165) had more than 100 participants; and 3% (n = 22) had more than 1000 participants. Noteworthy, in these samples, only about half of the participants are identified as dyslexic. The rest are normal readers or, in seven of the eight hundred studies, other poor readers. Since dyslexia is considered by some to affect as many as 20% of the population (Shaywitz 2003), the use of small sample sizes cannot be a function of the prevalence of reading difficulties. Sixty-two studies (8%) used only one group of participants (dyslexics), 529 (66%) used two groups (usually dyslexics + normal controls), and 175 (22%) used three groups (in most cases, the third group includes speech and language impaired children). Only seven (less than 1%) studies included poor readers and identified dyslexics.

Discussion

Inclusionary and exclusionary criteria in studies of dyslexia

Inclusionary criteria

Our results indicate that the inclusion of participants in studies of dyslexia typically relies upon performance on a battery of cognitive and/or reading tests. The IQ-Performance discrepancy is the most frequently used criterion in the 800 reviewed studies, despite recognition that such a criterion is currently inadequate (e.g., Cotton, Crewther, and Crewther 2005; Sternberg and Grigorenko 2002; Vellutino et al. 2004; Beaujean et al. 2018). As Schneider and Kaufman (2017) note, 'Defining learning disability as unexpectedly low academic achievement despite average or better IQ has intuitive appeal, but it focuses on distal and relatively intractable influences on academic ability' (p. 3). Still, according to our review, in 2000, 24 studies out of 40 used the IQ-Performance discrepancy as an inclusionary criterion, compared to only nine in 2017, 13 in 2018, and 11 studies in 2019 (but 32 in 2016). Although these numbers suggest that something might be changing in the selection of samples of dyslexics, and perhaps in the clinical practice, it is too early to draw definite conclusions.

Other criteria found in many studies to select dyslexic participants include the formal diagnosis of dyslexia and a personal history of reading problems. Nevertheless, in a quarter of the studies, inclusionary criteria are unclear and quite variable. Sometimes it is even hard to understand the nature and the number of participants. This lack of clarity conflicts with the expectation that inclusion criteria are explicit, extensively applied, and in line with current scientific knowledge (Scruggs and Mastropieri 2002).

Exclusionary criteria

Our review shows that many studies report a variety of exclusionary criteria, although some authors consider this practice as inadequate (e.g., Rutter and Maughan 2005; Fletcher 2009). Interestingly in most of the cases we examined, the criteria were reported as characteristics of the sample (e.g., normal hearing, right-handed, no emotional problems).

Although sensory deficits and comorbidities are by far the most frequent exclusionary criteria, the lack of educational opportunities/poor schooling is an interesting and controversial issue. As Elliott and Grigorenko (2014b) point out, deciding whether educational experience can be largely blamed for an individual's reading difficulties is generally impossible, at least in the developed world. Indeed there seems to be no reliable way to assure that a student had enough educational opportunities beyond the finding that he or she attended school. Perhaps this explains why, despite the widespread reference to this criterion, explicit exclusion from studies on these grounds is rarely, if ever, reported (Lopes et al. 2016). In the studies that we reviewed no specific evidence was presented about how the appropriateness of reading instruction was measured, or about how educational opportunities were conceptualised or approached. The results also show that many researchers used IQ both as an exclusionary and an inclusionary criterion.

Selection criteria for samples of struggling readers other than dyslexics

The results show that researchers typically use more criteria to select dyslexic individuals (including a formal diagnosis, not found for other poor readers) than to select other poor

readers. However, Shaywitz and Shaywitz (2013) hold that the specific features that may lead to a diagnosis of dyslexia or a diagnosis of any other poor reading condition are not apparent. This issue is critical for the validity of research studies of dyslexia, and its use as a clinical category. Unless, of course, this term is used as a synonym for poor reading. 'To test the hypotheses that developmental dyslexics differ from both normal readers and "ordinary" poor readers, researchers need two control groups, not one' (Rice and Brooks 2004, 33). Our review shows that this is seldom done. We found only 7 out of 800 studies in which there were two control groups: a group of normal controls and a group of poor readers other than dyslexics. In most of these seven studies, dyslexics and other poor readers differ in IQ scores but are matched by reading performance, a practice that is now considered inappropriate (Fletcher et al. 2007; Gresham and Vellutino 2010; Stuebing et al. 2009). Moreover, in the 800 studies, dyslexics are often interchangeably labelled as poor readers, delayed readers or struggling readers, thus suggesting that many researchers use dyslexia as a catch-all term for poor readers in general, not as a term to define a specific type of readers.

Contexts

Clinical and community settings are the most usual contexts for participants' recruitment for studies of dyslexia. However, in almost two-thirds of the reviewed studies, the researchers themselves took charge of the selection process.

