

Investigating the role of language in children's early educational outcomes

Sue Roulstone James Law, Robert Rush,
Judy Clegg, Tim Peters

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The views expressed in this report are the authors' and do not necessarily reflect those of the Department for Education.

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Research Brief/ Executive Summary

Introduction

Most children develop speech and language skills effortlessly, but some are slow to develop these skills and then go on to struggle with literacy and academic skills throughout their schooling. It is the first few years of life that are critical to their subsequent performance.

This project looks at what we know about the early communication environment in a child's first two years of life, and the role this plays in preparing children for school using data from a large longitudinal survey of young people (ALSPAC - the Avon Longitudinal Study of Parents and Children).

It examines the characteristics of the environment in which children learn to communicate (such as activities undertaken with children, the mother's attitude towards her baby, and the wider support available to the family) and the extent to which this affects a child's readiness for school entry (defined as their early language skills, reading, writing, and maths that they need to help them in school).

Key Findings

- There is a strong association between a child's ***social background and their readiness for school*** as measured by their scores on school entry assessments covering language, reading, maths and writing.
- ***Language development at the age of 2 years predicts children's performance on entry to primary school.*** Children's understanding and use of vocabulary and their use of two or three word sentences at 2 years is very strongly associated with their performance on entering primary school.
- ***The children's communication environment influences language development.*** The number of books available to the child, the frequency of visits to the library, parents teaching a range of activities and the number of toys available are all important predictors of the child's expressive vocabulary at 2 years. The amount of television on in the home is also a predictor; as this time increased, so the child's score at school entry decreased.
- ***The communication environment is a more dominant predictor of early language than social background.*** In the early stages of language development, it is the particular aspects of a child's communication environment that are associated with language acquisition rather than the broader socio-economic context of the

family.

- ***The child's language and their communication environment influence the child's performance at school entry in addition to their social background.*** Children's success at school is governed not only by their social background; the child's communication environment before their second birthday and their language at the age of two years also have a strong influence.

Background

Most children develop speech and language without effort, although there is considerable variation in the rate at which children acquire language with approximately 7% of children demonstrating impairments in these skills. There is increasing evidence of the links between children's early language and their success in school. Awareness of this is reflected in a number of policy and practice developments that focus on a child's language as a means of raising attainment.

Understanding the influences on children's language development in the general population can support evidence-based policy development in that factors which predict variation may indicate potential avenues for interventions. Those influences can be broadly conceptualised as internal to the child or as existing in the child's environment. Such influences are recognised to be interacting and dynamic. There is a well established model of risk associated with social disadvantage and poor language and cognitive development in the early years. However, such models are not well differentiated and rely on single measures or proxies such as a mother's level of education. This study offered the opportunity to understand how the child's socio-economic risk interacts with their early communication environment and language development in predicting their ability at school entry age.

There is a considerable body of academic research which shows that children from lower socio-demographic backgrounds tend to have poorer language skills when they start school. We know less about what it is in their early environment which leads to this.

Special educational needs and disability is an important Government priority. The Bercow Review of services for children and young people with speech language and communication needs in 2008 was followed by the setting up of the Communication Trust, the Communication Council and the 2011 Year of Speech Language and Communication Needs. The Special Educational Needs and Disabilities Green Paper, published in March 2011 looks to reform education and health support for children with special educational needs. In addition, there is increasing emphasis in the policy domain on language and communication in a child's early years. Recent reports including the review of

the Early Years Foundation Framework have recognised the foundational role of language and communication in children's learning.

Methodology

This research examines the characteristics of the environment in which children learn to communicate and the extent to which this affects a child's readiness for school (defined as their early language skills, reading, maths and social skills they need to help them in school).

There were three key research questions:

- To what extent is a child's early language development associated with the child's performance on assessments in the first years of formal schooling?
- To what extent is the child's early communication environment associated with a child's early performance on assessments in the first years of formal schooling?
- What are the characteristics of the child's early communication environment that contribute to children's language development at two years of age?

This study uses a large complex dataset from the Avon Longitudinal Study of Parents and Children (ALSPAC), also known as 'Children of the Nineties'. This is a population study of children born to mothers in and around the area of Bristol which used to be known as Avon. The children were born between April 1991 and December 1992. In the time since recruitment, mothers have completed questionnaires regularly about a wide range of developmental, social, medical and environmental aspects of their child and about family life as have the children too as they grew older. Since the children were seven years of age they have been invited to a number of 'Focus' clinics at which a range of direct assessments have taken place. Data has also been collected from the children's schools and also supplied by the Department for Education. This project focuses on the early questionnaires completed by mothers during the child's pre-school years and data collected from children's schools at school entry. 4941(51.3%) were boys and 4688 (48.6%) were girls.

To answer the three questions in the study, four measures were derived. This involved a complex procedure of 1) identifying suitable variables in the ALSPAC dataset that could be considered for inclusion in each of the measures; 2) where variables could be considered, checking the reliability of these variables in terms of the number of responses and the distribution of the responses; 3) re-coding variables and merging variables where appropriate to increase their reliability and likely explanatory value. From this process, the following four measures were derived.

Measure of socio-economic risk

The measure of socio-economic risk employed in this study is a multi-factorial measure derived from several measures of the child's socio-economic background including paternal occupation, mother's education, house tenure, overcrowding, financial difficulties and use of a car.

Measure of the child's early communicative environment

The communication environment measure was derived from questionnaires completed by mothers in their child's early years (first 2 years of life) about the activities and interactions their child engages in, the mother's feelings, attitudes and sense of wellbeing and resources available to the mother which underpin activity with the child.

Measure of the child's early language development

Children's language development up to the age of 2 years was measured using questionnaires completed by mothers when their child was 15 and 24 months old. The questionnaires cover development in language comprehension and production.

Measure of the child's school readiness at age 4 to 5 years

This was based on a baseline assessment that was in place for most of the ALSPAC children as they entered school between September 1995 and 1997. While the Early Years Foundation Stage Profile and its predecessors were not in place at this time, the Avon area had developed a single baseline assessment which was used by approximately 80% of the schools. The assessment covered core areas of language, reading, writing, maths, as well as social skills, problem solving, large motor skills and small motor skills. The four core areas were used to construct the primary outcome measure.

Once these main variables were identified and confirmed, a series of univariable and multivariable linear regression analyses were conducted. In these analyses, the outcome variable was the child's school entry assessment. Several models were tested to assess the contribution of socio-economic background, the early communication environment and early language development to the child's score on the entry assessment.

Findings

The impact of children's early language development on school entry assessments

Despite the strong influence of social class, children's early language made an important contribution to the variation in children's performance when they entered primary school. Children's understanding and use of vocabulary and their use of two-three word sentences at 24 months was very strongly associated with their performance even when adjusted for social class. So, a child's language added value to their development irrespective of their social background.

The impact of children's communication environment on school entry assessments

The communication environment was also a strong predictor of performance on entering school. So what the mother did (in terms of activities and interaction with her child), had (in terms of resources) and felt (in terms of feeling supported and sense of wellbeing) in the first two years of her child's life was shown to be important in children's performance at 5 years.

Influential factors in the child's communication environment included the early ownership of books, trips to the library, attendance at pre-school, parents teaching a range of activities and the number of toys and books available. So, for example, those children who owned more books and were taken to the library more frequently at age 2 achieved higher scores on the school assessment when entering primary school. The amount of television on in the home is also a predictor, as this time increased, so the child's score at school entry decreased. The measure of TV used in this study concerns the amount of time that the TV is on in the home, so this could include both children's and adult TV.

The role of the communication environment in the development of language skills

Given that both the child's language skills and communication environment are important for outcomes at the start of primary school, this research took account of inter-relationships between the two.

It found that there was a strong relationship between a child's communication environment and their ability to use words at 2 years.

There was, however, no association between the child's social background and their language development after taking account of the communication environment. This suggests that in these early stages of language development it is the very particular aspects of a child's communication environment that are associated with language acquisition rather than the broader socio-economic context of the family.

Conclusions and implications

These findings confirm, within a large population-based study, research from smaller and non-UK studies. The findings are important in three ways:

- they emphasise the importance of the child's very early years from 0-24 months;
- they provide confirmation about specific aspects of the child's communication environment which are influential;
- they suggest that the effect of a child's language and communication environment may operate similarly across levels of social

disadvantage.

The study identifies variables that are predictive of school entry performance and that could therefore be developed and tested as screening criteria, in particular the use of two or three word sentences. In addition, variables in the child's communication environment are identified that might be evaluated for their potential in interventions.

Further research is recommended to investigate the child's communication environment in older children and over longer periods.

1. Background

Most children develop speech and language skills effortlessly, acquiring this basic human skill with relatively little instruction. However, there is considerable variation in the rate at which children acquire language. For example, Roulstone et al (2002) found that, in a population sample of 1127 children aged 25 months, nearly 55% were using three to four word sentences; a further 27% were using two-word utterances and the remaining were at or below the single word level showing a wide spread of achievement in these two year olds.

Studies of the prevalence of speech and language impairments suggest that around 7% of children in primary schools will exhibit difficulties (Law et al, 2000a; Tomblin et al, 1996). Increasingly it is recognised that children with identified language difficulties achieve less academic success than their peers at both primary and secondary school age (Stothard et al., 1998; Conti-Ramsden et al., 2001; Conti-Ramsden et al., 2009). There are now clear causal associations between a child's level of language and communication development at school entry age and how this impacts on their literacy learning and attainment (Catts, 2002; Catts & Kamhi, 2005; Nathan et al., 2004). However, as with typical development, there is variation in how children with speech and language impairment progress. For example, a high percentage of toddlers who present as late talkers go on to resemble their typically developing peers before they reach school (Paul, 1996; Rescorla & Schwarz, 1990).

Until relatively recently, concerns about late developing language were primarily the province of the parent and the early years practitioner (health visitors, early educators, speech and language therapists, psychologists and the like). However in the last few years, they have been attracting interest from policy makers and politicians, not only in their own right as in the case of the Bercow Review of services for children and young people with speech language and communication needs (SLCN) (Bercow, 2008; DCSF, 2008), but as part of a wider drive to improve the learning environment of young children and especially those from socially disadvantaged backgrounds. This is evidenced over recent years in initiatives such as Sure Start¹ and specific universal interventions such as Every Child a Talker², the Speech, Language and Communication Framework³ and initiatives included in the Better Communication Action Plan (DCSF, 2008), the subsequent setting up of the Communication Trust, the Communication Council and the 2011 Year of Speech Language and Communication Needs (SLCN). Recent reports, from

¹

<http://www.dcsf.gov.uk/everychildmatters/earlyyears/surestart/whatsurestartdoes/>

² <http://nationalstrategies.standards.dcsf.gov.uk/>

³ www.communicationhelppoint.org.uk

the Centre for Social Justice (Allen & Duncan Smith, 2008) the Field report on poverty and the foundation years (Field, 2010) and the Tickell Review of the Early Years Foundation Stage (Tickell, 2011) have also acknowledged the importance of language and communication as a vital underpinning skill that contributes to children's success in life. Indeed Field proposes language and communication as one of the Life Chance Indicators that will be used to monitor the impact of policy on children's life chances and to deliver key messages to parents and service providers about those factors that can help to improve children's life chances (Field 2010 p.72). All these initiatives and reports point to the developing emphasis on the need for a better understanding of SLCN and what can be done to help the children concerned develop the communication skills needed to excel in school. This increased attention on language and communication comes in the context of government interest in a child's early years, in the notion of early identification and prevention of subsequent difficulties, with the review of Sure Start Children's Centres , the Early Years Framework and the national roll out of free education for 2 year olds in disadvantaged circumstances (DfE 2010).

