



Language, literacy and numeracy outcomes of adolescents with (Developmental) Language Disorder following a collaborative model of SLT delivery in specialist education.

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Summary

Background:

Language and educational outcomes for adolescents with developmental language disorders (DLD) are often poor, impacting on quality of life in adulthood. Previous cohort studies show changes on measures of language and literacy which either parallel that of typically developing (TD) children at a lower level or (for vocabulary) an increasing gap in performance. Little evidence exists to guide services regarding how speech and language therapists (SLTs) might best work with this population within education to improve their outcomes.

Aims:

We describe changes on standardised tests of receptive and expressive language, vocabulary, literacy and numeracy and results in national examinations for a cohort of 57 secondary-aged students with DLD who received an integrated model of SLT service delivery in a special school setting over an 11 year period. We compare these with previous cohort studies of adolescents with DLD. We also aim to provide preliminary insights into which service factors may warrant further consideration with regard to developing effective models of SLT service delivery for this population.

Methods and procedures:

Participants were assessed three times (at 11, 14 and 16) using standardised measures. These included tests of receptive and expressive language (Clinical Evaluation of Language Fundamentals; CELF 4), vocabulary (British Picture Vocabulary Scales; BPVS 2) literacy (reading and spelling) and numeracy (Wide Range Achievement Test; WRAT 4).

Outcomes and Results:

Significant positive changes in standard scores (and thus a closing of the gap with TD peers) between the ages of 11 and 16 were found on expressive language, one receptive language subtest, reading, spelling and numeracy. Stable standard scores in most areas of receptive language indicate rates of progress in line with typical development. Standard scores in receptive vocabulary decreased, indicating a widening gap with TD peers. However raw scores in receptive vocabulary showed a significant increase.

Conclusions and Implications:

Adolescents with language disorder who received a collaborative model of SLT within in special school setting made significant progress between ages 11 and 16 in most areas measured, closing the gap between their performance and that of TD peers. This suggests such adolescents can show measurable change in language, literacy and numeracy and therefore SLT services should not be limited during these years. We also suggest that SLT services might be best delivered in a collaborative way in schools.

Introduction

Language difficulties in school-aged children are likely to persist into adolescence and beyond (Tomblin et al., 2008, Conti-Ramsden et al., 2009). Such difficulties present a barrier to learning in the classroom (Dockrell and Lindsay, 1998), gaining paid employment (Conti-Ramsden et al., 2012a). and achieving financial independence (Reilly et al., 2014). Despite the impact of language difficulties over the lifespan, SLT services are significantly reduced or non-existent by secondary school age, at least in the UK (Bercow, 2008). Furthermore, there is little empirical evidence to guide service decision-making as to the best models of working with adolescents (Joffe et al., 2012).

The labelling of language difficulties has been the focus of recent debate and it is recommended that the previous term Specific Language Impairment (SLI) should now be referred to as Developmental Language Disorder (DLD) (Bishop et al., 2016, Bishop et al., 2017, in press). Thus, when referring to previous studies of children with SLI, we use the term DLD. With regard to the cohort we discuss in this paper, however, we use (D)LD. We do so because the majority of the cohort fit the criteria for DLD, but a minority have a known associated biomedical condition (such as hearing impairment or ASD) and therefore fit the criteria for the broader term of Language Disorder (LD).

What progress might we expect in language and literacy during adolescence for adolescents with (D)LD?

In the last 20 years, several studies have followed children with DLD into

adolescence. These include: in Canada, the Ottawa Language Study (OLS) led by Joseph Beitchman; three studies in the UK led respectively by Gina Conti-Ramsden (Manchester Language Study, MLS), Dorothy Bishop, and Julie Dockrell; 2 studies in the US led by Bruce Tomblin (Iowa Longitudinal Study, ILS) and Mabel Rice.

These longitudinal studies have considered progress in a variety of ways. Some have compared trajectories of children with (D)LD versus TD children. Parallel trajectories show similar rates of progress, even if actual scores remain at a lower level. This has been found for adolescents with (D)LD with respect to expressive and receptive language (Conti-Ramsden et al., 2012b), judgement of grammatical markers (Rice et al., 2009) and reading accuracy (St. Clair et al., 2010, Bishop et al., 1996, Catts et al., 2002). If the group with initially higher scores (i.e., the TD group) has a steeper slope, the gap between the two groups would widen. This pattern has been found for adolescents with respect to vocabulary, with a shallower slope for vocabulary acquisition for children with DLD compared with that of TD children (Rice and Hoffman, 2015).

