

Eadie PE, Conway L, Hallenstein B, Mensah F, McKean C, Reilly S.
[Quality of Life in Children with Developmental Language Disorder.](#)
International Journal of Language and Communication Disorders 2018
DOI: <https://doi.org/10.1111/1460-6984.12385>

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Date deposited:

05/03/2018

Embargo release date:

25 March 2019

Abstract

Background: Developmental language disorder (DLD) is common in children but little is known about its association with quality of life (QoL) in middle childhood. QoL is a complex construct, aligning with an individual's sense of well-being and is related to functional limitations associated with DLD. Biopsychosocial models of disability account for both the extent and functional limitations of the impairment, however the DLD literature rarely reports on both aspects. Studies are required that detail QoL in children with and without DLD.

Aims: This study aimed to investigate the association between DLD, identified at 4-years and persisting at 7-years, and QoL over 4, 7 and 9-years; to compare QoL for children whose DLD was mild-moderate and severe at 7-years; and to investigate how variables known to impact on language development (e.g., maternal vocabulary), as well as social-emotional behaviours at 4 and 7-years contribute to QoL at 9-years.

Method and Procedures: The analyses included 872 children who participated in the 4, 7, and 9-year data collection of the Early Language in Victoria Study (ELVS). We compared the parent-reported QoL profiles at 4, 7, and 9-years for children with and without DLD, and those with mild-moderate and severe DLD using the Pediatric Quality of Life Inventory (PedsQL). We conducted regression analyses to estimate how child, family, and environmental factors predicted QoL at 9-years, including social-emotional behaviours measured using the Strengths & Difficulties Questionnaire (SDQ) at 4 and 7-years.

Outcome & Results: Children with DLD (n=70) had lower parent-reported QoL at 9-years than typically developing children (n=802), mean scores of 74.9 and 83.9 respectively. There was no evidence of differences in QoL between those with severe (n=14) or mild-moderate (n=56) DLD. In contrast to their peers, children with DLD had a profile of declining QoL between 4 and 9-years. For all children, language skills at 7-years predicted QoL at 9-years. For children

with DLD, emotional symptoms and peer problems at 4-years, plus SDQ Total Difficulties at 7-years were predictive of lower QoL at 9-years.

Conclusions & Implications: Children with DLD had lower QoL than their typical peers at 9-years and, contrary to previous studies, differences in QoL were not observed with DLD severity. Co-occurring social-emotional problems appear to play an important role in contributing to the lower QoL experienced by children with DLD. Consideration of associated functional limitations is required to support the communication and social development of all young children with DLD.

What this paper adds:

What is already known? Biopsychosocial models of disability can account for both the extent of language impairment, as well as the associated functional limitations such as wellbeing and quality of life (QoL). However, more is known about these functional limitations in children with physical or developmental disability than developmental language disorder (DLD). The limited research conducted with children with DLD consistently reports lower QoL than their typically developing peers. The factors which contribute to functional limitations, including lower QoL, for children with DLD are not well understood.

What this study adds? Children with DLD had lower parent ratings of QoL than their typically developing peers at 9-years, and showed declining QoL from 4 to 9-years. In contrast to other studies, differences in QoL were not evident between children with more severe DLD and those with mild-moderate DLD. Co-occurring social-emotional problems are important factors influencing later QoL for children with DLD, with emotional symptoms and peer problems at 4-years and overall social-emotional difficulties at 7-years being significantly related to lower QoL at 9-years.

Clinical Implications. Speech therapy services need to focus on both the remediation of the language impairment and the functional limitations that children with DLD, regardless of severity, are experiencing in relation to QoL. Future work needs to focus on measurement and monitoring of functional limitations in children with DLD. Prioritising measurement of the functional impact of DLD in assessments, including QoL, will enable continued investigation of communicative functioning from a biopsychosocial perspective.

Developmental Language Disorder (DLD) refers to a range of language problems that can be diagnosed in the preschool years and persist into adolescence and adulthood (Clegg et al., 2005; Johnson, Beitchman, & Brownlie, 2010). DLD is one of the most common developmental concerns in children, with prevalence rates varying with age and definition but usually estimated as affecting around 8% of primary-school aged children (Norbury et al., 2016). Recent definitions of DLD refer to the significant impact the disorder has on social interactions and educational progress (Bishop et al., 2016). This is based on many studies demonstrating that children with DLD are at increased risk of poorer outcomes in their academic, social, and emotional development (Bretherton et al., 2013; Clegg et al., 2005; Arkkila et al., 2008; Tomblin, Zhang, Buckwalter, & Catts, 2000). A number of these outcomes are now more commonly referred to as functional limitations (Bishop et al., 2016). With high prevalence and life-long consequences, it is critical that health and education professionals understand the nature of DLD and related aspects of the child's wellbeing and quality of life (QoL). Definitions of disability which take account of the extent of the impairment, as well as an individual's functional limitations, resonate with recommendations to focus on functioning in everyday life rather than on diagnostic cut-points.

