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Pathways from the early language and communication environment to literacy outcomes at the end of primary school; the roles of language development and social development

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ABSTRACT

The quality of a child's early language and communication environment (ELCE) is an important predictor of later educational outcomes. However, less is known about the routes via which these early experiences influence the skills that support academic achievement. Using data from the Avon Longitudinal Study of Parents and Children (n = 7,120) we investigated relations between ELCE (<2 years), literacy and social adjustment at school entry (5 years), structural language development and social development in mid-primary school (7–9 years), and literacy outcomes (reading and writing) at the end of primary school (11 years) using structural equation modelling. ELCE was a significant, direct predictor of social adjustment and literacy skills at school entry and of linguistic and social competence at 7–9 years. ELCE did not directly explain variance in literacy outcomes at the end of primary school, instead the influence was exerted via indirect paths through literacy and social adjustment aged 5, and, language development and social development at 7–9 years. Linguistic and social skills were both predictors of literacy skills at the end of primary school. Findings are discussed with reference to their potential implications for the timing and targets of interventions designed to improve literacy outcomes.

KEYWORDS

Literacy; social relationships; language; linguistics; communication; longitudinal

Children's early oral language skills are positively associated with later academic outcomes (Bleses et al., 2016; Roulstone et al., 2011). This applies to many aspects of academic performance but it is especially relevant to achievement in literacy (Durkin et al., 2009). One reason for this is that oral language competencies in areas such as phonology, vocabulary, syntax, non-literal language and story-telling can form a secure foundation for reading comprehension and decoding (Bishop & Snowling, 2004; Bowyer-

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Crane et al., 2008). Reading skills in turn facilitate children's engagement with texts and production of their own writing, on which formal academic assessment often depends. In addition, linguistic skills enable a child to benefit from direct instruction from a teacher, which is typically delivered using linguistic means of communication.

There may also be influences on literacy outcomes via the relations between oral language skills and social development. Like oral language competence, early social competence has been linked to later academic achievement, in this case via positive school adjustment and engagement in collaborative learning with peers (Denham & Brown, 2010; Taylor et al., 2004; Von Salisch et al., 2015). Moreover, social competence has a close link to oral language competence (St Clair et al., 2011; Mok et al., 2014). Linguistic and social competencies have a mutually influential impact in early child development. A child's first words emerge in the context of early caregiver interactions (Carpenter et al., 1998). Later in toddlerhood and beyond, more advanced linguistic skills give children tools to make friends and engage in play (Fujiki et al., 1999; Hoff, 2006; Hoyte et al., 2014; Rakoczy et al., 2006). In turn, these social competencies may enable children to engage in peer learning opportunities (such as conversation or collaborative problem solving), which are associated with more positive educational outcomes (Mercer & Howe, 2012; Vrikki et al., 2019).

Both language development and social development are not only influenced by individual differences in underlying abilities but also by proximal and distal environmental factors. Oral language development is dependent on the nature, frequency and quality of early communicative experiences provided by the main caregiver and others (Huttenlocher et al., 2010; Romeo et al., 2018). These proximal influences on early linguistic development comprise a diverse and complex range of factors such as the activities and support that caregivers provide to scaffold early communication (e.g., talking to, reading or playing with, or singing to a child), alongside consideration of the economic resources that families put into communication-relevant activities, for example, books, toys or visits to the library (Roulstone et al., 2011). Reflecting the reciprocal influences discussed above, high-quality early environments have also been shown to be good predictors of social skills development (Rose et al., 2018), while parental behaviours that support language development also support social development.

Given that provision of a high-quality early learning environment draws on both temporal and financial resources, the construct should also be considered with reference to socioeconomic status (SES). Deleterious effects of poverty have been consistently observed for children's language development and social development (Bradley & Corwyn, 2002; Hoff, 2003; Law et al., 2019) as well as for literacy outcomes (Feinstein, 2003; Jerrim et al., 2015). Even so, a recent analysis has shown that while SES is an influential factor, good quality early learning environments can be created even in resource-limited families (Law et al., 2019). That is: while the availability of resources is significant, good use of whatever is available is more important (Hoff, 2003).

An array of factors, then, including environmental quality, SES and material resources, individual differences in the pace of linguistic and social development, bear on the skills a child has at the time of entry to school and contribute to 'school readiness'. The construct of school readiness captures the extent to which a child is ready to thrive in the context of formal schooling (Snow, 2006). It can be viewed across several domains, including academic competences such as literacy and numeracy, and so-called 'non-cognitive' or 'learning

readiness' skills such as social awareness, self-regulation, independence and persistence in problem-solving (Blair & Raver, 2015; Carton & Winsler, 1999; Denham, 2006; Fink et al., 2019).

Findings regarding the relative contributions of these different skill domains at school entry have been mixed. Konold and Pianta (2005) found that children characterised by a high level of social skill at school entry tended to do better than most other groups on academic outcomes measured after the first year of school. On the other hand, a meta-analysis of six longitudinal cohort studies (drawn from Canada, UK and USA), using school entry assessments as predictors of academic achievement, found moderate effects for early number skills, small effects for early literacy and language skills and null effects for early social skills (Duncan et al., 2007). Interestingly, however, a replication of this meta-analysis in the Canadian data, using multiple imputation to account for missing datapoints, found that social adjustment at school entry did in fact predict academic achievement (Romano et al., 2010). Furthermore, the original Duncan study aggregated outcome measures from quite a wide age range from age 7–8 years to 13–14 years, depending on the available data in each cohort. Therefore, some of the variability across domains may be due to the age of assessment; theorists have suggested that the influences of social competencies on learning may increase as children get older (Denham & Brown, 2010). In light of these mixed findings, there is still work to be done in understanding how the skills in different domains that children have at school entry develop in concert over time, and in identifying the pathways via which early environmental factors exert influence over the later linguistic and social competencies that ultimately affect academic outcomes.

