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Department of Education
University of Oxford

**Social Deprivation and Language Development: The Gap between
Language Abilities for Children Attending Schools from the Most
to Least Deprived Areas in the UK**

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Abstract

Objective: This study aimed to determine the association between social deprivation and children's language ability. There was evidence suggesting that children from underprivileged backgrounds have delayed language development. We tested the hypothesis that early childhood represents a critical period during which social deprivation levels could produce gaps in language development among nursery children from birth to five years old. We expected children from socially deprived areas to achieve lower language scores than children from more affluent areas. We also hypothesized that the neighborhood effects would be moderated by children's home language environment.

Methods: A secondary analysis of quantitative data from the NELI-N program (Schools = 62, N = 1496) was carried out. Social deprivation of children was measured in two domains, neighborhood poverty and home language environment. School-level neighborhood poverty was measured across five quintile levels by geographical-based income deprivation affecting children index (IDACI). The home language environment was recorded by English as Additional Language (EAL) status, assigning children into two categories, non-EAL and EAL groups. Children's language outcome was assessed by the LanguageScreen assessment. A language factor was extracted from four subtests of LanguageScreen, presenting children's generalized language ability at age 3 to 4. The main and interaction effects of IDACI and EAL were analyzed in ANOVA models.

Results: Social deprivation and EAL status were strongly related to children's language ability. For neighborhood poverty, there were significant differences in language development between children from the most deprived neighborhood quintile and children from higher quintiles. Involving varying home language backgrounds, EAL children achieved significantly lower language scores than non-EAL children in nursery years. The interaction effect between IDACI and EAL was highly significant and accounted for more variance in the scores compared to the effect of IDACI exclusively. Non-linear relationships were found in multilevel models, and children from the fourth IDACI quintile (60th-80th) had lower language scores than expected from a linear function.

Conclusions: This study provides strong evidence for both independent and combined effects of home language environment and school neighborhood poverty. These findings

demonstrate that children from socially deprived areas experience multiple risk factors. Neighborhood-level deprivation leads to lower language performance, especially for native children compared with other native pupils. EAL conditions strongly predict children's language scores in preschools, supporting the hypothesis that early childhood represents a critical period during which quantity and quality of language exposure create gaps in language development. The interaction of disadvantaged home and neighborhood experience negatively impacts children's language learning process and results in poor language skills by nursery ages. Implications for future language research were addressed.

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List of Abbreviations

ADHD	Attention-Deficit/Hyperactivity Disorder
ANOVA	Analysis of Variance
ASD	Autistic Spectrum Disorder
BPVS	British Picture Vocabulary Scale
CDS	Child-Directed Speech
CELF	Clinical Evaluation of Language Fundamentals
EAL	English as an Additional Language
EDI	Early Development Instrument
EV	Expressive Vocabulary
IDACI	Income Deprivation Affecting Children Index
LC	Listening Comprehension
LSOA	Lower Super Output Area
NELI-N	Nuffield Early Language Intervention Nursery
OWLS	Oral and Written Language Scale
POLAR	Higher Education Participation of Local Areas
PPVT	Peabody Picture Vocabulary Test
PTSD	Post-Traumatic Stress Disorder
RAPT	Renfrew Action Picture Test
RCT	Randomized Control Trial
RV	Receptive Vocabulary
SES	Socioeconomic Status
SR	Sentence Repetition
YARC	York Assessment of Reading for Comprehension

Chapter 1. Introduction

Children's language ability is critical for many aspects of development. Children with poor language skills appear to have problems with social competence (Longoria, Page, Hubbs-Tait & Kennison, 2009), academic performance (Vukovic & Lesaux, 2013; Hoff, 2013), psychosocial adjustment (Schoon, Parsons, Rush & Law, 2010), emotion and behaviour regulation (Cole, Armstrong & Pemberton, 2010; Cohen & Mendez, 2009), as well as the development of the Theory of Mind (Milligan, Astington & Dack, 2007). In addition, children's early language abilities, including their oral language and listening comprehension skills, provide the foundation for learning to read (Gough & Tunmer, 1986; Hoover & Gough, 1990). Language development, may therefore, influence children's ability to understand themselves, other actors in their lives, and the situation around them. Nonetheless, there is significant variation in the children's language development, especially between children from socially deprived and affluent backgrounds.

Intuitively, the negative association between social deprivation and children's language ability seems clear. Evidence has shown that social deprivation leads to developmental gaps between children from affluent and deprived backgrounds in domains such as intelligence quotient (McLoyd, 1998), early literacy development (Duncan, Brooks-Gunn & Klebanov, 1994), cognitive competence (Linver, Brooks-Gunn & Kohen, 2002), and maths skills (Ellen & Turner, 1997). However, the rationale and mediating mechanisms involved in the relationship are difficult to define and explain. Social deprivation, in this case, describes children's ability to access resources and learning materials essential for language development. Social deprivation is multi-dimensional, involving a combination of factors, including individual attributes, the home environment, and neighbourhood poverty. So far, however, few researchers have determined whether this association holds true in nursery age children, when evaluating multi-level contextual factors both independently and combined. To date, most of the existing early language literature has focused either on those specific to neighbourhood deprivation or on those of the home environment. In practice, no single model has been shown to predict an individual's developmental outcomes, as adverse consequences may result from the combination of a range of neighbourhood characteristics (Ellen & Turner, 1997).

1.1 Recent Trend in Language Development Study

In terms of the developmental delay of disadvantaged children, previous researchers have documented a “30-million-word gap” in vocabulary between 3-year-old children from a lower socioeconomic status (SES) background and their more privileged peers (Hart & Risley, 1995; Hart & Risley, 2003). This “30-million-word gap” described the difference in numbers of receptive vocabulary a child received from the primary caregiver in the first three to four years. For young children, the speech of the caregiver is a major source of words that contributes to children’s early vocabulary growth, which further facilitates the development of other aspects of language. This enormous word gap in deprived children indicated that early childhood experience could lead to disparate trajectories of language development. In that case, children from disadvantaged families could significantly underperform in the evaluation of language accomplishments. Nevertheless, several recent randomized control trials (RCTs) based in the United Kingdom (UK) have provided promising evidence that high-quality language instruction and interventions are effective in improving at-risk children’s vocabulary, phoneme awareness, letter-sound knowledge, grammatical skills, and oral language skills as defined by multitude language aspects (Bowyer-Crane et al., 2008; Fricke et al., 2013; Fricke et al., 2017; Hulme et al., 2020; West et al., 2021). In Muter, Hulme, Snowling and Stevenson’s (2004) two-year longitudinal study, phoneme awareness and letter-sound knowledge were linked to young children’s development of word recognition skills. Following that, children’s vocabulary, grammatical skills and priorly developed word recognition were fundamental precursor skills to predict children’s reading comprehension. Hence, these findings have suggested that well-structured and intensive language intervention could target several aspects of language development and ameliorate children’s language weaknesses due to early resource deprivation.

Though some of these findings demonstrated clearer evidence of improvement in the expressive aspects of language than in receptive language or more advanced reading comprehension, this may be because listening and reading comprehension skills typically require more systemic processing proficiency from young children, which might be relatively hard to develop in a short period of time. Also, evidence has shown that interventions that focus on a specific aspect of language are more effective in developing that particular language skill (Bowyer-Crane et al., 2008). Nonetheless, the demonstrated improvement in early vocabulary, phonological awareness, and oral language skills is likely to reduce the

vocabulary gap in children from disadvantaged backgrounds and, more importantly, stop the potential transferring effects that affect children's subsequent educational performance (Hulme et al., 2020). Despite the success of intervention programmes, however, it remains crucial to identify the factor or combination of factors that cause social deprivation to impact on children's language development in the first place. More information about the interaction effect of contextual factors could provide useful implication insights and help to identify the most at-risk children in our society. Moreover, identifying the factors that cause disparities among children can assist in the development and administration of relevant interventions that can efficiently reduce the language development gap for a vulnerable population.

1.2 The Present Study

This paper provides a critical review of the extensive empirical studies that have addressed how social deprivation, as determined by home environment and neighbourhood-level poverty, has been linked to negative developmental consequences, and in particular, delayed language development in children. Specifically, the literature review synthesizes the findings of several influential studies linking social deprivation to language development, supplements the previous results with some more recent evidence, and explains explicitly how the present study has arrived at its research question. In addition, the study evaluates a recently developed tablet-based language assessment tool used in England – the LanguageScreen app – and provides practical insights into the effectiveness of interventions for children from more disadvantaged backgrounds. Secondary data analysis has been conducted to provide a conclusive answer to the critical research question: does social deprivation have effects on children's language abilities?

Chapter 2. Literature Review

This chapter will first explore the definition of social deprivation; next, it will introduce the wider literature on the topic of social deprivation and emergent language and review the conceptual framework, addressing the linkages between child, home and school and the implications of the model in practice; finally, it will explain how the present study fits within the broader research area, the necessity of the research question, and how it contributes to the literature by filling the existing research gap.

2.1 Child-Focused Definition of Social Deprivation

Chambers suggested that deprivation has multiple dimensions, and should not only be regarded in terms of income poverty but “social inferiority, isolation, physical weakness, vulnerability, seasonality, powerlessness, and humiliation” (1997, pp. 17-20). In other words, though absolute income remains a valid method for estimating an individual’s capabilities to pursue social functions (Sen, 1999), there are many other resources that are essential to avoiding a state of deprivation. Since the 1980s, various methods have been used to classify and identify people living in poverty, such as being born into a social/cultural minority, living in a geographically isolated community, suffering from physical weakness and disabilities, being exposed to persistent insecurity and stress, experiencing seasonal inaccessibility and shortage of resources, being voiceless on social decisions, or being the victim of social shaming (Chambers, 1997; Narayan, Chambers, Shah & Petesch, 2000; Walker & Chase, 2014). To incorporate these separate aspects, the concept of social deprivation has been introduced as a complementary concept to poverty to describe the broader environment individuals are faced with and the social resources they have access to for their development (Mabughi & Selim, 2006).

In the field of educational psychology, the notion of social deprivation has been extended to identify not only children with deprivation of attachment (Harlow et al., 1966) or those viewed as vulnerable to contingency (Chambers, 1997) but more generally children with limited social and home resources as well as those who lack valuable social experience because of their belonging to certain categories of social deprivation. Poverty, therefore, is just one aspect of social deprivation, which is linked to a deprivation of economic resources and other resources essential for an individual’s development and wellbeing. For example, children from impoverished backgrounds tend to attain worse educational outcomes than

their affluent peers (e.g., Hulme et al., 2020). This low academic achievement is likely to result from a lack of access to educational resources that support a variety of typical developmental processes, from the neurological development of the early brain (Huttenlocher, 1990) and cognitive functioning (Kaler & Freeman, 1994), to socioemotional (Leventhal & Brooks-Gunn, 2000), behavioural outcomes (Moren-Cross, Wright, LaGory & Lanzi, 2006), and executive functions (Sarsour et al., 2011).

However, a concrete child-focused definition of social deprivation has not yet been developed, and, more importantly, there is no clear consensus on which particular dimensions of social deprivation have the most profound effects on children's developmental outcomes. This lack of a clear definition was pointed out by Garner and Raudenbush (1991), who suggested the problem was due to the complexity of disentangling the main and interaction effects of the wide-ranging factors that impact children's academic attainment. Over the last several decades, these various separate or collective effects, which range from individual and home factors to contextual variations, have been studied within neighbourhood units and have generally been called "neighbourhood effects." In this context, neighbourhoods, beyond simply residential areas, can represent a range of social communities. According to Suttles (Suttles, 1968; Suttles & Suttles, 1972), communities can be defined as mutually exclusive socio-spatial units, which can also be positioned in an ordered social system. Based on this definition, a neighbourhood could take the form of a school/class environment, a residential community, and even an ethnic or religious group. Practically, research on child development has primarily focused on the contexts of the home and school environment, which appear to provide the most relevant experiences to young children. Accordingly, the current study will be examining the school environment as the "neighbourhood" in question.