An alternative (although less robust method) of considering progress in impaired groups relative to typically developing children is to use standard scores. These control for maturation and general development as they are adjusted for age. Thus, if a child has stable standard scores, this shows they are in the same position relative to the distribution of the standardisation sample. Thus, relative to TD peers, they have neither caught up, nor fallen further behind. While we realise that standardisation samples are not

tested longitudinally, we interpret stable standard scores to reflect progress at a similar rate to the standardisation sample. This progress at the typical rate is likely to reflect maturation and access to education. Where progress is slower than typical, we would expect to see falling standard scores as the child's position relative to others in the standardisation sample falls. Increasing standard scores are found when a child is moving up relative to others in the standardisation sample and we interpret this as reflecting progress which is faster than the average rate of progress for typically developing children. One longitudinal study which has taken this approach is Stothard et al. (1998) who analysed changes in standard scores between the ages of 4 and 15 with respect to language comprehension and vocabulary. The analysis was carried out in two subgroups of children: a group initially identified as having DLD by Bishop and Edmundson (1987) at age 4 who showed good language outcomes at 15 years (no score below 3rd centile and at least 5 out of 6 measures scoring above 10th centile, called the "resolved" group) and a group who continued to show poor language outcomes at 15 years (the "persistent" group). In measures of language comprehension, the resolved group showed significantly higher standard scores at age 15 than at age 8. In contrast, the persistent group showed a tendency towards declining scores, although this was not significant. With respect to vocabulary, those who had resolved showed stable standard scores, whereas the persistent group showed a significant decline in these scores i.e. a widening of the gap from 8 to 15 years (in contrast to stable standard scores between 4 and 8 years).

As regards academic abilities, fewer data are available regarding progress during adolescence (with the exception of reading, discussed above). Impaired spelling abilities at age 16 were reported by Dockrell (2011) but longitudinal data were not provided. We are not aware of any study reporting changes over time on spelling measures in adolescents with (D)LD. Similarly, with numeracy, Tomblin (2008) reports that on a measure of mathematical problem solving, young people with (D)LD at age 15 scored significantly lower than TD controls but this study did not report on longitudinal progress on these measures.

In summary, adolescents with (D)LD show rates of progress with language and reading which are similar to those of their TD peers (although performance is at a consistently lower level). However, we do not have information about progress with spelling or numeracy into adolescence for this population. It is likely that, in the UK at least, very few of the participants in these studies would have received SLT support during adolescence (Bercow, 2008).

How should SLT services be delivered to adolescents with (D)LD?

Policy and professional guidelines for school-aged children with (D)LD in the UK and Ireland recommend that SLT services should be collaborative with education and delivered through effective inter-disciplinary collaboration (IDC) with teachers (Gascoigne, 2006, Dockrell et al., 2014, NCSE, 2015). However, findings from national surveys of SLT services to schools show that effective IDC between these professionals is not usual practice (Brandel and Frome Loeb, 2011). The barriers and facilitators to IDC have been

a focus of study (McCartney, 1999, Law et al., 2000, Tollerfield, 2003). At the level of the practitioner, time spent together in planning has been suggested to be important in facilitating effective co-working (Law et al., 2000, Tollerfield, 2003). A common language and shared conceptual understanding has also been identified as important in generating shared goals (World Health Organisation, 2010). A democratic relationship between the individuals where there is mutual respect and trust is also essential (Hudson et al., 1999). In terms of the organisational context, the extent to which collaboration is formalised within the organisation (D'Amour et al., 2008) has also been identified as important as are explicit processes for reviewing the effectiveness of IDC (Ranade and Hudson, 2003).

According to Roulstone (2012), studies which describe service delivery models can provide useful insights into factors which may potentially warrant further testing empirically. It is argued that frameworks which capture such contextual factors from a systems perspective may be particularly useful in doing so (McCartney et al., 1998, Lindsay and Dockrell, 2008). McCartney et al.