The current study

In the current study, we used a large cohort dataset, the Avon Longitudinal Study of Parents and Children (ALSPAC), to investigate the relative importance of linguistic and social influences on achievement in literacy at the end of primary school. Our thesis is that a positive early language and communication environment (ELCE) initiates a 'virtuous cycle' whereby early social and communicative experiences boost individual development in these domains, thus supporting school readiness. We consider the features of a positive early language and communication environment to be parental resources and behaviours that provide optimal conditions for child language development (Bradley & Corwyn, 2002; Son & Morrison, 2010). This might include parental sensitive and contingent responding, engaging the child in play and other one-to-one activities, and emotional warmth (Son & Morrison, 2010). In turn, skills at school entry enable children to capitalise on opportunities in the school environment, further promoting linguistic and social development and ultimately supporting academic attainment at the transition to high school.

We need also further evidence to address the fascinating possibility that, as children progress through primary school, learning may be increasingly influenced by different domains of development or that the impact of development in different domains upon learning may vary over time. Oral structural language skills (i.e. expressive and receptive competence in morphosyntax and semantics) have been traditionally linked to literacy achievement but their relative importance when compared to social influences on literacy at different stages of development is not clear. Therefore, we plan to compare the relative influence of oral structural language skills with the influence of social competences upon

literacy outcomes. Given that performance in reading is strongly linked to decoding skills (Castles et al., 2018), we include this, along with performance IQ, in our model even though they are not variables of primary interest to the current study. Note that in the current study we use the term 'literacy outcomes' as a shorthand for academic performance in reading and writing.

To achieve these aims we adopt a longitudinal, community-based cohort approach. Modelling of children's development and achievement over time allows us to address the following predictions:

We expect to find a direct effect of early environmental influences on academic and social school readiness at school entry, on linguistic and social development in middle-primary school and also on literacy attainment at age 11 years. We also expect that indirect paths from linguistic and social abilities may differentially impact on academic performance in literacy outcomes at the end of primary school. Based on the weight of previous evidence, we predict stronger effects of linguistic ability, compared to social abilities, on literacy outcomes.

Materials and methods

Ethical approvals

Ethical approval for the study was obtained from the Avon Longitudinal Study of Parents and Children (ALSPAC) Ethics and Law Committee and the Local Research Ethics Committees. Ethical approval for the secondary analysis of existing ALSPAC data was obtained from the University of York Education Ethics Committee (reference: 18/5).

Study sample

Data from the ALSPAC sample were used in this study (Boyd et al., 2013; Fraser et al., 2013). All pregnant women in the old administrative region of Avon, whose estimated delivery was between April 1991 to December 1992, were eligible to participate. The ALSPAC enrolled sample consisted of 15,454 pregnancies, which resulted in a total number of 15,589 children (including multiple births). Of these, 14,901 were alive at 1 years of age. Parents and children provided biological samples, questionnaire data, and took part in direct assessments. Full details of the cohort are reported elsewhere. The study website contains details of all the data that are available and provides a fully searchable data dictionary and a variable search tool (http://www.bristol.ac.uk/alspac/researchers/our-data/).

A number of exclusionary criteria were applied: second-born children, those who did not take part in the speech and language session at age 8 years, and those with a performance IQ below 60 were removed (n = 8,325). This resulted in a final sample size of 7,120 (50% boys).

Measures

Early language and communication environment (ELCE, 18–24 months)

When the child was aged 18–24 months, ELCE was assessed using a measure previously used by Roulstone et al. (2011). Higher scores on the measure are indicative of richer

home environmental support for language and communication. The ELCE measure includes five subscales: mother-child direct teaching (e.g., mum teaches songs), mother-child activities (e.g., frequency mum has physical play with child), child's interactions with others (e.g., child sung to), resources (e.g., number of toy vehicles a child has at home), and other activities (e.g., frequency child taken to park). The composite sum scores from these five subscales were used to create a continuous latent variable within a structural equation modelling (SEM) framework (CFI =.952, TLI = .904, RMSEA = .063, SRMR = .028). Full details of the measure are provided in Appendix A.

Early socio-economic status (SES)

A composite measure of socioeconomic status was taken from Roulstone et al. (2011) and adapted (car ownership question removed because 95% of the sample owned a car). The measure consisted of a number of parent-report questions, which were taken at 8- and 32-weeks gestation. They were coded as described in Roulstone et al. (2011). Responses were coded on a binary scale for paternal occupation (0 = *manual*, 1 = *non manual*), maternal education (0 = *lower than A level*, 1 = *A level or higher*), house tenure (0 = *not owned*, 1 = *owned*), home overcrowding (0 = *more than one person per room*, 1 = *less than one person per room*), and financial difficulties (0 = *financial difficulties reported*, 1 = *no financial difficulties reported*). These binary variables were then summed to create an early SES score ranging from 0 to 5. Higher scores indicate higher SES.

School entry measures (4–5 years)

Children in the UK usually begin school by starting in 'Reception' class in the September following their fourth birthday and then transition into formal schooling in 'Year 1' during their fifth year of life. Although at the time the ALSPAC children reached Reception-age there were no statutory assessments, the local region had its own school entry assessments, and these were used in the current study. We have used these assessments as teacher-rated school readiness indicators in the domains of social adjustment and literacy. Each assessment area was teacher-rated on a scale of 2–7 with higher scores indicating greater competence. Assessments were carried out in the first half-term following entry once teachers were satisfied the children were settled. Two measures from these assessments were used in the analyses reported here:

Literacy at school entry. This latent variable (described in the statistical analyses section) comprises early reading and writing skills as rated during the reception year.

Social adjustment at school entry. This observed variable is the teacher assessment of the child's social adjustment in the first half-term after school-entry.

Mid-primary school measures (7–9 years)

At the mid-point of primary school, measures of linguistic and social development were taken. These were a combination of in-clinic assessments and parent-report:

Language development at age 8 years. This was based on measures of expressive and receptive language skills. These skills were measured using subtests from the Weschler Objective Language Dimensions (WOLD; Rust, 1996) and were carried out via direct

assessment with each child. The expressive language task was a 10-item picture naming task and the receptive language task involved being shown a complex picture, listening to a paragraph about it, and subsequently being asked 16 comprehension questions about what the child had heard. For both tests, incorrect responses were scored as 0 and correct responses were scored as 1. Scores were then summed to create a score ranging from 0 to 10 for expressive language and 0 to 16 for receptive language. Composite sum scores for both measures of language development were used to create a latent variable for language ability (as described in the statistical analyses section).