The Child, Home and Neighborhood Model

Evidence has shown that factors stemming from individual attributes, the home, and the neighbourhood environment all affect children's development through an extensive array of pathways, through which adverse contextual factors are linked to the development of individual children (Garner & Raudenbush, 1991). In terms of personal characteristics, children's poor health (Larson, Russ, Crall & Halfon, 2008), mental illness (Butler, Kowalkowski, Jones & Raphael, 2012), and disabilities (Missiuna & Pollock, 1991) can supply negative early childhood experiences. At the household level, the key factors involve

substandard housing conditions (Evans & English, 2002), language deprivation, and single parenthood (Sarsour et al., 2011). Relevant neighbourhood contexts, on the other hand, involve neighbourhood poverty (Brooks-Gunn, 1997), violence and crime (Gorman-Smith & Tolan, 1998; Curry, Latkin & Davey-Rothwell, 2008), community cohesion and social support (Fone et al., 2007; Kohen, Leventhal, Dahinten & McIntosh, 2008; Butler, Kowalkowski, Jones & Raphael, 2012), and, finally, school quality and characteristics (Aikens & Barbarin, 2008).

Most studies mentioned above examined the factors in isolation and, since 2000, they have been studied in combination. An increasing number of studies in the last two decades has shown that children's developmental performance, in terms of their social and academic competencies, can be regarded as a product of the joint effects of factors involving individual characteristics, home environment, and neighbourhood functionality (Leventhal & Brooks-Gunn, 2000; Bradley & Corwyn, 2002; Sampson, Morenoff & Gannon-Rowley, 2002). In particular, a study by Mashburn and Pianta (2006) suggested that a possible mediator of the link between social deprivation and children's school readiness is the social relationships they have with peers (individual factor), parents (home factor), and teachers (school factor). Despite Mashburn and Pianta (2006) only addressing a single mediating pathway and measuring children's ability at a relatively general level, the authors applied a comprehensive systematic model to the developmental process of children, which extended a previous conceptual model identified by Leventhal and Brooks-Gunn (2000). Since the original model presents a simplified child-focused perspective to evaluate the interaction effects among multiple levels, it is suitable for use in other studies on the effects of social deprivation and neighbourhood factors. An additional merit of the conceptual model is that it emphasizes the processes and contexts in which abilities are fostered in children, rather than measuring the outcomes through a single-level factor or assessment. Therefore, the model provides a useful theoretical framework for the study of neighbourhood effects because it addresses the importance of the interaction between children's personal attributes, home characteristics, and neighbourhood environment in their development of particular educational skills.

2.2 Mental Health and Developmental Consequence

To date, many studies have documented the negative consequences of social deprivation, particularly in two separate yet interrelated areas: mental health outcomes and developmental

difficulties. Social deprivation has become a growing area of research since Harlow et al.'s (1966) work with infant rhesus monkeys first revealed the importance of an enriching childhood environment and non-material contact between infants and others. Infant monkeys raised in isolation failed to communicate with other members when they finally joined the society (Harlow et al., 1966). Since that time, adverse early childhood experiences have been more and more studied in human society. Indeed, research has demonstrated that the privation of attachment and interaction, and the failure to grow up in an enriched environment have prolonged adverse effects on an individual's development. Likewise, neighbourhood-level poverty as an index of social deprivation is more strongly related to an individual's long-term well-being than ethnic-related segregation (Ludwig et al., 2012). According to a simple yet effective definition of well-being (Dodge, Daly, Huyton & Sanders, 2012), social deprivation can introduce a state of imbalance between an individual's resources and their lifespan challenges. Children need to solve challenges to stimulate their development of a range of skills (Hendry & Kloep, 2002), but an early-stage inability to solve challenges due to limited resources can result in developmental delays that impair their problem-solving ability in future life. Hence, it is important to provide children with the necessary resources, including psychological, social, and physical support during early childhood, to foster their early development of skills crucial for maintaining a strong homeostatic state of well-being (Dodge et al., 2012).

Multi-Level Analysis of Social Deprivation

Social deprivation has been found to contribute to an inability to cope with a variety of psychological challenges faced by individuals, such as major and short-term depression, distress, anxiety, and other coping issues during their lifespan (e.g., Rutter, 1972; McLoyd, 1998; Skapinakis et al., 2005). For instance, Fone and Dunstan's (2006) multi-level analysis demonstrated a negative correlation between neighbourhood deprivation and individuals' mental health. The study used cross-sectional data from the Welsh Health Survey to analyse the neighbourhood effect on mental status in 24,975 participants aged 17 to 74. Significant negative correlations were found with area-based social deprivation and the employment status of individuals, respectively. A further unique feature of this study is that it tested for the interaction effect between area-level deprivation and individual-level poverty. The results showed that the effect of neighbourhood deprivation was significant and potentially more prominent for those who were individually deprived. To put it another way, for those

individuals who live in more socially deprived regions, suffering from unemployment or a high level of insecurity contributes to lower mental health scores. The conclusions drawn from these findings are in line with previous research connecting lower-level vulnerability (e.g., Weich, Lewis, & Jenkins, 2001) and higher-level regional deprivation to adverse psychosocial outcomes (e.g., Skapinakis et al., 2005). Furthermore, Fone and Dunstan (2006) evaluated individual risk factors in the presence of higher-level contextual disadvantages. This cross-level analysis has provided a methodological solution to Mashburn and Pianta's (2006) developmental system perspective. The analytical approach used in the study can be adapted to the present study to explore younger children subjects and how the interaction of environmental factors shapes their developmental experience. In particular, the model could be used to evaluate the home-level environment of nursery-age children, who are largely defined by home-related risk factors rather than individual characteristics, as they experience fewer socially defined expectations and positions during early childhood. With that being said, Fone and Dunstan's (2006) analysis plan can also be applied to other social deprivation studies that investigate how multiple variables impact children's conditions and future success.

Early Childhood Development Model

Having recognized that mental health problems in the adult population can be contributed to by multi-dimensional deprivation experiences in childhood, developmental psychologists have also evaluated the persistent effects of deprivation on young children's achievement of developmental milestones. In contrast to most mental health studies, which focus on a number of relatively congruent consequences, such as depression, anxiety, and post-traumatic stress disorder (PTSD), the research of children's developmental outcomes has introduced a wide assortment of domains for examination.

A study of reception-aged children in Canada used the Early Development Instrument (EDI; Offord & Janus, 1999) to measure children's achievement of five developmental milestones at age 5. The five domains targeted were physical well-being, social competence, emotional maturity, cognitive and communication skills, and knowledge development (Janus & Offord, 2007). A total of 2,196 children from enriched and community backgrounds were compared. In this study, social deprivation was measured by a combination of factors, including family socioeconomic resources, single parenthood status, maternal education, home language

environment, child and parental health conditions, and parent-child interaction activities. Evidence has shown that children from more disadvantaged backgrounds are significantly more vulnerable at school entry, which is reflected in their school readiness scores (Janus & Duku, 2007). Janus and Duku (2007) noted that nearly 20 percent of children in the most deprived 10th decile were shown to have disadvantages in one or more of the measured domains listed above. Furthermore, the predominant socioeconomic predictors of family income and parents' highest education yield the highest correlation and significance level with children's language and communication skills, after controlling for children's age and gender. The findings of their F-test analysis indicated a greater dispersion of outcome scores across deprivation levels when considering children's reading, writing, and speaking abilities. Nevertheless, it was noted that although significant correlations were found for most domains, even the most robust domain only explained a small portion of the variance (less than 5.4%) in children's school readiness (Janus & Duku, 2007). As variance measures the distance between scattered data and the mean (Field, 2017), limited divergence indicates that home-level socioeconomic factors alone are insufficient to predict children's development, despite being the most influential predictor in the performed analysis.

Janus and Duku's (2007) study contributed to the existing literature by evaluating the EDI model that had been developed to measure children's development prior to elementary school entry. They demonstrated that the model could be improved and used in future studies and adapted to different populations of children of varying age ranges. Also, each domain of development mentioned in the model could be tested separately or in combination, as well as the various social deprivation factors. More importantly, Janus and Duku's (2007) study highlighted the strong connection between home-level deprivation, as defined by family income and education, and language development in 5-year-old children, leading other researchers to explore the effects of home environment on children's delayed early development. Brinkman et al. (2013), for example, used an Australian adaptation of the EDI model (Australian Early Development Index; AEDI) to exclusively measure younger children's literacy outcomes, at ages 3, 5, and 7. More recently, Davies, Janus, Duku, and Gaskin (2016) applied the EDI model to evaluate 45,000 children's reading and writing scores across preschool and elementary years, and their findings suggested a correlation between preschool performance and language achievement 2 to 3 years later. Davis et al.'s (2016) conclusion was consistent with the results observed in Brinkman et al. (2013) that children's language and communication skills at 3 years old can effectively predict their

literacy skills at ages 5 and 7. Moreover, Brinkman and colleagues suggested that the correlation between children's overall development and their reading skills seems to get even stronger as children get older, compared to other skills. By using an established early development model, these large-scale studies revealed a consistent link between economic-based social deprivation and early language development, laying preliminary yet essential groundwork for future studies to thoroughly explore the pathways and agencies involved in the relationship. Hence, these studies identified that home and community characteristics were strong and consistent predictors of children's language difficulties. At last, the statistical models and methods used in the above-mentioned analyses could provide helpful methodology references for researchers conducting wide-ranging data analyses with a quantitative design.

2.3 Language Development Pathways

As noted above, in the social deprivation literature, increasing importance is being attached to children's language development. Up to this point, a limited number of mechanisms has been proposed linking a particular domain of neighbourhood deprivation to children's early language development. One possible mechanism is that various disadvantaged conditions may often coincide for a prolonged period (Bradley & Corwyn, 2002) and have a joint effect on children's language development. For that reason, it is difficult to separately evaluate the language-related domains of social deprivation. Language development has been defined through a link connecting language development and language environment, and the term is distinct from language attainment, which focuses more on the result of the development (Harris, 2013). Since language development has been defined as a process rather than an outcome, especially in the field of psychology, the dynamic of the learning environment might be crucial for determining children's stage of development at a certain point in time. Therefore, this section reviews the stages or gaps in children's language development produced at different environmental levels. The divergence discussed is generated by single or multiple co-existing environmental factors that influence children's typical learning. The works of literature have been selected to present an exploration of the individual, home, and neighbourhood model, as discussed in earlier sections, in terms of language development.

Bio-Ecological Development of Children

Neurological divergence happens within every individual child. According to Huttenlocher (1990), brain development can be largely influenced by early childhood experience. Research has since examined the biological processes that might be involved in this bioecological relationship. A growing body of neurobiological evidence shows that some neuronal activities and functions supporting children's language learning may be linked to environmental variability. For example, the glial is a type of cell that plays an indispensable role in our central and peripheral nervous system by supporting, protecting, and transferring energy for daily brain activities (Jessen, 2004). The peak production of neuroglial cells occurs primarily during early childhood, and thus, as most other neurochemical development that occurs in the early brain, they are sensitive to experience-based signals produced by early-years environments (Perry, 2000). As expected, the differentiation in the development of these glial cells has been linked to many developmental disorders, such as autism spectrum disorder (ASD; Chez et al., 2007), attention-deficit/hyperactivity disorder (ADHD; Oades et al., 2010), and Alzheimer's disease (Hanani, 2005), as well as difficulties in memory encoding and consolidation (Fields et al., 2014), and language development (Perry, 2000). The existence of a relationship between environmental influences and neurons, brain functions, and brain maturation was also supported by Owens (2015), who argued for the essentiality of neurological bases for language and speech development.