In order to target resources effectively to improve children's language, it is important to understand the source of variation that occurs between children. Understanding the sources of this variation may provide indicators of possible public health interventions. There is a huge amount of research that investigates predictors of children's success in school. This is summarised in the Field report as a series of 'key drivers' for children's life chances (Field, 2010, p.39). Similarly, there is an extensive literature that investigates factors that predict children's language outcomes (see Nelson et al, 2006 for a review of these). There is a well established model of risk demonstrating an association between social disadvantage and poor language and cognitive development in the early years, through schooling and into adulthood (Schoon et al, 2010a & b; Law et al, 2009). However such models tend not to be very highly differentiated, emphasising comparatively simplistic notions of poverty and social disadvantage using measures such as the Index of Multiple Deprivation or proxies such as maternal education. Other models focus on genetic risk which seek to identify genetic markers associated with specific language impairment (Bishop, 2002; Bishop, 2003; Plomin & Kovas, 2005) or on physical and medical characteristics such as birth difficulties which are likely to predispose the child to subsequent speech and language difficulties with economic consequences for society as a whole (Feinstein, 2000).

1.1 The communication environment

Although there is a clear case for the role played by social disadvantage in predicting language skills in young children, the studies often make it difficult to disentangle precisely what it is about children's social backgrounds that are important for child development. For this reason we are developing, in this present study, a model of risk which is specifically tied to the child's communication environment. Specifically we are interested in what parents **do** to promote the communication skills of their child, what they **feel** in terms of the support they receive and what they **have** in terms of the materials at their disposal to facilitate the child's communication. Knowing, for example, that a family lives in council rented accommodation will give some indication of material poverty but knowing the specific resources at the disposal to the parent and child and what they do with those resources is likely to be much more informative about the process by which the child's communication skills are encouraged and ultimately the child's preparedness for school (Locke et al, 2002). Thus we hypothesise that the communication environment comprises:

- What parents **do**: aspects of the mother's activity and interaction with the child;
- What parents **feel**: specifically, the mother's feelings, attitudes and sense of wellbeing;
- What parents **have**: resources which are available and underpin activity with the child.

What parents do:

Recent analyses have tended to be circumspect about the precise characteristics of environments which do and which do not promote language development. Probably the most influential single study in the field has been Hart and Risley's study (1995) of the verbal input received by children from different social groups. The results very clearly indicate that the children from so called "welfare mothers" consistently received less verbal input than children from blue collar or professional parents. Recent argument has developed this further, using larger representative samples as their source. For example Pan and colleagues (2005) have suggested that it is not the amount that a mother talks to her child that predicts how their language will subsequently develop but it is the number of word types used by the mother and the language and literacy levels of the mother. This suggests that it is something about the nature of those parental skills which interacts with the communication needs of the child, specifically their sensitivity to the child (Hoff-Ginsberg, 1995). This is supported from an analysis of the 10% "Children in Focus" sample from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort. Boyle and colleagues (Boyle et al submitted) suggested that different cognitive styles, measured from clips of videoed parent/child interaction at one year of age, are associated with parenting

behaviour and appear to be associated with different aspects of communication development two years later.

Interestingly there is a tension developing in the literature over when parental input plays the most significant role. While many argue that the environment plays a role from the word go and thus that intervention should be targeted at the earliest possible age, a recent strand of research suggests that the influences of the parenting environment increases as the role of "biological" factors decreases. For example, reports from Australia's ELVS study suggest that the variance accounted for by environmental factors increases from less than 10% of the variance in expressive and receptive language skills at two years to 20% by four years (Reilly et al, 2007 & 2010). In short, while the social circumstances in which the child is raised in the early years are clearly linked to early language development, it remains unclear which specific aspects of the child's early experiences are most important and which are most likely to be modifiable at which time point. Indeed it is likely that the higher level, more distal social risk factors (such as maternal education, income or social deprivation generally) will be less amenable to change than the more proximal factors that affect the day to day interactions of the child with their parents and others in their immediate environment.

What parents feel:

The child's mother or primary carer, is a crucial component of a child's communication environment and as outlined above, the mother has been the focus of much research investigating how she interacts with her child in order to facilitate language development (Hart & Risley, 1995). It is the mother's communicative behaviour that has dominated this research (Hart & Risley, 1995; Hoff-Ginsberg, 1998) as opposed to considering what factors may underlie this behaviour. The mother's communicative behaviour is very dependent on her capacity to understand the need to interact with her child, her motivation to engage in this process and the quality of the communication environment that she is able to provide. Furthering our understanding of the mother's attachment to her child can inform us of how mothers can be supported to provide a facilitative communication environment for her child.

Although research in this area is under-developed, there are three factors reported in the literature that are taken to define a mother's capacity. These are 1) the age and experience of the mother; 2) her mental well being and 3) her attachment to the child. Age and experience has been studied by comparing the language abilities of children born to teenage mothers to children of older mothers. Preliminary research suggests that the young children of teenage mothers have poorer language abilities compared to the children of older mothers (Keown et al, 2001). Teenage mothers are reported to provide a communicative environment that has a negative impact on their child's language development by using less complex and varied

language and being more directive and less facilitative in their actions than older mothers (Keown et al, 2001; Oxford & Spieker, 2006). The lack of adequate measures to control for social background and the small sample sizes compound the findings from these studies. Nevertheless there is an important question to consider of whether the communicative behaviour of mothers is dependent on their age and experience or even their own language and literacy abilities (as outlined earlier), and their communicative competence which may well not be fully developed in their teenage years.

The impact of maternal depression on children's general development is well documented and is known to be a significant risk factor for poor attachment in the first few years of a child's life. Maternal depression certainly limits the mother's capacity to care for her child, to stimulate her general development and to form a robust attachment. In contrast, much less is known about the mechanics by which maternal depression impacts specifically on a young child's language development and the role of the attachment process in this. One proposal is that maternal depression impacts negatively on the attachment process which then leads to a reduction in the amount of shared time a mother will interact with her child and ultimately resulting in fewer opportunities for a child to develop their language skills (Paulson et al, 2009). However, the literature is inconclusive about the impact of parental depression. On the one hand Pan et al (2005) found that maternal depression had a negative impact on the child's rate of vocabulary growth between the ages of one and three years in children of low income families. On the other, Paulson et al (2009) found an association between both maternal and paternal depression and the amount of parent-to-child reading that took place, but only the father's depression impacted on child's language development (expressive vocabulary) at 24 months.

Some of the literature around child neglect and language development may be of relevance here, although it is acknowledged that this literature is very specific to this group of children. The few studies in this area to date suggest that severe parental neglect has more of an impact on children's language development than physical abuse (Culp et al, 1991; Allen & Oliver, 1982; Eigsti & Cicchetti, 2004). Explanations for this finding are weak but propose that children who are neglected are more likely to stay in the home where language stimulation is poor whereas children who are physically abused are usually removed from the parental home into a more verbally stimulating environment.

The relevance of these findings is in trying to understand whether the impoverished language of children who are severely neglected is due to specific factors related to the impoverished communication environment or the more cumulative effects of social risk. Some insights have been offered into this by a recent study that has identified specific risk factors rather than cumulative effects of social risk. These specific risk factors are 1) maternal depression; 2) the mother's own history of neglect and/or abuse and 3) the mother's poor attachment to the child (Sylvestre & Merette, 2010).

Therefore, there is some evidence to show that the mother's capacity to provide a communicative environment is certainly influenced by her mental well being and the attachment she has with her child. However, much of this research needs further confirmation in other cohorts. Of particular interest, is whether mothers perceive they are supported in maintaining or increasing their capacity to engage in and provide an adequate communication environment. To date, there is very little research which explores these perceptions.

What parents have:

As indicated above, the broad models of social disadvantage focus on measures of financial risk and poverty, on the parental employment as a proxy for income or education, or on the mother's education. However, these do not indicate how the parents choose to spend their money (and time). Myers (1992 in Evangelou et al, 2009) identifies aspects of the physical environment that impact on a child's development and notes factors such as space, amenities and materials. Those resources that can be linked more specifically to a child's language and communication include the books, toys and media that are available to the child in the home along with the amount of time devoted to the use of these with children by parents.

Research investigating the relationship between the use of television in the home and language development has focused on the impact of children's TV on vocabulary development. For children under the age of two years, even children's TV has been found to have limited value (Close, 2004. p13). Although there is some evidence that children of 18 months are attentive to visual stimuli from TV, and respond verbally to TV, it is also apparent that children of this age find it more difficult to acquire new vocabulary via the TV than they do within a face-to-face interaction, particularly where they have few foundations in language (Close, 2004).

Investigations of the value of books for developing children's language have found an association between the amount of literacy activities in the home, (such as the number of books, trips to the library and shared reading activities) and children's language outcomes at 4 years of age (Payne et al 1994; Debaryshe, 1993). Debaryshe found that, the earlier the age of onset of shared reading activities, the better the language outcomes at two years of age, particularly their receptive language. However, this study asked the parents retrospectively about their literacy activities. More recently, Karras & Braungart (2005) found no relation between shared reading with children at 4 months of age and their language outcomes at 12 and 18 months. However, shared reading at 8 months was strongly associated with children's expressive language at 12 and 18 months.

Piagetian and Vygotskian theories view a child's interaction with objects as having an important role in the development of the child's understanding of

the world (Evangelou et al, 2009) and thus in the development of a child's vocabulary. From this one might assume that the toys available to a child might significantly impact upon their acquisition of words. However, the literature which specifically addresses this relationship is sparse, although the association has been investigated as part of the Home Observation for the Measurement of the Environment (HOME) (Caldwell & Bradley, 1984). The infant-toddler version of this observational assessment includes six subscales, one of which is the 'provision of appropriate play materials' (Totsika & Sylva, 2004). In one of the early investigations of this tool, Elardo et al (1977) reported significant correlations between the child's environment at the age of 24 months as measured by HOME and aspects of the child's language at the age of 3 years. Subscales of the HOME appeared to correlate differently with different aspects of language and operate differently according to gender: for example, the provision of appropriate play materials was significantly correlated to language skills in boys, but not in girls.