Social development. This was based on three measures: play skills, prosociality and pragmatic language, which were combined to generate a latent variable (as described in the statistical analyses section).

Play skills at 7 years. Parents were asked to rate their child's social play skills such as sharing toys and easily taking turns in a game. There were eight items and the responses to each item were recoded onto a two-point scale (1 = *yes but not well*, 2 = *yes can do well*) and a mean score was calculated. Scores ranged between 1 and 2, with higher scores indicating higher levels of skill in play-based interactions.

Prosociality at 7 years. The prosociality scale was based on parental ratings on the Strengths and Difficulties Questionnaire (SDQ) prosocial subscale (Goodman, 1997), which consists of five statements rated on a three-point scale (0 = *not true, 1 = somewhat true, 2 = certainly true)*. Scores ranged from 0 to 10 with higher scores showing higher levels of prosociality.

Pragmatic language at 9 years. The Children's Communication Checklist (Bishop, 1998) was used to assess pragmatic language. This is a parental rating of child communication skills. The following subscales were summed to form the pragmatic score: *inappropriate initiation, coherence, stereotyped conversation, use of conversational context*, and *conversational rapport*. Higher scores indicate greater pragmatic language ability. The pragmatic scale was included in the social development latent variable as it involves the social use of language (for example, in a conversation) rather than the more traditional 'structural' measures of comprehension and expression indexes in the language development variable. Of course, pragmatics also relies on linguistic skills and the distinction is not absolute; for this reason, we co-varied the language development and social development latent variables in our model (see statistical analyses section).

Performance IQ at age 8 years. The Wechsler Intelligence Scale for Children (WISC: Wechsler, 1991) was used to assess performance IQ (PIQ). To generate a performance IQ score, the five performance subtests were used: picture completion, coding, picture arrangement, block design, and object assembly. The raw scores were standardised using the WISC manual to generate an age-appropriate score for each child. Higher scores indicated higher performance IQ.

Decoding skills at age 9 years. This was assessed face-to-face by asking the child to read out 10 words and 10 non-words. Both types of words were taken from a larger battery of words (Nunes et al., 2003). Incorrect responses were coded as 0 and correct responses were coded as 1. These were summed to create a score out of 10 for words and the same for non-words with higher scores indicating better reading ability. These two scores were

then combined to generate a latent variable for decoding skills (as described in the statistical analyses section).

End of primary school literacy outcomes (11 years)

The literacy outcomes measures are based on statutory national assessments that all children in England complete at the end of primary school (key stage 2). The ALSPAC study team obtained data from the National Pupil Database (NPD, the English national record of educational achievement for children in state schools) and linked it with the data for each child. In the present study, we used scores from key stage 2 reading and writing assessments to compute a latent variable, literacy outcomes.

Statistical analyses

A SEM approach was used to address the research questions. Prior to implementing the SEMs, a theoretical model specifying the relations and pathways we expected to see between the study variables was constructed (see Figure A1 in Appendix).

The SEM model was specified in Mplus version 7.3 (Muthen & Muthen, 2012). All other analyses were run in Stata/MP 16 (StataCorp, 2019). Pathways between the ELCE and end of primary school literacy outcomes were investigated. This included direct paths and also indirect paths via social school readiness (4–5 years) and a number of latent variables: literacy at school entry (4–5 years), language development (8 years), and social development (7–9 years). We also included direct and indirect paths via covariates such as performance IQ (8 years) and decoding skills (9 years). Latent variables can be interpreted in the same way as composite sum scores but with less measurement error. This is because the extent of the associations between the subscales and the continuous latent variable can vary, whereas with a composite sum score this is not possible. Taking the example of the ELCE, in a composite sum score, it is assumed that all five subscales contribute equally to ELCE. In a latent variable, if one of the subscales is more important for ELCE then this is accounted for in the model.

SEM models allow for a measurement (i.e., the latent factor modelling) and structural model (i.e., the path analysis) to be run concurrently within a single model. The measurement model allows for an account to be taken of measurement errors that would otherwise downwardly bias the apparent strength of association between the predictor and outcome. Individual items were not loaded directly onto the latent factors. Instead, a method known as parcelling was used. To do this, first, composite sum scores were created for each of the constituent variables for any given latent variable and these scores were treated as observed variables for the purposes of the latent factor loadings. In total, there were six latent variables in the SEM; ELCE (mother-child direct teaching, mother-child activities, child's interactions with others, resources, and other activities), literacy at school entry (reading and writing), language development in mid-primary school (expressive and receptive language), social development in mid-primary school (play skills, prosociality, and pragmatic language), decoding skills (word reading and non-word reading), and end of primary school literacy outcomes (reading and writing).

The MLR estimator, which is robust to non-normality, was used in the SEM. Residual variances for all latent variables at age 5 years and 7–9 years were correlated with all others at the same time point to account for the overlap between the constructs. The

MODEL INDIRECT command was used to test for indirect paths between ELCE and end of primary school literacy outcomes. All indirect paths were tested rather than just when there was a significant main effect; the indirect paths were calculated post-hoc using the delta method. This is in line with other literature that uses a similar approach and allowed potential suppressor effects to be revealed (St Clair et al., 2015; MacKinnon, 2000).

Missing data

Given the nature of longitudinal studies, sample attrition is almost inevitable. The ALSPAC sample was no exception as there was sample attrition and thus missing data. We compared children who took part at both age 1 and also at the end of primary school. There was no significant gender difference in sample attrition ($\chi^2(1, N = 14{,}854 = .13$, $p = .723$) between the sample at 1 years old and those with literacy outcomes data at the end of primary school. For those who dropped out, socioeconomic status was lower ($t(13{,}957) = 6.61$, $p < .001$) compared to those who continued to participate at the end of primary school. For the SEM, the full information maximum likelihood method was used to deal with missing data.

Results

Pairwise correlations between all variables of interest and descriptive statistics are shown in Tables 1 and 2, respectively. The final SEM is shown in Figure 1 (CFI = .965, TLI = .949, RMSEA = .033, SRMR = .033). A full list of coefficients for all paths and factor loadings are provided in Table 3 and the indirect effects are shown in Table 4. For precision, the path coefficients in this section, and in Tables 3 and 4, are reported to three decimal places.