Regarding the significance of the early experience and environment in children's brain development, Bradley et al. (2001) found that 4-year-old children from deprived families in the US experienced more hazardous home environmental signals such as spanking and other aggressive behaviours. In the meantime, these children were exposed to less educational stimulation, for example, in the form of books and toys. Moreover, regardless of the differences between ethnic groups, children from low-income families had fewer opportunities to read magazines, watch television, or choose the types of food they ate (Bradley, Corwyn, McAdoo & García Coll, 2001). In other words, it was highly likely that these children experienced sensory deprivation during childhood, and they lacked plentiful opportunities to speak and express their feelings. Language input is multi-component, consisting of phonological, visual, printed, and other forms of signs and symbols, all of which are input sources for daily communication and expression. In deprived children, the input-output cycle of language development was inhibited in terms of both the encoding and

decoding of verbal or non-verbal messages. Hoff (2013) argued that children's language development happened simultaneously across different domains, including expression and reception, as well as comprehension. The presence of diverse forms of language symbols in the living environment could provide children with substantial learning sources to facilitate the development of cognitive functions and language abilities via various perceptual paths.

To sum up, according to the research on early childhood experience, sensory deprivation due to limited early literacy exposure can negatively impact children's subsequent language development because diverse neurological stimulation could be significant in building a well-functioning brain, as well as forming the cognitive foundation for language learning.

Home Literacy Environment

Whether a child has adverse, standard, or enriched childhood experiences largely depends on their parents' involvement and investment. And a variety of language experiences can shape children's ability to learn and practice the language. Especially in the last decades, one pathway that researchers have frequently used to link environment factors to children's language outcomes is maternal speech and engagement (e.g., Hoff, 2003; Hurtado, Marchman & Fernald, 2008). First of all, maternal care is correlated with neighbourhood deprivation, in that children living in a wealthier neighbourhood with higher safety and social cohesion receive higher-quality childcare (De Marco & Vernon-Feagans, 2013). Moreover, parents in deprived households were found to be less sensitive and less responsive to children's needs, as well as more authoritative and inconsistent in their parenting techniques (Evans, 2004; Bradley, Corwyn, McAdoo & García Coll, 2001).

In addition to the direct physical costs of inadequate nutrition, the overall low-quality childcare and, equally important, insufficient parental speech present more indirect yet negative impacts on children's language development. Indeed, parents in poor households tend to produce less child-directed speech and use less expressive vocabularies when talking to infants than parents in advantaged families (Weisleder & Fernald, 2013). This diversity in parent-child communication and parental involvement across socioeconomic status have been shown to be mediated by parents' knowledge of children's language development (Rowe, 2008). Child-directed speech (CDS), also known as motherese or child-directed language, has a simplified linguistic structure that is easier to understand, and a higher pitch with an

exaggerated expression that is more attractive to infants. Fernald (1985) found that infants prefer to listen to child-directed speech than the conversational speech typically employed by adults (adult-directed speech). Due to the increased use of CDS, children in affluent families tend to hear and process more words and information. The gaps in the number of words heard by affluent and deprived children can then be cumulative and lead to the “30-million-word gap” by age 4 (Hart & Risley, 1995). A longitudinal study by Fernald, Marchman and Weisleder (2013) demonstrated that the disparities between infants from deprived and affluent backgrounds were significantly revealed by delayed vocabulary growth and language processing efficiency at 18 months. Furthermore, in a follow-up study that tracked infants from 18 to 30 months old, children’s varying vocabulary growth indicated that the early language gaps found in the previous study seem to increase at an accelerated rate over the years, predicted by language processing skills at an earlier stage (Fernald & Marchman, 2012). This finding is supported by previous evidence from Newman et al. (2006), who demonstrated an existing association between children’s word segmentation ability, part of the language processing ability, at 18 months and their later expressive vocabulary capacity at 24 months of age.

Similarly, a five-year longitudinal study examined 168 children from different social backgrounds and found that children who had access to storybooks achieved better performance in vocabulary and listening comprehension tasks, which predicted later literacy outcomes in grade 3 (Sénéchal & LeFevre, 2002). It is worth mentioning that this finding might be partly explained by parents’ involvement in story reading and interactive activities, which enhance the effect of storybook access and improve children’s phonological awareness and listening comprehension skills. Also, studies that evaluate children’s early language outcomes frequently use children’s reading performance as the principal outcome measure, as was the case in Sénéchal and LeFevre’s (2002) study. According to the Simple View of Reading Model (Gough & Tunmer, 1986; Hoover & Gough, 1990) and the Emergent Literacy Model (Whitehurst & Lonigan, 1998), both phonological awareness and phoneme-grapheme knowledge are essential foundations for children’s reading development. In practice, parents might either deliberately or unconsciously target these skills during most story reading and sharing activities. Certainly, evidence from Evans, Shaw and Bell’s (2000) study revealed that direct instruction on letter-sound knowledge and phoneme awareness had a significantly greater impact on children’s subsequent literacy success than access to books alone. Nonetheless, Evans et al.’s (2000) study focused on a sample of middle class to higher

class children, to whom the presence of reading materials at home might be considered the norm, and the effects of those sources could be moderated. For children from relatively advanced backgrounds, enriched living conditions tend to provide adequate early childhood stimulation for well-developed language competence, even in cases where some sources of input are not available.

Despite these findings, other researchers have suggested that the quality of parental speech is more important than quantity. For example, Rowe (2012) found that in a single 90-minute child-directed communication, the parents' use of diverse word types, sophisticated vocabulary, and decontextualized utterances, indexed by narrative, pretend, explanation, and nonimmediate practices were linked to children's receptive language skills. In Rowe's (2012) study, a standardized language assessment, the Peabody Picture Vocabulary Test (PPVT), was used with children at 30, 42, and 54 months of age. In all age groups, a relationship was revealed between parental speech and the child's vocabulary skill across early childhood development, yet stronger correlations between sophisticated speech and vocabulary scores were found in the older age groups, the 42- and 54-month-old children. In conclusion, Rowe (2012) suggested that the number of words heard by children is reasonably meaningful during earlier childhood, but, after 2 years of age, the general quality of parental speech overcomes the quantity of input in its importance to children's receptive vocabulary development. More recent evidence has yielded similar conclusions. Anderson et al. (2021) found a more robust statistical level of correlation between linguistic input quality and children's language development compared to the association between input quantity and language. In addition, the effect size of quality of speech continued to increase as children age.

Therefore, both Rowe (2012) and Anderson et al. (2021) conclude that as children achieve the initial stage of early language development via quantity, parental language skills become crucial to support more advanced development as children enter the later stages of language acquisition. In addition to the education level of the caregivers, the linguistic diversity and complexity provided by a child's literacy environment also vary in homes where English is used as an additional language (EAL). EAL status is a possible family factor that could constrain a household's ability to provide high-quality speech and interactions that would be perceived as linguistically elaborated and polished, or if this is provided, then not in English. In January 2021, the Department for Education (DfE) in the UK reported the latest census result that 19.3 percent of students nationwide were EAL children who spoke another first

language. This percentage increased to 28.9 percent in the nursery school population. In other words, approximately 3 in 10 children in UK nurseries are from EAL families and speak a language other than English, the widely used official language in the UK education system besides Welsh. While parental education has been largely linked to children's language ability, the more specific home factor of EAL variations has been explored rather less.

Related to EAL outcomes, research addressing bilingual children's language competence has produced paradoxical results. A longitudinal study following Spanish children learning English in preschools found that bilingual children seem capable of dealing with two coding systems synchronously by transferring some cross-language abilities that are essential for the development of early reading skills, such as phonological awareness, letter knowledge, and word concepts (Lindsey, Manis & Bailey, 2003). However, it must be noted that Spanish and English are two highly similar languages in terms of the number of related words and similarity of sentence structures (Colorado, 2007), which would support smooth transformations in early language development. This cross-linguistic transition might be less applicable to EAL children who speak languages with a more complex or different structure than English, which was found to be the case in many UK minority groups. Certainly, a review of UK-based studies reveals a recent trend of research demonstrating a link between EAL children and poor reading performance (e.g., Strand, Malmberg & Hall, 2015).

According to the binary Simple View of Reading formula – Decoding (D) $\times$ Language Comprehension (LC) = Reading Comprehension (RC, Gough & Tunmer, 1990) – the two principal predictors of reading comprehension are decoding and linguistic or listening comprehension. Accordingly, EAL children's weakness in these two aspects of language is also evidenced in the literature. For example, Bowyer-Crane et al. (2017) found weaker expressive and oral language skills in EAL children when compared to their native speaker peers, reflecting poor decoding skills due to difficulties in linking printed inputs with their phonological mental representations. Also, Babayiğit and Shapiro (2020) documented EAL children's weakness in listening comprehension, referring to their ability to extract semantic information from spoken and heard narratives according to speech contexts.

To sum up the above studies, regardless of the strengths and weaknesses of bilingualism, language environments with varying EAL status have an influence on children's early language abilities across multiple aspects. Nevertheless, some may argue that bilingualism might be linked with early delays (in both languages) but long-term advantages. If this is the

case, the early delays may not be necessarily problematic and require additional intervention. It is possible that bilingual children's language ability is symptomatic of a non-typical but not inferior language development process in the long run. However, this concept may have serious consequences. EAL children need to improve their language skills as early as possible not only to achieve higher academic marks but support the early development of other social, psychological, and cognitive competence, which are essential to forming critical social connections. Also, denying the gap between EAL and native children, researchers may fail to notice and identify EAL children who experience other unfavorable conditions. And the joint effect of home language environment and other neighborhood or school experiences may significantly impact those children's typical developmental process.

Preschool Experience and Stimulation

Beyond the home environment, neighbourhood-level effects have also attracted much attention in social deprivation research. Recently, Sperry, Sperry and Miller (2019) have used contrasting evidence to question the notion of the "30-million-word gap" in low-income children (Hart & Risley, 1995). Sperry and colleagues argue that Hart and Risley's study only measured children's vocabulary input from their principal caregivers. However, in reality, children not only hear words spoken directly to them by the primary caregiver, but all conversational and background words provided in their language environment. According to Sperry et al. (2019), children from a disadvantaged social class might not be subject to such a massive gap compared to their more affluent peers because the community context is another important factor that contributes to their vocabulary growth and language development. However, Golinkoff et al. (2019) disputed Sperry et al. (2019)'s claim by challenging the quality of the speech that children overhear in such environmental situations. Critically, considering Rowe's (2012) quantity versus quality discourse across different age groups of children, discussed above, younger children below the age of 2 might benefit most from the number of words spoken by primary caregivers, given limited chances to connect linguistically with the broader environment. On the other hand, for children over the age of 2, the quality of speech in general explains an increasing variance in language development. Therefore, for older children, neighbourhood factors should be considered in conjunction with their earlier home language factors when trying to predict their language development. In conclusion, the inconsistency yield across different studies may relate to the age of children addressed in the study.