In conclusion, in the general population, socio-economic adversity is a key predictor of children's later educational attainment (Schoon et al., 2004) where greater socio-economic adversity predicts poorer educational outcomes. Furthermore, socio-economic adversity is known to be negatively associated with children's language and communication development in the first five years of life (Locke et al., 2002; McIntosh et al., 2007). There are then, some complex associations between social disadvantage, children's language and communication development in the early years and later educational attainment. However, the relationships between these two factors are poorly understood and it remains unclear which specific aspects of the child's early experiences are most important and which are most likely to be modifiable at which time point.

This project was set up to examine what we know about the early communication environment and the role it plays in preparing the child for school. By identifying key drivers predicting children's performance, it will help with the future targeting of intervention. It draws on data from the Avon Longitudinal Study of Parents and Children (ALSPAC), a birth cohort initiated in the early 1990s, which provides one of the richest sources of data about the home background and early experiences of children as well as assessment of their abilities as they enter school.

2. Methodology

2.1 The research questions

The overall aim of the study was to examine the relationships between social disadvantage, those aspects of a child's early environment more specifically related to communication, the child's emerging language and their performance during their early years at school.

Specific questions included:

- To what extent is a child's early language development associated with the child's performance on a school entry assessments?
- To what extent is the child's early communication environment associated with a child's early performance on a school entry assessment?
- How does the child's early communication environment contribute to children's language development at two years of age?

2.2 The ALSPAC dataset

This research uses a large complex dataset from the Avon Longitudinal Study of Parents and Children (ALSPAC). This is a prospective population study of children born to mothers in the area around Bristol which used to be known as Avon. Eligible children were born between April 1991 and December 1992 and approximately 85% of those eligible mothers were recruited to the study (North Stone et al, 2000) with a resultant cohort of 13,992 live births.

The sample was found to have some under-representation of less affluent families and fewer families from black and ethnic minority groups than is the case nationally, although the overall developmental trajectories of the children were similar to national norms for the period⁴.

In the time since recruitment, mothers, their partners, and latterly the children themselves, have completed questionnaires regularly about a wide range of developmental, social, medical and environmental aspects of their child and about family life. Since the children were seven years of age, they have been invited to a number of 'Focus' clinics at which a range of direct assessments have taken place. Data are also available on the children's statutory school assessments. This project focuses on the early questionnaires completed by mothers during the child's preschool years, particularly between 0 and 2 years. Data collected from children's schools at school entry were used to create the outcome measure (see below).

⁴ <http://www.bristol.ac.uk/alspac/sci-com/resource/represent/>

2.3 The questionnaires

The questionnaires from ALSPAC used in this study were all completed by the child's mother during the child's preschool years. The data from these questionnaires include parents' observations of aspects of their child's language development, reports of their own and others activities, their own feelings and attitudes as well as factual reporting regarding their environment (such as whether or not they own a car). In the first instance data were requested from questionnaires completed throughout the child's preschool years. However, in order to keep the study feasible, it was decided to focus primarily on the early years from 0-24mths. Table 1 shows the relevant questionnaires and the number of respondents for each one.

Table 1. Questionnaires used and respondent numbers

ALSPAC Questionnaire code	Child's age at the time of the questionnaire	description	Numbers responding
C	32 weeks gestation	Questionnaires about the mother completed by the mother	12418
E	8 weeks		11710
F	8 months		11210
G	21 months		10310
Kb	6 months	Child-based questionnaire completed by the mother	11478
Kc	15 months		11067
Kd	18 months		11120
ke	24 months		10422

The use of parent report is a common means of assessing children these days although the variability in the validity of such means of measuring children's development has been questioned. Emond et al (2005) examined the relationship between an adapted parent report version of the Denver used within ALSPAC at 6 and 18 months and the Griffiths Scales of Mental development at 18 months. They found that the parental reported version was a poor predictor of the Griffiths version. As they note, this could be for a variety of reasons – one of which might be that parents are poor observers of their children's developmental abilities.

Studies that have investigated parents' reporting of children's early language have been generally more positive. So for example, Dale et al (1991) reported high agreement between parent reports of vocabulary, sentence construction and behavioural assessments. Similarly others (Rescorla 1989, Thal & Bates, 1988, Thal & Tobias, 1994) have found the Macarthur Communicative Development Inventory (CDI) – a parent report of children's vocabulary has validity as a parent report instrument. However, Law & Roy (2008) in a review of parental reporting in the CDI, identified a number of areas where parental reporting was less accurate or valid. For example, in

different studies parents from lower social classes were considered to over-report or under-report their child's vocabulary output and that the reporting of the child's expressive vocabulary has been found to be more valid than their reporting of their levels of understanding.

Generally it is found that parents are more likely to be accurate reporters with younger children – where the range and complexity of the child's output is less. Within the ALSPAC dataset about the measures of the child's early language follow a similar process to the CDI and require parents to report whether or not their child understands and uses listed vocabulary items and grammatical forms (such as tenses, plurals) and joins word together. Further detail on the particular items used from the questionnaires and the process of selection is given below. Results should therefore be interpreted with the caveats usually applied to parent-reported language data.

2.4 Analytical framework

The underlying premise of this study acknowledges the interactive nature of children's development with the environment. Following the ideas of Bronfenbrenner (Bronfenbrenner & Morris, 2006), the child sits at the centre of a dynamic system consisting of the child's family, setting and neighbourhood community. It is that system, external to the child that is of interest in this study and, in particular those aspects that are considered to be relevant to children's emerging language. Although individual children's developmental and emotional processes are clearly associated with variation in how children respond to their environment, those child-centered processes are not the focus of this study.

In order to identify appropriate variables from ALSPAC, a very large dataset, a general model was developed which set out the possible propositions of relevance to the research questions (figure 1). Variables within the ALSPAC dataset were then examined to identify those which might be relevant to this model. Once these had been agreed within the team, the variables were requested from ALSPAC via our assigned data buddy.

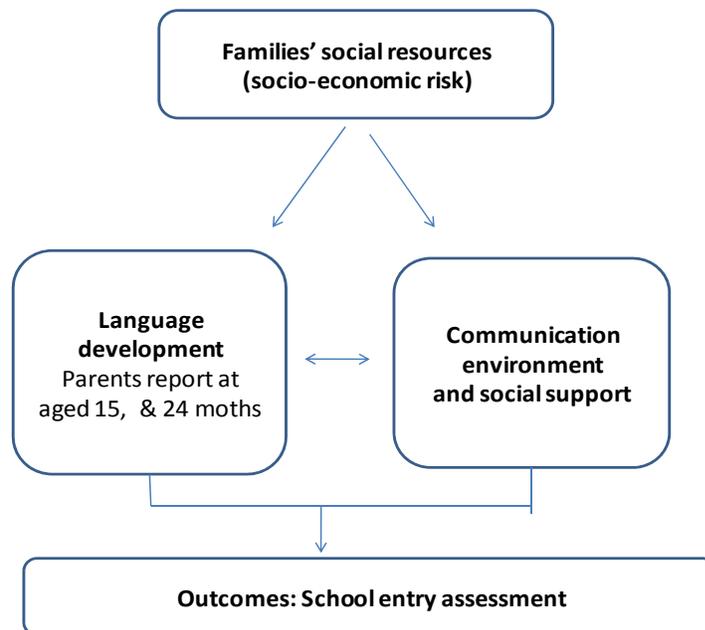
In brief, the model in figure 1 proposes that the child's **socioeconomic** context is a fundamental and underpinning influence on a child's development. Within their particular context, a child is exposed to an environment that facilitates the development of the child's **language – the communication environment**. Each family has the possibility of **social networks and support** mechanisms that additionally contribute to the potential of the **communication environment**. This environment influences the child's **language development** and their potential **success as they enter formal schooling**.

For this study, the plan for the analysis therefore focused on the relationship between the socioeconomic background of the family, the child's

communication environment (including the social support available to the parent) and the child's early language, as predictors of the child's performance on an assessment as they entered school. Further information is provided below about the components of this model and the related variables in ALSPAC.

Full details of the steps in the modeling procedure are given in Section 3.1.6. In brief, from the large number of variables in the ALSPAC dataset obtained via the data buddy⁵, the first step in the analysis was an initial screen to filter out any variables where the distribution was such that they clearly had no potential in the modeling process. The remaining variables were placed into groups of similar risk factors according to the model in Figure 1. Using this group structure a series of univariable⁶ and multivariable regression models were employed to derive a final set of variables independently associated with school entry assessment. At each stage, in this modeling procedure, attention was paid to the effects of adjusting for other variables on the regression coefficients and the confidence intervals as well as on the p values. Since the outcome variable was a single continuous measure, ordinary linear regression was used.

Figure 1. Social risk, language and the communication environment as predictors of school readiness.



⁵ The ALSPAC 'data buddy' is employed by the ALSPAC core team. They are responsible for providing the dataset and liaising on all queries regarding the variables.

⁶ We follow the conventions set out in Peters, 2008 Multifarious terminology: multivariable or multivariate? Univariable or univariate? Paediatric and Perinatal Epidemiology. 22, 506. See Appendix V

Once the main regression analyses had been completed a number of post hoc analyses were carried out to further understand these relationships. These included further descriptive and regression analyses and an interaction analysis to investigate possible interactions between social disadvantage and the relative impact of a child's language and communication environment across different social groupings.

The analyses were conducted in SPSS(v 17) and Stata, V11.

2.5 Missing data

As indicated above, the number of live births occurring to recruited mothers was 13992. Within any large cohort, as the years progress, there is inevitably a loss to follow-up. Furthermore, within each questionnaire, mothers do not always answer every question. In addition, seven children were excluded from the dataset since their ages on the school entry assessment suggested errors in the dataset.

So, for example, there are data on 11832 children for the social disadvantage score, and 9629 for the school entry assessment. An analysis which combines these two variables reduces the numbers still further. The sample for each analysis can therefore vary. The sample size is shown for each of the final major regression analyses, which were conducted on a complete case basis.

2.6 The measures

The primary outcome variable: school entry assessment

The first ALSPAC child to enter school would have done so in 1995. At that time, the Early Years Foundation Stage Profile (EYFSP) and its predecessors were not in place. In 1996 the Department for Education and Employment published its 'desirable outcomes ...on entering compulsory education' and the National Framework for Baseline Assessment became a requirement in 1998 (DFEE, 1996). However this requirement did not specify the use of any particular assessment process and there had been a proliferation of these assessments leading up to and post 1998. Fortunately for ALSPAC, educators in the Avon area had worked together to produce a single assessment: "Entry assessment in South Gloucestershire" (South Gloucestershire, 1996) that was already in place for ALSPAC children as they entered school between September 1995 and 1997. Throughout Avon, approximately 80% of the schools were reportedly using the same entry assessment.