The effect of ELCE on school readiness at school entry, language development and social development in the middle-years of primary school

As shown in Table 3, ELCE was associated with literacy at school entry (β = .225, 95% CI: .193, .256) and social adjustment at school entry (β = .090, 95% CI:.053, .127); as well as language development (β = .118, 95% CI: .086, .150), social development (β = .247, 95% CI: .208, .286), performance IQ (β = .039, 95% CI: .003, .055), and decoding skills (β = .087, 95% CI: .058, .116) in the middle years of primary school. In short, a richer ELCE was associated with more favourable school readiness in literacy and social adjustment, language development and social development, and performance IQ and decoding skills in the middle years of primary school.

As expected, higher pre-natal socioeconomic status was associated with better literacy (β = .312, 95% CI: .286, .338) and social adjustment at school entry (β = .157, 95% CI: .127, .188) as well as better language development (β = .196, 95% CI: .168, .225) and social development (β = .128, 95% CI: .090, .167), and performance IQ (β = .139, 95% CI: .117, .162) and decoding skills (β = .149, 95% CI: .125, .173) in the middle years of primary school. Therefore, early socioeconomic status and ELCE each make a unique contribution to subsequent outcomes at school entry and middle years of primary school.

Table 1. Pairwise correlations between all variables of interest.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Mother-child direct teaching	1																	
2. Mother-child activities	.36***	1																
3. Child's interactions with others	.30***	.45***	1															
4. Resources	.09***	.18***	.26***	1														
5. Other activities	.16***	.25***	.25***	.20***	1													
6. Early socioeconomic status (< 2 years)	.07***	.10***	.20***	.17***	.15***	1												
7. Reading (5y)	.13***	.10***	.19***	.09***	.10***	.25***	1											
8. Writing (5y)	.12***	.10***	.15***	.05**	.10***	.19***	.55***	1										
9. Social adjustment at school entry (5y)	.07**	.05*	.11***	.05*	.10***	.14***	.49***	.47***	1									
10. Receptive language (8y)	.06***	.07***	.11***	.10***	.06***	.19***	.21***	.15***	.15***	1								
11. Expressive language (8y)	.10***	.10***	.19***	.10***	.07***	.24***	.30***	.24***	.18***	.40***	1							
12. Play skills (7y)	.07***	.11***	.12***	.08***	.05***	.09***	.12***	.11***	.14***	.07***	.12***	1						
13. Prosociality (7y)	.10***	.12***	.11***	.02	.05***	.00	.05**	.08***	.13***	.03*	.04**	.34***	1					
14. Pragmatic language (9y)	.07***	.10***	.15***	.11***	.08***	.20***	.18***	.18***	.20***	.13***	.19***	.26***	.20***	1				
15. Performance IQ (8y)	.08***	.05***	.13***	.13***	.08***	.24***	.29***	.26***	.19***	.24***	.35***	.13***	.03**	.17***	1			
16. Word reading (9y)	.11***	.09***	.17***	.07***	.08***	.22***	.26***	.24***	.18***	.23***	.37***	.13***	.03	.23***	.27***	1		
17. Non-word reading (9y)	.08***	.07***	.13***	.07***	.04**	.17***	.20***	.18***	.13***	.17***	.29***	.10***	.01	.17***	.23***	.72***	1	
18. Reading (11y)	.14***	.11***	.22***	.08***	.14***	.32***	.40***	.35***	.29***	.35***	.48***	.16***	.07***	.29***	.42***	.61***	.49***	1
19. Writing (11y)	.11***	.10***	.18***	.04**	.13***	.27***	.36***	.35***	.27***	.21***	.34***	.12***	.08***	.25***	.31***	.53***	.45***	.67***

*** p < .001, **p < .01, * p < .05.

Table 2. Summary statistics for all variables of interest.

	n	Mean (SD)	Range
Early language and communication environment (18–24 months)			
Mother-child direct teaching	6,425	8.05 (1.56)	0–10
Mother-child activities	6,409	32.84 (3.22)	14–40
Child's interactions with others	6,234	28.10 (2.07)	5–30
Resources	6,230	21.53 (2.16)	6–24
Other activities	6,408	8.38 (1.92)	2–15
Early socioeconomic status (< 2 years)	6,765	8.38 (1.92)	0–5
School entry measures (5 years)			
Reading	4,787	5.25 (.85)	2–7
Writing	4,788	5.04 (.84)	2–7
Social adjustment	2,459	5.57 (1.02)	2–7
Mid-primary school measures (7–9 years)			
Receptive language	7,113	7.49 (1.94)	2–15
Expressive language	7,091	7.47 (1.80)	0–10
Play skills	5,830	1.74 (.19)	1–2
Prosociality	5,715	8.21 (1.71)	0–10
Pragmatic language	5,557	151.32 (7.16)	98–162
Performance IQ	7,120	99.98 (16.71)	60–151
Word reading	6,371	7.63 (2.38)	0–10
Non-word reading	6,368	5.29 (2.47)	0–10
End of primary school literacy outcomes (11 years)			
Reading	6,047	31.36 (8.29)	0–49
Writing	6,049	27.81 (7.85)	2–50

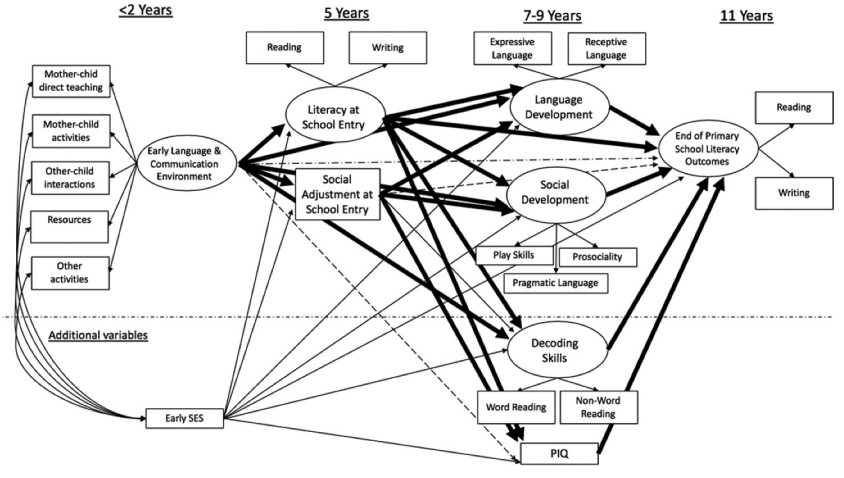

Figure 1. Pathways to end of primary school literacy outcomes. Dot-dashed lines depict non-significant paths. Solid lines depict significant direct paths at p <.05 or lower. Bold solid lines depict significant indirect pathways at p <.05 or lower. Note. The covariance arrows between all the mediators at age 5 and 7–9 years have been removed to make the figure clearer. The coefficients for these covariances are shown in Table 3.