For preschool-age children, most neighbourhood-level interactions are likely to be provided by nurseries and preschools. Thus, children's daily school environment might be regarded as an important language input source. To 2 to 4-year-old children in the UK, nursery schools provide a consistent childcare environment for the development of early language abilities through the preschool years. A neighbourhood deprivation study based in Glasgow found that the number of public nurseries was higher in more deprived areas, with the most deprived district having the highest number of government-funded nurseries (Macintyre, Macdonald & Ellaway, 2008). As public nurseries offer free (government-sponsored) childcare services, higher attendance rates in the deprived neighbourhoods explain the higher density of nurseries in these areas (Gambaro, Stewart & Waldfogel, 2015). Besides offering a childcare service that provides essential support for children's bio-ecological development, nursery schools are also known for offering early education opportunities and group activities that can increase the richness of children's language resources. In their book, Dickinson and Tabors (2001) suggest that the preschool classroom environment and interactions, home-school connections, and children's relationships with teachers are associated with pupils' literacy and language development. They also indicate that mealtime and free play with classmates and peer groups are important activities in which language exchange between children takes place (Dickinson & Tabors, 2001). Yet, since the quality of vocabulary exchanges was found to be more crucial for this age group, high-quality classroom and teacher instruction might be equally or more important than free play activities with peers. Mashburn et al.'s (2008) study has confirmed this notion by measuring 4-year-olds' expressive and receptive language with standardized measurements, the Peabody Picture Vocabulary Test-Revised (PPVT-R) and the Oral and Written Language Scale (OWLS). The results suggest that the two most important school factors that were strongly and positively associated with children's expressive language ability at the end of their preschool year were the overall quality of the preschool environment and, more importantly, the quality of instructional support provided by proficient teachers, when controlling for the children's baseline performance assessed at the beginning of the programme (Mashburn et al., 2008). In short, language improvement in the preschool years could be largely attributed to the language instruction and literacy environment provided by the nursery.

Therefore, it might be beneficial if children from more at-risk backgrounds could access high-quality preschool classrooms that provide comprehensive language curricula and

professionally trained teachers who are able to deliver high-standard instruction. These supportive preschool experiences could, to some degree, ameliorate the language gap resulting from language deprivation in the early home environment. However, there is some evidence that it is too optimistic to assume nurseries in poor neighbourhoods are able to provide children with high-quality environments for development (Gambaro, Stewart & Waldfogel, 2015). In brief, although school environment and experience are influential factors in children's language development, sadly, the quality of nursery resources varies based on the sociodemographic conditions of the neighbourhood in which the preschool is situated. A recent study in the US found that the preschools that provided the best instructional support for children's development were those located in the neighbourhoods ranked higher-than-average in both resources and neighbourhood-level SES (Wei et al., 2021). The quality of instruction in neighbourhood nurseries in the UK has not been thoroughly evaluated, and it remains unclear whether attending these nurseries could facilitate children's early language development. Nevertheless, existing literature still indicates a transmissive effect for children from disadvantaged neighbourhoods, who may experience double deprivation in both home and school environments.

2.4 Literature Gap Analysis

In summary, the literature discussed in this section mostly holds a negative expectation towards children from impoverished backgrounds and identifies them as holding a vulnerable position in comparison to their more privileged peers. The various studies on early language development have demonstrated a lower starting point, delayed development, prolonged cognitive consequences, and limited social resources for children from socially deprived regions. Hence, additional support and intervention programmes can be crucial and necessary for those in which initial stage developmental delays have been identified. To more efficiently implement language interventions, it is essential to first locate these at-risk populations. One possible solution is to evaluate language development across a large, diverse sample and find the characteristics of children who will benefit from additional support or otherwise be left susceptible to disadvantaged contextual elements during early development. However, the single or combined effects of geographical school poverty and home language variation on children's language abilities have not yet been adequately explored. The developmental gaps between deprived and affluent children with varying

childhood experiences remain largely unknown. This section of the paper further analyses the existing literature gap and situates the present research topic in the broader context.

Language Measurement

First, many previous social deprivation studies targeting young children's language development have used measurement data from parental surveys and observational records. Few large-scale studies have conducted standardized language assessments because they are comparably time-consuming and expensive to administer. The best measurement to assess children's language ability has long been debated (Anderson et al., 2021), but standardized measures have been considered favourable in many comprehensive evaluations (e.g., Hoff, 2003; Rowe, 2012) and interventional studies (Bowyer-Crane et al., 2008; Fricke et al., 2013; Fricke et al., 2017). One concern about parental reports is that the data might be distorted towards social desirability. Observational measures, while ecologically and naturalistically preferable (Bornstein & Haynes, 1998), can provide inconsistent results based on children's personal characteristics (Hoff, 2003). Standardized assessments, though time-consuming, produce reasonably consistent results that are high in reliability and validity. If appropriately administered, the test scores are more directly related to children's language ability at the time of measurement. Unfortunately, few studies have used standardized language assessments to investigate neighbourhood effects, especially with large sample sizes. The present study aims to address this gap by using an efficient language assessment tool to evaluate how environmental risk factors impact early language development, specifically, the home language environment and school-level deprivation.

Addressing the complexity of using traditionally administered language assessments, another objective of the present study is to evaluate the efficacy of a newly-developed assessment app in identifying children for language intervention programmes. To date, most standardized language assessments can only target a single or a limited number of aspects of language when independently administered. For example, the British Picture Vocabulary Scale (BPVS, Dunn & Dunn, 2009) mainly assesses children's vocabulary knowledge; on the other hand, the Renfrew Action Picture Test (RAPT, Renfrew, 1988) primarily measures children's expressive and narrative language. Some more integrated assessments, such as the Clinical Evaluation of Language Fundamentals (CELF-Preschool-2, Wiig, Secord & Semel, 2004) and York Assessment of Reading for Comprehension (YARC, Snowling et al., 2009), can be

used to assess multiple aspects of language ability, including decoding, listening comprehension, and reading comprehension skills. However, their traditional paper-based format can be difficult for schools and research teams across the country to access. Therefore, the present study aims to evaluate a newly developed digital assessment tool – the LanguageScreen app – which was designed for the express purpose of identifying children with developmental language delays. The paper will discuss the implications of using digital assessment in future studies.

Dynamic Model and Joint Effects

Researchers of early childhood development have, moreover, suggested that the dynamic process and persistence of poverty plays a critical role in transferring home and neighbourhood deprivation to children's adverse language outcomes (Duncan, Brooks-Gunn & Klebanov, 1994; Brooks-Gunn & Duncan, 1997; Smith, Brooks-Gunn, & Klebanov, 1997). As suggested by the definition of well-being (Dodge, Daly, Huyton & Sanders, 2012), a sustained period wherein a child is deprived of the resources to overcome challenges in early life will lead to an impaired ability to learn and develop from challenges. With that being said, the persistence of poverty experienced during early childhood should be a factor in measuring the depth of deprivation. However, in many previous studies, children's level of deprivation has invariably been measured by parental income or education level. While home conditions have conclusively proven to be strong predictors of children's developmental outcomes, especially during early childhood, they do not explain the contribution of schools to children's developmental resources. As mentioned above, nursery-age children's language progress is highly influenced by a high-quality school environment and teacher instruction. Therefore, the present study evaluates persistent disadvantage in children, from birth to the end of their preschool years, by measuring both "home" and "school" factors, as suggested by Leventhal and Brooks-Gunn's (2000) conceptual model.

Another limitation of previous early language development studies is that few have considered home factors in combination with neighbourhood factors or evaluated their joint effects on children's language growth. This gap has also been documented in some previous literature (Bradley & Corwyn, 2002; Aikens & Barbarin, 2008). Most researchers point out that deprived children frequently experience multi-level adversities, yet few studies on deprivation have used a structural system to test for joint mediating effects. The inclusion of

additional home language factors might explain more variance in children's literacy outcomes than using neighbourhood factors alone. Therefore, another goal of the present study is to investigate how home characteristics and school poverty influence children's language scores, both in isolation and in combination. Hitherto, there has been limited information about EAL children and their home language environment, especially among nursery-age children. As the quality of speech becomes essential after a child's first few years, it is also important to evaluate the language-related effects of being an EAL child, as well as whether children's home language experiences interact with broader neighbourhood poverty. Without taking this home dimension into consideration, it is difficult for researchers to identify the most vulnerable groups of children for interventions, particularly due to the high proportion of EAL learners attending nursery schools. Additionally, a better understanding of EAL children and families would be helpful for developing effective language intervention programmes that apply to a wider range of children.

Children in Nursery Years

Last but not least, from a neurological perspective, children's neural migration, differentiation, and arborization are complete by age three (Perry, 2000). Thus, any language gap could have been created and even enlarged as early as three or four years old. Research has demonstrated that unequal prior experiences could result in children starting nursery school (3-4 years old) and reception class (4-5 years old) at varying stages of development (Coley, 2002). Furthermore, Duncan, Yeung, Brooks-Gunn and Smith (1998) have evaluated the ability of individuals to complete schooling from birth to 15 years old, and found that deprivation has a greater impact if experienced in the early preschool years than in middle childhood. Nonetheless, previous research has not provided sufficient data about younger children in deprived environments, and thus it is challenging to develop effective instruction and intervention programmes that target this age group. According to Coley (2002), early interventions for children with a deprived background, while crucial, should also be conscious of the characteristics and circumstances of children. As stated above, children with issues relating to their cultural heritage, such as their competence in the official languages used in a particular country and early language deprivation, have attained little attention in the previous literature. The present study also plans to address this gap.

2.5 Research Questions

The present study investigates how social deprivation is related to nursery children's language ability. Accordingly, three research questions addressed are: (1) whether a school-level measure of social deprivation is related to children's language ability; (2) whether coming from a home where English is an Additional Language (EAL status) influences children's language development; (3) whether interactions exist between the effects of social deprivation and EAL status on language ability.

Chapter 3. Methodology

3.1 Rationale for Methods

This chapter describes the measures, design, and analysis plan associated with the study. The study conducted a secondary analysis of the quantitative data from the NELI-N program (Schools = 62, N = 1497). Secondary data analysis is appropriate for answering the research questions because a large sample size is usually required when evaluating children with varying social backgrounds. The sample of the study should be determined to provide valid generalization as well as external validity (Fox, Hunn & Mathers 2009, p.5). When the sample of children is large and diverse, it is more likely that the finding of the study is representative of the children in nursery schools across the UK. Pre-test data from the original NELI-N trials are used as measures of children's language ability. These data were gathered using standardized LanguageScreen assessment, which captured multi-aspects of language in the nursery-age population. Therefore, the dataset fits well with the study purpose.

A quantitative research method was used in this study based on the assumption that children's language skills can be measured. Language measures were selected according to the Simple View of Reading theory (Gough & Tunmer, 1986). The theory states that decoding and language comprehension are essential skills to develop for learning to read. These skills were, therefore, chosen as measures of children's general language ability. According to Bowey, Snowling and Hulme (2005), decoding skills were linked to children's letter-sound knowledge and phoneme awareness. These phonological aspects were targeted in expressive oral language tasks of the LanguageScreen assessment. Language comprehension, on the other hand, referred to listening and linguistic comprehension and was measured by receptive vocabulary and listening comprehension tasks in the evaluation.

3.2 The Original Study and Participant

Clustered RCT Design

The original Nuffield Early Language Intervention Nursery (NELI-N) study had an interventional design that conducted cluster randomized controlled trials (RCT) in nursery schools. The trial aimed to empirically evaluate the effectiveness of the official 20-week version NELI program, a school-administered language intervention program designed for

children with language difficulties in the nursery population. The NELI-N program extended the previous protocol of the NELI programs that had targeted both nursery and reception class children in 20- and 30-week intervention (Fricke et al., 2013; Fricke et al., 2017; West et al., 2021). The current NELI-N study implemented the shortened 20-week instruction in younger nursery children for language improvement. Participants were nested in schools. Schools were randomly assigned to either the intervention group or the waiting control group. Waiting control schools would receive the same intervention after the study. Consistent with the former methods, children's language ability was assessed at two time points: before (pre-test) and after the intervention (post-test). Children with generalized language difficulties or scored among the lowest were selected to receive additional language interventions at school. Trained research assistants and teachers had worked in schools and delivered structured language interventions in a variety of forms: additional support and teaching for the whole class, a small group of children, or the targeted individual child. Those children's post-test scores were then compared to controlled school peers. More than 1500 children aged 3-4 had enrolled in the study, coming from 62 schools located in the most to least deprived districts across the UK. The intervention ethics was reviewed by the Departmental Research Ethics Committee (DREC) in the Department of Education, University of Oxford, and the approval for the trial was granted.