This assessment was an observational assessment carried out by the child's class teacher on entry to the reception class. It had four required areas

(language, reading, writing, maths) and 4 voluntary areas (social skills, problem solving, large motor skills and small motor skills). Teachers scored children according to a series of criteria in each area. Appendix I provides an example of the scoring for the reading assessment section⁷. As can be seen from Appendix II, the items used in the South Gloucestershire assessment are strikingly similar to the ones that are currently used in the EYFSP. The majority of the children who had results submitted on this assessment had data on the four required areas. We therefore use the totalled scores from these four to give an entry assessment score with a possible range of 0-20. This assessment process was standardised using local pupils and, in studies which compared the cohort's scores on a standardised reading measure (WORD – Rust et al, 1993), was found to yield comparable data (Meadows et al, 2007).

The school entry assessment was designed as a baseline measure against which any subsequent achievements of the children could be measured, thus allowing schools to evaluate the 'value added' by the school. However, coming as it does at the start of school, it provides a measure of how well the child's preschool experiences and environment have prepared them for school and is therefore a measure of their readiness for school. As indicated above, it is used in this analysis as our outcome measure.

Socio-economic risk

Typically, studies use a single measure such as the mother's education, or the father's employment, as a proxy of socio-economic status. However, this relatively simplistic approach has been criticised as it fails to recognize the complexity of children's broader economic context. In recognition of this, Schoon et al. (2004) identified a range of indicators of socioeconomic adversity, such as poor living conditions, overcrowding, lack of financial resources in addition to the more traditional indicators.

Within the ALSPAC dataset we identified a number of variables which correspond to Schoon et al.'s indicators (see table 2 for a comparison). Each variable was recoded into a binary variable and then summated to provide a continuous 'social disadvantage' score for each child, with a range of 0-6 where 0 is high risk social background and 6 represents a more advantaged background. Where children had up to 1 or 2 variables missing, these were calculated from other variables in the social disadvantage score.

⁷ A copy of the assessment is available from ALSPAC or from the authors.

Table 2 Socioeconomic risk in ALSPAC compared to Schoon et al (2004).

Schoon's category	ALSPAC variable	Binary Coding
Parental occupation	ALSPAC has both father's (c765)* and mother's social class (c755)* based on OPCS employment codes. In this study we have used paternal occupation.	Unskilled, partly skilled or manual occupation: 0 Skilled occupation: 1
Father education	Partner's education (c645a)* within ALSPAC there is considerable missing data and we have therefore excluded this variable	
Mother's education	Mother's education (c666)* This has been recoded into a binary variable 'O' level or below = 0 (including vocational) above 'O' level = 1	'O' level or below (including vocational): 0 Better than 'O' level: 1
House tenure	This is coded into a binary variable: owner occupied vs rented or other housing	Rented or other housing: 0 Owner occupied: 1
Over-crowding	ALSPAC has a 'crowding index', formed by the number of people in a house, divided by the number of rooms.	More than one person per room: 0 Less than one person per room: 1
Sole use of household amenities	Not available in ALSPAC	
Receipt of state benefits	Financial difficulties A set of questions are asked regarding the mother's ability to afford certain basic items for the baby, specifically food, clothing, heating, rent or mortgage and things she will need for the baby producing a continuous score.	Financial difficulties: 0 None or minimal financial difficulties: 1
Car ownership	Use of a car (A053)* 89.1% of ALSPAC answered yes	No: 0 Yes: 1

- ALSPAC questionnaire identifying item codes

Early Language development

The language development variables are drawn from questionnaires distributed when the children were aged 15 and 24 months. At each of these two ages, mothers were asked a series of questions about their child's understanding and use of language, focusing on their vocabulary, their grammar and their ability to join words together within an utterance (see Appendix III for a complete list of the variables included in this dataset). These variables are all derived from the CDI Development Inventory. As indicated above (section 3.2), this has been extensively validated.

The communication environment

In order to develop some hypotheses about the nature of the communication environment, a template was generated (see Figure 2) on the basis of the literature reviewed in section 1. This figure sets out a possible view of the range and nature of the components of the communication environment, what parents do, feel and have; that is, the things they do to stimulate the child, the attitudes and feelings they have towards the child and how supported they feel during their infants' early years and the material goods and resources that underpin their activities with their young child.

Within this, **stimulation** was divided according to whether the variables are specific to **language and communication** or to more general aspects of **child development** and welfare, whilst still having a relevance to a child's language development. Stimulation has been further coded into **resources** that are provided to the child and **activity** undertaken with the child; in the child development component, **environmental noise**, including TV and radio have also been included. **Attitudes** focuses on aspects of the mother's attitude towards her baby. Aspects of support available to the mother were conceptualised as potentially including the practical support available to the mother such as childcare but also the emotional and possibly financial support available through a partner.

A second dimension was hypothesised relating to the **locus** of the activity. The **locus** of the activity is seen as **proximal** (immediate to the respondent/partner and child), and **distal** by which we mean external to the family, provided by professionals etc. Appendix IV shows the variables from ALSPAC that this model generated.

Variables were identified for the entire preschool period. However, in this study, priority was given to those variables in the child's early life, up to 24 months of age.

Figure 2. The communication environment

		Locus		
		Proximal		Distal
Stimulation	Language/ communication	Resources/ books available to the child	Language and communication and interaction activity undertaken with the child by mother	Playing with other children
	Children development and welfare	Resources/toy s available to the child	Other activity undertaken with the child by mother	Environmental noise TV and radio use
Attitude		Mother's attachment Mother's attitude to infant		
Support		Support perceived by mother from partner		Support perceived by mother from wider community childcare

2.7 Reduction of variables

The number of variables available within the ALSPAC dataset is enormous and the model of the communication environment generated a large subset. Although variables had originally been requested from questionnaires throughout the child's pre-school years, the decision to focus on the early years from 0-24 months reduced the number of variables considerably. However, it was still necessary to find a way to further reduce the number of variables systematically and transparently. A series of interim analyses were therefore performed to identify variables which had a large distribution and which performed robustly against the outcome of interest.

Step 1

Descriptive statistics were produced for each variable showing the number of respondents for each item. Those variables in which any item showed less than 5% of the total responses were excluded. For example one question asked mothers if they played with their child and if their child spends time with children other than their siblings. In both cases, around 1% of mothers answered 'no' to these two questions. Thus the lack of variability in the answers of the respondents means that this variable has little power to distinguish between parenting practices and was therefore excluded. Those variables with items with less than 10% were checked to consider whether or not the categories could be sensibly combined and also to consider the conceptual strength of the question relative to our overall research question; we also checked for consistency of our decision making across variables that recurred over time; some variables were recoded to increase their ease of interpretation or meaningfulness in the context of our research question. In some cases it was possible to recode the variable to develop one with an acceptable variation across categories (for example, reducing categorical variables into binary variables). Just over 50 variables were excluded at this stage. This process is illustrated in Appendix IV which shows those variables that were excluded in Step 1 from the communication environment group.

Step 2

Once the main variables were confirmed, a series of univariable regression analyses were performed to test the strength of the association of each variable with the outcome variable, that is the school entry assessment. Where the association was significant at $p < 0.1$ then the variable was kept in the analysis for the next step. A value of $p < 0.1$ provides a liberal threshold and therefore variables that might yet prove to be important would not be excluded too early in the analysis.

Step 3

Variables that were within the same block on the model of the communication environment were grouped in a series of multivariable

analyses, with school entry assessment as the single outcome variable. So for example, on the model, the first component block concerns the “resources/books available to the child” (see Figure 2). Within this block there was data from questions that had been asked at a number of time points (how many books does the child own?). In other blocks, such as the “Language and communication and interaction activity undertaken with the child by mother”, there were a number of related questions such as does the mother sing nursery rhymes to the child or try to teach numbers to the child. Unsurprisingly within each block, many of the variables are closely associated, meaning that one can potentially account for another. This has to be addressed directly in the analysis by removing variables that do not “add value” to the analysis in the sense of adding to what existing variables already say. As many of the variables were highly related conceptually, a series of analyses were performed at this stage to test for co-linearity (that is, to examine the data for extremely high correlations between the explanatory variables that could lead to difficulties fitting the model).

In a similar way, multivariable analyses were also carried out to consider variables from each age group separately in a developmental model, considering variables across age levels: under 12 months, 18 months and 20 months. This approach was followed for two reasons. Firstly, a number of the variables are repeated at several age levels (eg social support, book ownership). Lack of independence between such variables creates possible difficulties in regression analysis, namely autocorrelation of residuals. Secondly, we would expect to see a closer statistical relationship between those variables measured closer in time to the outcome variable (school entry) and those measured earlier in the child’s life.

Any variables remaining significant at the 5% level within these multivariable analyses were carried forward to the final multivariable analyses. At each step in the multivariable analyses, where variables were not significant at the 5% level, they were dropped from the analysis one at a time, to identify the best explanatory combination, thus increasing confidence in the robustness of the final models.

At this point the variables were regrouped into three conceptual blocks: mother’s activity and social support, material support and environment (see Table 3). Further details of all these variables are given in Appendix III.

Table 3. Conceptual components of the communication environment for the final analysis

Mother's activity and social support	Mother tries to teach child Mother's parenting score at 6 and 18 months Social support score at 8 and 21 months Edinburgh postnatal score Maternal enjoyment score Babies need stimulation to develop
Material support	No of books child owns at 6 and 18 months Frequency child taken to library Toy score
Environment	'Home' score at 6 and 18 months TV or music usually on in the home 18 and 21 months

Step 4

The final model to examine the importance of social risk, language and the communication environment for the child's readiness for school followed a hierarchical model as represented in Figure 3.

Figure 3. Hierarchical Regression Model

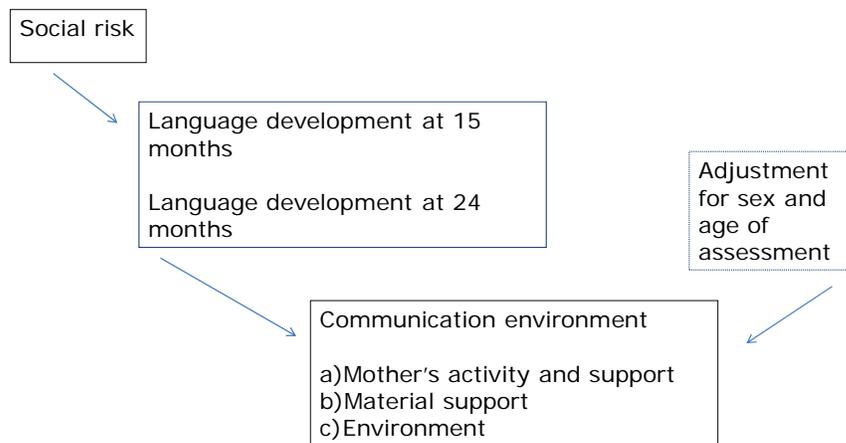


Figure 3. Hierarchical regression model

3 Sample characteristics

3.1 School entry performance

Of those children with assessment data, 4941(51.3%) were boys and 4688 (48.6%) were girls. The mean age at which the children were assessed by teachers was 54.5 months (range 49-61, SD: 3.7). The mean entry score for girls was 13.3 (SD: 3.18) compared to 12.2 (SD: 3.27) in the boys. These differences in achievement are significantly different ($p < 0.001$) although the age at which boys and girls undertook the assessment was not ($p = 0.25$). Because of the range of age at which the assessment was undertaken and the significant differences between the achievement of boys and girls, the final regression analyses were adjusted for sex and age of assessment (see section 5.3, p.42)

3.2 Social disadvantage

Children within ALSPAC were slightly more advantaged than the average child in the rest of the UK. Table 4 compares the subsample for this study with the entire ALSPAC dataset, and with data for the geographical area of Avon and the UK as a whole.

