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Research Report

Language, literacy and cognitive skills of young adults with developmental language disorder (DLD)

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Abstract

Background: There is limited evidence concerning the longer term language, literacy and cognitive skills of young adults with developmental language disorder (DLD). Studies that exist suggest continuing difficulties with language and reading, but abilities may change over time.
Aims: This study aimed to examine the language, literacy and cognitive skills of young adults with and without DLD.
Methods & Procedures: Data were used from the Manchester Language Study data set which was collected from a group of young adults with DLD (recruited originally at 7 years of age from language units—specialist educational resource bases). Participants were assessed on their language, literacy and cognitive functioning when they were aged 24. A comparison group of age-matched peers (AMPs; also 24 years old) were also assessed. For language and cognition, change in scores between 16 and 24 years was also available for analysis. Finally, self-rated measures of literacy difficulties were taken at 24 years for functional reading and writing.
Outcome & Results: The results indicate that the young people with DLD in this sample continue to perform more poorly as a group on formal oral and written language tests. A small but significant minority of young adults with DLD also report functional reading and writing difficulties compared with AMPs despite reporting reading as often as their peer group. Compared with scores at 16 years of age, this subsample now appears to show slightly less risk of non-verbal IQ difficulties, showing small but significant 'catch-up' to AMPs.
Conclusions & Implications: These preliminary data suggest that at least some individuals with DLD experience marked linguistic difficulties in adulthood, and that the pathways of language, literacy and cognition are not entirely parallel for this group. Continued support and awareness of challenges for young adults with DLD may be useful.

Keywords: Developmental Language Disorder, adults, cognition, literacy, outcomes.

What this paper adds

What is already known on the subject

It is known that DLD is long term and persists into adulthood. There has recently been a body of work reporting on the well-being of this population, as well as their employment, financial status and driving ability. However, there is very little information about language, literacy and cognitive skills beyond school age.

What this paper adds to existing knowledge

This study presents data on language, literacy and cognition from a large cohort of young adults with DLD and their AMPs. In this sample, a large proportion of participants score low on language, with fewer scoring as impaired on literacy and cognition. A significant minority reports difficulties in functional reading. Preliminary analysis appears to suggest that while language development remains depressed, non-verbal cognitive skills show some catch up over time.

What are the potential or actual clinical implications of this work?

Increased awareness and continued support for language, literacy and cognition may be useful for young adults with DLD.

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Introduction

The cognitive, language and literacy skills of children with developmental language disorder (DLD) have been documented in numerous studies, but there is a limited evidence base on adult outcomes. The body of research reporting childhood profiles has highlighted several important issues pertaining to the skill sets of this population. First, whilst a proportion of children with DLD show a resolving pattern of communication difficulty (Bishop and Edmunson 1987, Reilly *et al.* 2010), around half this population has continued difficulties with structural language into adolescence (Conti-Ramsden *et al.* 2001b). Second, language difficulties (especially in spoken language) are not always identified in secondary school settings and spoken difficulties may be masked and only revealed based on the identification of poor reading ability (Myers and Botting 2008). Third, there is increasing consensus that this population experience subtle but important cognitive challenges. This was one of the major motivations for changing the term from specific language impairment (SLI), which implies that only language is affected, to DLD, which encompasses a broader profile of difficulty (see Reilly *et al.* 2014, Bishop 2014, and Bishop *et al.* 2017 for discussions about terminology). Cognitive differences in this population include short-term memory problems in both verbal (Hick *et al.* 2005, Botting and Conti-Ramsden 2001) and non-verbal domains (Bavin *et al.* 2005, Marton 2008, Botting *et al.* 2013); procedural memory deficits (Ullman and Pierpont 2005, Lum *et al.* 2012); and also working memory and executive function impairments (Henry and Botting 2017, Henry *et al.* 2012). These specific cognitive profiles may also underpin the decline in non-verbal IQ first reported by Botting (2005). Conti-Ramsden *et al.* (2012) later modelled these data and found a largely stable pattern of IQ once measurement issues and attrition were accounted for. However, they still reported that nearly one-third (71/242) showed deceleration in non-verbal trajectories (developmental lag), whilst only 16/242 showed accelerated development (catch-up).