Participant

The dataset used in the present study included a sample of 1534 children who participated in the NELI-N study. Descriptive statistics of the social deprivation variables and language measurements are shown in Table 1. Missing data were rare and were handled by listwise deletion. The final sample for the present study was chosen by keeping children who had valid data recorded for all IDACI, EAL, and Language measures. The method resulted in a total of 1497 cases for analysis. Participants' age was measured by their completed months to pre-tests, with a minimum age of 25 months and a maximum of 58 months. The average age children completed the language assessment was 43.3 months. Gender was coded into dichotomous categories (0 = Girls, 1 = Boys). The dataset included 770 girls (50.2%) and 764 boys (49.8%). Table 1 presented more information about the sample.

3.3 LanguageScreen Assessment

In the original NELI-N study, children's language ability was measured by the school teachers using the LanguageScreen assessment offered by the research team. LanguageScreen is a tablet-based assessment app developed by a research team led by Professor Charles Hulme at the University of Oxford. This assessment tool was created with the NELI program and has been used in the previous interventional studies to identify children with language difficulties and evaluate the effectiveness of the intervention program.

LanguageScreen targets children's oral language skills and reading comprehension within a short 10-minute session. The assessment contains four subtests: expressive vocabulary, listening comprehension, receptive vocabulary, and sentence repetition. All tests begin with easier items and become more challenging as they progress. Scores of subtests are marked and saved. They are automatically added up at the end of the assessment to provide a comprehensive report reflecting the child's language abilities across various language aspects.

Assessment Protocol and Scoring

The administration and scoring process of LanguageScreen is different from most of the paper-based assessments, for example, the YARC (Snowling et al., 2009) and the RAPT (Renfrew, 2003) tests used in previous NELI studies. Before conducting the LanguageScreen measurement, researchers or examiners need to download the unique QR code of each child. Each QR code could only be used once and is linked to an auto-generated report. Teachers need to scan the code with the app and take four subtests with the child. At the end of the assessment, the app would upload data to a registered account, and researchers could download the report for each assessed child from the official website. Children's reports include scores of four language tasks and an automatically calculated standard score. The standard score combines all four subtests and gives an accurate measure of a child's overall language skills. The app also uses a creative Traffic Lights System, in which a green light represents a standard score of 90 or above, an amber light represents a standard score between 82 and 89, and a red light represents a standard score below 81. This lighting system helps identify children who need more support in developing language abilities (children with a red light) by highlighting the child's position among the same age group and reporting the lowest scores across subtests.

Psychometrics of LanguageScreen

LanguageScreen is a recently developed digital assessment that has not yet been extensively used in diverse contexts. Nevertheless, an RCT study conducted by West et al. (2021) has demonstrated a strong relationship between LanguageScreen standard score defined by four subtests and a latent language variable defined by four independently administered language tests, including expressive vocabulary subtest from the Child Evaluation of Language Fundamentals (CELF), the Renfrew Action Picture Test (RAPT), the Recalling Sentences subtest from CELF, and YARC Early Word Reading subtest ($r = 0.95$; West et al., 2021). Furthermore, in terms of reliability, evidence from previous NELI studies has indicated consistency between pre-tests and post-tests. Therefore, the reliability and validity of the LanguageScreen were confirmed. Subtest scores from the assessment were used in the present study.

3.4 Measures

Social Deprivation Measures

IDACI: Children's economic resources were measured by the Income Deprivation Affecting Children Index (IDACI) based on school districts. IDACI represents the percentage of children in the school district who live in income-deprived families. As an index of social deprivation, IDACI is a neighborhood-level measurement that highlights relative poverty instead of absolute poverty. It was used to summarize the intensity and the distribution of deprivation across local authority districts in England (McLennan, 2019). In the current study, postcodes of the nursery schools were used to record the Lower Super Output Area (LSOA) where children attend nursery school (1 = 10% most deprived; 10 = 10% least deprived). Children were nested in schools. A higher ranking indicated that a nursery was located in an area of low deprivation. In the study sample, the average IDACI rating was 5.44, and the data showed a good distribution across levels. This measurement can largely account for children's school and residential poverty, presenting a stable index to indicate children's growing up experience and environment, from home to school. And this contextual factor would not be influenced by changing resident addresses or switching between different residential zones.

EAL: Children's home language environment was recorded by the English as an Additional Language (EAL) status. Children from home with EAL were those who have been exposed to

languages other than English at home. The EAL status was used to group children who learned English as an additional language and children exposed to only native English at home into binary categories (0 = non-EAL, 1 = EAL).

Language Outcome Measures

Teachers and other school staff assessed children's language skills using LanguageScreen and app-based assessment with four subtests.

Expressive Vocabulary (EV; 0-24 points): The expressive vocabulary subtest tests children's ability to name 24 pictures of objects. They were scored 0 or 1 for each item according to the correctness of the answer provided. Vocabulary tests increased in difficulties to prevent ceiling effects in scoring. In terms of children's performance, the maximum score achieved in the sample was 24, while the minimum mark was 0 ($\mu = 7.42$, $SD = 4.61$). See Appendix 1.1 for examples of the EV task.

Listening Comprehension (LC; 0-15 points): The Listening Comprehension task assessed children's ability to understand short stories and make inferences from what they have heard. In this task, children listened to three short stories, from relatively easy to complex. For each story, they were asked to answer 4-6 comprehension questions. The questions targeted both explicit and implicit knowledge of the story. Trained examiners marked the correctness of the answer according to a scoring criterion provided on screen. For the LC task, the maximum score achieved was 15, while the minimum score was 0 ($\mu = 3.21$, $SD = 3.43$). See Appendix 1.2 for examples of the LC task.

Receptive Vocabulary (RV; 0-23 points): The Receptive Vocabulary test assessed children's capacity to understand spoken words. In this task, children were shown sets of pictures and asked to press the picture they heard. There were 23 vocabulary items in the task, increasing in difficulty throughout the test. Four images were presented in each set, with one picture depicted an unrelated item and two distractors that were similar in semantic meanings or phonological sounds to the target word. Answers were automatically scored by the app, according to the picture children pressed. For the RV subtest, the maximum score was 22, while the minimum was 0 ($\mu = 11.23$, $SD = 4.18$). See Appendix 1.3 for examples of the RV task.

Sentence Repetition (SR; 0-14 points): The Sentence Repetition task from the LanguageScreen assessment measured the child's ability to remember and repeat sentences. For the test, children listened to 14 sentences. After each sentence, children were asked to repeat the sentence as precisely as they heard. The examiner could only score the child's repetition as correct if the sentence was repeated verbatim. During the task, sentences would increase in length and difficulty. According to the dataset, the highest score reached by children was 14, and the lowest was 0 ($\mu = 4.75$, $SD = 3.69$). Sentence repetition was included as one of the language components because it shows a stable longitudinal correlation with other language measurements and is more reliable in reflecting children's language ability than working memory competency (Klem et al., 2015). As a multifaceted construct of language, the task also measures children's words, concepts, and grammatical encoding and reproduction. See Appendix 1.4 for examples of the SR task.

Table 1. Descriptive Statistics for Social Deprivation and Language Measures

	N	Mean	SD	Minimum	Maximum	Skewness	Kurtosis
Age (in months)	1534	43.30	3.79	25	58	-0.02	-0.10
Gender	1534	0.50	0.50	0	1	0.01	-2.00
English as an additional language (EAL)	1516	0.42	0.49	0	1	0.34	-1.89
Income deprivation (IDACI)	1534	5.44	2.55	1	10	0.08	-1.07
Expressive vocabulary (EV)	1529	7.42	4.61	0	24	0.27	-0.41
Listening comprehension (LC)	1512	3.21	3.43	0	15	1.01	0.19
Receptive vocabulary (RV)	1517	11.23	4.18	0	22	-0.12	-0.37
Sentence repetition (SR)	1504	4.75	3.69	0	14	0.51	-0.67
LanguageScreen total	1497	26.79	13.55	0	67	0.31	-0.58
Valid N (listwise)	1497						

Note: All parameter estimates are from SPSS.

Table 2. Language Measures Correlation Matrix

	Expressive vocabulary	Listening Comprehension	Receptive vocabulary	Sentence Repetition
Expressive vocabulary	1.00	0.65***	0.73***	0.63***
Listening Comprehension	0.65***	1.00	0.59***	0.67***
Receptive vocabulary	0.73***	0.589***	1.00	0.58***
Sentence Repetition	0.63***	0.67***	0.58***	1.00

Note: All parameter estimates are from SPSS. Determinant = .124; *** = $p < .001$, ** = $p < .01$, * = $p < .05$

3.5 Data Preparation and Analysis Plan

Taking into consideration that language measures and social deprivation indexes may correlate with each other, we carried out a factor analysis before comparing the difference between groups of children. Factor analysis is a dimension reduction technique used to calculate the intercorrelations of a range of variables and summarize them into fewer components if appropriate (Pallant 2020, p.188). Factor analysis is widely used in developmental studies to transform evaluation scales into a more workable form in advance of multiple regression or analysis of variance (Pallant, 2020). Nevertheless, Tabachnick and Fidell (2013, p. 615) claimed that a larger dataset of more than 300 participants was recommended, which could ensure that predicted factors were conclusive and derived from sufficient examples. As the NELI-N dataset contains more than 1400 valid cases (see Table 1), factor analysis could be applied to produce a reliable theoretical solution that accounts for the distribution of the different number of items in four subtests due to varying potential marks. As a result, the factor analysis yielded a one-factor solution. Four language test scores were combined to form a latent language factor, which explained 73 percent of the variance in the 77-item assessment. Factor scores predicted children's language ability and indicated how far they were positioned from the average level. The gap was measured in the standard score, normalizing children's language level to the number of standard deviations above or below the population mean. Thus, the discussion of difference, effect size, and other measurements was in the unit of standardized scores.

