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<LRH>Patricia Eadie et al.

<RRH>Quality of Life in Children with DLD

Research Report

Quality of life in children with developmental language disorder

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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

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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: 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 to 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.

Methods & 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 to 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 ($n = 802$), with 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 to 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 a 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.

Keywords: developmental language disorder, quality of life, outcomes.

<A>What this paper adds

What is already known on the subject

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

What this paper adds to existing knowledge

Children with DLD had lower parent ratings of QoL than their TD 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 to 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.

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

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 the measurement and monitoring of functional limitations in children with DLD. Prioritizing measurement of the functional impact of DLD in assessments, including QoL, will enable continued investigation of communicative functioning from a biopsychosocial perspective.

<A>Introduction

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 *et al.* 2010). It 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 *et al.* 2000). A number of these outcomes are now more commonly referred to as ‘functional limitations’ (Bishop *et al.* 2016). With high prevalence and lifelong consequences, it is critical that health and education professionals understand the nature of DLD and related aspects of the child’s well-being and quality of life (QoL). Definitions of disability that 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.

Biopsychosocial model of disability

[AQ5] The World Health Organisation (WHO, 2007) defines health as ‘a state of complete physical, mental, and social well-being and not merely the absence of disease’. This implicates a biopsychosocial model of disability where a person’s health and well-being 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, one must understand the nature of the functional limitations and the factors that 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 conceptualizing health and well-being from a functional perspective. QoL is one construct by which to measure an individual or proxy’s perspective on their well-being. It can be defined as an individual’s perception of their physical, psychological and social well-being (Markham *et al.* 2009). Measures of QoL are multidimensional and focus on physical functioning, participation, health and well-being, and allow for comparison of functioning across different health conditions, populations and interventions (Cieza and 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 best to measure objectively functional limitations within the overall picture of childhood language assessment and diagnosis. A recent scoping review concluded there was currently lack of tools for measuring functional limitations in the paediatric speech and language field (Cunningham *et al.* 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.

QoL in children with DLD

Studies focused on QoL in children with communication impairments, ranging in age from birth to 18 years, consistently find negative impacts on social functioning, e.g., difficulties getting along with others (Feeney *et al.* 2012), as well as difficulties in psychosocial well-being and school functioning (Hubert-Dibon *et al.* 2016, McKean *et al.* 2017). Interpersonal relations, participation in school and play activities, learning, socializing, and behaviour were all identified as areas of concern by parents and clinicians describing children's (2–5 years) well-being in open-ended survey questions before starting therapy ($n = 210$) (Thomas-Stonell *et al.* 2009). In a study of 29 children with specific language impairment (SLI), aged 8–12 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 aged 6–18 years. The themes that emerged focused on difficulties with relationships, emotions, achievement, independence and support, all of which impacted on overall well-being and QoL. More recently, Nicola and Watter (2015) used the PedsQL to explore QoL in a sample of 41 children with severe SLI aged 5–18 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 *et al.* 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 QoL in children with DLD

We know that child (e.g., gender, general health), family (e.g., maternal education and mental health), and environmental factors (e.g., socioeconomic 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 *et al.* 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 *et al.* 2016, Conti-Ramsden *et al.* 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 *et al.* 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:

- (a) Do children with DLD experience limitations in parent-reported QoL compared with their TD peers?

(b) At what age do parent perceptions of lower QoL emerge and does severity of the DLD contribute to lower QoL?

- What contribution do language skills, across the full range of abilities, make to parent-reported QoL, accounting for variables known to influence language development?
- To what degree do vulnerabilities in socio-emotional behavioural skills in children with DLD contribute to parent-reported QoL, accounting for variables known to influence language development?

<A>Materials and methods

Background to the Early Language in Victoria Study (ELVS)

This study draws on data collected as part of the ELVS, a longitudinal study following the language, social, communication and early literacy development of a large community sample of children from Melbourne (VIC), 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 0–6 years, and supplemented by recruitment from the 7–9-month hearing screening programme 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 ages 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 *et al.* 2006) at 4 years, Clinical Evaluation of Language Fundamentals—4th edition (CELF 4)

(Semel *et al.* 2006) at 7 years, and the Pediatric Quality of Life Inventory, Parent—Proxy Report (PedsQL) 4.0 (Varni *et al.* 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 socioeconomic 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.