Table 4. Comparison of social disadvantage on sample with local and UK data

	Our data	ALSPAC	Avon	UK
Owner occupier	73.3%	79.1%	68.7%	63.4%
1+person/room	6.9%	33.5%	26.0%	30.8%
Car in household	89.1%	90.8%	83.7%	75.6%

There is a strong association between a child's social background and their readiness for school as measured by their scores on the school entry assessments ($p < 0.001$; confidence interval 0.71, 0.81). Table 5 shows the increasing score on the assessment with increasing social advantage. This confirms our underpinning hypothesis that the child's social background is associated with achievement in school.

Table 5. Distribution of social risk and entry assessment

Social risk score	Number (percent)	School entry score
0	115 (1%)	11.04
1	467 (3.9%)	10.63
2	1022 (8.6%)	11.24
3	1475 (12.4%)	12.17
4	2886 (24.3%)	12.68
5	3322 (28%)	13.37
6	2566 (21.6%)	14.69
Total	11853	

4 Findings

The findings are organised to address directly the study's research questions.

Research Question 1. To what extent is a child's early language development associated with the child's performance on assessments in the first years of formal schooling?

4.1 Children's language

Despite the strong influence of social class, children's early language also makes an important contribution to the variation in children's performance as they enter school. Children's understanding and use of vocabulary and their use of two-three word sentences at 24 months is very strongly associated with their later performance on the school entry assessment when adjusted for social class (Table 6).

Table 6. Multivariable analysis of child's language and school entry scores

Factor/Continuous variable	Regression coefficient ⁸	95% confidence interval	p value
No of words child understands at 24 months	0.02	0.01, 0.02	<0.001
No of words a child can say at 24 months	0.03	0.03, 0.04	<0.001
Child's understanding and use of irregular verb tenses at 24 months	-0.02	-0.03, -0.01	0.001
Child's use of word combinations at 24 months	0.70	0.49, 0.92	<0.001
Social risk	0.67	0.62, 0.72	<0.001

So, a child's language adds value to their development irrespective of their social background. The child's language achievements at 15 months were not associated with the outcome variable once the analysis adjusted for the relationship with the child's language at 24 months. That is, although the earlier skills were important when considered on their own, it is the later skills that were the ones that were independently associated with the outcome variable, school entry assessment score.

⁸ For continuous variables, the regression coefficients are gradients; that is, they are the expected change in the entry assessment score for a unit change in the continuous explanatory variable; for categorical variables, they are the difference in the mean entry assessment score for the category of individuals compared with the reference category, for example, girls compared to boys.

Research Question 2. To what extent is the child's early communication environment associated with a child's early performance on assessments in the first years of formal schooling

4.2 Communication environment

The key features of a child's communication environment that were associated with the child's school entry assessment included mother's parenting score, which includes a range of activities and interactions, her perceived feelings of being supported (by family, partner and by the social system generally), including access to childcare, the resources available to the mother and child such as books and toys available as well as the environment at home including the amount of time that the television is on in the home. Aspects of the mother's parenting activity include various teaching activities that the mother reports using such as teaching their child clapping games, names of body parts, colours, numbers, songs; it also includes the frequency with which the mother (as opposed to someone else) carries out childcare activities such as feeding and bathing their child as well as reading to their child, playing with them and taking them for walks (the full list of activities included in this parenting variable is in Appendix VI and the list of variables included in the communication environment analysis at this stage is in Appendix VII). These individual variables are combined as a score of parenting activities where the higher the score, the more positive parenting is available to the child. Interestingly, the frequency of trips to the library also remained strongly associated to the outcome.

Of the 10422 mothers responding to the questionnaire when their child was 24 months, just under 10% (n=1022) reported that their child attended crèche/pre-school. The average amount of time spent in crèche/pre-school by these two year olds was 13 hours per week although the range was wide (SD: 11.66). Using a binary variable (attended crèche/pre-school or not), the study showed that children who attended crèche/pre-school performed better in school than those who did not.

Table 7 shows the level of association between all these variables and the school entry assessment, adjusted for the other variables within the communication environment, but not for social background at this stage.

Table 7. Communication environment and school entry (n=5241)

Code	Factor/Continuous variable	Regression coefficient*	95% confidence interval	p value
Kd415	Mother's parenting at 18 months	0.043	0.022, 0.065	<0.001
F920	Perceived Social support at 8 months	0.030	0.014, 0.0476	<0.001
Ke506	Child looked after in crèche/pre-school	0.77	0.47, 1.064	<0.001
Kb540	Books owned at 6 months			<0.001
	0	0	-	
	1-2	0.93	0.64, 1.22	
	3-9	0.80	0.56, 1.051	
	10+	0.47	0.21, 0.721	
Kd320	Frequency of trips to the library at 18 months			<0.001
	Never	0	-	
	Nearly every day	-1.19	-4.16, 1.79	
	Once/week	0.38	-0.025, 0.73	
	Once/month	0.58	0.37, 0.79	
	A few times/year	0.74	-0.16, 0.31	
Ke042	Toys owned at 24 months	0.054	0.029, 0.079	<0.001
Kd380a	'Home' score at 18 months	0.13	0.073, 0.190	<0.001
Kd3812	Amount of TV on in the home at 18 months	0.62	0.39, 0.85	<0.001

Within these multivariable analyses, a number of variables were no longer influential. However, generally these are variables which are similar to another variable at a different age. So for example, the amount of TV on in the home at 21 months was no longer associated with the school entry performance in the multivariable analyses. However, the amount of TV watching at 18 months is still strongly associated. Similarly, the number of books that the child owns at 18 months is no longer associated with the outcome; however, surprisingly this time the number of books owned at the much earlier age of 6 months remains influential in the model. Of particular note, amongst those that are no longer associated is the score based on the Edinburgh Postnatal Depression Score, although this was strongly related to the outcome score in the univariable analysis.

4.3 The importance of social risk, language and the communication environment

In the final model, which includes social background, communication environment and the child's language, the influence of social disadvantage is still strong. However, the child's early language skills also continue to make a

strong contribution, with a range of language achievements at 24 months being strongly associated with the school entry assessment.

The range of factors in the child's communication environment that continue to be influential have reduced and now include early ownership of books, trips to the library, attendance at crèche, the amount of TV on in the home and a 'Home' score which includes elements of parent teaching, toys and books available. So those children who owned more books and were taken to the library more frequently achieved higher scores on the school assessment.

Attendance at crèche/pre-school was also associated with higher achievement. The measure of TV used in this study concerns the amount of time that the TV is on in the home, so this could include both children's and adult TV. As this time increases, so the child's score at school entry decreases.

Table 8. Final model showing social risk, language factors and communication environment factors associated with school entry assessment(n=5643)

Factor/Continuous variable	Regression coefficient*	95% confidence interval	p value
No of words child understands at 24 months	0.011	0.006, 0.015	<0.001
No of words a child can say at 24 months	0.029	0.024, 0.034	<0.001
Child's understanding and use of irregular verb tenses at 24 months	-0.016	-0.026, -0.006	0.002
Child's use of word combinations at 24 months	0.70	0.47, 0.93	<0.001
Social risk	0.57	0.51, 0.63	<0.001
Child looked after in crèche/pre-school	0.44	0.17, 0.71	0.001
Books owned at 6 months			<0.001
0	0	-	
1-2	0.43	0.17, 0.69	
3-9	0.45	0.22, 0.68	
10+	0.25	0.024, 0.48	
Frequency of trips to the library at 18 months			<0.001
Never	0	-	
Nearly every day	-0.47	-2.75, 1.80	
Once/week	0.485	0.16, 0.80	
Once/month	0.55	0.36, 0.74	
A few times/year	0.91	-0.12, 0.31	
'Home' score at 18 months	0.067	0.017, 0.12	0.009
Amount of TV on in the home at 18 months	0.33	0.12, 0.53	0.002

Four factors lost their significant association at this stage of the analysis: the mother's parenting score, the 'Toy' score, the 'Home' score and the social support score. The first three of these overlap considerably in terms of the sub-items within each score and they are likely to be strongly associated with each other as well as the outcome variable. They were therefore dropped from the analysis one at a time, to discover the best final combination. As can be seen from Table 8, the final model retained only the 'Home' score (which contains elements of mother's teaching activity and toy score). It is interesting to note that once social risk is introduced back into the analysis, the social support of the mother is no longer significant. Whilst we cannot rule out that social support is important, in this analysis, it is encompassed in the social risk variable.

If children's success at school entry were entirely governed by the social background of the family, in particular, their social and financial risk level, then the impact of the language and communication environment variables would disappear at this stage. However the model presented in Table 6, suggests otherwise: a range of language and communication related variables remain strongly associated with the school entry outcome. This remained the case when this model was adjusted for the child's gender and age of assessment and the unadjusted results are therefore presented.

4.4 Language and the communication environment

There is a strong relationship between the elements of the child's communication environment and their ability to use words at 24 months. Table 9 shows that the number of books available to the child, the amount of television on in the home and the 'Home' score are all important predictors of the child's expressive vocabulary at 24 months. It is also clear that some elements that have a relationship with the school entry outcome are less influential when the outcome variable is the early language of the child; for example whether or not the child is looked after in crèche/pre-school is not related to the child's emergent language.

Of particular interest is the lack of association between the child's social background and their expressive language at this stage, although social background was strongly related to expressive language within a univariable analysis ($p < 0.001$). Given the known influence of gender on expressive language development, this analysis was adjusted for gender effects.

This suggests that, in these early stages of language development, it is the very particular aspects of a child's communication environment that are associated with the rate of language acquisition rather than the broader socioeconomic context of the family.

Table 9. Communication environment and the child's expressive language at 24months (n=8461)

Factor/Continuous variable	Regression coefficient*	95% confidence interval	p value
Social risk	0.43	-1.39, 0.99	0.14
Child looked after in creche	1.21	-1.17, 3.59	0.32
Books owned at 6 months			<0.001
0	0		
1-2	5.9	3.5, 8.5	
3-9	4.11	1.91, 6.31	
10+	2.52	0.29, 4.76	
Frequency of trips to the library at 18mths			<0.001
Never	0		
Nearly every day	6.31	-14.40, 27.02	
Once/week	1.10	-1.81, 4.01	
Once/month	-0.076	-1.87, 1.71	
A few times/year	-0.78	0-2.85, 1.28	
'Home' score at 18mths	4.65	4.18, 5.12	<0.001
Amount of TV on in the home at 18mths	3.89	2.01, 5.76	<0.001
Child's sex			<0.001
Boys	0		
Girls	14.64	13.21, 16.07	

4.5 Interaction analysis

As indicated in the previous section, the analysis shows a strong association between the child's language and the communication environment with the school entry assessment score when adjusted for the level of social advantage using a measure of social risk. Thus, we concluded that, whatever the level of social risk, a child's language and their communication environment have an important influence on the scores they achieve at school entry. A post-hoc question arose from this: could a differential effect be observed for different children of their language and environment on their scores in contexts of different social risk. We therefore carried out a posthoc interaction analysis.