(1998) adapted one such systems analysis model for use in describing and evaluating collaborative models of SLT delivery to schools. This model includes the function (aims and purposes of the services), structures (permanent consistent aspects of the service), processes (what is done) and the systems environment (the context of the service). We use this model to describe our SLT model of service delivery in the methods section of this paper.

Summary

There is little empirical evidence to support service decision-making in meeting the needs of adolescents with (D)LD. In terms of progress, most longitudinal cohort studies of adolescents with (D)LD show progress in language and reading which parallels that of TD peers, but with scores at a consistently lower level. Progress in vocabulary tends to be slower than in TD peers, leading to a widening gap. We have little evidence regarding progress in spelling or numeracy with this group. Previous longitudinal studies do not include a description of the SLT intervention received by the participants in relation to progress tracked over time.

Aims of the Study

In this study, we aimed to

1. Establish whether the standard scores of a cohort of adolescents with (D)LD increase, remain stable, or decrease over time (indicating rates of progress greater than, similar to, or less than TD children) with respect to receptive and expressive language, vocabulary, reading, spelling and numeracy.
2. Provide a description of the model of service received by the adolescents with (D)LD from a systems perspective. We do so in order provide some insights into which factors may warrant further testing in developing our evidence-base with regards to collaborative service delivery models for this population.

Methods

Participants

Fifty seven participants (45 boys and 12 girls) were included in this study. These were six cohorts of students who had completed five years of secondary education at a specialist school for children and young people with (D)LD. They had started secondary schooling at 11 years of age in the years 2005 to 2010 inclusive and had taken national examinations at age 16 years in 2011 to 2016. All students who attended the school continuously from age 11 to 16 were included in the analyses. No student was excluded from our study for any reason other than non-continuous attendance from 11 to 16 years. However, two participants did not have CELF-4 data at age 11 (due to this being administered too recently prior to starting the school) and spelling data were missing for one participant at age 14. The numeracy test was introduced into the school assessment cycle one year after this service evaluation started and thus not all participants were assessed on numeracy at all three timepoints. Language and literacy assessments were carried out by SLTs working within the SLT service as well as trainee SLTs from partner universities who were given support in doing so.

All participants met the new criteria for LD (Bishop et al., 2016, Bishop et al., 2017, in press). The majority (>70%) met the criteria for DLD, but a proportion had associated diagnoses such as hearing impairment, epilepsy or ASD. 82% of the participants had both receptive and expressive language difficulties (standard scores <85 on the CELF-4) at age 11; all had expressive language difficulties, but for three participants, these difficulties were primarily in the area of pragmatic language.

SLT model received by the participants

Functions: (aims and purposes of the SLT service)

1. To provide co-ordinated SLT services within an educational setting for students with LD.
2. To work collaboratively with teachers in the classroom as well as directly with students to improve their speech, language and communication skills.
3. To provide intensive SLT on an ongoing basis as identified in the student's education, health and care plan (EHC)¹.

Structures: (permanent consistent aspects of the service)

1. SLT manager sits on the school Senior Management Team and is involved in policy decision-making and strategic planning and implementation.
2. SLT service structure mirrors class structures i.e. an SLT is assigned to each class group rather than working across different groups.
3. A multi-disciplinary team (MDT) is set up each year to work with each student which includes SLT, subject teachers, Special Teaching Assistant (STA) and if indicated, an Occupational Therapist and/or a Literacy Tutor.
4. Communication systems set up around the MDT groups regarding student issues, staff training, weekly case discussions and annual review processes. This

¹ An EHC plan is a legal document in the UK that describes a child or young person's special education, health and social care needs and recommends the necessary interventions to meet these needs.

structure promotes a democratic culture where all professionals are considered of equal “value” and regularly plan their work together.

5. Timetabled weekly planning hour with the teacher, STA and SLT primarily to plan the delivery of English lessons.
6. Annual reviews are carried out with the whole team present. Individual Education Plans (IEPs) with individual student goals to be achieved that year are set jointly as part of this process and are reviewed termly.
7. Class sizes are small (maximum of 15 students).
8. The school follows the national mainstream curriculum in the UK.