Bio-psychosocial Model of Disability

The World Health Organisation (WHO) defines health as 'a state of complete physical, mental, and social wellbeing and not merely the absence of disease' (World Health Organisation, 2007). This implicates a bio-psychosocial model of disability where a person's health and wellbeing are the result of how biology (e.g. an impairment) interacts with their ability to perform everyday activities (i.e. whether their participation or activity is limited or restricted), both of which are influenced by personal and environmental factors. Implicit in this framework is a need to focus equally on an individual's impairment and functional limitations in everyday life events. Furthermore, the WHO definition implies a shift in emphasis of interventions to

include a greater focus on the functional consequences of impairment. In order to develop these interventions, we must understand the nature of the functional limitations and the factors which predict them. However, we do not currently have a comprehensive picture of how language abilities are associated with children's QoL in general, or the associated factors that influence QoL for children with DLD.

The WHO framework provides a way of conceptualising health and wellbeing from a functional perspective. QoL is one construct by which to measure an individual or proxy's perspective on their wellbeing. QoL can be defined as an individual's perception of their physical, psychological and social wellbeing (Markham, van Laar, Gibbard, & Dean, 2009). Measures of QoL are multidimensional and focus on physical functioning, participation, health, and wellbeing, and allow for comparison of functioning across different health conditions, populations, and interventions (Cieza & Stucki, 2005). There are a limited number of measures of paediatric QoL and most rely on parents reporting their perceptions of the child's QoL. The measurement tools available clearly impact on our understanding of and ability to consider QoL limitations in service planning. QoL has been explored in many child populations, including those with chronic health conditions (Varni et al 2003) and cerebral palsy (Varni et al 2005). To date, there has been insufficient consideration of how to best objectively measure functional limitations within the overall picture of childhood language assessment and diagnosis. A recent scoping review concluded that there was currently a lack of tools for measuring functional limitations in the paediatric speech and language field (Cunningham, Washington, Binns, Rolfe, Robertson & Rosenbaum 2017). Furthermore, we are not aware of any studies that have quantified the contribution of language abilities across the developmental spectrum to QoL in children more generally.

Quality of Life in Children with Developmental Language Disorders

Studies focused on QoL in children with communication impairments, ranging in age from birth to 18-years, consistently find negative impacts on social functioning, for example, difficulties getting along with others (Feeney, Desha, Ziviani, & Nicholson, 2012), as well as difficulties in psychosocial wellbeing and school functioning (Hubert-Dibon et al., 2016; McKean et al., 2017). Interpersonal relations, participation in school and play activities, learning, socialising, and behaviour were all identified as areas of concern by parents and clinicians describing children's (2 to 5-years) wellbeing in open-ended survey questions before starting therapy (n=210) (Thomas-Stonell, Oddson, Robertson, & Rosenbaum, 2009). In a study of 29 children with specific language impairment (SLI), aged between 8 and 12-years, Sylvestre et al (2016) concluded that the children's social participation, measured by parent-report of life habits, was impaired and that there was evidence that parental stress can mediate the extent of the social participation difficulties.

Markham et al (2009) used qualitative methodology to determine the QoL of children with DLD from 6 to 18-years. The themes that emerged focussed on difficulties with relationships, emotions, achievement, independence and support, all of which impacted on overall wellbeing and QoL. More recently, Nicola and Watter (2015) used the PedsQL to explore QoL in a sample of 41 children with severe SLI aged 5 to 18-years. They compared parent and child ratings of QoL and found no significant differences between the two raters, except for social functioning where the children rated themselves higher than their parents. Overall, the PedsQL Total Summary Score and the subscales of social functioning (parent and child ratings) and physical functioning skills (child ratings) were lower in this group than would be expected from population means. The PedsQL has been used successfully in this and other studies to describe the QoL profiles of children with DLD (McKean et al., 2017).

In summary, studies have used different methods, measurement tools, and raters (i.e., self or parent-report) to determine QoL in children with DLD. In the only systematic review to

consider measurement of QoL in children with speech and/or language difficulties, aged from birth to 18-years, Gomersall et al (2015) concluded that there had not been a consistent or systematic approach to capture QoL in this group, as no DLD specific measurement exists. Studies had predominantly used generic, rather than disorder specific measures, with variability in the domains reported. Follow-up into adulthood of children with DLD has demonstrated inconsistent findings related to QoL and mental health, with some studies reporting no ongoing difficulties (Johnson et al 2010) and others finding significant long-term concerns (Schoon, Parsons, Rush & Law, 2010). Furthermore, there has been no report of repeated measures of QoL in a group of children where concurrent language and social-emotional behavioural assessment has occurred from preschool through to primary school years.

Predicting Quality of Life in Children with Developmental Language Disorder

We know that child (e.g., gender, general health), family (e.g., maternal education and mental health), and environmental factors (e.g., socio-economic status, parents' engagement in work) contribute to both language and social-emotional development (Bayer et al. 2012; Reilly et al. 2010) and children's QoL when parents have concerns regarding their child's speech and language development (Feeney, Desha, Khan & Ziviani, 2017). Children also need adequate language skills to develop their social relationships, to engage with school learning, and to learn how to manage and self-regulate their behaviour (Snowling, Duff, Nash, & Hulme 2016; Conti-Ramsden, Mok, Pickles, & Durkin, 2013). Together, these skills contribute to children's ability to participate fully in daily life. Clinical and population based studies have demonstrated that children with DLD are at risk of life-long behavioural and social-emotional problems (Conti-Ramsden et al, 2013; Law, Rush, Schoon, & Parsons, 2009; Bretherton et al 2013). Despite this, it is currently unclear whether language difficulties in the presence of emerging social-emotional behavioural difficulties also contribute to the lower QoL reported for children with DLD. This information could inform interventions for children with DLD by helping

explain the perceived impact that restrictions have on achieving adequate levels of functioning in everyday life.