Interactions were considered for social risk with language development and communication environment on the school entry assessment. There were significant interactions for the language variables only and not for the communication environment variables. So there was no interaction effect between the child's communication environment and social background. The interactions found between social background and language although

significant, showed no clear pattern and were difficult to interpret (full data available on request). So it is therefore not possible to draw any conclusions about any differential effect of the communication environment for children from different social backgrounds. This suggests that the effects of a child's language and their communication environment operate similarly for children experiencing different levels of social risk.

5. Discussion

5.1 Findings

The results confirm those of other studies in that the children's school entry performance is clearly associated with socio-economic status – the greater the disadvantage the lower the child's score. Furthermore, the child's communication environment and language are important influencing factors on the child's school entry scores, the more advanced the child's language and the more supportive the child's communication environment, the higher the child's school entry score.

The findings from this study are important in three ways:

- they emphasise the importance of the child's very early years from 0-24 months;
- they provide confirmation about specific aspects of the child's communication environment that are influential;
- they show that the effect of a child's language and communication environment can operate similarly across levels of social disadvantage.

Early influence

The explanatory variables considered in this study were prospectively reported by mothers when their children were between 0 and 24 months old. Of the language variables, those measured at 24 months were found to be dominant in the regression analyses over those measured at 15 months. This could be because they are more proximal in time to the entry assessment outcome measure, that there is less noise of very early development by 24 months or that there is something new happening in the child's language at this time. Whatever the reason, these variables, the child's vocabulary and ability to combine words, are candidates that could be considered, with further development and testing as potential screening variables. Whilst these variables have been identified previously as predictors of a child's later language outcomes (Dale, Price & Bishop, 2003; Hart & Risley, 1995), they have not been tested as risk indicators on the type of measures routinely used within a school setting.

Of the communication environment variables, a number of the early variables were dominant in the regression, including variables prospectively gathered at 6, 18 and 24 months. Of particular interest was the finding that the child's expressive language at 2 years of age was predicted by elements from the communication environment. Although on its own, the broader measure of social risk was very strongly associated with the child's language at 24 months, when entered into a multivariable analysis with the communication

environment variables, these other variables captured the risk more effectively than the broad social risk variable. Thus the variables that are more specifically related to communication appear to be dominant explanations of the child's early language performance. Reilly et al (2009) and Zubrick et al (2007) similarly found that broad measures of social disadvantage were not associated with children's expressive language at 24 months. In those studies (also longitudinal population studies), a number of family and environmental variables were included such as socio-economic status and maternal mental health. However, they found that the child's gender, family history of speech and language impairment, early indicators of neurobiological functioning (including prior language measures) were the only remaining predictors in their multivariable models. Both concluded that the neurobiological factors, including the trajectory of children's language growth may be a better predictor of later language than environmental and social factors. The current study however suggests that the child's early environment may indeed have a role to play over and above the genetic and developmental. Further development of the model to include additional child characteristics would be needed to tease out the role of the environment.

Specific aspects of the communication environment

The research has identified a number of variables in the child's communication environment that are associated with higher levels of language at 24 months and with higher achievements on the school entry assessment. In order to explore the nature of the child's communication environment we initially characterised that environment in terms proximal and distal features, stimulation, attitudes and support (see Figure 2). We conceptualised this in terms of what the mother **did**, what the mother **felt** and the materials they **had** at their disposal.

Following the initial reduction of variables, the remaining communication environment variables were regrouped under the three headings of mother's activities and support, material support and the environment (Table 3). When the relationships between these variables were considered in multivariable analyses, variables from each group were still significantly associated with the outcome score: that is, the mother's parenting and social support scores; book ownership and trips to the library; 'Home' score and TV usage at home were all associated with the outcome score.

We then combined the language and communication environment variables and examined their relationship with school entry performance taking into consideration the more generic effects of social risk. One might predict that the effects of social risk would leave little to be accounted for by details of the child's emerging language performance or the detail of the communication environment. In fact while the effect of social risk remains important these other variables are also closely associated with performance at school entry. In this final model however, the range of communication

environment variables has narrowed: it includes book ownership and visits to the library, TV usage and a home score (that includes a parenting variable and toy score) as well as crèche/Pre-school attendance.

So for example, those children who owned more books and were taken to the library more frequently achieved higher scores on the school assessment. Previous research has established home literacy activities as predictive of school success and improved language outcomes, although this has not been universally established. For example Roberts et al (2005), found that a general measure of the home environment was more predictive of African American children's language and emergent literacy levels at four years of age than the particular home literacy activities such as shared book reading. It may be that for different populations the relative contribution of such activities will vary. Nonetheless, this study, using prospective data, confirms that where such associations are important they can begin early in a child's life.

The variable which examines TV usage in the home looks only at the amount of time that the TV is on in the home. This, then, could include those times when the TV is on as background noise, when adults are watching TV as well as those times when children are watching TV specifically aimed at their own age group. Previous research suggests that children under the age of 2 years were unlikely to benefit from children's TV in that, whilst they might find it visually stimulating, they will find it more difficult to acquire new vocabulary from that milieu than in face-to-face interactions (Close, 204). This study adds to that picture suggesting that the greater usage of TV generally in the home in a child's early years, the lower the language levels at 24 months and the lower the child's school entry performance. One cannot assume from this that it is the presence of television per se that is the problem. It may be that there is an opportunity cost involved here in that, if the TV fills a substantial part of the child's visual and auditory environment, there is less opportunity for the child to make use of other kinds of verbal and visual stimuli.

Attendance at pre-school facilities⁹ was also associated with higher achievement at school although not with the child's development at 2 years. We are also unable to say from this variable whether it is the quality or the amount of time spent in crèche/pre-school that is influential.

Social disadvantage

There was some indication of an interaction between the child's social risk, language, communication environment and the school outcome but the patterns were not clear so it is not possible on the basis of these data to claim that language acts as a protector for low social class in determining the child's success in school. Nonetheless, the association between the child's language development at 24 months and the school outcome, on average,

⁹ In this study, the wording in the ALSPAC questionnaires actually refers to 'attendance at creche'.

held strong across all social groups suggesting that a child's language adds value in that a child who is performing well at 24 months in their language skills is more likely to do well in their early years at school.

5.2. Implications for practice

In the first instance it is critical that parents and practitioners are aware of both the timing and the importance of the associations identified in this study, specifically that the impact of the child's environment starts within the first two years of life. On the one hand this places the role of health visitors, community midwives and others who go into the home in the first few months of life squarely in the frame as those most able to speak directly with the families. This has implications for the child health surveillance programme and for the content of the Red Book – the book given to all parents on the birth of their child. This concurs with a recommendation from the Tickell report that an insert should be placed in the Red Book to encourage the monitoring of children's communication and explicit discussion of children's needs (Tickell, 2011, p.57). It also has a bearing on the information provided for parents in antenatal groups and in the type of input related to childcare provided to children in secondary school.

On the other hand there is a need for public health "messages" to ensure that this knowledge is readily available and not just the result of interaction with professionals. The well-being of the child in terms of the experiences and the role than parents can play in fostering this from the very earliest months of life are crucial albeit familiar messages to which we need to constantly return. The link between this and school achievement is a critical message with which many may be less familiar and probably need to be made clearer to the parents of young children.

The critical role played by language and its association with early school performance at 24 months is an important finding as far as clinical practice is concerned. There has been a long running debate about the role of the early identification of children with developmental difficulties and particular the use of tests or protocols to do this (Law et al, 2000; Laing et al, 2002; Nelson et al, 2006). The evidence here suggests that these early achievements in vocabulary and word combinations may be useful indicators of the child's subsequent development. This is not new knowledge as such. This type of question has been used in a range of early screening studies but the association in a whole population through to school entry does highlight the potential predictive power of these items (Law, 1994; Miniscalco et al, 2006). Once identified, of course, the issue becomes how best to provide appropriate intervention for this group of children. The provision of language rich environments within early years provision is almost certainly a necessary condition for good outcomes carrying with it implications for the training of the children's workforce who must provide these enabling communication environments and also work with parents to do the same in the child's home

context. The question will always remain as to whether they are sufficient for all children especially those with more individual needs. Here we probably have to look to more specialist mechanisms through additional resource in the nursery and specific support services such as speech and language therapy. In either case our data would suggest that while the child's language skills are certainly a way of identifying need, any attempt to provide the most appropriate support must affect the home environment and family expectations. One message that comes out loud and clear from these data is that the context in which the child learns in the very earliest years is critical for the transition into the education system.

5.3. Implications for Policy

The model proposed in this analysis suggests that, although social risk is clearly important, "communication environment" variables make a significant additional contribution to the explanation of variation at school entry and suggests that they may be a way of modifying outcomes in an accessible and meaningful way. This is a very positive message because it gets us away from undue determinism faced with having to change standard measures of socio-economic disadvantage such as income, housing or maternal education which may be amenable to macro economic policy but not to individualised models of intervention by health or educational services.

From a policy perspective it is certainly viable to consider *how* parents and carers can be supported to engage in interventions that aim to promote their interaction with their children. It is then, not only about the content and delivery of such interventions, but also how parents can be supported to feel ready to engage in these interventions. Fostering parents' attitudes towards their children and enabling parents to find resources for support could help them to feel more positive about interacting with their children.

Our data suggest that what we are seeing here may be the roots of health and social inequalities which have been highlighted so often in recent analyses. The emphasis on early communication skills may help point in the direction of the type of "proportionate universalism" highlighted in the 2010 Marmot Report (Marmot, 2010). There is an ongoing tension between universal and targeted models of service delivery. Provision tends to oscillate between the two, for example, Health for all Children and Sure Start towards a more targeted approach. Although there is a concern that universal services tend to increase health inequalities because those who are best informed make greatest use of the services (White & Adams, 2009), this could be obviated by emphasising the role played by health visitors and other early years professionals in supporting individuals identified as being in need. The nature of the targeting is the issue. Screening is an appealing panacea but it is not accurate enough to introduce in early childhood (Law et al. 1998). The idea of a model of advice that is available to all parents very early in their child's development – ie when they are most receptive – may get us

around the problem. At the moment many of these types of messages are there but they tend not to be explicitly linked to performance in primary school which our data suggest they should be.