Language Factor Analysis

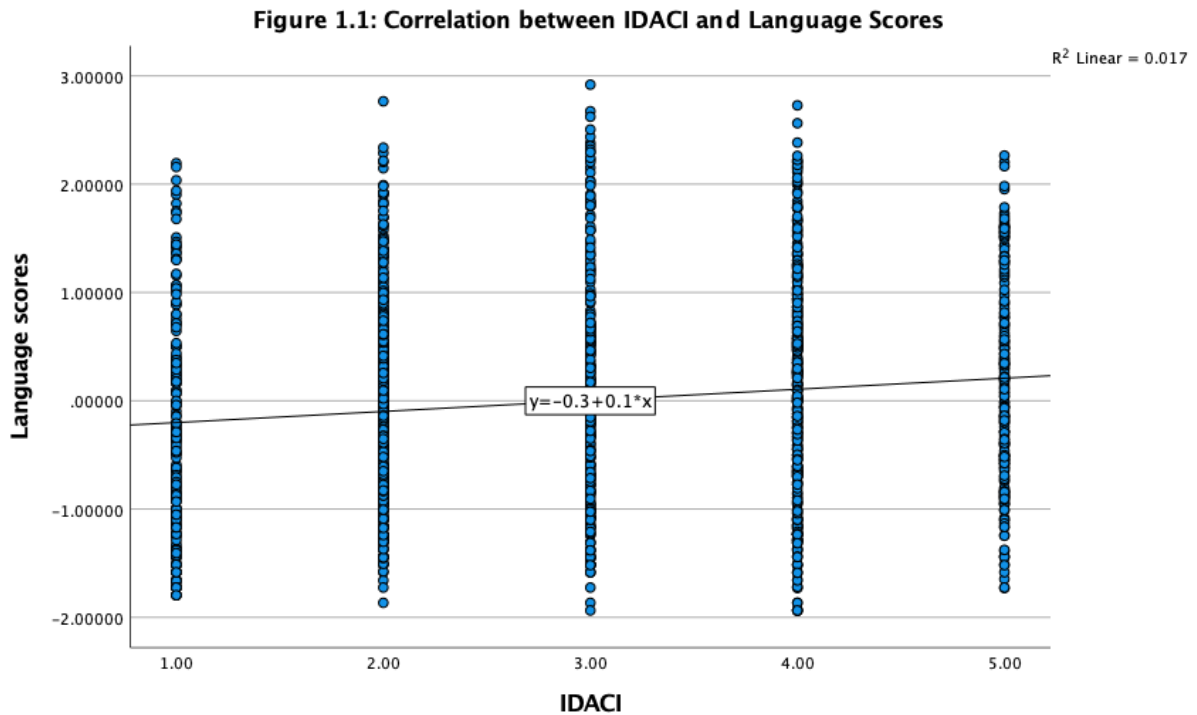
Firstly, the suitability and factorability of the data were assessed. Language measures were quantitative data at a ratio level. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy score ($KMO = .81$; see Appendix 2.2) was above the borderline of acceptability score 0.5 (Kaiser 1974, p. 35-36) or 0.6 (Tabachnick & Fidell, 2013). The Bartlett's Test of Sphericity value ($\chi^2 = 3113.48, p < .001$; Bartlett, 1954) was significant, demonstrating that factor analysis was appropriate for the chosen language variables. According to Kaiser (1974, p. 35), a score of 0.81 suggested a meritorious level of factorial simplicity. The correlation matrix showed that coefficients between LanguageScreen subtests are greater than 0.3, demonstrating suitable intercorrelations and factorability among variables of this underlying category (Tabachnick & Fidell, 2013). And on the other hand, the correlation values did not

exceed 0.8, a statistical cut-off value that may indicate an issue of multicollinearity. Multicollinearity was also checked by using Haitovsky's test of the determinant, which proposed that the determinant score should be significantly different from 0 (Haitovsky, 1969; cited in Rockwell, 1975). The linearity of all combinations of variables was confirmed through scatter plots because it is generally assumed by correlation-based analyses (Pallant 2020, p. 194). Regarding the sensitivity of factor analysis, we checked for outlier observations or incorrectly entered data in the screening process, and no extreme value was found or should be transformed.

As all assumptions of factor analysis were satisfied, a language factor was extracted from expressive vocabulary, listening comprehension, receptive vocabulary, and sentence repetition subtests as an estimate of children's overall language ability. The factor yielded an eigenvalue above one and explained a total of 73 percent of the variance in the score. The inter-rater reliability of the scale is high (Cronbach's Alpha = .87). Factor rotation was not performed as the analysis demonstrated a single underlying dimension. All items showed high loadings on the factor. Therefore, the multiple regression method was used in SPSS to produce factor scores as a new variable. Missing data were excluded listwise to prevent overestimation. The factor scores were calculated using the regression method and were standardized with a mean of 0 and a standard deviation equal to 1 (See Appendix 2.2). The regression method was preferred to all other variations with a single factor because it can produce maximal validity to the estimated factor, meaning the computation yields the highest correlation between the factor and their factor scores (DiStefano, Zhu & Mindrila 2009, p. 6-8). The factor score was a valid representation used in further analyses, which could provide more information than the total score calculated by the assessment. In particular, it predicts children's language ability level by indicating their position in development compared to peers and distance from the average performance.

IDACI Scale Transition

As the principal neighborhood-level factor, IDACI measured children's ability to access quality neighborhood/school resources. As shown in Figure 1.1, IDACI was significantly correlated to children's overall language scores ($r = .13, p < .01$).



The quadratic relationship indicated a non-linear model between the IDACI and the language factor. See Appendix 2.3 for the correlation coefficients between IDACI and each language subtests. A non-linear relationship was found within both EAL and non-EAL groups (Scatterplots see Appendix 2.4). To increase the sample size at either end of the scale as well as to get a simplified statistical pattern with fewer children groups, IDACI rankings were reduced to five levels (quintiles). In that case, every two contiguous levels were combined. For example, ranking 1 and 2 were merged as band 1, representing children from the most deprived 20th neighborhoods; ranking 3 and 4 were grouped as band 2, combining children from the most deprived 20th-40th school areas in the UK. In that case, group 1 spoke for the most impoverished population. On the other hand, group 5 was appointed to represent children from the wealthiest backgrounds who were perceived to have the most enriched school experiences. Such adjustment could slightly balance the unequal sample size of children across the levels of deprivation, especially in the most and the least deprived categories, which included fewer cases.

As Figure 1 illustrated, the sample sizes of non-EAL children from the most deprived areas ($N = 61$) and EAL children from the least deprived areas ($N = 67$) were relatively small compared to other groups even after the scale reduction. We also observed a slightly skewed

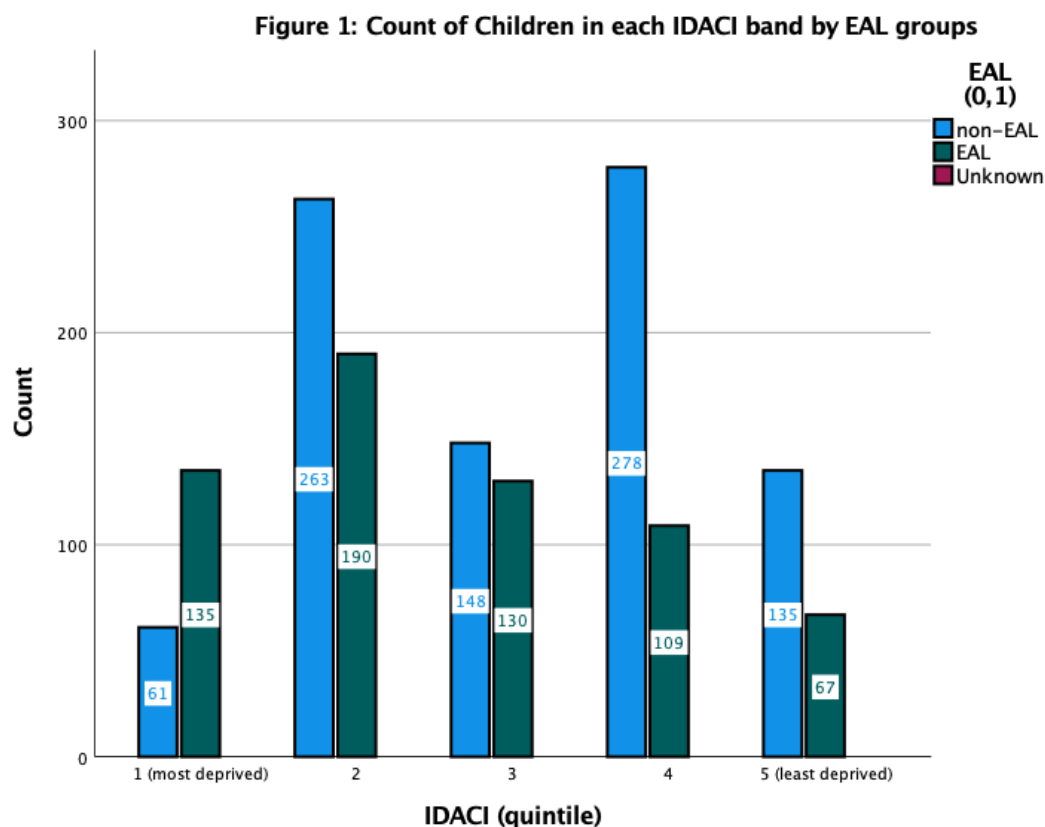
distribution of EAL children in deprived neighborhoods across the IDACI ratings. Figure 1 showed that most non-EAL children assessed fell into the second and the fourth bands, while most EAL cases fell under the bottom three bands. Figure 2 showed a particular clear bar representation of the column proportion within each band. We observed more EAL children in the most deprived band (68.88%) than non-EAL children (31.12%). Likewise, of those who lived in the wealthiest neighborhoods, 66.93 percent were non-EAL children, and only 33.17 percent were EAL children.

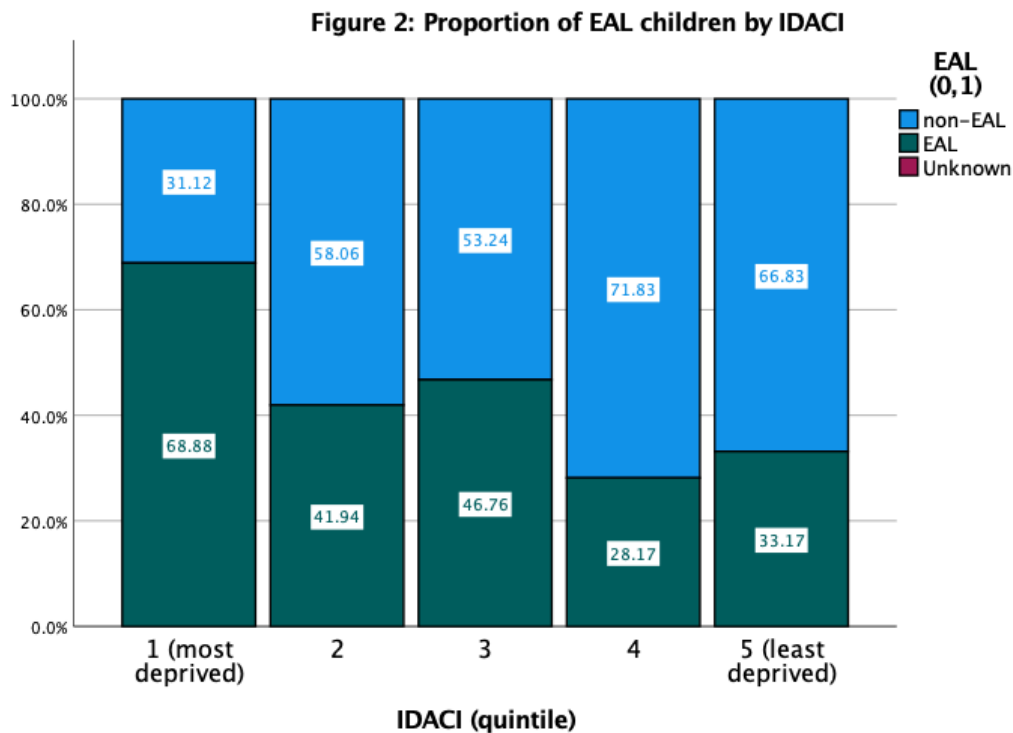
Scale Type of Measurements and ANOVA model

Social deprivation measures, such as socioeconomic status (SES) classification, were often treated as continuous variables, as in some cases, the distance between categories could be measured in terms of income intervals. Certainly, some scholars described this categorization as “an ordinal representation of an underlying continuous variable (Winship & Mare 1984, p.513)”. This application might be more practical and yield an increase in statistical power, meaning it increases the possibility that the test correctly rejects the null hypothesis (power=1-type II error). However, scientists are prone to incorrect judgment about these measurements, and many self-reported ordinal data were misused as continuous (Field 2017, p.47-50). The ordinal IDACI variable has five populated categories and a roughly normal spread of values with no skew according to the dataset. However, the variable did not display a linear relationship with the language outcome. It did not satisfy the widely used rule of thumbs of treating ordinal variables as continuous (e.g., field, 2017). Therefore, The IDACI data should still be regarded as an ordinal scale with a ranked categorical structure corresponding to the school neighborhood’s general income level. This approach was appropriate because the equal difference between IDACI scales did not represent an equivalent income or deprivation interval. For example, the income gap between a family from rank 5 district and a family from a rank 4 district is not equivalent to the gap between a family from rank 4 district and a family from rank 3 neighborhood. The reason may seem straightforward: the IDACI scale measured deprivation in percentiles instead of using absolute income measures.