Importantly, research has established that literacy is also affected in many young people with DLD. Several studies have reported that between 50% (de Bree *et al.* 2010) and 80% (Botting *et al.* 2006) of children with DLD also have difficulties with reading; and Freed *et al.* (2011) emphasized the heterogeneity of literacy difficulties for children with DLD. Some studies have indicated a direct role for oral language comprehension (Botting *et al.* 2006), early reading (Catts *et al.* 2002) and phonological processing (Loucas *et al.* 2016) in determining whether a child with DLD will have concomitant reading difficulties. An important longitudinal study of children with pre-school language difficulties by Snowling and colleagues was one of the first to show that for many young people with DLD, literacy difficulties are a long-term issue (Stothard *et al.* 1998, Snowling *et al.* 2000) and may affect the educational status of the young people as they exit full-time education (Snowling *et al.* 2001). Furthermore, expressive grammar intervention has been shown to improve emergent literacy skills in pre-schoolers with DLD (Washington 2013) suggesting a causal link. There is also a body of evidence suggesting overlaps between dyslexia and oral language difficulties (see Adlof and Hogan 2018 for an overview). However, for all these difficulties, a wide range of abilities is noted in DLD as a group, perhaps suggesting it is best conceptualized as a spectrum of difficulties (Lancaster and Camarata 2019).

Despite the importance of language and literacy throughout the lifespan, very few studies have assessed the language, literacy and cognition of individuals with DLD into adulthood. However there are notable exceptions. Clegg *et al.* (2005) showed that a group of children with severe receptive DLD remained linguistically impaired when reassessed in their 20s and 30s. Their cohort also had changing literacy status over time, showing no deficit at the earlier assessment, but severe literacy difficulties at the latter. Cognitive profiles also showed a changing pattern but in the opposite direction, that is, IQ scores were depressed at 24 but appeared cognitively normal at 36. An ongoing study by Beitchman and colleagues also showed reading and language impairments compared with typical adults and adults who had grown up with speech problems only (Johnson *et al.* 2010). Whitehouse *et al.* (2009) followed a small group of participants into their early 20s and again these authors reported persisting difficulties with structural language and literacy compared with peers. Interestingly the type of earlier language profile partly predicted later outcomes. Similar findings have been revealed by Law and colleagues using large scale cohort data from 11,000 participants (Law *et al.* 2009). Although outcome measures were relatively crude and based on national examination performance rather than direct testing. Law *et al.* also found this pattern of persisting difficulties pattern in the epidemiological sample, and indicated that early language learning difficulties of any sort (at 5 years of age) were a more important predictor than demographic factors.

Much of the research into adult outcomes has focused on general quality of life (Conti-Ramsden *et al.* 2016, Johnson *et al.* 2010), behavioural difficulties (Pickles *et al.* 2016), emotional health (Botting *et al.* 2016a, 2016a) or employment (Carroll and Dockrell 2012, Conti-Ramsden *et al.* 2018). This is not surprising given the important concerns families and individuals have regarding these elements of daily life. However, while wider outcomes are a central issue for young adults

with DLD, there is a need to also report the cognitive, language and literacy skills of this population. The motivation for this is fourfold. First, these skills are likely to underpin some aspects of functional activities such as applying for jobs, reading for pleasure, making lists and managing finances. Second, they may also relate indirectly to the increased likelihood of mental health issues in this population (Botting *et al.* 2016a, 2016a, Clegg *et al.* 2005). Third, documenting language, literacy and cognition into adulthood gives us a better theoretical understanding of longer term trajectories of these functions more generally. Finally, it is useful for policy-makers, clinicians and theoreticians to understand the adult outcomes of developmental disorders in terms of their primary area of difficulty (i.e., language) in order to inform practice, advise parents and develop lifespan policies.

Present study

This paper reports on the language, literacy and cognitive status of a subsample of young adults aged 24 years of age who took part in the Manchester Language Study study. In total, 83 adults with DLD and 86 aged-matched peers (AMPs) took part. The study has a mixed cross-sectional and longitudinal design.

Specifically, the following research questions are addressed:

- Are levels of language and literacy lower for young adults with DLD compared with AMPs? Does the pattern of change over time differ between groups?
- Is non-verbal ability different across groups; and does the pattern of change over time differ between groups from 16 to 24 years?
- Do young adults with DLD experience functional literacy difficulties or report different literacy behaviours when compared with AMPs?

Method

Participants

Both DLD and AMP samples were recruited as part of a wider longitudinal research programme: The Manchester Language Study (MLS). The MLS 24-year data set is open access and available from the UK Data Service (http://reshare.ukdataservice.ac.uk/852066/).