Direct pathways from ELCE, early SES, and language development and social development to end of primary school literacy outcomes

There was a direct effect from early socioeconomic status to end of primary school literacy outcomes (β = .057, 95% CI: .037, .076). There was not, however, a residual direct effect between ELCE and end of primary school literacy outcomes (β = −.009 95% CI: −.032,

Table 3. Coefficients for structural equation model.

	Standardised β coefficients [95% Confidence Intervals]
Latent variable factor loadings	
Mother-child direct teaching → ELCE	.473 [.448,.498]
Mother-child activities →ELCE	.664 [.640,.688]
Child's interactions with others →ELCE	.691 [.662,.719]
Resources →ELCE	.326 [.297,.355]
Other activities →ELCE	.382 [.358,.405]
Reading → literacy at school entry	.771 [.753,.790]
Writing → literacy at school entry	.709 [.690,.728]
Receptive language →language development	.529 [.510,.548]
Expressive language →language development	.751 [.732,.771]
Play skills → social development	.589 [.544,.633]
Prosociality → social development	.472 [.430,.514]
Pragmatic language → social development	.533 [.484,.583]
Word reading → decoding skills	.942 [.931,.952]
Non-word reading → decoding skills	.769 [.757,.780]
Reading → end of primary school literacy outcomes	.902 [.893,.911]
Writing → end of primary school literacy outcomes	.746 [.735,.758]
Path coefficients	
ELCE → literacy at school entry	.225 [.193,.256]
ELCE → social adjustment at school entry	.090 [.053,.127]
ELCE → language development	.118 [.086,.150]
ELCE → social development	.247 [.208,.286]
ELCE → performance IQ	.039 [.003,.055]
ELCE →decoding skills	.087 [.058,.116]
ELCE → end of primary school literacy outcomes	−.009 [−.032,.014]
Early SES → literacy at school entry	.312 [.286,.338]
Early SES → social adjustment at school entry	.157 [.127,.188]
Early SES → language development	.196 [.168,.225]
Early SES → social development	.128 [.090,.167]
Early SES → performance IQ	.139 [.117,.162]
Early SES →decoding skills	.149 [.125,.173]
Early SES → end of primary school literacy outcomes	.057 [.037,.076]
Literacy at school entry → language development	.461 [.402,.520]
Literacy at school entry → social development	.145 [.072,.217]
Literacy at school entry → performance IQ	.371 [.324,.418]
Literacy at school entry → decoding skills	.357 [.307,.407]
Literacy at school entry → end of primary school literacy outcomes	.235 [.191,.278]
Social adjustment at school entry → language development	−.092 [−.149, −.035]
Social adjustment at school entry → social development	.155 [.084,.226]
Social adjustment at school entry → performance IQ	−.079 [−.127, −.032]
Social adjustment at school entry → decoding skills	−.068 [−.119, −.018]
Social adjustment at school entry → end of primary school literacy outcomes	−.016 [−.056,.024]
Language development → end of primary school literacy outcomes	.278 [.244,.313]
Social development → end of primary school literacy outcomes	.076 [.044,.108]
Performance IQ → end of primary school literacy outcomes	.085 [.065,.105]
Decoding skills → end of primary school literacy outcomes	.452 [.427,.477]
Residual correlations	
Mother-child direct teaching with early SES	.099 [.075,.124]
Mother-child activities with early SES	.142 [.113,.171]
Child's interactions with others with early SES	.274 [.241,.308]
Resources with early SES	.171 [.148,.194]
Other activities with early SES	.154 [.131,.177]
Literacy at school entry with social adjustment at school entry	.630 [.600,.661]
Language development with social development	.140 [.089,.190]
Language development with performance IQ	.320 [.293,.348]
Language development with decoding skills	.372 [.340,.403]
Social development with performance IQ	.108 [.074,.141]
Social development with decoding skills	.156 [.112,.201]
Performance IQ with decoding skills	.166 [.142,.189]

Table 4. Coefficients for mediated effects in structural equation model.

	Standardised β coefficients [95% Confidence Intervals]	Proportion of effect explained (%)
Indirect paths		
ELCE → literacy at school entry→ end of primary school literacy outcomes	.053 [.040,.065]	26%
ELCE → social adjustment at school entry → end of primary school literacy outcomes	−.001 [−.005,.002]	n/a
ELCE → language development → end of primary school literacy outcomes	.033 [.023,.043]	16%
ELCE → social development → end of primary school literacy outcomes	.019 [.010,.027]	9%
ELCE → performance IQ → end of primary school literacy outcomes	.002 [.000,.005]	1%
ELCE → decoding skills → end of primary school literacy outcomes	.039 [.026,.053]	19%
ELCE → literacy at school entry→language development → end of primary school literacy outcomes	.029 [.022,.035]	14%
ELCE → literacy at school entry →social development → end of primary school literacy outcomes	.004 [.002,.001]	2%
ELCE → literacy at school entry →performance IQ→ end of primary school literacy outcomes	.002 [.001,.004]	1%
ELCE → literacy at school entry→decoding skills → end of primary school literacy outcomes	.036 [.029,.044]	17%
ELCE → social adjustment at school entry→ language development →end of primary school literacy outcomes	−.002 [−.004, −.001]	1%
ELCE → social adjustment at school entry→ social development →end of primary school literacy outcomes	.001 [.000,.002]	0%[a]
ELCE → social adjustment at school entry→ performance IQ →end of primary school literacy outcomes	−.001 [−.001,.000]	n/a
ELCE → social adjustment at school entry→ decoding skills →end of primary school literacy outcomes	−.003 [−.005,.000]	n/a

The last column is only populated for indirect effects that were significant. [a]the value here is 0.485, which is rounded down to 0%.