Following a biopsychosocial model, we investigated the following research questions:

1. i) Do children with DLD experience limitations in parent-reported QoL compared to their typically developing peers?
ii) At what age do parent perceptions of lower quality of life emerge and does severity of the DLD contribute to lower quality of life?
2. What contribution do language skills, across the full range of abilities, make to parent-reported quality of life, accounting for variables known to influence language development?
3. Finally, to what degree do vulnerabilities in socio-emotional behavioural skills in children with DLD contribute to parent-reported quality of life, accounting for variables known to influence language development?

Method

Background to the Early Language in Victoria Study

This study draws on data collected as part of the Early Language in Victoria Study (ELVS), a longitudinal study following the language, social, communication, and early literacy development of a large community sample of children from Melbourne, Australia, a city of approximately 4 million people. ELVS commenced in 2002, recruiting 1910 infants aged between 7.5 and 10-months. The children were selected from six local government areas (LGAs) from metropolitan Melbourne based on rankings from the Australian census-based Socioeconomic Indices for Areas (SEIFA) for Relative Socioeconomic Disadvantage (Australian Bureau of Statistics, 2001).

Infants from these LGAs were recruited through the Victorian Maternal and Child Health Nurse Service, a universal nursing service for families with children 0 to 6-years, and supplemented by recruitment from the 7 to 9-month hearing screening program and local newspaper advertising. The original recruitment for ELVS excluded children with serious disability or developmental delay at birth (e.g., Down Syndrome, hearing impairment). The recruitment process is further detailed by Reilly et al. (2010). Data were collected annually by questionnaire from 1 to 9-years, as well as face-to-face assessments at age 4, 5 and 7-years.

Participants

Participants in the present analysis were drawn from the ELVS cohort when the children were 9-years. The sample comprises all of the children from the original cohort who completed the Clinical Evaluation of Language Fundamentals – Preschool, 2nd edition (CELF P2) (Wiig, Secord, & Semel, 2006) at 4-years, Clinical Evaluation of Language Fundamentals – 4th edition (CELF 4) (Semel, Wiig, & Secord, 2006) at 7-years, and the Pediatric Quality of Life Inventory, Parent-Proxy Report (PedsQL) 4.0; (Varni, Burwinkle, Seid, & Skarr, 2003) at 4, 7, and 9-years. Children whose parents reported that their child had been diagnosed with autism or developmental delay, were excluded from this sample. Information was collected about each child's demographics and general health and development, including gender, caregiver education, family history of speech and language problems, and socio-economic disadvantage when they were first recruited to the study prior to their first birthday.

Measures

All measures included in the present analyses were collected as part of the larger ELVS study; no additional data were collected.

Language measures. The Australian adaptations of the CELF-P2 (Wiig et al., 2006) and CELF-4 (Semel et al., 2006) were used to assess language ability at 4 and 7-years, respectively. The CELF assessments measure receptive and expressive language, yielding a standardised

receptive, expressive and composite or core language score, with a mean of 100 and standard deviation (SD) of 15.

Social-Emotional Measure. The social-emotional behavioural adjustment of children was characterised using the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997), completed by parents when the children were aged 4 and 7-years. The SDQ is a 25-item behavioural screen for children aged 3 to 16-years. It comprises five scales: emotional symptoms, conduct problems, inattention/hyperactivity, peer problems and prosocial behaviour. A Total Difficulties score can be generated from the first four of these scales. The Total Difficulties score and the subscale scores at 4 and 7-years are reported.

Associated Factors. We included factors in the predictive analyses known to influence language outcomes that were representative of child (e.g., gender and cognitive abilities), family (e.g., maternal education and vocabulary) and environmental (e.g., socio-economic status) characteristics. This data was collected through annual questionnaires designed specifically for the ELVS study. The matrices subtest of the Kaufman Brief Intelligence Test, 2nd edition (K-BIT2; Kaufman & Kaufman, 1990), administered at 4-years, and the block design and matrices subtests of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) administered at 7-years, provided estimates of the non-verbal cognitive abilities of participants. Maternal vocabulary was measured using the multiple-choice version of the 44 item Mill Hill Vocabulary Scale (Raven, 1997). Socio-economic disadvantage was measured using the Australian Bureau of Statistics SEIFA index of relative social disadvantage (Australian Bureau of Statistics, 2001), with lower SEIFA scores representing greater disadvantage.

Outcome measure. Health related QoL was measured using the parent-report PedsQL when children were 4, 7, and 9-years. This is a validated 23-item measure with US norms for

children aged 2 to 18-years. It incorporates standardised scales for physical, emotional, social and school functioning, as well as a Total score used here as the primary outcome.

Procedures

Data were drawn from several waves of ELVS, including: demographic data and general health information collected at baseline (8 months); parent-report SDQ questionnaires at 4 and 7-years; parent-report PedsQL at 4, 7, and 9-years; and face-to-face CELF assessments at 4 and 7-years. Questionnaires developed specifically for ELVS (Reilly, Cook, Bavin, Bretherton, Cahir, Eadie, . . . Wake, 2017) were sent to parents within a month of their child's birthday each year. The face-to-face assessments were administered individually to each child by an experienced trained researcher, usually in a single sitting at the child's local health centre, school or home.