Young adults with DLD

In total, 242 children with DLD were originally recruited at 7 years of age as having primary language difficulties. The current study compares the outcomes for a subset of this sample which remained in the study in young adulthood. In total, 83 participants (55 males, 28 females) with DLD were included in the analyses presented here. The educational and employment status of the group are fully described by Conti-Ramsden *et al.* (2018), but as an overview, the final compulsory-educational placement (i.e., at 18 years) was recorded as mainstream for the majority of the subsample (61/83—with no support for 20%; with support for 53%). At 24 years, just under half the sample were in full-time employment or education (35; 43%). The subsample appears to be representative of the original sample of children with DLD in the MLS: No significant differences were found between those who did and did not participate at 24 years on 7-year-old receptive or expressive language scores, non-verbal IQ (NVIQ) or demographic information (family income and maternal education) (all $p > 0.2$). Attrition over time was higher for males compared with females ($\chi^2(1) = 7.5$, $p = 0.006$) but the distribution of males:females was not significantly different from the AMP group at 24 years of age (see below). At 16 years of age, the DLD group scaled scores (where 10(3) are the mean(SD) for the population) were 4.7(SD = 2.0) for CELF Recalling Sentences (Expressive) and 7.1 (SD = 3.6) for CELF Word Classes (Receptive).

Age-matched peers (AMPs)

As a comparison group, 86 AMPs (47 males, 39 females) were recruited at age 16 from the same secondary schools as the DLD participants (except for young people attending specialist placements not attached to mainstream schools). These participants had no history of special educational needs or speech and language therapy provision and were all in mainstream education at the time of recruitment. Note that individuals were not excluded if they subsequently scored low on tests of language. This is because scoring low on one assessment does not necessarily indicate diagnosis or clinical need. Excluding these participants would bias the sample towards the top end of the normal distribution and create inaccurate and circular comparisons. At recruitment and again when participants were 17 years of age (as part of the wider study) teachers were asked to state whether they thought the participant should have a Statement of Educational Needs, which at the time of testing was a legal document applied to children in UK schools deemed to require educational support. None of the teachers of AMPs felt this should be the case. Thus, a statistically conservative approach has been taken: Including the lower scoring AMPs, which if anything underestimates the true difference between groups. At 24 years, just over half of the AMP group were in full-time education or study (57; 66%).

At the current stage, DLD and AMP groups did not differ on gender ($p = 0.16$), household income at

recruitment (p = .80) nor on personal income at age 24 (p = .40). The DLD group were slightly older at 24 years 4 months (SD = 8 months) compared with 24 years 0 months (SD = 10 months) for the AMP group ($t(170) = 3.1$, $p = 0.002$).

Measures

Language

The Clinical Evaluation of Language Fundamentals (CELF-4[uk]; Semel *et al.* 2006) was used to assess language ability. The CELF-4 has norm data available up to the age of 21;11 and was deemed the best fit assessment for the cohort at 24 years of age given the lack of appropriate language measures for young adults. A core language index was created using standard scores (based on 21;11 year norms following Fidler *et al.* 2011) from the Recalling Sentences, Formulated Sentences, and Word Classes subscales. Note that, again, this represents a conservative approach which is more likely to overestimate DLD performance and limit the chances of significant differences between the groups. A core language score was not available at 16 years of age, but the CELF Recalling Sentences subtest (widely reported to be a marker of language impairment; see Conti-Ramsden *et al.* 2001a; Klem *et al.* 2015) was used to examine change over time.

Overall the CELF-4 has excellent reliability: test–retest (0.87–0.92), inter-scorer (0.88–0.99) and split-half reliability (0.87–0.95). It has sensitivity of 1.00 and specificity of 0.89 when used diagnostically with a –1.5 SD threshold. However, it should be noted that these psychometric results hold for younger ages and may not be representative in this sample who were older.

Literacy: formal and functional measures

Several measures were taken to assess literacy, functional difficulties and reading frequency. The Sight Word Reading subtest of the Test of Word Reading Efficiency (TOWRE-2; Torgesen *et al.* 2012) was used to assess single word reading and standard scores were calculated. The TOWRE-2 provides normative data up to 24 years and 11 months. Test–retest for the TOWRE-2 is 0.89–0.93, interrater reliability is 0.99 and criterion validity is between 0.89 and 0.96.