Process: (what is done)

SLT & Literacy intervention in Key Stage 3²

1. SLT three times weekly individually or in pairs for 30 minutes
2. Four out of five English lessons jointly planned and delivered by the SLT and teacher.
3. SLT advice (ongoing) given to subject specific teachers e.g. science and maths.
4. SLT approaches include implicit and explicit methods and techniques targeting the language impairment.
5. Two hours of life and social skills interventions delivered jointly each week with the SLT and Teacher.
6. Students, who meet the criteria for additional literacy support, receive an additional hour of literacy support per week delivered by Literacy Tutor 1:1.

² Between ages 11 and 16 in the UK students complete 2 stages of their secondary education. The first is referred to as “Key Stage 3” (KS3), a three year curriculum undertaken from age 11 to 14 years.

SLT & Literacy intervention in KS4³

1. SLT once a week individually or in pairs for 30 minutes explicitly teaching metacognitive strategies.
2. SLT intervention focus shifts to a strategy-based approach
3. English delivered jointly by SLT and teacher
4. Weekly SLT groups target strategy-based work.
5. Additional 1:1 literacy support continues if required

Systems Environment: (context of the service)

1. The school is a registered charity.
2. Funding for a place in the school for the majority of students is agreed via a process of parental appeal at special education needs tribunals.⁴ At appeal, parents argue the need for a different educational provision for their child.
3. The funding of the SLT service is costed as an integral part of the educational placement and is paid for by the Local Authority of the borough in which each student lives.
4. The SLTs are under the employment of the school. The SLT to student ratio is 1:12.

³ “Key stage 4” (KS4) is a 2 year curriculum undertaken from age 14 to 16 years. At age 16 and at the end of KS4, students sit national examinations called the General Certificate of Secondary Education (GCSEs).

⁴ When Local Authorities make certain decisions about the education and/or training of a child or young person with SEN, parents have a right of appeal to an independent tribunal.

Measures

Receptive and expressive language were measured using the Clinical Evaluation of Language Fundamentals-4 (CELF-4UK) (Semel et al., 2006). The subtests administered were those required for calculating the receptive and expressive language indices. For expressive language, these remain constant at different ages and thus the overall expressive language scores can be compared over time. However, for receptive language, the subtests used to calculate the receptive language index are different at age 11 from ages 14 and 16. Thus, the overall standard score at ages 14 and 16 can be compared, but the results at age 11 cannot, as only one subtest (Word Classes-Receptive) remains constant at all ages. In order to compare progress reliably over time on the CELF-4, we also aimed at age 11 to carry out the other two receptive subtests used for calculating the receptive language index at ages 14 and 16 (Semantic Relationships and Understanding Spoken Paragraphs). However, because these are optional for this age group, they were omitted for some participants. The British Picture Vocabulary Test-2 (BPVS-2, Dunn et al., 1997) was used to assess receptive vocabulary. Reading, spelling and numeracy skills were assessed using the Wide Range Achievement Test-4 (WRAT-4, Wilkinson and Robertson, 2006).

Ethical approval was not required for this study as it involved data gathered routinely by the service. However, the school ethics forum gave permission to publish the anonymised data.

Procedure

The participants were assessed at three time points: at 11, 14 and 16 years. These ages correspond to transition points within the UK education system (transition to secondary education, from KS3 to KS4 and to post-16 education following national examinations). Assessments were carried out either by SLTs in the school or SLT students from local universities.

Analyses

Studies involving participants with initially low scores could have issues with “regression to the mean” and floor effects. Regression to the mean can arise when participants are selected for a study on the basis of low scores on a particular measure. In such a case, some low scores may not be representative of a child’s true abilities and these scores may “regress” towards their true mean when next tested. These increased scores could look like progress, but in fact are just a statistical artefact. Regression to the mean can be avoided in longitudinal studies by selecting participants in other ways than on the basis of low scores on the test on which you will then measure progress (Zhang and Tomblin, 2003). In our study, the participants were selected on the basis of a rigorous school selection process, prior to our first testing point and on different tests. Therefore regression to the mean should not be an issue in this study. However, floor effects could be an issue as when participants’ standard scores are towards the lower end of the distribution, they have more scope for larger positive than negative changes. For this reason, we used non-parametric statistics when looking at progress, as these only consider the direction not magnitude of any change.