The focus on the wider communication environment also has potential implications for our understanding of parental wellbeing. The preliminary analyses showed that maternal feelings of being supported, for example, were linked to the child's early school performance. So it could be argued that if a mother feels supported in the first year of her child's life, this then leads her child to achieving more when they first attend school than those children whose mothers felt less supported. This suggests that interventions need to focus not only on how to facilitate the communication environment but also how the mother or primary carer and his/her family can be supported to facilitate this. This accords with the findings of Pan et al (2005) whose univariable analyses identified a relationship between dysfunctional families using inappropriate methods of discipline and children's language outcomes. In both studies, these associations were no longer significant in multivariable analyses, suggesting that other factors in the model were dominant. Further investigation of the relationships between how families function to support each other and how this relates to the broader measures of social disadvantage and language outcomes, might help to tease out the most appropriate form and delivery mechanisms for interventions.

The challenge is how to get these messages across. Is it possible to reach those who need it most without one to one advice or mentoring? Our reading of the findings would suggest that the complex interaction of variables is not likely to be amenable to traditional public health interventions such as leaflets and posters. Those in need of the messages may be the least likely to respond to this sort of literature, particularly since some of these families may have limitations in literacy (Pan et al, 2005). Perhaps these could be developed as primary prevention interventions with key messages being delivered by mobile phone or other technology, encouraging parents to think about their child's communication skills at regular intervals and encouraging them to see communication as fun rather than another example of things that they have to remember to do. The main message from these data is that parents can be involved in all sorts of ways in promoting the communication environment.

5.4. Implications for further research

The ALSPAC dataset is extremely large and complex. Organising the data transparently and robustly is time-consuming. However, there are a number of further analyses that could be completed to further investigate the relationship between a child's early environment, their language and their achievements as they reach school and progress through the education system. In particular the role of the communication environment from 2 years upwards to school age could be further analysed. In this investigation

we combined various factors of the family's social risk into a single continuous variable. Additional analysis of the variables contributing to this created social risk factor could provide clues as to the relative contribution of the different components of that risk to a child's language development, and to their school achievement.

The multivariable model suggested has implications for intervention research. Some of the items identified here are potentially mutable and thus it would be possible to test the implications of changing elements of the model. Thus it might be possible to use this model to check whether increasing book usage or expressive and receptive language made a difference to school readiness.

As indicated above the results reported here need confirmation in other comparable datasets. We would suggest that parallel analyses of the Millennium Cohort Study be considered and that relevant comparable variables be included in the new National Birth Cohort to be started in 2013. in the UK. It is possible, of course, that these findings are a function of the context in the mid nineteen nineties when these data were collected but if the results were replicated twenty five years later this would increase confidence that they are robust.

As reiterated on a number of occasions above, these results are associative rather than causal. We need to explore these findings more fully in properly deigned intervention studies which pick apart the causal mechanisms. For example we already know a considerable amount about the impact of interventions for children with delayed language development (Law et al, 2003) but these interventions tend to be small scale over relatively short periods. We need population level intervention studies which specifically include the identified risk factors as dimensions in a public health intervention. Such interventions are being developed by colleagues in the Murdoch Children's Research Centre in Melbourne, Australia although with slightly older children but such studies have yet to be initiated in the UK.

5.5. Caveats associated with the analysis

As usual with this type of analysis care needs to be taken not to over interpret the data. From the demographic characteristics of the population it is clear our population was slightly less socially disadvantaged than the population of the UK as a whole. It is also important to be aware that although the associations identified in the analysis were statistically significant, demonstrating the risk in the sample concerned, this does not necessarily translate into prediction about individual outcomes. We would therefore suggest that although relatively robust in the sample concerned, these analyses should be subject to confirmation using other comparable data sets, especially since some of the coefficients were small in magnitude.

The fact that our findings reflect a number of earlier studies increases our confidence in their validity.

6. Conclusions

There can be little doubt that these findings confirm the association between the child's earliest experiences and their preparedness for primary school, fostering that school readiness which is so central to their capacity to thrive throughout primary school and beyond. Although traditional aspects of social risk such as material wealth remain important, the present analyses suggest that many of the variables identified here are mutable in the sense that it is possible to enhance children's language development. Similarly it is possible to encourage wider book ownership and library use with infants. Indeed this has been a feature of Book Start and other initiatives widely used in Sure Start local programmes.

The suggestion that the predictive role of language becomes clear by 24 months suggests that this is a critical time to identify those at risk. Although most children are not in education facilities at this point they are covered by health visiting services in the NHS. This highlights the importance of an interagency approach to addressing these issues. In short we are already aware of the type of resources that need to be available and the models of service delivery which need to be put in place to address the issues reported here. If we want to use these findings to improve school entry performance we have to ensure that such services are consistently available for all children and that those least likely to access them are enabled to do so.

7. Appendices

Appendix I extract of scoring for Reading from South Gloucestershire Entry Assessment

At Stage 3, can the child

- A Listen to a story lasting 5-10 minutes
- B Turn pages of a book one at a time
- C Look at books alone
- D Talk about pictures in a book

At Stage 4 can the child

- A Know the direction in which pages are turned, ie from front to back
- B Demonstrate that you read words not pictures
- C Re-tell part of a story using pictures in a book
- D Recognise his/her own first name

If 0 or 1 item was ticked by teacher at stage 1 the child scored at stage 2

If 2 items were ticked at stage 2 the child scored at stage 3

If 3-4 items were ticked, the teacher moves onto the next stage

If 0-2 items were ticked at stage 4, then the child scored at stage 4

If 3-4 items were scored the teacher moves onto the next stage...

A similar process occurs with stages 5 and 6, providing a possible score up to stage 7. Within the ALSPAC dataset, these 'stage' scores were recoded to produce a 6-point scale (0-5). So each child could score a maximum of 5 points for each of the 4 required areas (reading, writing, maths, language).

Appendix II Comparison of reading items from South Gloucestershire Assessment and the Early Years Foundation Stage Profile

South Gloucestershire Assessment	Early Years Foundation Stage Profile
Listen to a story lasting 5-10 minutes	Is developing an interest in books
Turn pages of a book one at a time	Knows that print conveys meaning
Look at books alone	Recognises a few familiar words
Talk about pictures in a book` `	Know s that in English, print is read from left to right and top to bottom
Know the direction in which pages are turned, ie from front to back	Shows an understanding of the elements of stories, such as main character, sequence of events and openings
Demonstrate that you read words not pictures	Reads a range of familiar and common words and simple sentences independently
Re-tell part of a story using pictures in a book	Retells narratives in the crrect sequence, drawing on language patterns of stories
Recognise his/her own first name	Shows an understanding of how information can be found in non-fiction texts to answer questions about where, who why and how
Arrange a sequence of up o 4 pictures and tell the story which makes sense to the child	Reads books of own choice with some fluency and accuracy
When shown one word finds the same one on the page	
Notice and remark on visual details in words	
From a collection select 2 objects that begin with the same sound	
Answer 2 or more literal comprehensible questions about a story	
Recognise at least 15 letters by sound	
Have a sight vocabulary of at least 15 words from different contexts	
Draw inferences from stories	
Suggest more than on possible ending for a story	

Appendix III. Language variables used from ALSPAC 15 and 24 month questionnaires

KC800	<p><i>Before beginning to speak, children often show signs of understanding some words and phrases. Does your child do any of these?</i> <i>Yes No Usually Sometimes</i> <i>F1. (a) turns when her name is called</i></p>
KC801	<p><i>stops what she is doing (even for a moment) when you say 'no'</i></p>
KC 814 understands	<p><i>Which of these does your child understand?</i> <i>She understands:</i> <i>Yes No</i> <i>Are you sleepy</i> <i>Be quiet</i> <i>Come here</i> <i>Do you want more</i> <i>Don't do that</i> <i>Give me a kiss</i> <i>Don't touch</i> <i>open your mouth</i> <i>sit down</i> <i>spit it out</i> <i>stop it</i> <i>time for bed</i> <i>Top score = 12</i></p>
KC815 imitates words	<p><i>Some children like to imitate things that they've just heard.</i> <i>How often does your child imitate words?(never sometimes often)</i></p>
KC816 Names things	<p><i>Some children like to name or label things.</i> <i>How often does your child do this?(never sometimes often)</i></p>
KC954 Vocabulary score	<p><i>Here are some words that your child might understand and some that she might say.</i> <i>If she uses a different pronunciation (like efant for elephant) tick it anyway.</i> The mother is asked to consider a list of 134 items comprising nouns, verbs, adjective, greetings words and words to describe routines such as bedtime. This variable was recoded to differentiate when the child is understanding only and when they are using a word. That is, we used two variables, one for a child's understanding of vocabulary and one for a child's use of vocabulary.</p>
KC968 Nonverbal communication score	<p><i>When children are first learning to communicate, they often use gestures to make their wishes known. Which does your infant do?</i> Made up of 10 items 958-967 Max score 20 <i>Series of gestures/actions (nods, shakes head, points, shows objects, hush, requests an object, blows kisses, indicates a wish to be picked up, waves bye bye, reaches out and gives a toy).</i></p>
KC 986 Social develop	<p><i>Does she do or try to do any of the following?</i> Items 970- 985 Examples: eating with a fork, aspects of dressing, early pretend play</p>

ment score	actions
KC 990 Total communication score	<i>A derived variable which combines the scores from these variables: 986+968+954+814 Maximum scored 330</i>
KE 643 vocabulary score	<i>Similar to kc 954</i>
KE 654 Grammar score	<i>Use of grammar word endings (plurals, possessives, and past tenses)</i>
KE680La language score plurals	<i>Use of irregular grammar (plurals)</i>
KE681La language score tenses	<i>Irregular tenses</i>
KE683 grammar score	<i>Irregular grammar combines previous two variables</i>
Ke683 combines words	<i>Has your son begun to combine words yet, such as "nother sweet", or "doggie bite?" Not yet Sometimes Often</i>

Appendix IV. Variables for the Communication Environment

Variables excluded in Step 1 because of poor distribution of the population within the variable are highlighted.

Stimulation- Language/communication- Proximal

Babies should be picked up whenever they cry

It is important to develop a regular pattern of feeding and sleeping with a baby

Babies should be fed whenever they are hungry

Babies need to be stimulated if they are to develop well

Babies need quiet secure surroundings and should not be disturbed too Much

Parents need to adapt their lives to the baby's demands

A baby should fit into its parents routine

Babies should be left to develop naturally

Talking, to even a very young baby, is important

Cuddling a baby is very important

Do you talk to your baby while you work? (eg. while you do housework).

Does your baby see children (other than brothers or sisters)?