Defining Developmental Language Disorder. In order to identify children with persisting language difficulties standard scores equal to or lower than 81 (i.e., more than 1.25 SD below the mean) on the CELF receptive and/or expressive scales at both 4 and 7-years defined the DLD group. Standard scores higher than 81 (i.e., less than 1.25 SD below the mean) at either or both 4 and 7-years, defined the typically developing (TD) group. This meant that some children who may have fallen into the DLD category at *only one* time-point were categorised as TD. This meant that the children in the DLD group had a persistent problem, and ensured our comparative analyses would be conservative estimates. The 1.25 SD cut-point was adopted to be consistent with previous epidemiological and longitudinal studies, as well as other analyses of ELVS data (Reilly et al., 2010; Tomblin et al., 1997).

To examine the effect of the severity of DLD on the outcome measures, the children with DLD were divided into two groups. Those with standard scores equal to or lower than 70 (i.e., more than 2 SD below the mean) on the CELF receptive and/or expressive language scales at 7-years were classified as having severe DLD, while those with standard scores between 71 and 81

(i.e., between 1.25 and 2 SD below the mean) at 7-years were classified as having mild to moderate DLD.

Health Related Quality of Life. Each of the subscale scores and the total score of the PedsQL were used to compare QoL between DLD and TD groups, as well as to examine differences between mild-moderate and severe DLD groups. While the authors have published clinical cut-points (Varni et al 2003) we were interested in exploring the full range of QoL scores in our cohort rather than identifying a clinically at-risk group.

Analysis

To address our first research question, to investigate the association between DLD, identified at 4 and persisting at 7-years, and QoL over 4, 7 and 9-years; and to compare QoL for children whose DLD was mild-moderate and severe at 7-years, we summarised the PedsQL scores using descriptive statistics (mean and standard deviations). As the PedsQL measure does not follow a normal distribution because of potential ceiling effects, we completed non-parametric and parametric analyses. The same pattern of results was found, most likely due to the large sample size (Lumley, Diehr, Emerson, & Chen 2002), consequently, parametric analyses are reported here. Means for the total score and subscales were compared between DLD and TD groups, and between mild-moderate and severe DLD groups using independent t-tests at 4, 7 and 9-years. Despite multiple comparisons resulting from these analyses a formal correction for multiple testing (such as the Bonferroni method) was not undertaken as this can be too conservative, increasing the chances of type II errors (Perneger, 1998). Instead p values were interpreted cautiously and we took an exploratory approach to look for common patterns and consistency across the Peds-QL, rather than focussing on isolated statistically significant findings which may be due to chance.

Regression models were used to investigate the associations between language ability and QoL taking account of factors known to influence language development (research question 2).

Initially, we looked at associations between the full range of language abilities and quality of life, unadjusted and accounting for *a priori* child, family and environmental confounders known to influence language development (e.g., gender, non-verbal cognitive ability, maternal vocabulary and SEIFA). The continuous core language score at 7-years was used in these regression analyses, as this was the closest time-point to the QoL outcome at 9-years and the age at which language scores had been used to determine severity of DLD in the previous analyses. Secondly, only variables associated with the outcome at the 10% level ($p < 0.1$) were included in the model of best fit. The variability explained by each of these models was reported as R^2 .

A similar series of regression models explored how social-emotional factors at 4 and 7-years contributed to QoL at 9-years in children with DLD (research question 3). Within the children with DLD, associations were estimated between individual SDQ subscale scores (i.e., emotional symptoms, conduct problems, peer problems, hyperactivity/inattention,) at 4-years and Total Difficulties score at 7-years and the QoL outcome. Adjusted regression models then accounted for *a priori* confounder variables and all concurrent SDQ subscale or Total Difficulties scores together. Finally, only variables associated with the outcome at the 10% level ($p < 0.1$) in either the 4 or 7-year-old adjusted models were included together in the model of best fit.

Results

Of the 872 participants, 70 children (8%) were persistently language disordered (DLD) *at both* 4 and 7-years, that is, they had expressive and/or receptive language scores which were consistently more than 1.25 SD below the mean. Eighty percent of the DLD group were classified as having mild-moderate difficulties, that is, their language scores were between 1.25 and 2 SD below the mean. The remaining 20% ($n=14$) had severe language difficulties, with scores more than 2SD below the mean.

Table 1 presents participant characteristics according to the classification of DLD. There were more boys (60%) than girls in the DLD group. All remaining children (n=802) were classified as TD. This included some children (6-8%) who were characterised as having low language at one *but not* both time points. The DLD group had a lower mean SEIFA score, lower levels of caregiver educational attainment and maternal vocabulary than the TD group. The DLD group were more likely to report a family history of speech and language difficulties than the TD group. All of these differences were statistically significant. The DLD group had significantly lower non-verbal cognition scores at both time points compared to the TD group. They also had higher mean scores on the SDQ Total Difficulties, Conduct Problems, Hyperactivity/Inattention, Emotional Symptoms and Peer Problems subscales at 4-years. By 7-years, significant differences between the DLD and TD groups were evident for the Total Difficulties, Conduct Problems, and Hyperactivity/Inattention subscales (see table 1). There were no differences detected between the groups on Prosocial scores at either timepoint. SDQ Total Difficulties and scale scores at both time points were within normal limits for both DLD and TD groups.