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

<C>*Social-emotional measure*

The social-emotional behavioural adjustment of children was characterized 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 3–16 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 score and the subscale scores at 4 and 7 years are reported.

<C>*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., socioeconomic status) characteristics. These data were collected through annual questionnaires designed specifically for the ELVS

study. The matrices subtest of the Kaufman Brief Intelligence Test, 2nd edition (K-BIT2; [AQ6] Kaufman and 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). Socioeconomic disadvantage was measured using the SEIFA index of relative social disadvantage (Australian Bureau of Statistics 2001), with lower SEIFA scores representing greater disadvantage.

<C>*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 2–18 years. It incorporates standardized scales for physical, emotional, social and school functioning, as well as a total score used here as the primary outcome.

<C>*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 *et al.* 2017) were sent to parents within 1 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.

<C>*Defining DLD*

In order to identify children with persisting language difficulties, standard scores \leq than 81 (i.e., > 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 > 81 (i.e., < 1.25 SD below the mean) at either or both 4 and 7 years defined the TD group. This meant that some children who may have fallen into the DLD category at *only one* time point were categorized 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, [AQ7] 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 ≤ 70 (i.e., > 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.

<C>Health-related QoL

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 to 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 years and persisting at 7 years, and QoL over 4, 7 and 9 years; and to compare QoL for children whose DLD was mild to moderate and severe at 7 years, we summarized the PedsQL scores using descriptive statistics (mean and SD). 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 *et al.* 2002), consequently, parametric analyses are reported here. Means for the total score and subscales were compared between DLD and TD groups, and between mild to 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 PedsQL, rather than focusing 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 QoL, 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.

<A>Results

Of the 872 participants, 70 children (8%) were persistently language disordered (DLD) *at both* 4 and 7 years, i.e., they had expressive and/or receptive language scores that were consistently > 1.25 SD below the mean. A total of 80% of the DLD group were classified as having mild to moderate difficulties, i.e., their language scores were between 1.25 and 2 SD below the mean. The remaining 20% ($n = 14$) had severe language difficulties, with scores > 2 SD 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 characterized 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 these differences were statistically significant. The DLD

group had significantly lower non-verbal cognition scores at both time points compared with 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 (table 1). There were no differences detected between the groups on prosocial scores at either time point. SDQ total difficulties and scale scores at both time points were within normal limits for both DLD and TD groups.

<tab 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 (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 time points.

<tab 2>

PedsQL profiles of children with mild to moderate and severe DLD

Children with severe versus mild to 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 summarized in table 3.

<tab 3>

Predicting QoL 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% confidence interval (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 socioeconomic status did not contribute significantly to ratings of QoL (table 4).

<tab 4>

Predicting QoL 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 coefficient ($r = 0.29$; $p \leq 0.05$).

<tab 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 socioeconomic disadvantage) were run with SDQ subscale scores from 4 years (table 6, model 1). Those reaching a significance 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 = $-1.79, -0.71$, $p < 0.001$).

<tab 6>

<A>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 to explore 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 and Watter 2015), children with DLD demonstrated lower QoL 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 QoL 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 and 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 with 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 well-being (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 and 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 and 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 to 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 > 2 SD below the mean. Nicola and 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, e.g., 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 versus 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., [AQ8] Bretherton 2013, St Clair *et al.* 2011, Durkin and 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 and Watter (2015) achieved with children with severe SLI.

<A>Conclusions

DLDs 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 TD 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 in to 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 well-being 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. Prioritizing 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.

