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A longitudinal study of behavioral, emotional and social difficulties in individuals with a history of specific language impairment (SLI)

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ABSTRACT

Children with specific language impairment (SLI) have often been reported to have associated behavioral, emotional and social difficulties. Most previous studies involve observations at a single time point, or cross sectional designs, and longitudinal evidence of the developmental trajectories of particular difficulties is limited. The Strengths and Difficulties Questionnaire was used to measure behavioral (hyperactivity and conduct), emotional and social (peer) problems in a sample of individuals with a history of SLI at four time points from childhood (age 7) to adolescence (age 16). A decrease in behavioral and emotional problems was observed from childhood to adolescence, although emotional problems were still evident in adolescence. In contrast, there was an increase in social problems. Reading skills and expressive language were related only to behavioral problems. Pragmatic abilities were related to behavioral, emotional and social difficulties. As a group, those with a history of SLI have poorer long term social and, to a lesser extent, emotional outcomes. In contrast, behavioral difficulties appear to decrease to normative levels by adolescence. Different aspects of early language abilities and reading skills exert different types and degrees of influence on behavioral, emotional and social difficulties.

Learning outcomes: Readers will be able to: (1) understand the types of behavioral, emotional and social difficulties present in individuals with a history of SLI; (2) be familiar with the developmental trajectory of these difficulties from childhood to adolescence; and (3) understand the relationships between behavioral, emotional and social difficulties and early language and literacy ability.

1. Introduction

Specific language impairment (SLI)[1] is a developmental disorder involving significant language impairments in the context of normal nonverbal ability, hearing, and neurological status (Bishop, 1997; Leonard, 1998). The prevalence of SLI in young children has been estimated as 7% (Tomblin et al., 1997). It is thought that 40% of children identified with language impairments have persistent language difficulties (Law, Boyle, Harris, Harkness, & Nye, 2000), and some individuals continue to have language difficulties in adulthood (Clegg, Hollis, Mawhood, & Rutter, 2005; Howlin, Mawhood, & Rutter, 2000). It is

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[1] Specific language impairment (SLI); Behavioral, emotional and social difficulties (BESD); Attention Deficit and Hyperactivity Disorder (ADHD); Strengths and Difficulties Questionnaire (SDQ).

important to note, however, that people with SLI demonstrate considerable heterogeneity in their profiles of strengths and difficulties (Conti-Ramsden, 2008). Thus, research in this area includes participant pools that may not meet the traditional, verbal–nonverbal discrepancy definition of SLI. The present longitudinal study is no exception. However, we continue to use the term SLI in order to situate our findings within the research literature in this area with the acknowledgement that these individuals may or may not meet traditional SLI criteria continuously throughout development. For this reason, we refer to the participants in this study as having a history of SLI.

The term behavioral, emotional and social difficulties (BESD) is complex and clusters together a series of constructs related to aspects of young people's development. Each of these domains of functioning is distinct. Nonetheless, the term BESD can be a useful shorthand for providing a balanced coverage of a range of areas of functioning in young people, i.e., behaviors, emotions and relationships. It is widely recognized that children who have specific language impairment experience not only difficulties with language but also BESD. The co-occurrence of language impairments and BESD has been found in children with primary language difficulties (Beitchman, Hood, Rochon, & Peterson, 1989; Cantwell, Baker, & Mattison, 1981; Lindsay, Dockrell, & Strand, 2007) and also in children with primary psychiatric difficulties (Cohen et al., 1998; Gualtieri, Koriath, Van Bourgondien, & Saleeby, 1983). Less is known, however, about the developmental trajectories of these difficulties. This study examines the longitudinal development of BESD in children with a history of SLI over a nine year time period and investigates how language and reading abilities relate to the developmental course of other difficulties.

1.1. SLI and BESD

Early work in this field focused on the prevalence of psychiatric disorders in children with SLI, in particular, behavioral difficulties (Baker & Cantwell, 1982; Beitchman et al., 1989). The general findings indicated that behavioral difficulties of the attention deficit and hyperactivity disorder (ADHD) type can co-occur with language difficulties. This has been supported by more recent findings of general attentional difficulties in individuals with SLI (Lum, Conti-Ramsden, & Lindell, 2007) as well as a higher prevalence of hyperactivity/attention behavioral difficulties among children with SLI when compared to children with typical language development (Benasich, Curtiss, & Tallal, 1993; Snowling, Bishop, Stothard, Chipchase, & Kaplan, 2006). In terms of behavioral difficulties of the conduct type, recent studies have provided mixed evidence. Some investigations suggest higher levels of externalizing difficulties in childhood in individuals with SLI (Tomblin, Zhang, Buckwalter, & Catts, 2000; van Daal, Verhoeven, & van Balkom, 2004) whilst others do not (Lindsay et al., 2007; Redmond & Rice, 1998, 2002). For emotional problems, the research is scant and the available results are also not consistent. Some studies have found higher levels of internalizing difficulties in childhood (Coster, Goorhuis-Brouwer, Nakken, & Lutje Spelberg, 1999; Redmond & Rice, 1998, 2002) as well as in adolescence, in particular anxiety and depression (Conti-Ramsden & Botting, 2008). However, a number of studies have found little evidence of specific emotional problems in children with SLI (Snowling et al., 2006; Tomblin et al., 2000) or have found evidence when using particular methodologies, e.g., teacher report but not parental report (Redmond & Rice, 1998, 2002).

A large body of literature points to the presence of social difficulties in children and adolescents with SLI (Benasich et al., 1993; Conti-Ramsden & Botting, 2004; Lindsay et al., 2007). Research suggests difficulties with social withdrawal. Children with SLI are more likely to play alone and exhibit symptoms of shyness (Fujiki, Brinton, Isaacson, & Summers, 2001). Some studies have reported shyness only for girls with SLI (Benasich et al., 1993; Tallal, Dukette, & Curtiss, 1989). There is more consistent evidence, however, of difficulties in peer relations (Fujiki, Brinton, Morgan, & Hart, 1999; Gertner, Rice, & Hadley, 1994), poorer quality friendships (Durkin & Conti-Ramsden, 2007) and risk of victimization (Knox & Conti-Ramsden, 2007).

In sum, trends in the literature suggest that ADHD is likely to co-occur in individuals with SLI, at least in childhood. The evidence regarding conduct and emotional difficulties is less consistent. In respect of peer relations, children and adolescents with SLI appear to be disadvantaged. However, although a growing literature enriches our knowledge of BESD in SLI, different studies have examined different age groups and have included different measures, making comparisons across datasets difficult. Questions about the course of development are still to be addressed.

Longitudinal research has been limited, both in terms of scope and breadth of BESD measures used. Redmond and Rice (2002) found a decrease in emotional problems in children with SLI from 5 to 7 years of age, but also observed more stable patterns of attentional and social problems across this time period. Benasich and colleagues (1993) reported no developmental change from 4 to 8 years of age in an overall measure of behavior problems in children with SLI. Examining older children with SLI from 7 to 11 years of age, Silva, Williams and McGee (1987) found a decrease in an overall measure of BESD, as did Lindsay and colleagues (2007) for 8 to 12-year-olds with SLI. These data suggest that there may be a decrease in BESD in children with SLI from early to later childhood. In this sense, individuals with SLI may be similar to individuals with reading disabilities. Maughan and colleagues (1996) found decreasing attention and conduct problems from childhood to adolescence in their sample of reading disabled young people. The above data also raise the possibility that specific aspects of behavioral, emotional and social functioning may differ in their developmental trajectories.