With categorical predictors, the between-groups analysis of variance (ANOVA) model can be applied to assess the impact of home and school-level factors on the language scores by analyzing the expected difference across IDACI and EAL groups. According to Field (2017),

the ANOVA model investigates whether the between-group variance is larger than the within-group variance and provides various intergroup comparisons through the use of contrast and post-hoc tests. Like most other parametric tests, ANOVA tests assumed homogeneity of variance, independence of observations, and an approximately normally distributed dependent variable (Field, 2017). Two-way between-group ANOVA, also known as factorial analysis, was the ANOVA model applied to the present study because the model compares two multi-level categorical independent variables with a continuous dependent variable (Pallant 2020, p.282). In the study, the school-level deprivation factor IDACI was included as the first ordinal independent variable with five levels, the home language factor EAL was included as the second dichotomous independent variable, and the LanguageScreen factor score produced a continuous outcome measurement. Normality of the dependent variable was confirmed (Skewness = .345, Kurtosis = -.570; Graph see Appendix 2.1). No significant outliers were detected. And the original study design met the assumption of independence of observations because every child belonged to only one IDACI and EAL group. Likewise, schools were assigned to either a waiting control or intervention group. In conclusion, the ANOVA model was applicable to scale types of variables and fitted the study design well.





3.6 Statistical Hypotheses

As mentioned in previous chapter, this study investigates (1) whether a school-level measure of social deprivation is related to children's language ability; (2) whether coming from a home where English is an Additional Language (EAL status) influences children's language development; (3) whether interactions exist between the effects of social deprivation and EAL status on language ability. Accordingly, the statistical hypotheses can be stated as:

RQ 1:

H_0 : children's language score does not vary by IDACI groups ($\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$)

H_1 : children's language score varies by IDACI groups (one or some μ different)

RQ 2:

H_0 : children's language score does not vary by their EAL status ($\mu_1 = \mu_2$)

H_1 : children's language score varies by their EAL status ($\mu_1 \neq \mu_2$)

RQ 3:

H_0 : IDACI and EAL interaction will have no significant effect on children's language score

H₁: IDACI and EAL interaction will have a significant effect on children's language score

Chapter 4. Results

A 5 (IDACI) $\times$ 2 (EAL) two-way ANOVA model was conducted in the SPSS to compare the main effects of IDACI and EAL as well as their interaction effects on children's language scores. The normality of the sample and the residuals were confirmed. However, Levene's test of equality of error variances ($F_{[9, 1469]} = 2.43; p = 0.01$; see Appendix 2.5) showed that the data failed to reject the null hypothesis that the error variance of the dependent variable was equal across groups. In other words, the data violated the assumption of homogeneity of variances with an alpha level of 0.05. This finding may be declared as a limitation in data, yet, with large sample sizes, many statistical studies have demonstrated that moderate deviation from equality or normality has a negligible effect on the robustness of the F-tests or t-tests in two-way ANOVAs (e.g., Glass, Peckham & Sanders, 1972; Field, 2017).

Nevertheless, a higher significance level might be determined for a rigorous evaluation (Field 2017, p. 286). Therefore, we would consider the effects as significant when the significant value is below the level of 0.01 instead of a more widely used 0.05. This rule applied to the following analyses.

4.1 IDACI Effect

Children were assigned into five groups according to their IDACI rankings, Group 1 (children attend nurseries in the most deprived 20th neighborhoods in England), Group 2 (20th-40th), Group 3 (40th-60th), Group 4 (60th-80th), and Group 5 (children attend nurseries in the least deprived 20th areas nationally). Language factor scores were used as the outcome measure. As shown in Table 3, a main effect of IDACI was found ($F_{[4, 1469]} = 3.21; p < .01; \eta^2 = .010$). To further investigate the significance of differences found across groups, a further hypothesis was proposed that children in the most deprived group (group 1) achieved lower scores in language development than other groups attending nurseries in wealthier areas. As illustrated by contrast tests 1-4 in Table 3, planned t-tests showed that the average score of children in the most deprived group ($\mu = -0.36$) was lower than those of children in the second most deprived quintile ($\mu = -0.03, t_{[341]} = 4.04, p < .001$), those in the third quintile ($\mu = 0.07, t_{[471]} = 4.35, p < .001$), those children in the fourth quintile ($\mu = 0.10, t_{[576]} = 5.17, p < .001$) and finally those in the least deprived band ($\mu = 0.14, t_{[395]} = 5.06, p < .001$). The difference between groups was also visually displayed by the overlap pattern of the confidence intervals. A clear pattern was displayed in Figure 3. For example, there was a gap

between the upper end of the most disadvantaged group's 95% confidence interval and the lower end of any of the rest of the group's 95% confidence interval, indicating a significant result $p < 0.01$ (Field 2017, p.140). In other words, we were 95% confident that the true scores of children's language tests would fall in these confidence intervals. The difference between groups was unlikely to have arisen by chance.

As children from the most deprived group yielded a significantly lower mean-level score in language tests when compared to either of other groups, children in the second quintile (Group 2) might also have experienced a lack of resources in multiple domains. Correspondingly, follow-up tests showed that the mean language score of children in Group 2 ($\mu = -0.03$) was significantly lower than those of children in Group 5 ($\mu = 0.14$), which indicated that children from the second quintile tend to perform worse in language tests than those from the highest quintile (see Table 3, Contrast test 5). On the other hand, both the difference in scores between Group 3 and Group 4 children and that of Group 4 and Group 5 children were not statistically significant. These children's language ability did not differ from children from the most advanced Group 5, meaning children from the 40th to 100th school neighborhoods have developed their language skills to approximately the same level as children from the most advantaged background (see Table 3, Contrast tests 6-7). These findings were consistent with the pattern observed in Figure 3. In general, of those in Group 1 and 2, children's average language score was below the observed grand mean for the language factor score ($z\text{-score} = 0$). In contrast, those children in Group 3, Group 4, and Group 5 achieved a higher-level performance, on average. Therefore, we can reject the null hypothesis and conclude that there was a difference in the language performance for children across different IDACI groups. These differences remained after controlling for children's age and gender (see Appendix 2.6, SPSS outputs).

Table 3. Children's Language Performance by IDACI Ranks

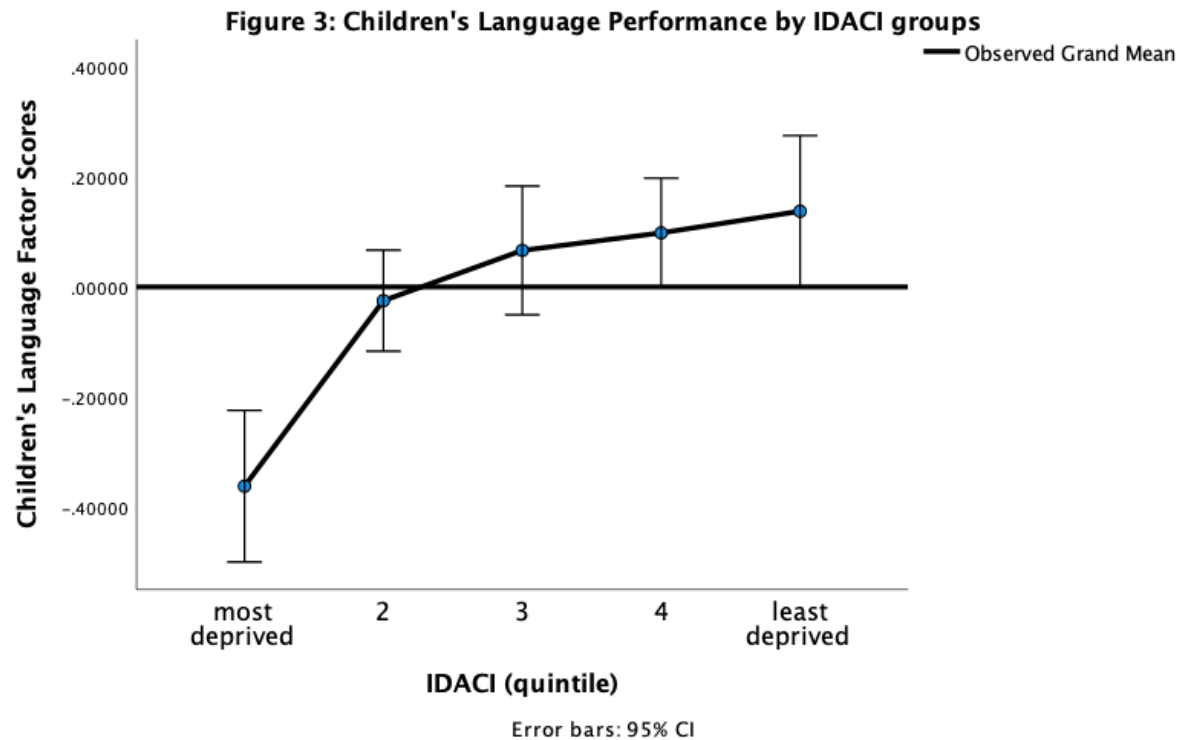
Rating	N	M	SD	Main effect	Contrast 1	Contrast 2	Contrast 3	Contrast 4	Contrast 5	Contrast 6	Contrast 7
1 (most deprived 20%)	198	-0.36	1.01	a	a	a	a	a			
2 (20%-40%)	445	-0.03	0.90	b	b				a		
3 (40%-60%)	275	0.07	1.09	c		b				a	
4 (60%-80%)	380	0.10	1.02	d			b				a
5 (least deprived 20%)	199	0.14	0.96	e				b	b	b	b
Total	1497	0	1								
				(F [4, 1469] = 3.21	t [341] = 4.04	t [471] = 4.35	t [576] = 5.17	t [395] = 5.06	t [642] = 2.08	t [472] = 0.74	t [577] = 0.45
				**	***	***	***	***	*	n.s.	n.s.

Note: All parameter estimates are from SPSS. Values indicates significant mean-level differences between groups.

Contrast 1 = the most deprived group vs. the second group, Contrast 4 = the most deprived group vs. the least deprived group, etc.