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<<t/s Set names in caps and scaps as per usual style>>

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Table 1. Participant characteristics and Clinical Evaluation of Language Fundamentals and Strengths & Difficulties Questionnaire (SDQ) scores at 4 and 7 years by language status

	Typically developing language ($n = 802$)		Developmental language disorder (DLD) ($n = 70$) ^a	
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/postgraduate	355 (44.65)		16 (23.19)	
Maternal vocabulary ^b , mean (SD)*	28.69 (4.36)		26.46 (4.86)	
Family history ^c , N (%)*	204 (25.44)		27 (38.57)	
SEIFA ^d disadvantage, mean (SD)*	1047.40 (51.00)		1022.64 (61.58)	
	Typically developing language ($n = 802$)		DLD ($n = 70$) ^a	
	Age 4 years	Age 7 years	Age 4 years	Age 7 years
Core language ^e , mean (SD)*	104.57(11.76)	100.57 (10.46)	79.19 (8.64)	75.44(12.47)
Nonverbal cognition ^f , mean (SD)*	107.21 (11.35)	106.41 (14.52)	90.87 (16.01)	92.65 (10.72)
SDQ subscale scores, mean (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, mean (SD) ^{#†}	7.38 (4.30)	6.39 (4.47)	10.51 (5.53)	9.07 (6.33)

Notes: ^aDLD was identified at 4 years and persisted at 7 years with scores > 1.25 SD (standard deviation) below the mean at both time points.

^bMaternal vocabulary measured by the [AQ14] Mill Hill Vocabulary Scale.

^cSelf-reported history of speech and/or language difficulties.

^dSEIFA, Socioeconomic Indices for Areas.

^eCELF P2 at 4 years and CELF 4 at 7 years.

^fKaufman Brief Intelligence Test (K-BIT) at 4 years and Wechsler Abbreviated Scale of Intelligence (WASI) at 7 years.

*Differences significant at the $p < 0.001$ level; [#]between-group differences at 4 years significant at the $p < 0.01$ level; [†]between-group differences at 7 years significant at the $p < 0.05$ level.

Table 2. Pediatric Quality of Life Inventory (PedsQL) at 4, 7 and 9 years for children with typical language and those with developmental language disorder (DLD)^a

PedsQL scores, mean (SD)	4 years		7 years		9 years	
	Typical ^b	DLD	Typical ^c	DLD	Typical	DLD
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	74.85	75.46	75.79	73.85	67.23

	(14.12)	(17.12)	(14.65)	(18.9)	(15.72)*	(21.0)*
))	8)		
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)*

Notes: ^aDLD was identified at 4 years and persisted at 7 years with scores > 1.25 SD (standard deviation) below the mean at both time points.

^bTotal number of children in typical group is 802 and in a DLD group is 70.

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

Table 3. Pediatric Quality of Life Inventory (PedsQL) at 4, 7 and 9 years for children with mild to moderate and severe developmental language disorder (DLD)^a

PedsQL Scores mean (SD)	4 years		7 years		9 years	
	Mild to moderate DLD ^b	Severe DLD	Mild to moderate DLD	Severe DLD	Mild to 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)

Notes: ^aDLD was identified at 4 years and persisted at 7 years with scores > 1.25 SD (standard deviation) below the mean at both time points.

^bTotal number of children in mild to moderate DLD group is 56 and in severe DLD group is 14.

*Differences between mild to moderate and severe DLD at the same age point were significant at the $p < 0.05$ level.

Table 4. Predictors of quality of life at 9 years across all participants ($n = 872$)

	Model 1			Model 2		
	$R^2 = 0.044$			$R^2 = 0.042$		
	Coefficien t	95% CI	p	Coefficien t	95% CI	p
Gender	-0.010	-1.84, 1.34	0.76			
Maternal vocabulary ^a	0.040	-0.75, 0.29	0.25			
SEIFA ^b	-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	0.00 0	0.21	0.13, 0.26	0.00 0

Notes: Model 1: adjusted for gender, maternal vocabulary, Socioeconomic Indices for Areas (SEIFA) and non-verbal cognition.

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

^aMaternal vocabulary measured by the [AQ14] Mill Hill Vocabulary Scale.

^bSEIFA measured by the Australian Bureau of Statistics Index of Disadvantage.