Insert table 1

PedsQL profiles of children with and without DLD. The PedsQL scores at 4 and 7-years were similar for the DLD and TD groups, with the exception of school functioning, where scores were significantly lower for the DLD group (see table 2). By 9 years, the PedsQL total score and all subscale scores, differed significantly between the groups. Mean QoL scores for the DLD group declined at each age, such that 9-year mean scores were lower than 7-year mean scores, which were lower than 4-year mean scores. In contrast, mean QoL scores were similar for the TD group across all three timepoints.

Insert table 2

PedsQL profiles of children with mild-moderate and severe DLD. Children with severe versus mild-moderate DLD had similar PedsQL subscale and total scores at all ages, with one exception; children with severe DLD scored significantly lower on the PedsQL School Functioning scale at 9-years. These scores are summarised in table 3.

Insert table 3

Predicting Quality of Life Outcomes at 9 years: Language Skills. Language skills at 7-years were significantly positively associated with the total PedsQL score at 9-years for all children in the cohort, albeit explaining only 4% of the variability in parent ratings. PedsQL scores increased by 0.21 for every unit increase in language standard scores (95% CI 0.13, 0.26 $p<0.001$). In contrast, the variables identified *a priori* as potential confounders, gender, maternal vocabulary, non-verbal cognitive skills, and socio-economic status, did not contribute significantly to ratings of QoL (see table 4).

Insert table 4

Predicting Quality of Life Outcomes in Children with DLD at 9 years: Social-Emotional Factors. A correlation matrix examined univariate associations between 4 and 7-year language scores, SDQ subscale scores at 4 and 7-years and QoL at 9-years in children with DLD. Correlation coefficients are provided in table 5. At 7-years SDQ subscale scores were significantly correlated with each other, so regression modelling was applied to each age separately to avoid confounding results due to collinearity at 7-years. Correlations between receptive language and PedsQL at both ages and expressive language at 7-years were non-significant; expressive language at 4-years and the PedsQL were significantly correlated, albeit with a small co-efficient ($r=0.29$; $p\leq.05$).

Insert table 5

For children with DLD, the total PedsQL score at 9-years was significantly associated with the emotional symptoms, hyperactivity/inattention, and peer problems scales of the SDQ at 4-years

in the unadjusted linear regression models. In addition, the SDQ Total Difficulties score at 7-years was associated with the total PedsQL score at 9-years. Most coefficients were negative suggesting that higher SDQ scores were associated with lower QoL scores.

Regression models adjusting for variables identified *a priori* as potential confounders (gender, maternal vocabulary, and socio-economic disadvantage) were run with SDQ subscale scores from 4-years (table 6, model 1). Those reaching a significance value of $p=0.1$ were included in the final model (table 6, model 2) (gender, emotional symptoms and peer problems at 4-years). This model explained 23% (R^2) of the variability in QoL ratings at 9-years. For every unit higher in emotional symptoms or peer problems scores at 4-years, PedsQL scores were 2.55 and 2.23 points lower respectively (95% CI -4.43, -0.67 $p=0.009$, and -4.64, 0.19 $p=0.07$). At 7-years the SDQ Total Difficulties score explained 24% (R^2) of the variability in parent reported QoL at 9-years. For every unit higher in SDQ Total Difficulties score at 7-years, PedsQL scores were 1.25 points lower (95% CI -1.79, -0.71, $p<0.001$).

Insert table 6

Discussion

This study examined data from a large cohort of Australian children to investigate the association between language abilities and parent-reported QoL, as well as exploring DLD severity, socio-emotional behaviour, and parent reported QoL during their preschool and middle primary school years. Children with and without DLD in this study did not differ across PedsQL total and scale scores at 4 and 7-years, except in school functioning. However, by 9-years, differences were evident between DLD and TD children in their PedsQL total and all scale scores. Consistent with previous research (Markham et al., 2009; Nicola & Watter, 2015), children with DLD demonstrated lower quality of life at 9-years than their peers, demonstrating that parents perceived challenges that impacted on their child's QoL that reached beyond their

language disorder. We found that for the whole cohort of children, language skills at 7-years were an important determinant of QoL at 9-years.

Children with DLD in this sample had declining quality of life from 4 to 9-years and to the best of our knowledge this is the first study to report repeated and concurrent language and QoL measurements in children across this transition to schooling period. As a group, children with DLD in our sample had mean PedsQL scores that were lower than the only other sample of children with severe DLD (referred to as SLI) reported in Nicola & Watter (2015), with the exception of school functioning scores at 9-years. It is important to note that the point of reference for 'at risk' health related QoL is children with both chronic and severe health conditions (Varni et al 2003) and we specifically excluded children with known co-occurring biomedical conditions such as autism from these analyses. The QoL results for the ELVS sample may reflect our community ascertained cohort, where there is expected to be less children with severe language disorder when compared to clinical samples. In addition, other studies (Snowling et al 2016) have identified a later emerging group of children with DLD, that our conservative selection criteria (i.e., low language scores at both 4 and 7-years) may have missed.