1.2. BESD and its relation to language and reading impairments

In the existing literature, the account of the association between language impairments and BESD is somewhat limited and mixed, depending on the area of functioning being examined and the types of measures being used. Benasich et al. (1993) and Hart, Fujiki, Brinton, and Hart (2004) found no discernable relationship between language abilities and

behavioral outcomes in childhood. However, Botting and Conti-Ramsden (2000) found more children with SLI over the clinical threshold for behavioral/social difficulties at ages 7 and 8 when they had language problems involving more than one linguistic modality. Snowling et al. (2006) also reported that a combined expressive and receptive language difficulty profile was related to social problems. Difficulties involving the expressive domain only were associated with attentional/hyperactivity problems. Similarly, Durkin and Conti-Ramsden (2007) found that receptive language at age 7 differentiated social outcomes in terms of good versus poor friendships at age 16. Overall language abilities have also been associated with behavioral difficulties (Lindsay et al., 2007), including attention/hyperactivity (Redmond & Rice, 2002). These studies raise the possibility that different aspects of language may be related to different areas of functioning in the behavioral, emotional and social domains (Beitchman, Brownlie, & Wilson, 1996). Lindsay et al. (2007) provide important additional evidence that measures of pragmatic abilities are linked to behavioral difficulties, though the use of an overall measure of BESD in that study means that the relationship to specific areas of functioning remains to be investigated.

Problems with reading have also been linked with BESD (Maughan et al., 1996). In particular, reading difficulties have been associated with behavioral problems in childhood in both the attention/hyperactivity and conduct domains (Frick et al., 1991; Maughan et al., 1996). Interestingly, individuals with SLI often exhibit impairments in reading (Bishop & Adams, 1990; Botting, Simkin, & Conti-Ramsden, 2006; Snowling, Bishop, & Stothard, 2000). However, research examining the association between reading impairments and BESD in individuals with SLI is only just emerging. The evidence so far suggests that reading difficulties in SLI are related to behavioral problems, particularly of the attention/hyperactivity and conduct types, but not to emotional difficulties (Tomblin et al., 2000).

1.3. The present study

Although there are several studies pointing to the presence of BESD in individuals with SLI, much less is known of the developmental trajectories of their difficulties. To our knowledge, this study is the first to investigate BESD in individuals with SLI from childhood to adolescence and their relation to language and reading abilities. We included a global measure of BESD and investigated four specific domains of functioning: two domains related to behavioral difficulties, i.e., hyperactivity and conduct, as well as emotional problems and difficulties with peer relations. Based on the previous literature, we expected to find a decrease in overall BESD across time. In terms of specific areas of functioning, a basis for predictions was less clear. We anticipated we were likely to discover differences in the developmental trajectories of specific areas of functioning, with the literature suggesting peer relations as particularly problematic for individuals with SLI. We also aimed to investigate the developmental relationships between language abilities and BESD and between reading abilities and BESD. We examined three aspects of language – expressive, receptive and pragmatic abilities – as well as reading accuracy.

2. Method

2.1. Participants

The participants were individuals with a history of SLI who took part in the Manchester Language Study (Conti-Ramsden & Botting, 1999a, 1999b; Conti-Ramsden, Crutchley, & Botting, 1997). The original cohort of 242 children represented a random 50% sample of all children attending year 2 (age 7) in language units across England. Language units are usually attached to mainstream schools. They are specialized classrooms set up to support children with primary language difficulties. Children reported by teachers to have frank neurological difficulties, diagnoses of autism, known hearing impairment or general learning impairments were excluded. All children had English as a first language, but 12% had exposure to languages other than English at home. Informed consent was gained from all participants. This study includes 234 children from the initial study cohort aged 6;5 to 7;9 years (females: 23.5%) with reassessments at age 8 ($n = 203$), 11 ($n = 167$), and 16 ($n = 103$). The attrition observed was partly due to funding constraints at follow-up stages of the study. There was no difference in either age 7 receptive or expressive language abilities between those who participated at 16 and those who did not participate, ps > .8. However, given that the number of participants varied at the different time points assessed, it was necessary to take this into consideration in our longitudinal analyses. Thus, we employed statistical models that account for participant attrition. The method used accounts for bias due to attrition on an assumption that losses may be selective of individuals with higher or lower observed measures but does not allow additional selective loss associated with the unobserved measures (Missing at Random). Summary of the language skills in these children at age 7, 8, 11, and 16 is displayed in Table 1.

Performance IQ (PIQ) at age 7 (Coloured Progressive Matrices; Raven, 1986) was within the normal range, $M = 105.98$, SD = 14.89. PIQ was not found to be related to the SDQ total difficulties score, nor any of the subscales, ps > .1. In addition, parental income and maternal education at age 16 were analyzed with regard to the SDQ total difficulties and the four subscales. There were no differences between the four levels of parental income (<£10,401, £10,401–£20,800, £20,801–£36,400, and >£36,401; at 2003–2005 income levels) neither for the SDQ total difficulties score nor for any of the subscales, ps > .05. There were also no differences between the three levels of maternal education (no qualification, basic educational qualification [GCSE/O-level to some college education] and higher education [university degree/postgraduate]) for the SDQ total score or for any of the subscales, p > .3.

Table 1
Average expressive and receptive language abilities at ages 7, 8, 11 and 16.

	7	8	11	16[a]
Expressive language[b]	83.79 (10.48)	83.94 (11.31)	73.64 (11.56)	72. 71 (10.52)
Receptive language[c]	83.74 (10.95)	85.98 (12.04)	86.55 (15.62)	82.33 (16.30)

[a] The age 16 data contain a subset of individuals tested at age 14; funding constraints only allowed psycholinguistic tests to be conducted at age 16 if there were no data available from an additional age 14 follow-up that is not reported in this study.
[b] Expressive language measures: ages 7 and 8 – Bus Story (Renfrew, 1991), ages 11 and 16 – Clinical Evaluation of Language Fundamentals-Revised (CELF-R) Recalling Sentences subtest (Semel et al., 1987).
[c] Receptive language measures: ages 7, 8 and 11 – TROG (Bishop, 1982), age 16 – CELF-R Word Classes subtest.

Though all children attended language units at age 7, 15.5% (31) transferred to mainstream school with no support at age 8 and a further 13.5% (27) transferred to mainstream school with support at age 8. However, 64.0% (128) either stayed in the same language unit or transferred to another similar language unit. A minority of children (6.5% or 13 children) were enrolled in special units or schools. There was no information available for three of the children. At age 11, 13% (21) of the sample was in mainstream education without support with a further 51% (82) with support. Only 11.1% (18) remained in language units while 4.3% (7) were placed in language schools. An additional 18.5% (30) were placed in special schools and 2.5% (4) were held back in primary school. There was no information available for the remaining 5 children at age 11. At age 16, 16.5% (17) were in mainstream school with no support while 51.5% (53) were in mainstream with support. Language units were attended by 1.9% (2) and language schools by 3.9% (4). Additionally, 4.9% (5) attended a special unit while 21.4% (22) attended a special school.