Interestingly we found no samples of poor readers (as contrasted with dyslexic individuals) selected in clinical contexts, with the resultant unfortunate bifurcation of struggling readers into those with a clinical v non-clinical condition, and the implications this has for the provision of intervention services. Authors such as Fletcher et al. (2007) have long noted that dyslexia, often presented as a medical condition, led to a schism between the medical and the educational communities and almost excluded the educational community from dyslexia/poor reading debate.

Professionals

Although our results show that the researchers themselves most commonly conduct the selection of samples of dyslexics, a significant number of other professionals are involved in the selection/diagnosis process. Interestingly, teachers are very rarely considered as potential diagnosticians. At best, they are called upon to indicate which of their students show problems with printed words. This finding is logical if one accepts that dyslexia is a neurological condition, but it is questionable since teachers are the most experienced professionals dealing with reading problems, and because effective interventions in reading problems are almost exclusively pedagogical (McGuinness 2005).

Journals that publish studies on dyslexia

The results show that almost 90% of the studies of dyslexia are published in medical, neuropsychological or psychological journals, with only 6% published in educational journals. More than 40% ($n = 342$) were published in neuroscience journals. In a previous study, Lopes (2012) found that 'dyslexia research is overwhelmingly published in medical

or psychologically oriented journals, with a strong neuropsychological perspective' and that 'As important as, or even more important than, the number of published articles is the impact of each of these journals' (p. 3).

The finding that only 6% of the reviewed studies are published in educational journals is rather puzzling. Even considering that in most studies, dyslexia is conceptualised as 'neurological in origin ...' (e.g., Norton, Beach, and Gabrieli 2015; Richlan 2014; Xia et al. 2016; Su et al. 2018; Luciano et al. 2018; Di Liberto et al. 2018) we could expect a more balanced number of medical and educational articles. It is important to take note of this imbalance because it seems to reflect a more general imbalance of the concept of dyslexia itself. Specifically, dyslexia is conceptualised as a condition that (a) is neurological in origin (i.e. somehow a disease), (b) affects explicitly reading (that is, depends on a social interaction/condition), (c) is primarily diagnosed through a reading test (any other tests are supplementary and ultimately expendable), and (d) requires instruction above any other intervention strategy. That is, dyslexia is mostly conceptualised as a medical condition that is better treated by instructional methods.

The relative absence of papers in educational journals is potentially problematic if the research that addresses practitioner concerns about effective teaching methods is given lower consideration and status. It is now more widely understood that interventions for complex reading difficulties need to be based upon educational practices rather than based on psychological, neuropsychological, or medical approaches (Fletcher and Wagner 2014; Moats 2014).

Conclusion

In conclusion, the picture that emerges is one of significant inconsistency in the selection of participants for studies of dyslexia. In most cases, researchers seem to use the term dyslexia to describe anyone who is struggling with reading (and sometimes spelling). Interestingly, our findings of dyslexia samples seem to parallel the problems that have been found in the more general field of learning disabilities (LD). In a review of studies published in the period 2001–2013, involving samples of students with LD, Williams et al. (2016) found that 'nearly one-quarter of all identified studies investigating LD did not describe who identified the participants as having LD or how they were identified' (p. 226), a proportion that is similar to what was found by Durrant (1994) more than two decades earlier. These authors also found a generalised lack of control over identification procedures, as well as persistence in the use of the IQ-Achievement discrepancy method (although the proportion of studies using this method 'drops precipitously' after 2010). Williams et al. (2016) therefore conclude that it is essential that researchers 'move toward more complete descriptions of participants with LD, including information about the criteria with which they were identified and the persons by whom they were identified'. (p. 228).

Our results indicate that explicit criteria for the composition of research samples of designated dyslexics are many times uncertain, or are highly questionable. In many cases, it is unclear whether the authors are using the term dyslexia as a synonym for poor reading or to describe a subset of poor readers. Where they do seek to make such a distinction, it is incumbent upon them to provide clear information about the specificity of their dyslexic participants in comparison with other struggling readers. Such detail, however, may well lead to challenging because their criteria are invalid and inappropriate

(Elliott and Grigorenko 2014a; Elliott and Nicholson 2016). It is important to note that clinicians often use findings from dyslexia studies to justify their diagnostic differentiation between dyslexic and non-dyslexic poor readers. However, this practice makes little sense if the findings that they are citing are not related to a dyslexic subgroup, but the full heterogeneous group of struggling readers.

Limitations and future studies

This study presents a main limitation: only a small number of studies (about 6%) identify dyslexic participants who are then contrasted with other struggling readers. While this necessarily limits our ability to compare the criteria used in participant selection, it also points to the fragile research basis for making such a distinction. This limitation suggests that future studies should deeply explore the few studies that include dyslexic subjects and other poor readers or studies with other poor readers only to clearly understand what the inclusion criteria in any of these groups are. The specificity of dyslexia ultimately depends on the demonstration that the set of diagnostic criteria are unique.

Note

1. An Excel file containing the complete data set can be found at <https://www.dropbox.com/s/b3j0u2ldmo0wsdl/2000-2019.xlsx?dl=0>.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

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