While previous longitudinal studies have reported poor long-term outcomes for children with DLD in terms of mental health and social wellbeing (e.g. Clegg et al, 2005; Arkkila et al., 2008), few have used measures of QoL as a specific outcome measure. The present study found significant differences between the DLD and TD groups across all PedsQL domains examined, including physical functioning, where language difficulties are not always perceived as contributing to QoL ratings. This finding is a replication of Nicola & Watter's (2015) child-reported QoL data, and broadens our understanding of the impact of DLD from a biopsychosocial perspective. More severe DLD symptoms have been linked to increased behavioural problems (Tomblin et al, 2000), psychiatric problems (Beitchman et al, 1996) and

social problems (Durkin & Conti-Ramsden, 2007). Given the evidence linking these factors to poor long term outcomes for adolescents with DLD, it has been suggested that the severity of the disorder may play a role in the social participation and QoL of children with DLD (Arkkila et al, 2008). Importantly, however, this association was not evident in our analyses. The QoL scores of children with mild-moderate and severe DLD were not significantly different, except for the school functioning domain of the PedsQL. Given that this domain reflects parent report of child attention, memory, and completion of school work, it is perhaps not surprising that it alone detected differences based on severity of DLD symptoms. It is also important to note that while the overall DLD group comprised 70 children, only 14 (20%) had standard scores more than 2SD below the mean. Nicola & Watter (2015) found lower QoL scores using the same measure with a larger clinically defined group of children with SLI. Clearly replication with a larger group of children with severe DLD would strengthen these preliminary findings and allow for further examination of the predictive association between social-emotional behaviours and QoL.

The SDQ Prosocial scores of the children with and without DLD were equivalent at both 4 and 7-years, indicating no differences in capacity to share and help others, and consider others feelings. This is a positive finding amongst other more challenging differences in the social-emotional domain, for example peer and conduct problems, and hyperactivity. As expected from previous studies, children with DLD had more social-emotional behavioural difficulties than the typical language learners. SDQ emotional symptoms and peer problems at 4-years together with gender and SDQ Total Difficulties at 7-years were important predictors of QoL at 9-years, these models explained approximately a quarter of all the variability in QoL ratings. The modest associations found between the different factors and outcome measures suggest that other variables that we did not take account of in our regression models influence QoL. More detailed analysis of complex risk factor models may provide a better understanding of

impacts of social-emotional behaviour, family and environmental factors on the QoL of children with DLD over time (Feeney et al., 2017). For example, we recommend future studies examine modalities of DLD which are known to vary in response to intervention (e.g. expressive vs. receptive) and a more comprehensive set of child, family and environmental factors, including how protective factors, such as family support, home learning environments, and good peer relationships modify impacts of DLD on QoL.

Peer problems at 4-years had a significant impact on QoL at 9-years for the participants in this study. This is not surprising given a large body of evidence linking DLD with poor peer relationships and social difficulties (e.g. Bretherton, 2013; St Clair et al., 2011; Durkin & Conti-Ramsden, 2007). It is possible that the different social-emotional behaviours have a changing influence on QoL over time, reflecting also the developmental trajectory of behavioural difficulties. Previous studies have found that children with DLD, moving into adolescence, demonstrate an increase in social problems (St Clair et al, 2011). Importantly, changes in the behavioural profile of children and developmental trajectories may differentially impact the effect of DLD as children take on different social roles as they get older. Continued monitoring of this cohort would enable examination of trajectories of QoL across transition from primary to secondary school and into adolescence.

A major strength of our study was the use of a large, longitudinal, community sample with prospective, repeated measurements allowing for analysis of the developmental history of children with and without DLD from infancy. There has been recent discussion amongst researchers regarding the importance of obtaining children's own views on their QoL, to gain an accurate self-report of impacts of DLD. Our study relied on parent report only, though as the ELVS children get older they should be able to complete the self-report version of the PedsQL to address this limitation, as Nicola & Watter (2015) achieved with children with severe SLI.

Conclusions

Developmental language disorders are complex and have important ramifications on children's QoL from a very young age. Social-emotional behaviour plays a significant role in predicting QoL outcomes for children with DLD, though this relationship is still not completely understood. Children in this study had lower QoL by 9-years than typically developing children, though these differences were not observed between children with more severe DLD and those with milder symptoms. Decisions regarding provision of intervention services should take this finding into account. All children with DLD, who also have social-emotional difficulties, may benefit from language and social skills interventions, which in turn, may help improve their QoL as they progress through primary school. Interventions need to be tailored to family resources and the role they may play in improving children's overall wellbeing and QoL. The finding that QoL declines from 4 to 9-years, in combination with the lower QoL experienced even by children with mild to moderate DLD, highlights the need for including these young children with less severe impairments in these intervention strategies. Furthermore, monitoring children's QoL over time for later emerging difficulties is clearly warranted. Prioritising measurement of the impact of DLD, including associated perceptions of children's QoL, will enable continued investigation of communicative functioning from a biopsychosocial perspective across multiple domains.

Acknowledgments:

The ELVS study was supported by the Australian National Health & Medical Research Council (NHMRC) Project Grants 237106, 9436958 and 1041947. Dr Mensah was supported by an NHMRC Early Career (1037449) and Career Development Fellowship (1111160), and Professor Reilly by a NHMRC Practitioner Fellowship (491210). Dr McKean's postdoctoral position was funded by NHMRC Centre for Research Excellence Grant 1023493. Ms Conway was supported by an Australian Postgraduate Award. Research at the Murdoch Children's Research Institute is supported by the Victorian Government's Operational Infrastructure Support Program. The authors sincerely thank all the children and parents participating in ELVS.