2.2. Measures

The Strengths and Difficulties Questionnaire (SDQ) teacher report version was used to measure BESD (Goodman, 1997). Given the changing nature of teachers' relationships with students from primary to secondary school, the potential for under-reporting by secondary school teachers was investigated. Our results indicate this was not the case and furthermore, there was comparability between teacher-report and self-report versions of the SDQ (see Appendix A).

The SDQ includes a total difficulties score as well as four subscales measuring behavioral (hyperactivity and conduct), emotional and social (peer relations) difficulties. The SDQ scores at ages 7 and 8 were calibrated using multiple imputation from the Rutter Behavioural Questionnaire (Rutter, 1967). Full details of this procedure can be found in Appendix B.

The SDQ has a cutoff of 12 on the total difficulties score, as this was the best clinical indicator of psychiatric difficulties (Goodman, 1999). The clinical cutoffs for the individual subscales on the teacher version (6, 3, 5 and 4 or above for the hyperactivity, conduct, emotional and peer subscales, respectively) indicated that 80% of children from a community sample were considered normal, leaving 20% scoring over the cutoff. These ranged between borderline and abnormal (Goodman, 1997). In the present study, we combine those who score in the borderline or abnormal range as "impaired".

Language measures at age 7 and 11 were used. At age 7, expressive language was measured with the Bus Story (Renfrew, 1991). The Test of Reception of Grammar (TROG; Bishop, 1982) was used to measure receptive language at age 7. At age 11, the teachers completed the pragmatic scale of the Children's Communication Checklist (CCC; Bishop, 1998). High scores (132 or above) on this scale indicate no pragmatic problems; scores below 132 indicate pragmatic impairment.

Reading measures at age 7 were also used in the analyses. Participants completed the word reading subtest of the British Abilities Scale (BAS; Elliot, 1983), a measure of single word reading. The Bus Story, TROG and BAS word reading raw scores were translated to a percentile rank based on the published population norms and then converted to standard scores (with a mean of 100 and standard deviation of 15) for comparison purposes.

2.3. Statistical analyses

The statistical program Stata/SE (StataCorp, 2007) was utilized for all statistical analyses. Participant gender was a covariate in all analyses. Because SDQ subscale scores are highly skewed, for formal inference they were analyzed as ordinal variables using the Generalized Linear Latent and Mixed Models procedure—www.gllamm.org (Rabe-Hesketh, Skrondal, & Pickles, 2002). Graphs of trends in cohort mean scores were compiled from fitted values from a multilevel mixed-effects linear regression model. In all analyses, the non-independence and attrition of the longitudinal data were accounted for under an assumption of missing at random. Results from the imputed datasets were combined using Rubin's rule. To control for multiple comparisons, the significance level was set to the .01 level. However, for interest, we report results as marginal when alpha varied between 0.01 and 0.05 for the main findings. Full details of these analyses are given in Appendix C.

3. Results

3.1. BESD developmental trajectories in SLI

The total difficulties score as well as all subscales were analyzed longitudinally to determine whether BESD increased or decreased in individuals with SLI from childhood to adolescence. All analyses were carried out in terms of linear and
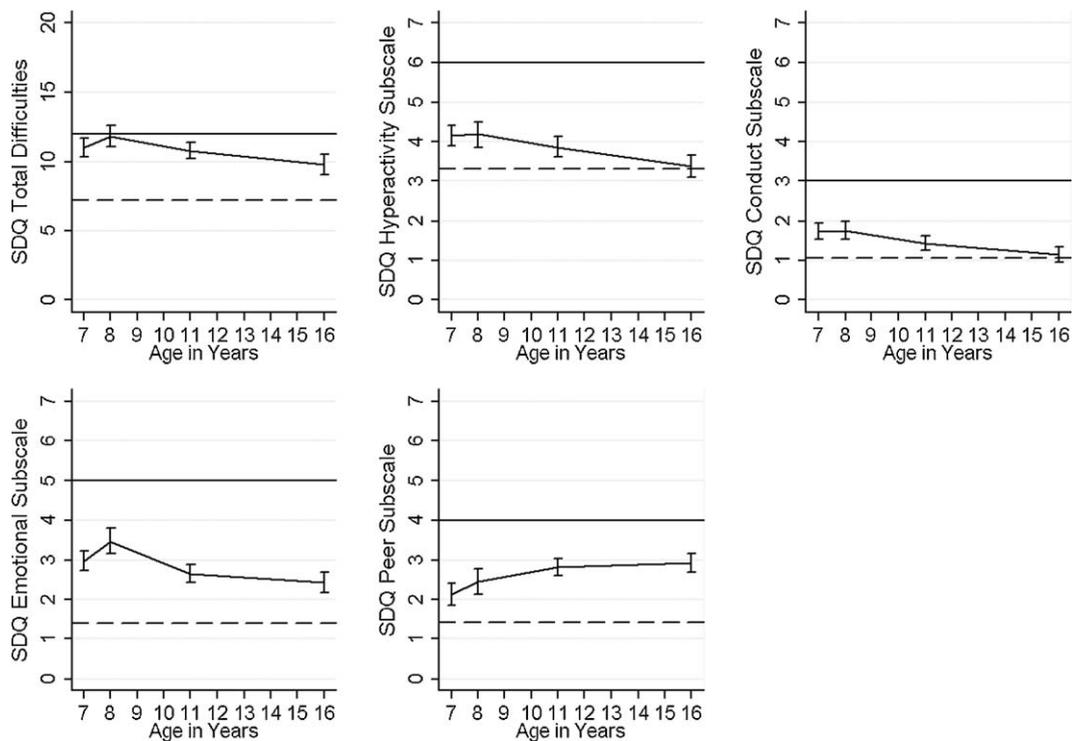
Figure 1. Developmental trajectories of the mean SDQ total difficulties score and all subscale scores with standard error of the mean bars. The clinical cutoff line (solid) and a line showing the mean for the normative sample (Ages 5–10 Normative Sample Means (SD): SDQ total – 6.7 (5.9); Hyperactivity – 3.0 (2.8); Conduct – 0.9 (1.6); Emotional – 1.5 (1.9); Peer – 1.4 (1.8). Ages 11–15 Normative Sample Means (SD): SDQ total – 6.3 (6.1); Hyperactivity – 2.6 (2.7); Conduct – 0.9 (1.7); Emotional – 1.3 (1.9); Peer – 1.4 (1.8)) aged 5–15 years old (dotted) are included for reference. All scores are fitted values to account for attrition over time.

quadratic trends, and if the trends were significant or marginally significant, also categorically (testing directly the different age periods). Marginal significance in the overall trends are reported, but for the categorical analyses only significant differences are reported for ease of reading with one exception where their inclusion clarifies the findings. As there were no quadratic trends in the data, only the linear and categorical models are discussed. An age by gender interaction term was also included in all longitudinal analyses, but the interaction was not found to be significant, indicating that the longitudinal trends were consistent for male and female individuals with SLI. See Fig. 1 for graphical representation of the developmental trajectories and Table 2 for means and standard deviations.