.014). Both language development (β = .278, 95% CI: .244, .313) and social development (β = .076, 95% CI: .044, .108) predicted end of primary school literacy outcomes but the effect of language development was stronger (χ^2(1, N = 7,120) = 7.12, p = .008)

Indirect pathways from ELCE to end of primary school literacy outcomes

As shown in Table 4, there were a number of indirect pathways between ELCE and literacy outcomes at the end of primary school. At school entry, there was a significant indirect pathway via literacy (β = .053, 95% CI: .040, .065) but not social adjustment (β = −.001, 95% CI: −.005, .002). There were also significant indirect pathways via language development (β = .023, 95% CI: .023, .043), social development (β = .019, 95% CI: .010, .027), performance IQ (β = .002, 95% CI: .000, .005), and decoding skills (β = .039, 95% CI: .026, .053) in the middle-primary school years. Language development was not a stronger mediator than social development of the relationship between ELCE and end of primary school literacy outcomes (χ^2(2, N = 7,120) = .55, p = .758). In sum, a richer ELCE was associated with better academic and social school readiness, as measured by literacy and social adjustment at school entry, but only academic school readiness was subsequently associated with better literacy outcomes at the end of primary school. Similarly, a richer ELCE was associated with higher levels of language development and social development in the middle years of primary school which, in turn, are associated with better literacy outcomes at the end of primary school.

In addition to the independent indirect pathways from ELCE to end of primary school literacy outcomes via literacy at school entry and language development and social development in middle-primary school years, there were also further effects. There was a significant indirect effect from ELCE to end of primary school literacy outcomes via literacy at school entry and language development in middle-primary school (β = .029, 95% CI: .022, .035). This was also the case for literacy at school entry and social development in middle-primary school years (β = .004, 95% CI: .002, .004). These findings reveal that a richer ELCE is associated with better literacy skills at school entry, which in turn are associated with better language development and social development in the middle years of primary school, which in turn are associated with better literacy outcomes at the end of primary school.

The equivalent effects were also observed for social adjustment at school entry. There was a significant indirect effect from ELCE to end of primary school literacy outcomes via social adjustment at school entry and language development in middle-primary school (β = −.002, 95% CI: −.004, −.001). This was also the case for social adjustment at school entry and social development in middle-primary school years (β = .001, 95% CI: .000, .002). Therefore, a richer ELCE is associated with better social skills at school entry, which in turn are associated with better language development and social development in the middle years of primary school, which in turn are associated with better literacy outcomes at the end of primary school.

We had anticipated that the indirect pathway from the ELCE via literacy at school entry and language development aged 7–9 years to literacy outcomes at the end of primary school would be stronger than the indirect pathway from the ELCE via social adjustment at school entry and language development in middle-primary years to literacy outcomes at the end of primary school. We found no evidence to support this expectation, χ^2(2,

N = 7,120) = 1.74, p = .419. Similarly, we expected that the indirect pathway from the ELCE via literacy at school entry and social development in middle-primary years to literacy outcomes at the end of primary school would be stronger than the pathway from the ELCE via social adjustment at school entry and social development in middle-primary years to literacy outcomes at the end of primary school. Again, we found no evidence to support this expectation (χ^2(2, N = 7,120) = .12, p = .40). These results do not support our hypothesis that academic school readiness in literacy may exert stronger indirect effects via support for later language development.

There was a significant indirect effect from ELCE to end of primary school literacy outcomes via literacy at school entry and performance IQ in middle-primary school (β = .002, 95% CI: .001, .004). A significant effect was not observed, however, when we examined the relationship between social adjustment at school entry and performance IQ in middle-primary school years (β = −.001, 95% CI: −.001, .000). Similarly, there was a significant indirect effect from ELCE to end of primary school literacy outcomes via literacy at school entry and decoding skills in middle-primary school (β = .036, 95% CI: .029, .044), but not for social adjustment at school entry and decoding skills in middle-primary school years (β = −.003, 95% CI: −.005, .000).

Discussion

The findings from the present study shed new light on pathways to literacy outcomes at the end of primary school. We first discuss the direct influence of the early factors measured (early SES and ELCE) before going on to explore the implications of the various direct and indirect influences on academic achievement in reading and writing.

Notably, this study illustrates the direct, enduring and wide-ranging influence of socioeconomic factors present in early life. Significant, direct paths from early SES to all predictor variables and to the academic outcome measure were observed. This complements the findings of Law et al. (2019), who reported similar SES effects on language development at age 2 years in the ALSPAC dataset; we now provide evidence of such effects extending into later childhood. The present results extend previous findings to demonstrate that early SES influences upon literacy outcomes remain even when a number of other factors are taken into consideration: social adjustment and literacy skills at age 5 years, and PIQ, decoding skills, and language development and social development aged 7–9 years and literacy outcomes aged 11 years.

Furthermore, this study confirms that the quality of the ELCE is influential over and above early SES effects. This adds to mounting evidence that quality of ELCE makes a difference even in otherwise adverse circumstances. To give some examples, mitigating effects of higher quality ELCE have been reported for early language development (Law et al., 2019), early cognitive development (Melhuish, 2010; Melhuish et al., 2008), and even on academic achievement at GCSE and A level (Sammons et al., 2018). Our findings are also congruent with research beyond the UK, including studies from Australia, Germany and USA. For example, Rodriguez and colleagues found both early learning environment and SES effects on school readiness (Rodriguez & Tamis-Lemonda, 2011), while other studies have emphasised the role of early communication and literacy activities with caregivers in influencing school readiness in literacy (Aikens & Barbarin, 2008; Neuman et al., 2018; Niklas & Schneider, 2013; Niklas et al., 2015). In the present study, we see that

direct effects of ELCE extend to school readiness in literacy and social domains aged 5 years, and beyond, to influence oral language skills and social development in middle-primary school (ages 7–9 years).