For the functional measures, participants were asked a series of questions about how often they read books; magazine; newspapers and internet material and asked to respond never/sometimes/often. They were also asked to report whether they had difficulties (yes or no) reading each of the following: bills, statements, letters, emails, menus, timetables, forms, texts, websites and shopping lists. Finally, reported writing difficulties were assessed by asking participants whether they had problems (yes or no) writing each of the following: notes for people, shopping lists, telephone messages, formal letters, emails, texts, and filling out forms.

Cognition: non-verbal IQ (NVIQ)

At 16 years of age, the Weschler Intelligence Scale for Children (III) was used to measure non-verbal IQ. This test has norms from 6;0 to 16:11 years of age. The test–retest reliability for the 16–17 year age range is 0.89.

At 24 years of age, the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler 1999) Performance subscale was administered as a measure of non-verbal IQ. This test has norms for individuals aged 6–89 years. The test–retest reliability of the Performance IQ scale for the age range 20–24 years is 0.94.

Procedure

The University of Manchester Research Ethics Committee, UK approved the study and written informed consent was obtained from the participants themselves. All measures were completed as part of a face-to-face interview with a research associate trained in the administration of the tests, which took place in a quiet room in the participant's home or at an arranged community location. Wherever possible the participant was alone to ensure validity of testing. Questions on functional literacy difficulties and reading behaviour were read out to participants to avoid comprehension problems. The assessments and literacy items were part of a wider interview which for some participants took place over several visits within 1 month. For participants with DLD, several visits was often necessary because they tired more quickly or took longer to complete the assessments. For AMPs, fewer multiple appointments were needed, and where they were this was usually due to availability rather than fatigue.

Analysis

Data were initially analysed using a simple parametric comparison approach (t-tests) between those with DLD and AMPs. Cohen's d-values are reported as effect sizes where over 0.2 is small, 0.5 is medium and > 0.8 is large. Mixed analysis of variance (ANOVA) was used to compare cognitive and language outcomes over time across groups. Partial eta squared values are reported, where > 0.01 is small, 0.06 is medium and 0.14 is large (Cohen 1988).

Results

Language

Simple comparative analyses showed that young adults originally recruited as having DLD were still performing more poorly at 24 years of age on formal language assessment subtests compared with AMPs and also compared with published norms. The Core Language Index from the CELF was significantly lower for young adults with DLD (mean = 69.9, SD = 20.5) compared with AMPs (mean = 100.0, SD = 13.9; $t(137.8) = -10.98$, $p < 0.001$, $d = 1.7$). In total, three participants with DLD did not have CELF data available; 50% (40/80) fell below –2 SD from the mean (standard score < 70) and a further 24% (19/80) fell between 70 and 84. The remaining 26% (21/80) scored within the normal range for core language. These proportions compare with AMP distribution of 3.5% (3/86) scoring < 70; 11.5% (10/86) between 70 and 84; and 85% (73/86) scoring ≥ 85, which follows the expected normal distribution of scores (whereby 16% of people fall below 1 SD by definition). Although formal tests of structural language may not be entirely representative of language ability in adulthood, those with standard scores < 70 are likely to experience some communicative challenges in everyday life.

Language change over time

No Core Language Index was available at 16 years, so CELF Recalling Sentences raw scores were examined over time for those who had both data points available (DLD $n = 79$; AMP $n = 64$[1]) using a Group × Time mixed ANOVA. A small but significant 'lag effect' interaction was found ($F(1,141) = 12.35$, $p = 0.001$, $\chi^2_p = 0.08$) with the DLD group raw scores moving from mean = 52.94 (SD = 11.51) at 16 years to 57.51 (17.22) at 24 years, compared with the AMP group who changed from mean = 70.67 (SD = 5.65) at 16 years to 81.45 (14.33) at 24 years. This suggests that the language skills of the DLD group were not developing as fast as those of the AMP group.

Literacy skills as measured by formal assessments

Literacy assessment also showed the DLD group to be performing significantly below their AMPs. When standardized TOWRE scores were calculated, the DLD group scored just outside the normal range (mean = 78.8, SD = 11.6), whereas the AMP group scored well within the normal range on this measure (mean = 94.8, SD = 12.9; $t(167) = -8.47$; $p < 0.001$). In total 16.9% (14/83) of this subsample of adults with DLD fell below –2 SD from the mean (standard score < 70) and a further 57.8% (48/83) fell between standard scores of 70 and 84 (–1 and –2 SD) on the TOWRE. The remaining 21/83 (25.3%) scored within the normal range. This positive skew towards low scores compared with the distribution of the AMP group: 1.2% (1/86) scoring < 70; 24.4% (21/86) between 70 and 84; and 74.4% (64/86) scoring ≥85.