Mum plays with child

FREQ MUM sings to CH

FREQ MUM shows CH picture books

FREQ MUM & CH play with toys

FREQ MUM cuddles CH

FREQ MUM physically plays with CH

FREQ MUM takes CH for walks

FREQ MUM does other things with CH

KD365 NO of Books Owned by Child

KD366 MUM Tries to Teach Child

KD367 MUM Teaches Clapping Games

KD368 MUM Teaches Names of Body Parts

KD369 MUM Teaches Waving Good-bye

KD370 MUM Teaches Colours

KD371 MUM Teaches Alphabet

KD372 MUM Teaches Numbers

KD373 MUM Teaches Nursery Rhymes

KD374 MUM Teaches Songs

KD375 MUM Teaches Shapes and Sizes

KD376 MUM Teaches Politeness

KD377 MUM Teaches Other Things

KD377 MUM Teaches Other Things

KD405 FREQ MUM Baths CH

KD405 FREQ MUM Baths CH

KD407 FREQ MUM Sings to CH

KD408 FREQ MUM Reads to CH

KD409 FREQ MUM Plays With Toys With CH

KD410 FREQ MUM Cuddles CH

KD411 FREQ MUM Plays Pat-a-Cake Etc With CH

KD412 FREQ MUM Has Physical Play With CH

KD413 FREQ MUM Takes CH For Walks

KD414 FREQ MUM Does Other Activity With CH

KE010 CH allowed to play W messy OBJs

KE011 CH allowed OBJs for building

KE012 CH sung to
KE013 Stories read to CH
KE014 CH praised
KE015 CH kissed or cuddled
KE016 CH shouted at
KE017 CH slapped
KE018 CH taken to park or playground
KE019 Carer has meal W CH
KE020 CH allowed to make lot of noise

Distal Stimulation

KD390 FREQ CH Plays With Other Kids

Stimulation- Child development and welfare-proximal

G925 TV or music usually on in home
G926 Outside noises are disturbing
G927 Difficult to converse due to noise
KB530 NO of times CH is taken to local shops
KB532 NO of times CH is taken to supermarket
KB527 Ch taken to supermarket
KB529 Ch taken to visit friends/family
KB535 CH has cuddly toys
KB536 CH has push/pull toys
KB537 CH has co-ordination toys
KB538 CH has walker
KB539 CH has baby bouncer
KB543 Mum tries to teach child
KB581 activity score (combines several of above scores)
KB582 home score
KD315 FREQ CH Taken to Local Shops
KD316 FREQ CH Taken to Department Store
KD317 FREQ CH Taken to Supermarket
KD318 FREQ CH Taken to Park
KD319 FREQ CH Visits Family/Friends
KD320 FREQ CH Taken to Library
KD321 FREQ CH Taken to Places of Interest
KD322 FREQ CH Taken to Places of Entertainment
KD360 Child Has Cuddly Toys
KD361 Child Has Push or Pull Toys
KD362 Child Has Co-ordination Toys
KD363 Child Has Baby Walker
KD364 Child Has Baby Bouncer
KD381 FREQ TV on in Mornings
KD382 FREQ TV on in Afternoons
KD383 FREQ TV on in Evenings
KD384 CH Watches TV
KD385 CH Watches Childrens Programmes
KD386 CH Watches Other Programmes
KD387 CH Watches Childrens Videos
KD388 CH Watches Other Videos
KD415 Mum's parenting score
KE030 NO of cuddly animals CH has at home
KE031 NO of dolls CH has at home
KE032 NO of swings CH has at home
KE033 NO of toy vehicles CH has at home

KE034 NO of jigsaw puzzles CH has at home
KE035 NO of mobiles CH has at home
KE036 NO of building blocks CH has at home
KE037 NO of books CH has at home
KE038 NO of balls CH has at home
KE039 NO of walkers CH has at home
KE040 NO of sit in walkers CH has at home
KE041 NO of interlocking toys CH has at home
KE042 Toy Score

Attitudes-proximal

F100 Enjoy the baby
F101 CH considered untimely
F102 Feel confident with CH
F103 Dislike mess surrounding CH
F104 Pleasure in CH development
F105 Cant bear CH crying
F106 Unsure if doing right thing for CH
F107 Guilty at not enjoying CH
F108 Feels lack of time for self
F109 More fulfilled by CH
F110 Babies are fun
F860 Should pick up crying baby
F861 REG feed & sleep important for baby
F862 Should always feed hungry baby
F863 Babies need stimulation to develop
F864 Babies should not be disturbed much
F865 Parents should adapt life to baby
F868 Important to talk to babies of all ages
F869 Cuddling babies is important
F111 Maternal enjoyment score

Support – Proximal

G226 Social support score
Edinburgh Postnatal depression score
F920 Social support score 1
Support distal
KE506 CH looked after in creche

Appendix V - Conventions set out in Peters, 2008 Multifarious terminology: multivariable or multivariate? Univariable or univariate? Paediatric and Perinatal Epidemiology. 22, 506.

See footnote 6

Paediatric and Perinatal Epidemiology, 22, 506. © 2008

Editorial

Multifarious terminology: multivariable or multivariate? univariable or univariate?

Tim J. Peters

Department of Community Based Medicine, University of Bristol, Bristol, UK

Perhaps all discussions of terminology can be thought of as semantics, but arguably some have implications that go beyond the pure version. One seemingly perennial issue for epidemiological reports is the use of the terms 'multivariate'/'multivariable', 'univariate'/'univariable', and even more variations on the theme, such as 'bivariate'. PPE therefore decided some time ago to adopt the following terminology for the various forms that regression models can take in terms of the number of outcomes and explanatory variables (this writer for one tries to avoid the terms 'dependent' and 'independent' respectively here given their technical connotations).

Regression models of all kinds (e.g. standard, logistic) that involve a single outcome are 'univariate' regardless of how many explanatory variables are included in the model. The term 'multivariate' regression should be restricted to those cases where there is more than one outcome (strictly speaking, a more general specification is where the model requires the assumption of a joint distribution of some kind, including certain applications of repeated measures regression). In practice, virtually all regression models in articles submitted to PPE therefore involve 'univariate' techniques; hence, unless you have a situation that is otherwise, we would not expect you to state this explicitly.

Where there clearly is a very common distinction to be made is when the models move from including just one explanatory variable to models involving more than one explanatory variable (when issues such as confounding and effect-modification are being taken into account and/or investigated). The terminology adopted by PPE is that where there is just one explanatory variable the model should be termed 'univariable' (rather than 'univariate' or 'bivariate'), and where there is more than one, then 'multivariable' should be the label used (rather than 'multivariate'). No system is perfect if for no other reason than it does not accord with everyone's established practice, but PPE hopes that the above approach is one that is both consistent from article to article, and moreover does have a rationale that avoids dangers of ambiguity.

Appendix VI. List of variables included in the parenting variable

KD367 MUM Teaches Clapping Games
KD368 MUM Teaches Names of Body Parts
KD369 MUM Teaches Waving Good-bye
KD370 MUM Teaches Colours
KD371 MUM Teaches Alphabet
KD372 MUM Teaches Numbers
KD373 MUM Teaches Nursery Rhymes
KD373 MUM Teaches Nursery Rhymes
KD375 MUM Teaches Shapes and Sizes
KD376 MUM Teaches Politeness
KD405 FREQ MUM Baths CH
KD406 FREQ MUM Feeds CH
KD407 FREQ MUM Sings to CH
KD408 FREQ MUM Reads to CH
KD409 FREQ MUM Plays With Toys With CH
KD410 FREQ MUM Cuddles CH
KD411 FREQ MUM Plays Pat-a-Cake Etc With CH
KD412 FREQ MUM Has Physical Play With CH
KD413 FREQ MUM Takes CH For Walks
KD414 FREQ MUM Does Other Activity With CH

Appendix VII. Variables used in final analyses of the communication environment 0 – 2 years

Variable code	Label	Age of child	Question and coding
KB540		6 months	About how many books does your child own? None: 1 1-2: 2 3-9: 3 10+: 4
Kb543	Mum tries to teach child	6 months	Base question was do you try to teach your child? Responses recoded into yes/no
Kb582	Home score	6 months	Derived variable 0-12 6 items Types of toys (a)cuddly,b) push/pull, c)co-ordination), no of books, tries to teach child, tries to talk during housework.
Kb583	Mother's parenting score	6 months	Derived variable 0-12 Includes questions about: Freq mum play with child, sings to child, show child picture books, Mum and child play with toys, cuddles child physically plays with child, takes child for walks
Kd365	No of books owned by child	18 months	About how many books does your child have of her own? None: 1 1-2: 2 3-9: 3 10+: 4
Kd320	Frequency child taken to library	18 months	Nearly every day Once per week Once per month A few times per year never
Kd380a	Home score	18 months	Derived variable 1-12 6 items Types of toys (cuddly, push/pull, co-ordination), no of books, tries to teach child, tries to talk during housework,
Kd 415	Mother's parenting score	18 months	Derived variable 6-51: Various teaching activities, general caring activities Teaches clapping games Teaches names of body parts Teaches waving goodbye Teaches colours, alphabet, numbers, nursery rhymes, songs, shapes & sizes, politeness, Freq mum baths child, feeds child, sings to child, reads to child, plays with toys with

			child, cuddles child, plays pat-a-cake with child, has physical play with child, takes child for walks, other
Kd3812rec	Recorded TV watching	18 months	Parents have TV on during the day (1 = everyday and sometimes)(2= no)
Ke042	Toy score	24 months	Derived variable 1-36 11 questions asking how many of each sort of toy does child have at home including cuddly animals, dolls, swing, cars, jigsaws, mobiles, bricks, balls, walkers to ride in, walkers to push, interlocking toys.
G925	TV or music usually on in the home	21 months	There is usually music or TV on in the home: yes/no
G226	Social support score	21 months	Derived variable 0-30. A series of questions about level of support perceived by mother. I have no one to share my feelings with My partner provides the emotional support I need There are other mothers with whom I can share my experiences I believe in moments of difficulty my neighbours would help me I'm worried that my partner might leave me No partner There is always someone with whom I can share my happiness and excitement about my baby If I feel tired I can rely on my partner to take over No partner If I was in financial difficulty I know my family would help if they could If I was in financial difficulty I know my friends would help if they could If all else fails I know the state will support and assist me
E390	Edinburgh postnatal score	8 weeks	10 items with a 0-3 score about feeling of mother in the last week Able to laugh and see the funny side of things Looked forward with enjoyment Blamed self unnecessarily when things went wrong Anxious or worried for no reason Scared or panicky for no reason Things getting on top of me Difficulty sleeping due to unhappiness Sad or miserable Crying due to unhappiness Thoughts of self-harm.

F111	Maternal enjoyment score	8 months	Derived variable 0-15; 5 items Enjoy the baby Pleasure in watching child's development Feeling guilty at not enjoying child fulfilled by child babies are fun.
F863	Babies need stimulation to develop	8 months	4 point scale from agree to disagree
F920	Social support score 1	8 months	Derived variable score 0-30 based on 10 items I have no one to share my feelings with My partner provides the emotional support I need There are other mothers with whom I can share my experiences I believe in moments of difficulty my neighbours would help me I'm worried that my partner might leave me No partner There is always someone with whom I can share my happiness and excitement about my baby If I feel tired I can rely on my partner to take over/ No partner If I was in financial difficulty I know my family would help if they could If I was in financial difficulty I know my friends would help if they could If all else fails I know the state will support and assist me

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