The linear trend for the SDQ total difficulties score was not significant, $\beta = -.05$, CI $= -.10$ to $-.001$, $p = .06$. However, there were significant differences in several of the subscales of the SDQ.

There was a significant linear trend in the hyperactivity subscale, $\beta = -.08$, CI $= -.13$ to $-.03$, $p < .005$, indicating fewer hyperactivity difficulties over time. There were significantly fewer hyperactivity difficulties at age 16 than at 7 and 8 years, $\beta = -.67$, CI $= -1.14$ to $-.19$, $p < .01$ and $\beta = -.71$, CI $= -1.24$ to $-.18$, $p < .01$, respectively.

A significant linear trend in the conduct subscale, $\beta = -.14$, CI $= -.20$ to $-.07$, $p < .001$, indicated fewer problems over time. When tested categorically, significantly fewer conduct problems occurred at age 16 than at ages 7 and 8, $\beta = -1.13$,

Table 2
Mean (and SD) SDQ total difficulties and subscale scores including percentage of individuals with a history of SLI who scored over the impairment threshold at age 7, 8, 11 and 16. The expected mean levels of difficulty and the expected percentages of impaired individuals are given as a reference.

	Total difficulties		Hyperactivity		Conduct		Emotional		Peer	
	Score	Impaired	Score	Impaired	Score	Impaired	Score	Impaired	Score	Impaired
7	11.05 (7.01)	42.1%	4.18 (2.95)	33.1%	1.76 (1.95)	26.0%	2.96 (2.68)	26.6%	2.14 (2.20)	23.0%
8	11.79 (7.02)	46.0%	4.16 (2.89)	31.6%	1.71 (2.00)	23.9%	3.48 (2.73)	34.1%	2.44 (2.24)	28.0%
11	10.72 (5.86)	38.3%	3.89 (2.51)	27.2%	1.36 (2.00)	21.0%	2.64 (2.14)	15.5%	2.79 (2.30)	32.7%
16	9.62 (6.51)	34.0%	3.35 (2.80)	20.6%	0.92 (1.53)	17.5%	2.45 (2.35)	20.8%	2.92 (2.39)	38.7%
Expected[†]	7.20 (6.06)	20.0%	3.32 (2.83)	20.0%	1.06 (1.68)	20.0%	1.40 (1.90)	20.0%	1.43 (1.83)	20.0%

[†] Population normative expected mean levels from Meltzer et al. (2000), adjusted for our gender distribution. This expected level appears relatively stable across development.

CI = −1.71 to −.56, $p < .001$ and $\beta = -1.09$, CI = −1.77 to −.42, $p < .005$. In addition, difficulties reported at age 11 were fewer than those reported at age 7, $\beta = -.66$, CI = −1.15 to −.16, $p < .01$.

There was a marginally significant linear trend in the emotional subscale, $\beta = -.06$, CI = −.11 to −.01, $p = .01$, in that generally there were fewer emotional problems over time. When tested categorically, it was found that at age 16 the SLI sample had significantly fewer emotional problems than at 8 years, $\beta = -.77$, CI = −1.29 to −.25, $p < .005$.

In contrast, a significant linear trend in the peer subscale, $\beta = .09$, CI = .02 to .15, $p < .01$, indicated an increase in peer problems over time. The categorical differences showed no significant effects between ages 7, 8, 11 and 16, $ps > .01$ (there were marginal increases in peer problems from age 7 to ages 11 and 16, $\beta = .64$, CI = .11 to 1.16, $p = .02$ and $\beta = .72$, CI = .17–1.27, $p = .01$), indicating that the increase in peer problems over the nine year time span was gradual.

It is important to note the mean scores for all the SDQ scores fell below what is considered to be a clinical level of difficulty. Table 2 presents the proportion of children at each age point that exceeded the clinical thresholds. Variation was observed in the proportion of individuals who scored above the impairment threshold for each domain. There was evidence of a decrease in the proportion of impaired individuals for behavioral and emotional problems whilst the opposite pattern was observed for social difficulties as indexed by the peer subscale. Longitudinal analysis using these proportions revealed the same pattern of findings as described above.

3.2. Developmental trajectories: robustness of the findings

Although attrition was accounted for in the analysis, we conducted further analyses including the subsample of individuals who had SDQ measures at all 4 timepoints ($N = 73$) and the subsample of individuals who had SDQ measures for 3 out of the 4 timepoints ($N = 166$). This was done to provide further evidence that the longitudinal results of the study (with all participants at each timepoint) were robust. The significant longitudinal results (linear and categorical differences) were replicated (at either the .01 or .05 level) when entering only the individuals who had three of the four timepoints available. The one instance that did not reach significance in the three out of four timepoints analysis became significant in the more stringent replication requiring all four timepoints (categorical 7–11 difference conduct subscale). With regard to the replication requiring all four timepoints, the patterns of results were replicated, but some results found to be significant in the full longitudinal analysis reported above did not meet the .05 level of significance in this smaller sample (linear trend emotional subscale $p = .10$; linear trend peer subscale, $p = .07$; categorical 8–16 difference hyperactivity subscale, $p = .08$; categorical 8–16 difference emotion subscale, $p = .13$). This is perhaps not surprising, as the difference in power from 234 to 73 individuals is substantial. In all of these cases, the 3 out of 4 timepoints analysis returned significant results at the .05 level. Thus, we are confident that the analyses involving all participants available at each time point reported in the main results of the study are representative of the development of individuals with a history of language impairment and are not influenced by attrition or sampling differences at different timepoints.

The above results provide further evidence that the longitudinal analyses reported in Section 3.1 are robust. The general pattern of results indicates there was a reduction of behavioral and emotional problems over time, i.e. there were more difficulties earlier in development. In contrast, data on the peer subscale revealed increasing social difficulties from childhood to adolescence.

3.3. Language ability, reading ability and BESD

The earliest measure available for each aspect of language and literacy examined was used, i.e., reading accuracy, expressive and receptive language at age 7 and pragmatic abilities at age 11. We examined the relationship between the early language and reading measures and the SDQ scores (total and subscales, respectively) at each of the age points (i.e., the relationship between language ability at age 7 and SDQ at age 7, then between language at age 7 and SDQ at age 8, and so on). For pragmatic abilities, we examined the relationship between these abilities and BESD at 11 and 16 years only. Previous research investigating the longitudinal trajectories of both language and literacy skills has found that these abilities are relatively stable. From ages 7 to 16 years, there is not much evidence of catch-up by individuals with a history of SLI in relation to same age peers (Conti-Ramsden, St Clair, Pickles, & Durkin, under review; St Clair, Durkin, Conti-Ramsden, & Pickles, 2010). Thus, using the earliest measure of language and literacy abilities is likely to give an indication of overall ability throughout the nine year time span studied.