CI, confidence interval.

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 4 year emotional symptoms	1										1				
2. SDQ 4 year conduct problems	0.187	1													
3. SDQ 4 year hyperactivity	0.232*	0.65**	1												
4. SDQ 4 year peer problems	0.41*	0.159	0.227	1											
5. SDQ 4 year total difficulties	0.65*	0.71**	0.81**	0.9*	1										
6. SDQ 7 year emotional symptoms	0.69*	0.247*	0.30**	0.4* 0.3*	0.57*	1									
7. SDQ 7 year conduct problems	0.35*	0.65**	0.56**	0.78*	0.66*	0.52*	1								
8. SDQ 7 year hyperactivity	0.24*	0.63**	0.73**	0.703*	0.67*	0.41*	0.72*	1							
9. SDQ 7 year peer problems	0.29*	0.129	0.085	0.40*	0.302*	0.28*	0.36*	0.243*	1						
10. SDQ 7 year total	0.50*	0.59	0.62	0.77*	0.75*	0.72*	0.87*	0.8651	0.51	1					

difficulties	*	**	**	*	*	*	*	**	**						
11: 9 year PedsQL total score	– 0.4 1*	– 0. 20	– 0. 23	– 0.3 4*	– 0.4 2*	– 0.5 0*	– 0.4 3*	– 0. 29	– 0. 28	– 0.4 8*	1				
12: 4 year receptive language	– 0.0 02	0. 01	– 0. 15	– 0.0 7	– 0.0 9	0.0 8	– 0.0 3	– 0. 16	– 0. 09	– 0.0 8	0. 1	1			
13: 4 year expressive language	– 0.0 9	0. 18	– 0. 13	– 0.1 7	– 0.0 9	0.1 1	0.1 3	– 0. 07	– 0. 17	0.0 02	0. 2	0. 44	1		
14: 7 year receptive language	– 0.1	– 0. 28	– 0. 23	– 0.1 3	– 0.2 7	– 0.0 4	– 0.1 7	– 0. 28	– 0. 1	– 0.2 1	0. 0	0. 4*	0. 06	1	
15: 7 year expressive language	– 0.1 5	– 0. 09	– 0. 27	– 0.2 8	– 0.2 9	– 0.1 4	– 0.2	– 0. 32	– 0. 22	0.3 *	0. 2	0. 44	0. 47	0. 4	1
								*			**	**	*	*	*

Note: * $p \leq 0.05$; ** $p \leq 0.01$.

Table 6. Association between socio-emotional behaviour at 4 and 7 years and quality of life (QoL) at 9 years in participants with developmental language disorder (DLD) ($n = 70$)

Model 1: 4 year SDQ subscales				Model 2: 4 year SDQ subscales		
$R^2 = 0.28$				$R^2 = 0.23$		
	Coefficient	95% CI	p	Coefficient	95% CI	p
Gender	-6.02	-13.43, 1.39	0.109	-4.95	-12.04, 2.14	0.168
Maternal vocabulary ^a	-0.29	-1.02, 0.44	0.43			
SEIFA ^b	0.01	-0.05, 0.06	0.848			
SDQ 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				Model 2: 7 year SDQ total difficulties		
$R^2 = 0.28$				$R^2 = 0.24$		
Gender	-4.66	-11.65, 2.33	0.188			
Maternal vocabulary ^a	-0.24	-0.95, 0.47	0.506			
SEIFA ^b	-0.01	-0.07, 0.04	0.659			
SDQ total difficulties	-1.29	-1.84, -0.73	< 0.001	-1.25	-1.79, -0.71	< 0.001

Notes: Model 1: adjusted for concurrent Strengths & Difficulties Questionnaire (SDQ) subscales, gender, maternal vocabulary, Socioeconomic Indices for Areas (SEIFA) at 4 and 7 years.

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

^aMaternal vocabulary measured by the [AQ14] Mill Hill Vocabulary Scale.

^bSEIFA measured by Australian Bureau of Statistics Index of Disadvantage.

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