Results

Scores at age 11 are shown in Table 1 for participants who had scores at all timepoints for each test. This shows an uneven profile where vocabulary, reading and spelling are relative strengths compared with expressive and receptive language. Numeracy scores fall between language and literacy scores. Indeed a repeated-measures ANOVA comparing scores at age 11 for all participants with full data on all tests at all timepoints showed a significant effect of test, $F(5,250)=39.8$, $p<.001$, $\eta p^2=.44$. Post-hoc Bonferroni corrected t -tests showed that reading, spelling and vocabulary standard scores did not differ, $p=1.0$, but all of these were significantly better than both receptive and expressive language, $p<.001$. Expressive language was also significantly lower than receptive language, $p=.005$. Numeracy scores did not differ from vocabulary, $p=.54$ but were significantly better than receptive language, $p=.01$ and expressive language,

$p=.001$ and significantly worse than reading, $p=.007$ and spelling, $p=.005$.

Effect of cohort

Our study included six different groups of students who started (and left) the school provision over a six year period. It is possible that the cohorts could have differed in their initial abilities on entry at age 11, therefore, we compared the standard scores of the different cohorts at this point. No significant differences were identified between the cohorts on receptive vocabulary, $F(5,51)=0.9$, $p=.50$, $\eta p^2=.08$, receptive language, $F(5,49)=0.74$, $p=.60$ $\eta p^2=.07$, expressive language, $F(5,49)=1.5$, $p=.20$, $\eta p^2=.14$ reading, $F(5,51)=.30$, $p=.91$, $\eta p^2=.03$; spelling, $F(5,51)=0.28$, $p=.92$, $\eta p^2=.03$ or numeracy, $F(4,48)=0.76$, $p=.56$, $\eta p^2=.06$. Because there were no significant differences across cohorts on any measure, we combined the six cohorts into one group for all subsequent analyses.

Table 1 – Mean standard scores (SD) for each test at each age.

	N	age 11	age 14	age 16
Receptive Language	55	66.9 (13.4)	70.8 (18.0)	72.9 (18.0)
Expressive Language	55	60.0 (15.2)	67.0 (16.1)	70.6 (17.6)
Vocabulary	57	80.2 (12.7)	75.7 (15.3)	n/a
Reading (decoding)	57	82.4 (13.8)	85.5 (12.5)	86.5 (12.8)
Spelling	55	82.5 (13.6)	85.7 (13.1)	85.3 (15.4)
Numeracy	47	74.0 (12.0)	79.9 (11.7)	83.8 (15.5)

NB: BPVS is only standardised to 15;11, thus standard scores were not available at 16 years

Effect of gender

The girls in our study had lower mean scores than the boys at all timepoints on all tests and some of these differences were significant⁵. However, no significant interactions between gender and age were found for any area, indicating that while the girls had lower scores than the boys, they made similar progress. Because we were interested in progress rather than absolute scores, we collapsed girls and boys into one group, as there is no evidence they responded differently to the provision.

Changes in standard scores over time

The standard score results for all participants who were tested at all three time points on each test are shown in Table 1. This shows that by age 16, standard scores are in most areas higher than at age 11. However, as a group, they still have low scores at age 16, showing that despite this good progress, they still have significant impairments in language and (to a lesser extent) in literacy and numeracy.

Receptive Language

In order to measure the effect of age on the CELF Receptive Language composite, we carried out a non-parametric Friedman test. This showed no significant effect of age, $\chi^2=2.3$, $p=.32$. However, because different subtests are used at age 11 and the other ages, we also analysed changes from 11 to 16 on the three subtests which

had been carried out at all three timepoints for the majority of the participants: Word Classes – receptive, Semantic Relationships and Understanding Spoken Paragraphs. We found no significant effect of age for Word-Classes – Receptive, $\chi^2=1.8$, $p=.40$ or Understanding Spoken Paragraphs, $\chi^2=5.4$, $p=.07$ showing that standard scores are stable. However, we found a highly significant effect of age for Semantic Relationships, $\chi^2=9.2$, $p=.01$. Post-hoc, Dunn Bonferroni tests showed this was due to a significant differences between ages 11 and 16, $p=.03$, where scores at 16 were higher. However, we found no significant differences between ages 11 and 14, $p=.11$ or ages 14 and 16, $p=1.0$.