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Table 1: Participant characteristics and CELF and SDQ scores at 4 and 7 years by language status

	Typically Developing Language (n=802)		DLD ^a (n=70)	
Female gender, N (%) [*]	424 (52.80)		28 (40.00)	
Caregiver's education, N (%) [*]				
Year 10 or less	38 (4.78)		10 (14.49)	
Year 11	102 (12.83)		17 (24.64)	
Year 12	300 (37.74)		26 (37.68)	
Degree/post grad	355 (44.65)		16 (23.19)	
Maternal vocabulary ¹ M(SD) [*]	28.69 (4.36)		26.46 (4.86)	
Family history ² N (%) [*]	204 (25.44)		27 (38.57)	
SEIFA disadvantage, M(SD) [*]	1047.40 (51.00)		1022.64 (61.58)	
	Typically Developing Language (n=802)		DLD ^a (n=70)	
	Age 4	Age 7	Age 4	Age 7
Core Language ³ M(SD) [*]	104.57(11.76)	100.57 (10.46)	79.19 (8.64)	75.44(12.47)
Nonverbal Cognition ⁴ M(SD) [*]	107.21 (11.35)	106.41 (14.52)	90.87 (16.01)	92.65 (10.72)
SDQ Subscale Scores M(SD)				
Emotional Symptoms [#]	1.38 (1.51)	1.50 (1.72)	1.95 (2.04)	1.79 (2.02)
Conduct Problems ^{#†}	1.52 (1.46)	1.28 (1.41)	2.24 (1.58)	1.89 (1.84)
Hyperactivity/Inattention ^{#†}	3.19 (2.16)	2.78 (2.22)	4.54 (2.63)	4.26 (2.97)
Peer Problems [#]	1.28 (1.45)	0.83 (1.16)	1.77 (1.59)	1.14 (1.33)
Prosocial Skills	7.44 (1.80)	8.38 (1.62)	7.14 (1.64)	8.13 (1.80)
SDQ Total Difficulties M(SD) ^{#†}	7.38 (4.30)	6.39 (4.47)	10.51 (5.53)	9.07 (6.33)

^a DLD was identified at 4-years and persisting at 7-years with scores more than 1.25 SD below the mean at both time-points

¹Maternal Vocabulary measured by the Mill Hill

²Self-reported history of speech and/or language difficulties

³CELF P2 at 4 years and CELF 4 at 7 years

⁴K-BIT at 4 years and WASI at 7 years

* differences significant at $p < 0.001$ level

between group differences at 4 years significant at $p < 0.01$ level

† between group differences at 7 years significant at $p < 0.05$ level

Table 2: PedsQL at 4, 7 & 9 years, for children with typical language and those with DLD¹.

	4 years		7 years		9 years	
	Typical ²	DLD	Typical	DLD	Typical	DLD
PedsQL Scores M(SD)						
Physical Functioning	87.66 (9.57)	86.13 (12.72)	88.77 (10.12)	86.85 (14.34)	88.63 (13.52)*	79.53 (24.58)*
Emotional Functioning	75.89 (14.12)	74.85 (17.12)	75.46 (14.65)	75.79 (18.98)	73.85 (15.72)*	67.23 (21.0)*
Social Functioning	88.70 (11.34)	86.08 (14.51)	87.55 (13.38)	84.21 (15.29)	87.24 (13.94)*	79.43 (18.56)*
School Functioning	93.41 (10.86)*	87.00 (15.45)*	83.83 (13.29)*	74.46 (19.0)*	83.07 (14.51)*	70.71 (19.17)*
Psychosocial Health Score	84.27 (9.69)	81.52 (13.21)	82.27 (11.02)	78.18 (14.20)	81.38 (12.30)*	72.47 (14.87)*
Total Score	85.64 (8.34)	83.40 (11.51)	84.56 (9.38)	81.20 (12.51)	83.89 (11.39)*	74.92 (16.17)*

¹ DLD was identified at 4-years and persisting at 7-years with scores more than 1.25 SD below the mean at both time-points

² total number of children in typical group is 802 and in DLD group is 70

* differences between typical and DLD at the same age point were significant at $p < 0.05$ level

Table 3: PedsQL at 4, 7 & 9 years, for children with Mild-Moderate and Severe DLD¹.

PedsQL Scores M(SD)	4 years		7 years		9 years	
	Mild-Moderate DLD ²	Severe DLD	Mild-Moderate DLD	Severe DLD	Mild-Moderate DLD	Severe DLD
Physical Functioning	85.47 (13.31)	88.28 (10.67)	86.17 (15.23)	88.97(11.27)	80.05 (23.14)	77.94 (29.37)
Emotional Functioning	75.29 (18.24)	73.44 (13.26)	77.39 (18.28)	70.81 (20.79)	68.58 (21.04)	63.01 (20.09)
Social Functioning	86.61 (15.14)	84.38 (12.50)	83.49 (16.04)	86.47 (12.84)	80.09 (18.85)	77.35 (18.04)
School Functioning	87.94 (16.06)	84.03(13.51)	77.13 (18.43)	65.94 (18.82)	73.87 (19.89)*	60.88 (12.78)*
Psychosocial Health Score	82.00 (14.13)	79.96 (9.90)	79.40 (14.32)	74.40 (13.52)	74.20(15.45)	67.08 (11.71)
Total Score	83.41 (12.49)	83.38 (7.84)	81.77 (12.88)	79.43 (11.47)	76.22 (16.48)	70.88 (14.87)

¹ DLD was identified at 4-years and persisting at 7-years with scores more than 1.25 SD below the mean at both time-points

²total number of children in mild-moderate DLD group is 56 and in severe DLD group is 14