Interestingly, and unlike the findings for early SES, there was no direct path from ELCE to the end of primary school outcomes measure. Instead, the influence is indirect, with significant routes via literacy at school entry, and, oral language skills and social ability at the middle-primary school time point. At school entry, the literacy measure, based on an assessment of reading and writing skills, was found to be much more influential upon literacy achievement at the end of primary school than the school-entry social adjustment variable. This finding is consistent with the meta-analysis by Duncan and colleagues (Duncan et al., 2007) but not with the later reanalysis of the Canadian data, as discussed in the Introduction (Romano et al., 2010). The present study elucidates this issue by revealing that it is slightly later in development (aged 7–9 years) when social skills begin to impact significantly on end of primary school literacy outcomes, in that this can explain unique variance in outcomes. This fits with the general developmental pattern that peer-based, social learning is a sophisticated skill that develops throughout middle childhood and into adolescence (Baines & Howe, 2010; Howe, 2009; Mercer & Howe, 2012). It may be the case that, once the basic building blocks of reading and writing skills are in place, children are better able to take advantage of their developing social competence for the purposes of academic learning. For example, a child with secure comprehension of a text may be more confident and able to discuss it with her peers, a level of social interaction which then helps her to engage with new perspectives and refer back to the text as appropriate.

Concerning the question of the relative importance of social development vs language development on the path to literacy outcomes, we found differing amounts of variance explained by these variables. The results underscore the role that oral language development plays in supporting academic outcomes in the domain of literacy (Snow, 1991). Higher oral language ability at 7–9 years was associated with better literacy outcomes at primary school leaving age and was the final step on an indirect pathway from ELCE to literacy outcomes, via literacy and social adjustment at school entry, as well as being directly linked to ELCE. These findings bolster existing links in the literature connecting early vocabulary skills to academic achievement (Bleses et al., 2016) and demonstrate that structural oral language skills, (i.e., language development in areas such as syntax, morphology and semantics), continue to be important throughout the primary school years. The magnitude of the direct effects on the end of primary school literacy outcomes (from 7 to 9 years to outcomes at 11 years) was stronger for oral language development compared to social development. For indirect paths (ELCE->5 years->7-9 years-> literacy outcome at 11 years), however, the effects were not found to be significantly greater for oral language competence than for social competence. This supports our hypothesis of differential influences of social and linguistic factors.

School-entry social adjustment was associated with relatively weaker effects. Social adjustment at age 5 was predictive of social development aged 7–9 years, and significant direct effects were also observed for later oral language development. Interestingly, although no significant indirect pathways from school-entry social adjustment were found, at 7–9 years there was a significant, direct pathway from social development to literacy outcomes. Taken together with the findings of mixed evidence for differential

pathways discussed above, we suggest these results show that both social and linguistic domains of development should be given due consideration when supporting children's academic progress in the later primary school years.

Alongside the variables associated with the main research questions motivating the present study we also included measures that have already been linked to literacy outcomes: performance IQ and decoding skills (Castles et al., 2018; Tiu et al., 2003). Findings from these measures support previous research, demonstrating that each of these constructs explains variance in literacy outcomes. Importantly, the findings reported here add the information that ELCE has a direct influence on decoding skills in particular.

Strengths and limitations

The present study has many strengths, including the large sample size and, unusually for a large cohort sample, direct measures of expressive and receptive language. There are also some limitations and caveats to be considered. One issue is that the sample was less ethnically and economically diverse than the UK population in general. This limits the potential generalisability of the study and we recommend replication of effects in diverse samples in the UK and beyond. Further, we did not have a measure of the home language and communication environment during the primary school years, nor ongoing measures of SES. These factors have been shown to be influential beyond the early years, as family circumstances can change for many reasons (Jeynes, 2002; Toth et al., 2020). In addition to this, the sample size for the measurement of social adjustment at school entry was much lower than that for literacy skills. Although the sample size for social adjustment was still substantial, this should be noted in interpreting the results and it would be desirable to address this issue in future research.

It is also a strength that this study contains measures of both structural language skills and pragmatic language skills. However, we recognise that not all language researchers would agree with the choice to include pragmatics as part of the social development latent variable rather than creating a generic linguistic variable. We made this decision a priori, taking a broad view of pragmatics as the act of putting language to use in social situations, in line with other studies that have made this distinction (Law et al., 2015; Law et al., 2014). To account for the inevitable dependence between the two, we allowed our measures of language development and social development to co-vary.

Finally, as we did not have access to objective test data to measure skills at school entry, we cannot assess teacher report measures for accuracy. Nevertheless, the school entry measures do behave as expected in the model and are associated with later outcomes in the predicted fashion.

Implications for policy and practice

The findings have implications for policy and practice in early childhood and in education. Firstly, the findings underscore the importance of policy responses to poor achievement in reading and writing that address distal social causes, alongside those that might focus on proximal environments or individual skills. Improving early family SES indicators such as education and income would likely have a direct impact on child outcomes throughout

primary schools. Further, as positive ELCE was observed to have an influence on later skills and outcomes even in the presence of early SES challenges, the present results provide yet additional support for the importance of early childhood interventions (Law et al., 2019; Melhuish, 2010; Sammons et al., 2004).

The lack of direct paths from the ELCE to literacy outcomes at the end of primary school illuminates that there are other possible routes to supporting academic development in those children who did not have optimal early learning experiences. There are implications for the timing and targets for interventions during the middle childhood period.

At school entry, the findings point to greater likely benefits for literacy outcomes from targeting early literacy skills, rather than social skills. Our findings also underscore the important role of decoding skills in literacy achievement (cf. Castles et al., 2018) and therefore we advocate that this should be a continued aspect of policy approaches to improving literacy outcomes.

Nevertheless, our findings show that social school readiness influences social and linguistic factors in the mid-primary school years and that these are in turn associated with improved literacy outcomes. Hence, there are good grounds for maintaining and strengthening educational strategies that combine both linguistic and social elements in order to support those students at risk of poor outcomes. Social interventions may not 'pay off' immediately in terms of literacy but afford a developmental context that can be drawn upon increasingly as the child's reading and writing skills advance.

Finally, we note that the social domain of development found to be significant for literacy outcomes in the present study may provide concrete and enjoyable intervention targets for 7–9 year olds. For example, educators could consider providing opportunities for practice of pragmatic language skills and social skills via supported collaboration and conversational engagement in classroom activities and in play and games with peers. This aligns with recent studies demonstrating the success of dialogic teaching strategies that take a social-constructivist approach to using talk in groups to promote learning (Mercer & Howe, 2012).