Expressive Language

A Friedman test showed a significant effect of age on the CELF expressive language index, $\chi^2=23.9$, $p<.001$. The results in Table 1 show that this is due to a gradual increase in standard scores from age 11 to 16, with greater change between 11 and 14. Post-hoc Dunn Bonferroni tests showed the differences were highly significant between ages 11 and 14, $p=.002$ and ages 11 and 16, $p<.001$. The difference between ages 14 and 16 was not significant, $p=1.0$.

Vocabulary

Standard scores on the BPVS were not available for the adolescents when tested at age 16, as they are outside the standardisation range of the test. A related samples Wilcoxon signed rank test comparing standard scores at age 11 and 14 showed a significant effect of age $Z=383$, $p<.001$. However, as can be seen in Table 1, for this test, the significant difference is due to a decrease in standard

⁵ Girls' standard scores were significantly below boys' on the following tests: receptive language at age 14 and 16, expressive language at age 14, reading at age 16, spelling at age 16, numeracy at all ages.

scores between ages 11 and 14. In order to assess whether this drop in standard scores was a result of a real drop in performance or not, we analysed the BPVS raw scores using a Friedman test (raw scores shown in Table 2). A significant effect of age was found, $\chi^2=76.9$, $p<.001$. Post-hoc Dunn Bonferroni tests showed this was due to significant differences between all ages: 11 to 14 and 11 to 16, both $p<.001$; 14 to 16, $p=.003$. Thus, raw scores on the BPVS increased significantly between each testing point.

Reading Accuracy and Spelling

Friedman tests revealed a significant effect of age on both reading, $\chi^2=13.4$, $p=.001$ and spelling standard scores, $\chi^2=12.8$, $p=.002$. The results in Table 1 show an increase in standard scores from ages 11 to 14, which is maintained by 16. Post-hoc Dunn Bonferroni tests showed significant differences between ages 11 and 14 in both reading, $p=0.02$ and spelling, $p=.003$ and between ages 11 and 16: reading, $p=.002$; spelling, $p=.04$, but

no significant differences between age 14 and 16 on either measure, $p=1.0$.

Numeracy

We analysed the WRAT numeracy standard scores for the 47 children with data at all three timepoints using a Friedman test. A significant effect of time was found, $\chi^2=41.2$, $p<.001$. Post-hoc Dunn Bonferroni tests showed this was due to a significant differences between 11 and 14, $p<.001$ and 11 and 16, $p<.001$. The difference between ages 14 and 16 did not reach significance, $p=.08$.

Table 2: Mean raw score (SD) on the BPVS-2 at each age.

age 11	age 14	age 16
85.9 (15.7)	98.4 (18.2)	107.3 (18.2)

Discussion

This study aimed to analyse the changes in language, literacy and numeracy of a group of 57 adolescents, the majority of whom (82%) had both receptive and expressive language difficulties (on the CELF-4), from the point at which they transferred to a specialist secondary school at the age of 11 to age 16. We also aimed to provide a description of the service received.

Between the ages of 11 to 16 years, we found significant increases in standard scores for expressive language, reading, spelling and numeracy, with all changes occurring primarily between ages 11 and 14. Standard scores for receptive language remained stable, with the exception of the subtest Semantic Relationships where significant changes between ages 11 and 16 were found. For vocabulary, a significant decrease in standard score was found between 11 and 14 years, but significant increases were found in raw scores from 11 to 14 and 14 to 16 years, showing that the participants were making progress with vocabulary, but at a slower rate than TD peers, as indicated by falling standard scores.

At age 16, our participants still had significant impairments, but these were less severe relative to the TD children in the standardisation samples of the standardised tests than at age 11 (indeed, for expressive language, the mean score had shifted from 60 to 71, characterised by the CELF-4 manual as a shift from “severe” to “moderate language disorder”). Due to our lack of a TD control group, we do not have direct evidence that the progress made is greater than that made by TD peers, but we infer this from the increasing standard scores of our participants relative to the

standardisation samples of the tests.