* differences between mild-moderate and severe DLD at the same age point were significant at $p < 0.05$ level

Table 4: Predictors of Quality of Life at 9 years across all participants (n=872)

	Model 1: $R^2 = 0.044$			Model 2: $R^2 = 0.042$		
	Coefficient	95% CI	<i>p</i>	Coefficient	95% CI	<i>p</i>
Gender	-0.010	-1.84, 1.34	0.76			
Maternal Vocabulary ¹	0.040	-0.75, 0.29	0.25			
SEIFA ²	-0.008	-0.2, 0.01	0.81			
WASI Non-Verbal Cognition	-0.013	-0.06, 0.08	0.71			
CELF-4 Core Language	0.192	0.11, 0.25	0.000	0.21	0.13, 0.26	0.000

Model 1: adjusted for gender, maternal vocabulary, SEIFA, non-verbal cognition

Model 2: adjusted for variables meeting 10% association level in model 1

¹Maternal Vocabulary measured by the Mill Hill

²SEIFA measured by Australian Bureau of Statistics Index of Disadvantage

Table 5: Correlation matrix (Pearson's product moment coefficient) of exposure and outcome variables for children with persistent low language (n=70)

	1:	2:	3:	4:	5:	6:	7:	8:	9:	10:	11:	12:	13:	14:	15:
1. SDQ 4yr Emotional Symptoms	1														
2. SDQ 4yr Conduct Problems	0.187	1													
3. SDQ 4yr Hyperactivity	0.232*	0.65**	1												
4. SDQ 4yr Peer Problems	0.41**	0.159	0.227	1											
5. SDQ 4yr Total Difficulties	0.65**	0.71**	0.81**	0.59**	1										
6. SDQ 7yr Emotional Symptoms	0.69**	0.247*	0.30**	0.34**	0.57**	1									
7. SDQ 7yr Conduct Problems	0.35**	0.65**	0.56**	0.278*	0.66**	0.52**	1								
8. SDQ 7yr Hyperactivity	0.24*	0.63**	0.73**	0.203	0.67**	0.41**	0.72**	1							
9. SDQ 7yr Peer Problems	0.29*	0.129	0.085	0.40**	0.302*	0.28*	0.36**	0.243*	1						
10. SDQ 7yr Total Difficulties	0.50**	0.59**	0.62**	0.37**	0.75**	0.72**	0.87**	0.86**	0.51**	1					
11. 9yr PedsQL Total score	-0.41**	-0.208	-0.23*	-0.34**	-0.42**	-0.50**	-0.43**	-0.29*	-0.28*	-0.48**	1				
12. 4yr Receptive Language	-0.002	0.01	-0.15	-0.07	-0.09	0.08	-0.03	-0.16	-0.09	-0.08	0.17	1			
13: 4yr Expressive Language	-0.09	0.18	-0.13	-0.17	-0.09	0.11	0.13	-0.07	-0.17	0.002	0.29*	0.44*	1		
14: 7yr Receptive Language	-0.1	-0.28	-0.23	-0.13	-0.27	-0.04	-0.17	-0.28*	-0.1	-0.21	0.09	0.4**	0.06	1	
15: 7yr Expressive Language	-0.15	-0.09	-0.27	-0.28	-0.29	-0.14	-0.2	-0.32*	-0.22	0.3*	0.2	0.44**	0.47**	0.42*	1

* $p \leq .05$; ** $p \leq .01$

Table 6: Association between socio-emotional behaviour at 4 and 7 years and QoL at 9 years in participants with DLD (n=70)

Model 1: 4 year SDQ subscales $R^2 = 0.28$				Model 2: 4 year SDQ subscales $R^2 = 0.23$		
	Coefficient	95% CI	<i>p</i>	Coefficient	95% CI	<i>p</i>
Gender	-6.02	-13.43, 1.39	0.109	-4.95	-12.04, 2.14	0.168
Maternal Vocabulary ¹	-0.29	-1.02, 0.44	0.43			
SEIFA ²	0.01	-0.05, 0.06	0.848			
SDQ ³ emotional symptoms	-2.36	-4.30, -0.42	0.018	-2.55	-4.43, -0.67	0.009
SDQ conduct problems	-0.64	-3.63, 2.36	0.673			
SDQ hyperactivity	-0.69	-2.55, 1.17	0.461			
SDQ peer problems	-1.99	-4.45, 0.47	0.11	-2.23	-4.64, 0.19	0.070
Model 1: 7 year SDQ Total Difficulties $R^2 = 0.28$				Model 2: 7 year SDQ Total Difficulties $R^2 = 0.24$		
	Coefficient	95% CI	<i>p</i>	Coefficient	95% CI	<i>p</i>
Gender	-4.66	-11.65, 2.33	0.188			
Maternal Vocabulary ¹	-0.24	-0.95, 0.47	0.506			
SEIFA ²	-0.01	-0.07, 0.04	0.659			
SDQ ³ Total Difficulties	-1.29	-1.84, -0.73	<0.001	-1.25	-1.79, -0.71	<0.001

Model 1: adjusted for concurrent SDQ subscales, gender, maternal vocabulary, SEIFA at 4 years and 7 years

Model 2: adjusted for variables meeting 10% association level in model 1

¹Maternal Vocabulary measured by the Mill Hill

²SEIFA measured by Australian Bureau of Statistics Index of Disadvantage

³Strengths & Difficulties Questionnaire