The continuous line in Fig. 2 and subsequent figures represents the average across all age points, i.e., the average linear relationship between a particular skill and BESD. These are prediction plots based on the raw data, not fitted values, thus the curvature of the trajectories may be more influenced by individual data points. Expressive language had a marginal effect on the SDQ total difficulties score, $\beta = -.02$, CI = −.04 to −.003, $p = .02$, as well as the hyperactivity, $\beta = -.02$, CI = −.04 to −.004, $p = .02$, and conduct subscales, $\beta = -.03$, CI = −.05 to −.003, $p = .03$. In all cases, lower expressive language ability was related to more behavioral problems, as can be seen in Fig. 2. Expressive language was not predictive of the outcomes on the emotional or peer subscales, $ps > .2$.

Fig. 3 presents the prediction plot for the relationship between pragmatic language and BESD. Pragmatic language had a significant linear association with the total difficulties score, as well as the hyperactivity, conduct, emotional and peer subscales, $\beta = -.06$, CI = −.08 to −.04, $p < .001$ for SDQ total score; $\beta = -.04$, CI = −.06 to −.01, $p < .01$ for the hyperactivity
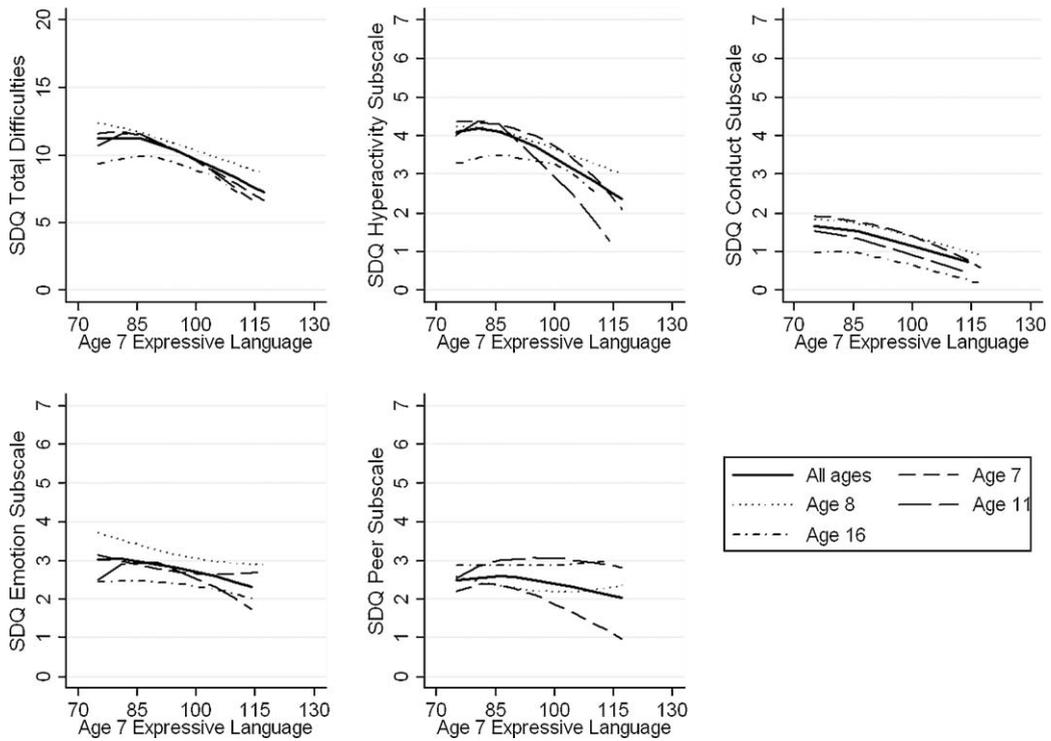
Fig. 2. SDQ total difficulties score and all subscale scores by age 7 expressive language ability for all ages (solid line) and separated into age 7, 8, 11 and 16 predictive trajectories.
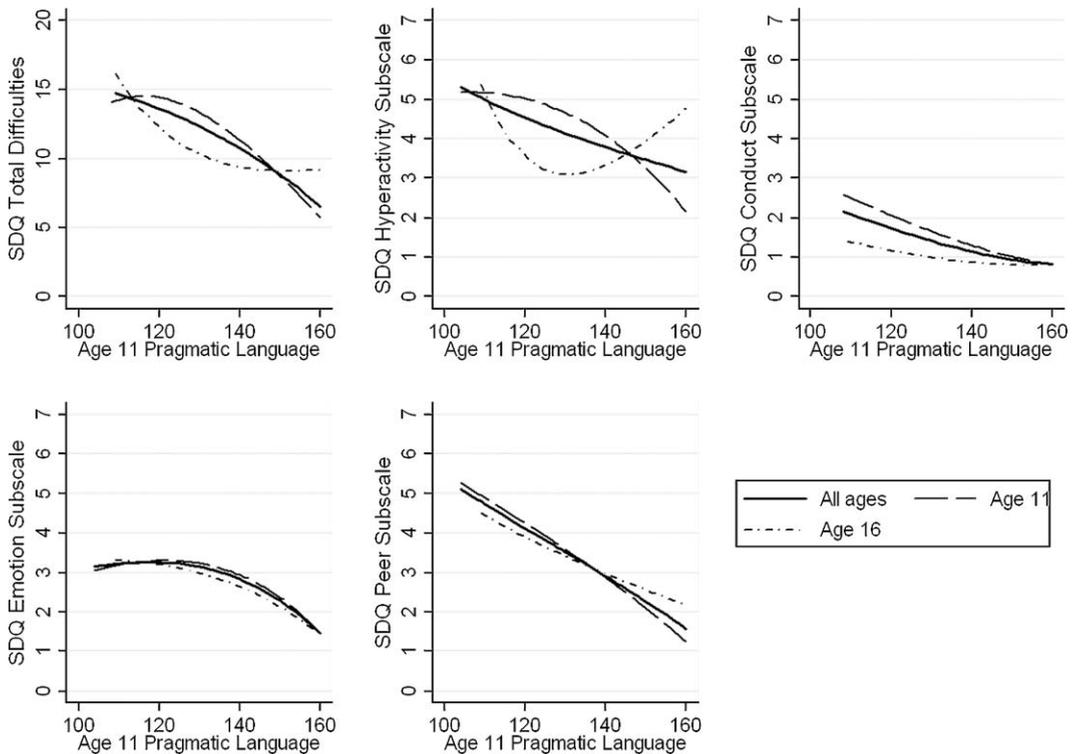