Our results with respect to expressive language are inconsistent with those of Conti-Ramsden et al. (2012b) who showed parallel rates of progress on language measures, indicating that their participants were not closing the gap with TD peers. Although direct comparison is not possible, it is reasonable to suggest that the difference in scores between the adolescents in our study and previous research could be due to the nature and degree of SLT and educational support which was received by our participants.

With respect to vocabulary, we found increasing raw scores in the context of decreasing standard scores. This is consistent with the findings of previous studies (Rice and Hoffman, 2015, Stothard et al., 1998). It may be that the ability to learn, retain and use new words is so efficient by this age in the TD population, who are still constantly learning new words that adolescents with (D)LD can never “catch up” or even “keep up”.

In our study, we also found increasing standard scores in reading accuracy, spelling and numeracy, indicating a greater rate of progress than TD children, a “narrowing of the gap”, although they are still in the low average to mildly below average range. This is again inconsistent with previous longitudinal studies where stable standard scores or a parallel trajectory in comparison with TD peers has been reported for reading (Palikara et al., 2011, Catts et al., 2002). No previous studies have documented progress with spelling or numeracy in adolescents with (D)LD. Given that phonological awareness skills have consistently been shown to have a large treatment effect on reading (Swanson et al., 2003, Ehri et al., 2001) and these skills are a major focus of

intervention delivered in the school, inside the classroom, in small group teaching and therapy sessions and as part of 1:1 SLT and literacy sessions, this is perhaps not a surprising result.

In all areas, we found greater changes between ages 11 and 14 than between 14 and 16. There are several possible reasons for this. Firstly, the period of time is different; three years allows more time for a positive response to intervention than two years. Secondly, the focus of intervention is different in the two Key Stages; more impairment-based between 11 and 14, but more focused on applying skills to improve social and educational functioning and outcomes between 14 and 16.

Consistent with previous studies, it appears that factors such as joint weekly training and case discussions that provide regular opportunities for SLTs and teachers to learn together and to develop a shared understanding may be important in providing services to schools (Tollerfield, 2003). The structures in the school ensure that all professionals are equally valued and have an equal voice in decision-making. This may also have contributed to the outcomes described, consistent with the findings of Hartas (2004). This may have also contributed to these positive outcomes. At an organisational level, collaborative working is formalised administratively and supported at the managerial level, an important factor highlighted in models of IDC developed elsewhere (D'Amour et al., 2008).

Although not described in this paper, it is important to note that the nature of the teaching and the classroom environment within the school are also likely to have contributed to these positive outcomes.

Limitations

In our study we describe a service delivery model received by a group of adolescents with (D)LD in a specialist educational setting and report the changes in language, literacy and numeracy measures over time. It is not possible to infer causal relationships between specific elements of the model of provision and the outcomes presented. There was no matched control group against which to compare changes over time, either receiving an alternative or no intervention. Indeed, finding a matched control group would be difficult given the complex nature of the process which determines who accesses specialist educational provision in the UK. The students in the study have additional associated difficulties and have been identified as needing a different provision from that which mainstream education can provide. They are therefore likely to represent a more severe and complex subgroup of students with (D)LD.

Conclusions

At present, SLT services to secondary-aged students are extremely limited (at least in the UK, Bercow, 2008) and little evidence exists as to which service models are most effective for this population. We observed that between the ages of 11 and 16, adolescents with (D)LD who received an collaborative model of SLT service delivery in a specialist educational setting were able to narrow the gap with their TD peers in expressive language, literacy and numeracy as shown by increasing standard scores over time. Stable standard scores were found in receptive language. Significant improvements were also noted in vocabulary raw scores across time, but in the context of decreasing

standard scores. Given the poorer outcomes in adulthood for this population (Law et al., 2009; Reilly et al., 2014), it is imperative that we develop our evidence-base in relation to the most effective ways of delivering services to this population, across a range of different educational settings. This is a complex task and as a profession we are at a preliminary, exploratory stage. Service descriptions can provide some clues as to where we might start in trying to understand the effective elements of different models of SLT services.

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