Literacy change over time

No TOWRE data were available at 16 years. Thus, no Time × Group analysis was performed for reading.

Non-verbal IQ

At 24 years, average non-verbal IQ scores were within the normal range for those with DLD, but were also significantly lower than AMPs (DLD: mean = 98.8, SD = 15.8; AMP: mean = 111.9, SD = 10.3; $t(140.2) = -6.38$, $p < 0.001$, $d = -0.97$).

Non-verbal IQ change over time

Non-verbal IQ change patterns were compared over time using a mixed (Group × Time) ANOVA for those with data available at both time points (DLD = 78; AMP = 64[2]). This indicated a small but significant 'catch-up' interaction for the DLD group ($F(1,140) = 4.3$, $p = 0.04$, $\chi^2_p = 0.03$) who changed from mean = 86.4 (SD = 19.1) to 99.9 (14.8) compared with an AMP change from mean = 104.3 (SD = 14.9) to 113.2 (10.8). This subsample shows a pattern of change that contrasts an earlier trend for falling NVIQ in the wider sample with DLD (Botting 2005; no earlier data are available for the AMP group). It is important to note, however, that this analysis is preliminary and does not take into account missing data through attrition, using only those participants with data at both time points.

Figure 1 shows the proportions of individuals with DLD and their AMPs falling into each ability band for language, literacy and cognition at 24 years of age.

Functional literacy and reading frequency

Although asking participants about their reading is not as objective a measure as the direct assessments above, it was felt important to include participants' own experience of functional reading difficulties in everyday contexts. A series of chi-square analyses were completed to assess functional literacy and reading frequency. Overall, results suggest that although there were some differences between young people with DLD and AMPs in relation to functional literacy, there were mostly similarities across the two groups in terms of reading frequency. Tables 1 and 2 summarize the results.