The present study demonstrates the importance of the early language and communication environment in supporting development of the skills that underpin children's achievement in reading and writing. Oral language comprehension and expression are important predictors of variance in literacy outcomes, while social competences, including pragmatics, prosociality and social play, also play an important role and should continue to receive attention in the mid-primary school years.

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Appendix. Early language and communication environment (ELCE)

When the child was aged 18–24 months, the mother was asked about the child's early language and communication environment. These questions were previously coded by Roulstone et al. (2011) and used as a measure of communication environment. The framework, proposed by Roulstone et al. (2011), included proximal and distal language and communication stimulation, proximal development and welfare, maternal attitudes, and maternal support. Two components of the framework were used here: language and communication stimulation and development and welfare. Each item used by Roulstone et al. (2011) was screened for duplicates (some questions were asked at two separate time points). Then, items within each of the sub-categories of language and communication stimulation and development and welfare were analysed using factor analysis to a) confirm that the items loaded on to a single factor within each construct (decisions were based on Eigenvalues of 1 or above and visual inspection of a scree plot) and b) remove items which loaded poorly on to the main factor (factor loadings of below 0.4 were removed). In summary, five subscales of early language and communication environment were created (mother-child direct teaching, mother–child interaction, child's interactions with others, resources, and other activities). Further details of each of the five subscales are provided below.

Mother-child direct teaching

This measure consisted of 10 items such as 'mum teaches clapping games' and 'mum teaches songs'. Responses were coded on a binary scale (0=no, 1= yes) and then summed to create a score

ranging from 0 to 10. Higher scores indicated that the mother taught the child a wider variety of things. The scale had acceptable internal consistency (Cronbach's alpha = 0.63). The variance explained by the latent factor in the SEM (without DLD: 23%, with DLD: 27%)

Mother-child activities

This measure consisted of eight items such as 'frequency mum sings to child' and frequency mum has a physical play with child". Responses were coded on a 5-point scale (1=never,2=<once per week, 3=1-2 times per week, 4=3-5 times per week, 5=almost daily) and then summed to create a score ranging from 8 to 40. Higher scores indicated that the mother and child engaged in activities more frequently. The scale had good internal consistency (Cronbach's alpha = 0.70). The variance explained by the latent factor in the SEM (without DLD: 44%, with DLD: 55%)

Table A1. Pairwise correlations between early language and communication environment subscales.

	1	2	3	4	5
1. Mother-child direct teaching	1				
2. Mother-child activities	0.41***	1			
3. Child's interactions with others	0.33***	0.48***	1		
4. Resources	0.14***	0.21***	0.32***	1	
5. Other activities	0.21***	0.29***	0.29***	0.22***	1

*p< .05, **p< .01, ***p< .001.

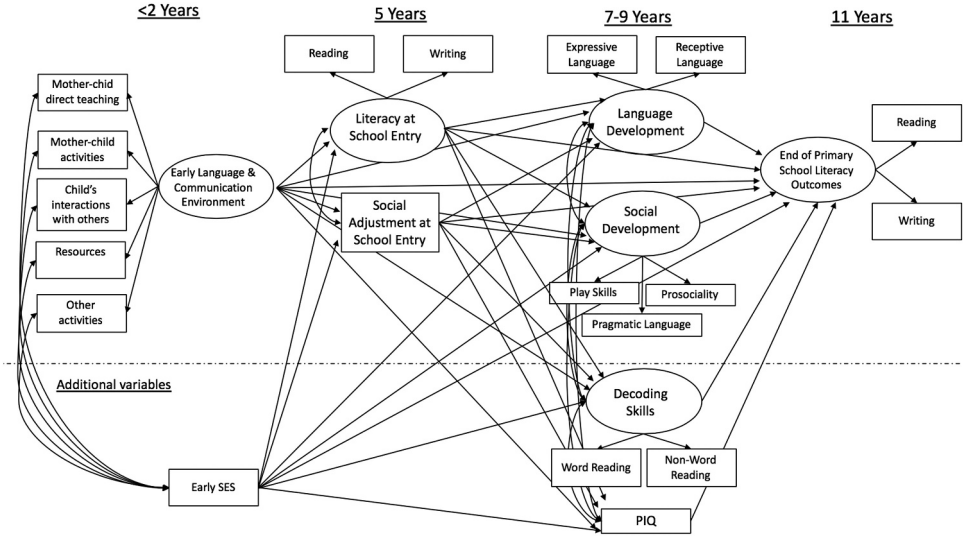

Figure A1. Theoretical Model for Pathways to End of Primary School Literacy Outcomes.

Child's interactions with others

This measure consisted of six items relating to others such as 'child sung to' and 'child kissed or cuddled'. Responses were coded on a 5-point scale (1=never, 2=rarely, 3=once a week, 4=several

times a week, 5=every day) and then summed to create a score ranging from 6 to 30. Higher scores indicated that the child was more frequently engaged in interactions with other people (not exclusive to but not excluding the mother). The scale had acceptable internal consistency (Cronbach's alpha = 0.54). The variance explained by the latent factor in the SEM (without DLD: 43%, with DLD: 53%)

Resources

This measure which consisted of six items such as 'number of toy vehicles child has at home' and 'number of interlocking toys child has at home'. Responses were coded on a 4-point scale (1=none, 2=one, 3=two or three, 4=four or more) and then summed to create a score ranging from 6 to 24. Higher scores indicated that more resources to underpin development were available to the child. The scale had acceptable internal consistency (Cronbach's alpha = 0.58). The variance explained by the latent factor in the SEM (without DLD: 12%, with DLD: 15%)

Other activities

This measure consisted of three items: frequency child taken to 'park', 'places of interest', and 'places of entertainment'. Responses were coded on a 5-point scale (1=never, 2=a few times per year, 3=once per month, 4=once per week, 5=nearly every day) and then summed to create a score ranging from 3 to 15. Higher scores indicated that the child was frequently taken places outside of the home. The scale had good internal consistency (Cronbach's alpha = 0.59). The variance explained by the latent factor in the SEM (without DLD: 14%, with DLD: 17%).