Fig. 3. SDQ total difficulties score and all subscale scores by age 11 pragmatic language ability for all ages (solid line) and separated into age 11 and 16 predictive trajectories.
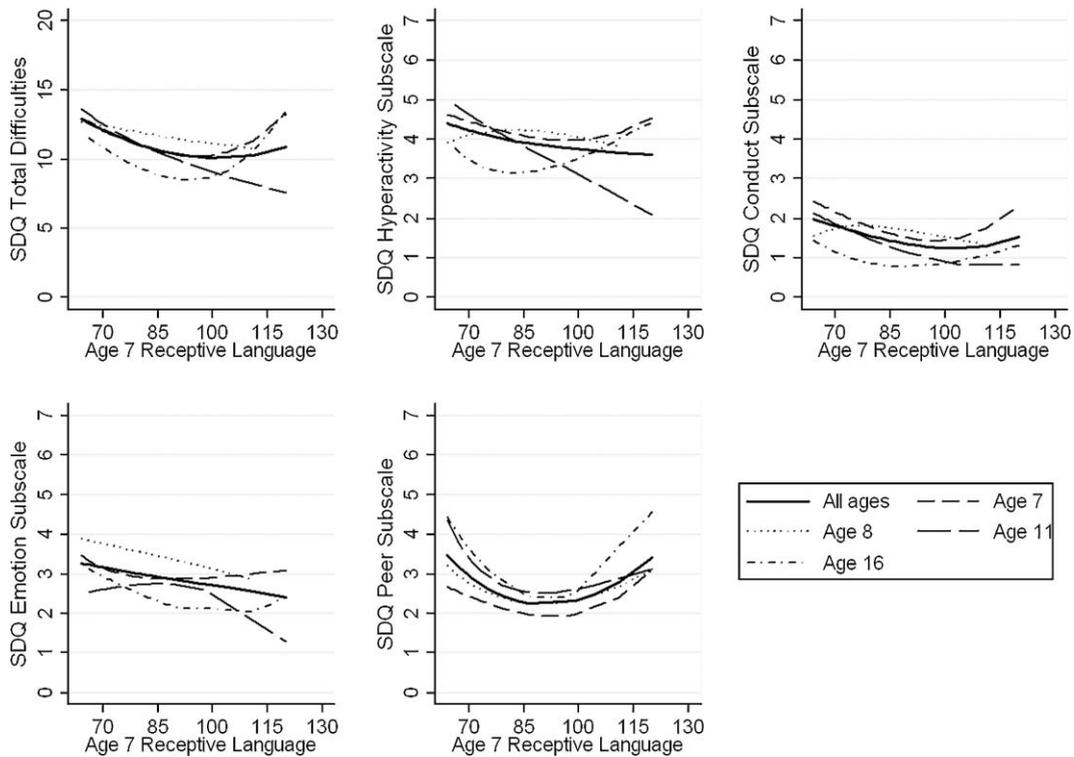
Fig. 4. SDQ total difficulties score and all subscale scores by age 7 receptive language abilities for all ages (solid line) and separated into age 7, 8, 11 and 16 predictive trajectories.

subscale; $\beta = -.05$, CI $= -.09$ to $-.02$, $p < .005$ for the conduct subscale; $\beta = -.03$, CI $= -.05$ to $-.01$, $p < .01$ for the emotional subscale; and $\beta = -.06$, CI $= -.09$ to $-.04$, $p < .001$ for the peer subscale. As can be seen in Fig. 3, lower pragmatic abilities were related to elevated levels in BESD in a roughly linear fashion, although this was less obvious for the hyperactivity scale. Early receptive language ability did not appear to influence the total difficulties score or any of the four SDQ subscales in a linear fashion, ps $> .07$ (see Fig. 4).

Although the figures show some variability in the prediction trajectories based on the time points, it is striking that the trajectories, for the most part, maintain the same relationship throughout the nine year time frame. The expectation would be that concurrent relationships would be stronger than distant ones. We tested this by using a language ability by age interaction term which was added to a model that included main effects of language ability, age, and the usual covariate of gender along with a gender by age interaction term as predictors. If the effect of language ability on BESD differed across time, we would expect a significant difference in the language ability by age interaction term. These analyses were carried out separately for each BESD measure and for each type of language skill examined. For the SDQ total difficulties score and all subscales the language ability by age interaction terms were non-significant for receptive, expressive, and pragmatic language, ps $> .02$.[2] This suggested that expressive language, receptive language and pragmatic abilities maintained a consistent relationship with behavioral, emotional and social difficulties throughout the developmental period examined.

Fig. 5 shows the relationships between the SDQ scores and the earliest measure of reading accuracy. There was a significant effect of reading accuracy on the hyperactivity subscale, $\beta = -.03$, CI $= -.04$ to $-.01$, $p < .005$, and a marginally significant effect on the conduct subscale, $\beta = -.02$, CI $= -.04$ to $-.01$, $p = .01$. Lower reading accuracy ability was associated with more behavioral difficulties. There was no relationship between reading accuracy and the emotional or peer subscales, $p > .3$. Similar to the language ability results, the relationship of reading accuracy at age 7 with behavioral, emotional and social problems remained constant from age 7 to age 16. The reading ability by age interactions revealed no significant differences, ps $> .3$.

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[2] The age by pragmatic language interaction term for the hyperactivity subscale was marginally significant, $\beta = .01$, CI $= .001$–$.02$, $p = .03$. The remainder of the interaction terms were ps $> .07$.
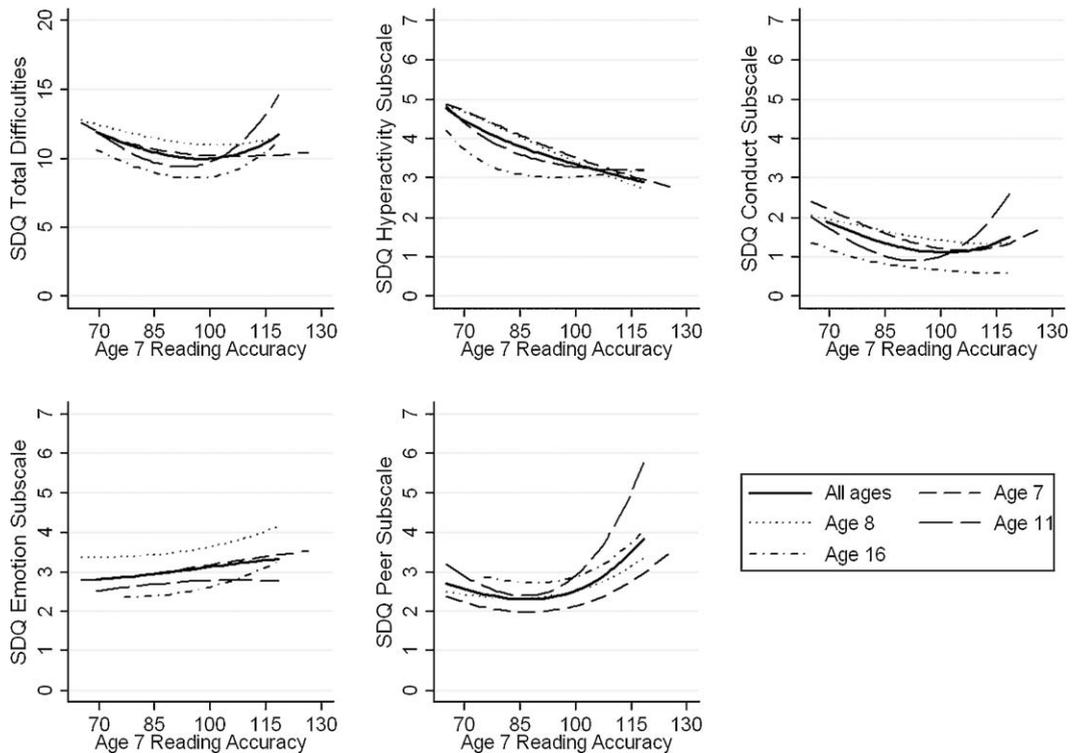
Fig. 5. SDQ total difficulties score and all subscale scores by age 7 reading accuracy ability for all ages (solid line) and separated into age 7, 8, 11 and 16 predictive trajectories.