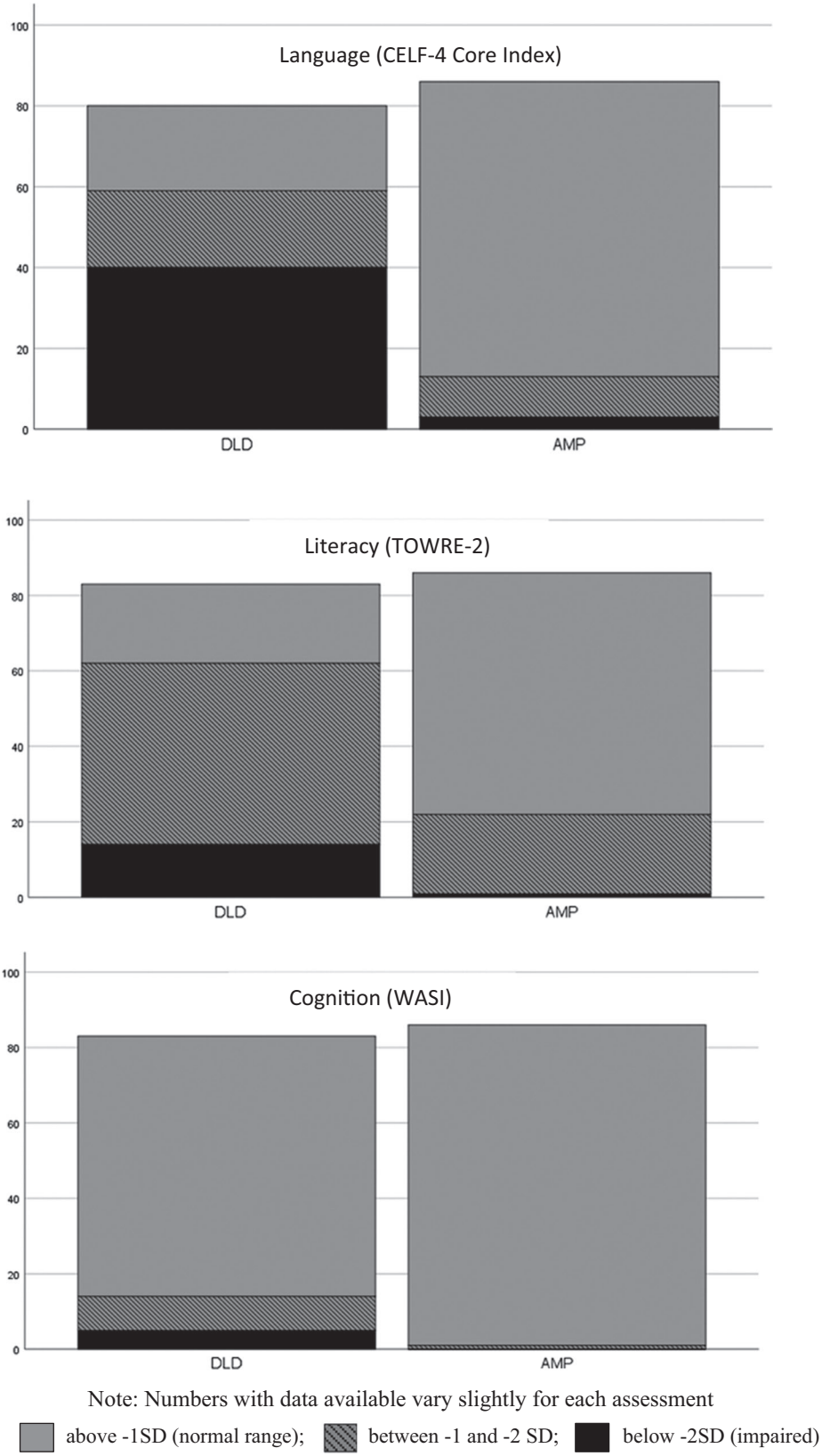

Figure 1. Number of young adults within standardization bands in each domain at age 24 years.

Table 1. Proportion of each group reporting difficulty in each functional literacy domain

	DLD ($n = 81$) (%)	AMP ($n = 86$) (%)	Fisher's exact p
Difficulty reading			
Shopping lists	7.4%	0%	0.012
Menus	12.3%	1.2%	0.004
Timetables	21.0%	2.3%	< 0.001
Bills	24.7%	1.2%	< 0.001
Bank statements	23.5%	1.2%	< 0.001
Forms	48.1%	4.7%	< 0.001
Letters	18.5%	0%	< 0.001
Emails	9.9%	0%	0.003
Texts	13.6%	1.2%	0.002
Websites	16.0%	1.2%	< 0.001
Difficulty writing			
Shopping lists	8.6%	0%	0.005
Cheques	32.1%	3.5%	< 0.001
Notes for others	16.0%	0%	< 0.001
Phone messages	37.0%	1.2%	< 0.001
Forms	50.6%	7.0%	< 0.001
Letters	61.7%	10.5%	< 0.001
Emails	19.8%	0%	< 0.001
Texts	11.1%	0%	0.001

As table 1 reveals, a significant minority of these young people with DLD reported finding all functional reading and writing more difficult than peers, suggesting that for many the formal assessment is not only picking up residual difficulties when tasks are formal and impairment focused, but also that every day literacy is affected in young adulthood for some of those with DLD.

Interestingly, despite some marked difficulties revealed on standardized tests and reported above, table 2 data reveal there were no differences between groups on how often individuals read material of various sorts for leisure, the only exception being reading from the internet. Overall, about three-quarters of both groups reported reading books, magazines and newspapers 'sometimes' or 'often'. Although there was a significant difference seen across groups for reading information from the internet, it should be noted that 94% of people with DLD reported reading in this way 'sometimes' or 'often'. The difference lay in the fact that AMPs were veracious internet readers with 78% of AMPs reading often. No individuals from the AMP group reported never reading internet material. See table 2 for detailed results.

Discussion

The aim of this paper was to document the language, literacy and cognitive status of a group of young people with DLD originally recruited into the MLS, who are now in early adulthood. Specifically, in response to our research questions we found the following. (1) Language, literacy and cognition levels remained low as a group for this sample of people with DLD even as young adults; however, while language continues on a slower trajectory over time, there is preliminary evidence that cognitive levels may have risen in the sample relative to AMPs. Various considerations around the robustness of this finding are discussed further below. (2) The experiences of the group with DLD matched the formal assessment findings in that they reported difficulties across the board in functional and every day reading and writing. However, they did not report lower frequency of reading except for internet based material.

The finding that language and literacy scores remain low in this sample of young adults originally diagnosed with DLD is perhaps not surprising given that other smaller scale studies have also reported continuing difficulties in adulthood (Clegg *et al.* 2005). However, the participants in previous studies were not as heterogeneous in profile as the current sample and had severe and complex receptive difficulties. This particularly severe profile has sometimes been used to explain the adult outcomes reported by Clegg *et al.*, but the current results suggests that a wider group of individuals who received specialist educational language provision are also at risk of adult language and literacy difficulties. It should also be noted that our participants fell outside the published norm age range for the CELF-IV which means the present findings might underestimate language difficulties in this sample.

Table 2. Reading for leisure behaviour across groups

Subtest		Never (%)	Sometimes (%)	Often (%)	Statistics
Books	DLD	21 (26%)	41 (51%)	19 (23%)	$\chi^2(2) = 3.4$,
	AMP	14 (16%)	43 (50%)	29 (34%)	$p = 0.18$
Magazines	DLD	21 (26%)	43 (53%)	17 (21%)	$\chi^2(2) = 0.95$
	AMP	23 (27%)	40 (46%)	23 (27%)	$p = 0.62$
Newspapers	DLD	22 (27%)	35 (43%)	24 (30%)	$\chi^2(2) = 0.58$
	AMP	19 (22%)	40 (47%)	27 (31%)	$p = 0.75$
Internet	DLD	5 (6%)	36 (45%)	40 (49%)	$\chi^2(2) = 16.9$
	AMP	0 (0%)	19 (22%)	67 (78%)	$p < 0.001$

Note: DLD ($n = 81$); AMP ($n = 86$).

Nevertheless, three factors should be noted. First, the current sample was recruited clinically and therefore consisted of children with persistent language disorder, severe enough to warrant attendance for most of their school week in a specialist class by age 7; second, one-quarter of the follow-up sample (and potentially more of those lost through attrition) now show normal range scores on language and literacy; third, although the majority of our sample did perceive functional difficulties in everyday life, this was not the case for all participants.

The different patterns of change over time (language showing relative decline; literacy and cognition showing relative catch up) warrant further investigation. It may be that, with time, young adults with DLD can learn functional or alternative strategies for literacy- and cognition-based tasks, which for AMPs are automatically supported by verbal skill. The apparent rise in non-verbal cognition contrasts the decline reported in Botting (2005) in middle childhood, and mirrors the 'bounce-back' seen in Clegg *et al.* (2005). These data need to be treated with some caution because the sample of MLS participants who continued until 24 are in part a self-selected subsample, and it may be that the most able young people were those who remained in the study. Nevertheless, it is worth noting that (1) this group of participants were no different at recruitment to those who did not participate at 24 on any measures; and (2) their language scores were still very low (and are lagging) making it less likely that this result represents a general bias towards better outcomes. Discussion of statistically modelled NVIQ data from the Manchester Language Study up to 17 years highlighted the potential likely effects of measurement error when different instruments were used across time (Conti-Ramsden *et al.* 2012). However, even taking this into consideration, the authors concluded that the magnitude of the observed drop suggested a decline of non-verbal IQ for at least a proportion of the participants. Their modelled data also presented a slight upward trend at the last data point (Conti-Ramsden *et al.* 2012: 124, fig. 2), which could be argued might indicate the first signs of re-acceleration.

Together with the earlier reports discussed above, the present findings suggest that NVIQ may in fact more fluid in atypical populations. Although the reasons for the apparent rise in NVIQ for some individuals with DLD are not known, one speculation could be that competing demands in adolescence (which might include social, emotional and educational pressures) limit cognitive capacity, and that NVIQ can develop faster once other aspects of development are more stable. While competing demands have been documented at task level (e.g., Just and Carpenter's 1992 working memory model; Murray *et al.*'s 1997 investigation into competing demands in adults with aphasia; and McClure *et al.*'s 2007 discussion of competing emotional–cognitive processes), it may also be useful to consider this framework developmentally. Alternatively, it may simply reflect that uneven trajectories are characteristic of individuals with DLD. Future studies with more complete data sets are needed to model cognitive change into adulthood.

It is encouraging that young adults with DLD do not report markedly different reading behaviour from their peers. There have been recent arguments made about the potential beneficial distal effects of early identification and intervention like that received by participants in the MLS (Winstanley *et al.* 2018). The vast majority of adults with DLD does read from internet sources; however, a small minority are never accessing this material. Compared with peers who are very high internet consumers, this represents an important functional group difference. It supports previous studies that have shown so called 'new media' to be as difficult for people with DLD, if not more so (Durkin *et al.* 2011) and report lower engagement with technology for education or leisure use in some young people with DLD (Conti-Ramsden *et al.* 2010). Given the increased use of these modes of communication, it is possible that this aspect of functional reading might lead to increased risk of social isolation and the various interactions that occur online. To the author's knowledge, the functional reading behaviour of individuals with DLD (i.e., how often they read; the type of material read) has not been reported previously in the literature and future research using more objective measures could usefully address this gap in the evidence base. If reading for leisure occurs as much as for AMPs, it could be a useful mechanism for support and language therapy in adulthood as well as younger ages.