4. Discussion

4.1. Development of BESD in SLI: from childhood to adolescence

This investigation examined the developmental trajectories of BESD in individuals with a history of SLI. In light of previous research findings, we expected that overall BESD would decrease from childhood to adolescence. This was not borne out; the global measure of total difficulties decreased from age 7 to age 16, but was not statistically significant. However, this lack of a significant difference in the overall measure may have been due to the distinct developmental trajectories observed for specific areas of functioning. Behavioral difficulties in terms of both hyperactivity and conduct problems decreased from childhood to adolescence, as did emotional problems. In contrast, we found evidence of increasing difficulties in peer relations over the nine year period studied. These patterns of development applied to both males and females.

SLI has long been associated with BESD (Beitchman, Nair, Clegg, Ferguson, & Patel, 1986; Cantwell et al., 1981; Lindsay et al., 2007). An inspection of the group means throughout development revealed BESD scores were generally in the sub-clinical range, higher than would be expected in the typical population but lower than the mean impairment threshold. Thus, individuals with a history of SLI, in general, are not exhibiting difficulties which alert professionals to the need for referral. This may mean that in practice at least some individuals with a history of SLI are living with difficulties for which they are not receiving support. This fact needs to be taken into consideration hand in hand with our finding that there were also individual differences in the nature and severity of the problems experienced. This may account for some of the inconsistency of the findings reported in this area. Individual differences can be extreme and are important. They can also vary across domains of functioning. In this study, variation was evident in the proportion of individuals who scored above the impairment threshold for each domain and across time.

Furthermore, our data reveal differential developmental vulnerability for specific aspects of BESD in SLI. Thus, in SLI, behavioral, emotional and social problems are not associated with equally strong developmental trajectories. Behavioral difficulties of the hyperactivity and conduct types are more prevalent in childhood but decrease to general population levels by adolescence. This developmental pattern for behavioral difficulties has also been observed for individuals with reading difficulties (Maughan et al., 1996). A decrease was also observed for emotional difficulties. However, emotional problems still remained above population norms. Difficulties in peer relations were found to be the most developmentally vulnerable area of functioning in individuals with a history of SLI. This is consistent with previous research documenting social difficulties in children and adolescents with SLI (Benasich et al., 1993; Botting & Conti-Ramsden, 2000; Conti-Ramsden &

Botting, 2004, 2008; Durkin & Conti-Ramsden, 2007; Lindsay et al., 2007; Redmond & Rice, 1998, 2002; Snowling et al., 2006). An increase in peer problems and in the proportion of individuals functioning in the impaired range was observed from childhood to adolescence. By 16 years of age, nearly 40% of individuals with a history of SLI appear impaired in their interactions with peers. Thus, SLI appears to be strongly associated with peer difficulties across development.

4.2. Language, reading and BESD: examining developmental relationships

The early measures of language abilities and reading skills used in this investigation were related in a similar manner to BESD at different age points. In other words, early expressive language and reading abilities were related in a similar manner to childhood difficulties as they were to adolescent difficulties. This result must be viewed in line with other findings that have indicated that in SLI, language and reading abilities in relation to peer norms remain remarkably stable across development (Conti-Ramsden et al., under review; St Clair et al., 2010). Thus, the maintenance of the relationship between BESD and early language and reading abilities is likely due to the consistency of individuals' language and reading skills from age 7 onwards.

Early language abilities and reading skills, however, exerted different types and degrees of influence on BESD. Consistent with the previous literature, early reading accuracy skills were only developmentally predictive of behavior problems (Maughan et al., 1996; Tomblin et al., 2000). Severity of early reading accuracy difficulties was found to be associated with hyperactivity and conduct problems in the present study. Levels of early reading skills were not associated with emotional problems or social difficulties in peer relations. Thus, the associations between literacy skills and BESD were specific and circumscribed.

In contrast, oral language abilities appeared to be more intricately associated with the development of BESD. However, the pattern was not identical for each of the three aspects of language studied. Pragmatic abilities were associated with BESD generally as well as with each specific domain examined (to different degrees). Early expressive language, like reading skills, was associated solely with behavioral difficulties. Early receptive language ability did not appear to relate directly to any of the specific BESD domains examined. It needs to be noted, however, that the measure used was the TROG (Bishop, 1982), which is designed to examine understanding of sentential grammar within a multiple choice context. This measure of language comprehension may not be as connected to behavioral, emotional and social functioning as measures which tap more dynamic and protracted processing of language, such as comprehension of discourse (Bishop, 1997).

Increasing difficulties with peer relations observed in the young people with a history of SLI may be at least partly due to the central role of language in peer interactions during adolescence. Talk with peers increases dramatically from childhood to adolescence (Raffaeli & Duckett, 1989). What this study makes clear is that pragmatic aspects of language seem to be more directly implicated in peer relation problems in individuals with a history of SLI. Other aspects of language did not reveal statistically significant effects. Expressive language difficulties may be more readily observed by others and perhaps for this reason may be more likely to be accommodated by peers. Problems in understanding language structure may lead to discomfort in peer communication and possibly breakdowns, but compensatory strategies involving the use of simpler grammatical structures may circumvent some of these difficulties. Pragmatic skills, such as the ability to make inferences in conversation, understand the perspective of others and appreciate humor, however, are more likely to impact on how adolescents "tune in" with peers during social interaction. However, it needs to be noted that the present study used single instruments to assess each of the areas of functioning examined. Thus, the results need to be interpreted with some caution and are in need of further replication in future longitudinal research.

To conclude, there appear to be distinct developmental trajectories for behavioral, emotional and social functioning in SLI. An encouraging finding is that behavioral difficulties appear to decrease to normative levels by adolescence. In contrast, those with a history of SLI have poorer long term social, and to a lesser extent, emotional outcomes.

Acknowledgements

Appendix A. Self-report to teacher-report calibration at age 16

The child's main teacher in primary school was the informant for this study. In secondary school, the informant was the teacher that was deemed to know the young person best (e.g. form tutor, special needs support teacher, or a specific subject teacher). There is a possibility that the longitudinal differences observed in the SLI sample studied (decreasing BESD problems except for the peer subscale) were due to the fact that teachers in secondary school are generally not as well acquainted with their students as teachers in primary school. Thus, secondary school teachers may under-report problems due to insufficient knowledge of their students.

Table A1
Average SDQ self-report and teacher report problems in the SLI sample (at age 16) and the adolescent normative sample.