Limitations and future directions

One key limitation is the fact that the data set contains scores from differing assessments over time. Where data from the same or similar tests were available, these have revealed interesting patterns of change, but it is possible that the changes in NVIQ are an artefact of the change from WISC III to WASI, which have some different features, despite being designed to measure the same skills, and being reported as congruent even in clinical populations (Scott *et al.* 2007).

As identified throughout, the attrition seen in both groups over time is a limitation for fully understanding the pathways of young people with DLD (although those remaining in the study at 24 years of age were no different at earlier time points than those who withdrew at earlier phases). Furthermore, those without one of the cognitive scores available were not included by necessity in the 'catch up' analysis, and this may have inflated the catch-up effect. Thus, this result should be treated with

some caution. In addition, the AMP group data are only available from age 16, and it would obviously be beneficial to have developmental trajectories from earlier age points. Future research should take several cognitive measures and employ advanced modelling techniques to ascertain whether the changes are similar when missing data is imputed statistically. Further longitudinal studies are needed that recruit DLD and AMP participants in early development, show reduced attrition, and use the same measures at each time point.

The original study recruited AMPs with no clinically identified needs but did not exclude those with low language scores when tested for research purposes, which could be seen as a limitation. However, at this stage of the study, 16% fell below 1 SD and this is exactly what we would expect from a normal distribution curve. Because the young people were tested on a single testing occasion, for the purposes of research, we would not want to categorize these individuals as having a language difficulty as no such clinical concern had been previously raised, and indeed teachers reported none when asked directly as part of this study at recruitment or a year later. While it is always possible that some of the AMPs had completely undetected language disorders, excluding low scoring individuals would bias the AMP data to the top end of the distribution, which we believe would give an inaccurate comparison. Including all AMPs is the most cautious approach scientifically because it increases the chance of non-significant differences between groups.

Although it is important to consider functional reading alongside formal assessments of literacy, there are several ways in which future studies could expand on the current study. First, the assessments of functional problems are self-reported and could be affected by the level of the adults' self-awareness. Second, the kinds of reading and writing evaluated here are likely to be less demanding that other forms of reading and writing demanded in other contexts. For example, an adult in a vocational training program may face far more demanding reading than explored here. A study that directly assesses functional reading material of different kinds would therefore be a useful next step.

Clinical implications

As noted throughout the discussion, the data presented here speak to potential implications for clinical practice. First, professionals, employers and families of young people with DLD should be aware of the persisting structural language difficulties experienced by this group as a whole. However, the apparent rise in IQ suggests that the needs of individuals with DLD might be more fluid than often assumed (that is, they may fluctuate rather than follow a stable pathway), and that despite some reported challenges with cognitive tasks, these might be less of an issue as adulthood progresses. The data also might suggest that individuals with DLD would benefit from disclosing their communication difficulties in workplaces. Recent data collected by the author suggests that whilst general managers are aware of autism, only a small minority have heard of DLD (or SLI) (Botting *et al.* in preparation). Greater awareness of language and literacy difficulties might result in better support and accommodations for adults with DLD. Finally, the fact that young adults with DLD report reading to the same extent as their peers may be a legacy of the intensive early language environments which they all attended. More support in adulthood to develop reading interests and skills, might also support continued language development.

In conclusion, this study is one of the first to document long-term language, literacy and cognition difficulties for adults with DLD. It also cautiously suggests that these skills may fluctuate over time in relation to AMPs, and that cognitive skills in particular may show some catch up compared with peers. Further work is needed to assess objectively functional reading, to understand fully the most high-risk profiles and to confirm pathways of development using larger longitudinal and cross-sectional samples. However, it seems clear that at least some young adults with DLD have continuing challenges with language and literacy that may benefit from continued support and awareness at this stage of their lives.

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1. The AMP participants who had both data points available scored significantly lower on recalling sentences at 24 than those AMPs with only 24-year data (those excluded from this analysis; $p < 0.001$). This suggests that the lag reported here is an underestimation.
2. Those AMPs with IQ data at both time points, and those excluded from this analysis due to missing 16 year data, did not differ on IQ at 24 ($p = 0.92$).

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