SDQ score	SLI self-report (SR)	SLI teacher (T)	SLI SR -T	Norms self-report	Norms teacher	Norms SR-T	SLI-Norms
Total	13.33 (5.92)	9.62 (6.54)	3.71	10.3 (5.2)	6.3 (6.1)	4.0	$p = .97$
Hyperactivity	4.46 (2.45)	3.35 (2.81)	1.11	3.8 (2.2)	2.6 (2.7)	1.2	$p = .19$
Conduct	2.53 (1.74)	0.92 (1.53)	1.61	2.2 (1.7)	0.9 (1.7)	1.3	$p = .45$
Emotion	3.85 (2.47)	2.45 (2.36)	1.40	2.8 (2.1)	1.3 (1.9)	1.5	$p = .15$
Peer	2.48 (1.87)	2.92 (2.40)	−0.44	1.5 (1.4)	1.4 (1.8)	0.1	$p > .01$

Examination of the data from the normative sample suggests this is not the case. Data reveals no decrease in the number of problems reported by teachers during the primary school years compared to the secondary school years, indicating that the changing nature of teacher–student relationships does not appear to alter the teachers' perception of students' strengths and difficulties (Meltzer, Gatward, Goodman, & Ford, 2000). We were in the fortunate position to have collected both self-report and teacher-report versions of the SDQ at 16 years. Thus, we were able to directly compare our findings at 16 years for both informants (self and teacher) with those of the normative sample reported by Meltzer et al. (2000). The results are presented in Table A1. As can be seen, the differences between the self-report and teacher report forms of the SDQ are not significantly different between our SLI sample and the normative sample. There was only one marginal difference for the peer scale and this was not in the direction of under-reporting by teachers (when compared to self-report).

Appendix B. SDQ score calibration from Rutter items

At age 7 and 8 the Rutter Behavioural Questionnaire was completed by the teachers of the individuals in the SLI sample. This questionnaire has been used extensively for several decades and consists of a total score as well as antisocial and neurotic subscales. However, in order to examine developmental trends we required a common scale spanning all periods of follow-up. The Rutter Questionnaire data at ages 7 and 8 were therefore rescored into the subscales and response format of the SDQ used in the assessments at ages 11 and 16. This was done by exploiting the detailed item-level pattern of association that could be estimated from a cross-instrument calibration sample (Collishaw, Maughan, Goodman, & Pickles, 2004) kindly made available to us, that is a sample of 313 children aged between 6 and 9 for whom both Rutter and SDQ measures had been completed. All of the Rutter items that were in both the SLI sample and the calibration sample were used to predict the SDQ subscales, these being summed to give a total score. The gender of the SLI and calibration participants was also accounted for in the imputation equation. A full list of the exact Rutter questions used in the imputation is included in Table B1.

In order to recognise the uncertainty in such a rescoring, we used the method of multiple imputation. This involved generating 20 datasets in which the scores at age 7 and 8 could differ across the datasets, the extent of variation reflecting how well or poorly the calibration sample suggested that an SDQ score could be predicted from a set of responses from a Rutter questionnaire. The results from the analysis of these 20 datasets were then combined using Rubin's formula to calculate appropriate average means, trends and coefficients with appropriate confidence intervals and p-values. The multiple imputation was undertaken in Stata/SE (StataCorp, 2007) using the iterative chained equation method implemented in the ice procedure and the combining of results across datasets used the micombine procedure (Royston, 2005).

Table B1
Age 7 and 8 Rutter Items used for calibration.

Very restless. Has difficulty staying seated.
Truants from school.
Squirmy, fidgety child.
Often destroys own or others' belongings.
Frequently fights or is quarrelsome with other children.
Not much liked by other children.
Often worried or worries about many things.
Tends to do things on own—rather solitary.
Irritable—quick to "fly off the handle".
Often appears miserable, unhappy, tearful or distressed.
Is often disobedient.
Cannot settle to anything for more than a few moments.
Tends to be fearful or afraid of new things or new situations.
Fussy or over-particular child.
Often tells lies.
Has stolen things on one or more occasion in the last 12 months.
Has had tears on arrival to school or has refused to enter the building in the last 12 months.
Has a stutter or stammer.
Bullies other children.

Appendix C. Additional information on the statistical analyses

Because SDQ subscale scores are highly skewed, for formal inference they were analyzed as ordinal variables. To account for the within-subjects correlation over time in these repeated measures, trends were estimated by maximum likelihood using a random intercept ordinal logistic regression model fitted using adaptive quadrature in the procedure gllamm (Generalised Linear Latent and Mixed Models – www.gllamm.org). The gender of the SLI participants was used as a covariate in all analyses. The method accounts for bias due to attrition on an assumption that losses may be selective of individuals with higher or lower observed measures but does not allow additional selective loss associated with the unobserved measures (Missing at Random).

The SDQ total difficulties score had variable range between the 20 sets of imputed data, which made the analysis impossible. Therefore, the top of the SDQ range was grouped to one value after the score of 25 (which was the lowest score that was missing in one of the 20 sets of data). This equated all imputations and allowed the analysis to run correctly. All scores above 25 were recoded as 25. This grouping affected only the top 4% of SDQ total difficulties scores.

Logistic regressions were conducted across time on the proportion of impaired individuals for the SDQ total difficulties score and the four subscales. A categorical age measure was used to determine whether the impairment distribution differed between the time points.

The graphs of trends in cohort mean scores were compiled from fitted values from a multilevel mixed-effects linear regression model (xtmixed with a random intercept; Fig. 1). The mixed effects regression model had a categorical age (7, 8, 11 and 16) and gender fixed effects. Fitted data were preferred to raw data as this accounted for attrition over time. The normative line included in Fig. 1 was adjusted for the specific gender distribution in the current sample (normative means for the males and female were weighted and averaged based on the gender distribution in the SLI sample). Each of the curves in Figs. 2–5 are prediction plots based on the raw data, which indicate the predictive curve of the relationship between language/literacy and SDQ scores given the raw data.

Appendix D. Continuing education questions

1. Individuals with a history of SLI showed increasing problems throughout development in which area of difficulty?
    a. Hyperactivity difficulties
    b. Conduct difficulties
    c. Emotional difficulties
    d. Social (peer) difficulties
2. Individuals with a history of SLI have severe and persisting behavioral problems from childhood to adolescence. True/False
3. Adolescents with a history of SLI showed sustained difficulties in which two areas?
    a. Social (peer) and emotional difficulties
    b. Emotional and hyperactivity difficulties
    c. Hyperactivity and conduct difficulties
    d. Social (peer) and conduct difficulties
4. What aspect of language/literacy ability was related to all measures of BESD in individuals with a history of SLI?
    a. Expressive language
    b. Reading accuracy
    c. Pragmatic language
    d. Receptive language
5. What statement best describes the relationship between reading accuracy in childhood and BESD in individuals with a history of SLI?
    a. High reading accuracy ability was related to increased rates of behavioral and emotional problems.
    b. High reading accuracy ability was related to lower rates of behavioral problems throughout development.
    c. High reading accuracy ability was related to fewer behavioral, emotional and social difficulties throughout development.
    d. High reading accuracy ability was related to fewer behavioral problems in childhood, but was not related to problems in adolescence.

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M.C. St Clair et al./Journal of Communication Disorders 44 (2011) 186–199

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