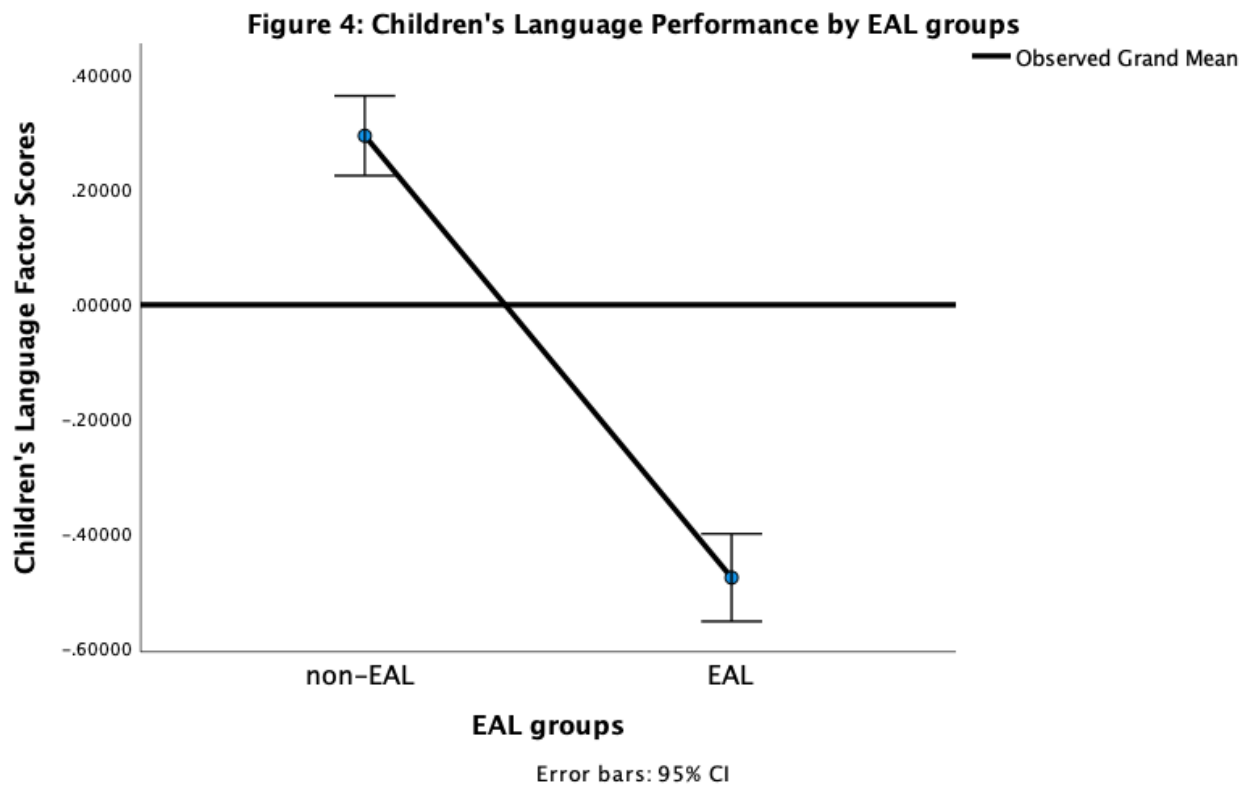
For Contrast 1 only, t-score from a two-sample t-test assuming unequal variances was reported

* = $p < .05$; ** = $p < .01$; *** = $p < .001$



4.2 EAL Effect

Children were assigned into two categories (Group 1: non-EAL children, Group 2: EAL children). The main effect of EAL yielded a medium effect size of 0.127, indicating that EAL conditions can explain 12.7 percent of the variance in the language scores ($F_{[1, 1469]} = 213.96, p < .001$; SPSS outputs see Appendix 2.7). As shown in Figure 4, children from the non-EAL group ($M = .29, SD = .04$) were found significantly outperformed those from the EAL group ($M = -.48, SD = .04$). These findings supported our hypothesis and suggested that children's language development varies by their status of English language acquisition and home language exposure.



4.3 IDACI × EAL Interaction

Finally, as shown in Table 4, the interaction effect was also statistically significant, $F_{[4, 1469]} = 6.21, p < .001, \eta^2 = .017$ (see Appendix 2.8). The results implied a joint effect for the IDACI level and EAL status on children's language scores. The significance level ($p = .00006$) for the interaction effect was much lower than the significance level for the IDACI effect alone ($p = .00376$), which indicated that the IDACI × EAL interaction was

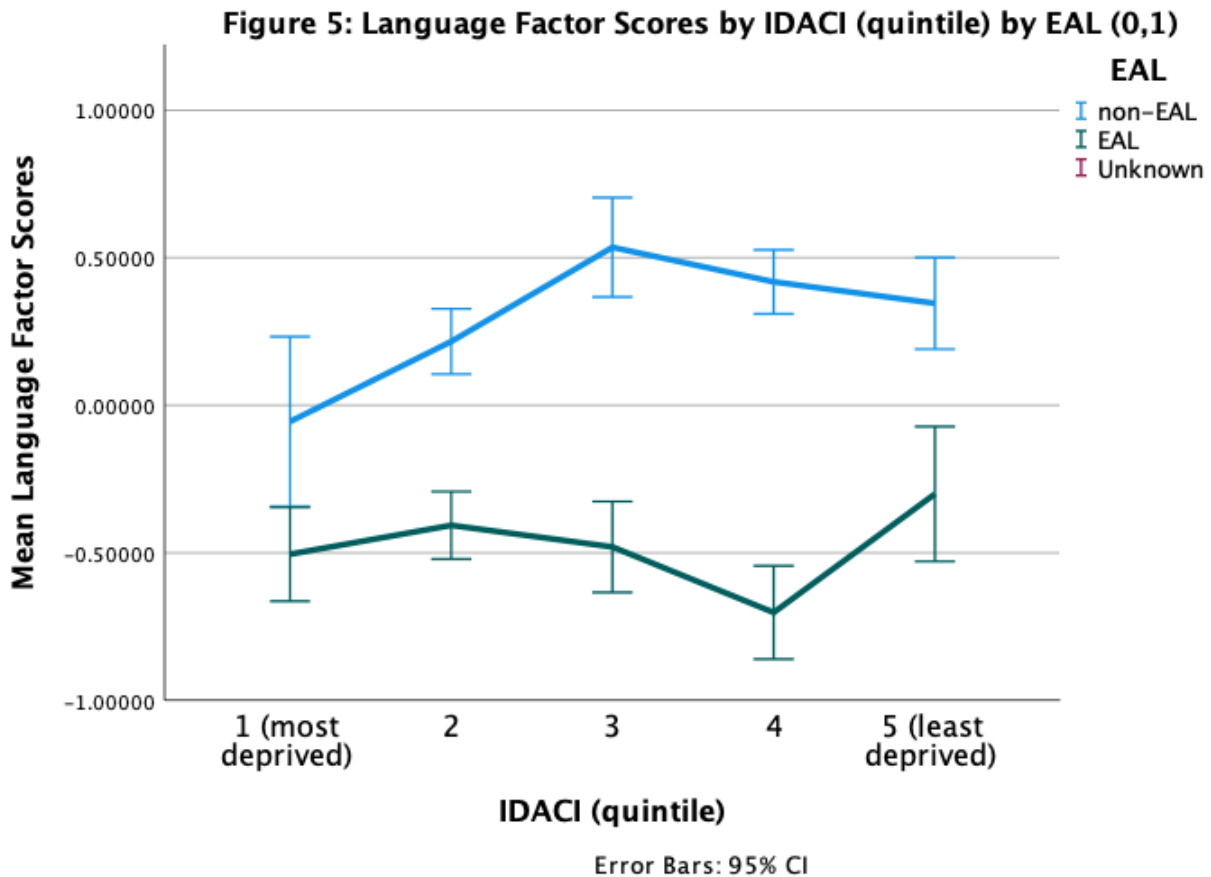
more significant at predicting children's language ability. Follow-up tests of simple effects were carried out, which helped simplify the scenario by keeping the EAL variable constant while looking at the effect of the IDACI.

Within the EAL and non-EAL groups

The results showed that, within non-EAL children, there was a significant difference in the five IDACI groups regarding the mean language scores of children ($F_{[4, 1469]} = 6.27, p < .001$). See Table 5 for pairwise comparisons across all groups. Particularly, non-EAL children in the most deprived Group 1 ($M = -.06, SD = 1.12$) significantly scored lower than non-EAL children in Group 3 ($M = .54, SD = 1.04$; *Mean Difference* = .59, $p < .001$), in Group 4 ($M = .42, SD = .91$; *Mean Difference* = .47, $p < .01$) and those in the most affluent Group 5 ($M = .35, SD = .91$; *Mean Difference* = .47, $p < .05$). unsurprisingly, the mean score of non-EAL children from Group 1 did not significantly differ from that of Group 2 ($M = .22, SD = .89$; *Mean Difference* = .27, $p = .36$). As noticed, non-EAL children of Group 2 achieved lower scores than non-EAL children of Group 3 (*Mean Difference* = .32, $p < .01$). As language factor scores were measured in the standard score units, the mean difference value above showed the between-group gap in the distance of the standard deviations, which were fairly substantial differences among groups. In general, as shown in Figure 5, non-EAL children from the most deprived quintile school areas achieved significantly lower language scores than children from the top three quintiles.

Within EAL children, the effect of IDACI on language scores was significant ($F_{[4, 1469]} = 2.54, p < .05$), but there was no significant difference found in pairwise comparisons (See Table 5). Figure 5 was a graphical representation of children's language performance by the interaction of IDACI and EAL. One interesting pattern was that, of those who learned English as an additional language (EAL group), children in the fourth quintile (Group 4) tend to yield the lowest scores ($M = -0.70, SD = 0.82$) instead of those in the most deprived quintile ($M = -0.50, SD = 0.93$). Furthermore, EAL children performed significantly worse than non-EAL peers. The highest mean score achieved by EAL

children (Group 5) was lower than the lowest score obtained by non-EAL pupils from the least deprived group (Group 1).



Of those children from non-EAL backgrounds, the lowest language performance was found in the most deprived group, while the highest average score was attained by Group 3. However, within children from EAL households, the lowest mean score was recorded for Group 4, and the highest was found for the least deprived group. To conclude, we can reject the third null hypothesis and suggest that IDACI and EAL interaction has a significant effect on children's language scores.

Table 4. Children's performance by IDACI and EAL

IDACI rank	EAL status						Main and interaction effects		
	EAL			Non-EAL			IDACI	EAL	IDACI × EAL
	M	SD	SEM	M	SD	SEM			
1 (most deprived)	-0.51	0.93	0.08	-0.06	1.12	0.12	F [4, 1469] = 3.21**	F [1, 1469] = 213.96***	F [4, 1469] = 6.21***
2	-0.41	0.78	0.07	0.22	0.89	0.06			
3	-0.48	0.88	0.08	0.54	1.04	0.08			
4	-0.70	0.82	0.09	0.42	0.91	0.06			
5 (least deprived)	-0.30	0.92	0.11	0.35	0.91	0.08			

Note: All parameter estimates are from SPSS 21. M = mean, SD = standard deviation, SEM = standard error of the mean. * = $p < .05$; ** $p < .01$; *** $p < .001$

Table 5. Mean Difference of Language Scores by IDACI within EAL groups

	(I) IDACI (J) IDACI Mean Difference (I-J)				(I) IDACI (J) IDACI Mean Difference (I-J)		
	(I) IDACI	(J) IDACI	Mean Difference (I-J)		(I) IDACI	(J) IDACI	Mean Difference (I-J)
non-EAL	1	2	-0.271	EAL	1	2	-0.098
		3	-0.59***			3	-0.025
		4	-.474**			4	0.198
		5	-.401*			5	-0.204
	2	1	0.271		2	1	0.098
		3	-.319**			3	0.073
		4	-0.202			4	0.295
		5	-0.129			5	-0.106
	3	1	.591***		3	1	0.025
		2	.319**			2	-0.073
		4	0.117			4	0.222
		5	0.19			5	-0.179
	4	1	.474**		4	1	-0.198
		2	0.202			2	-0.295
		3	-0.117			3	-0.222
		5	0.073			5	-0.402
	5	1	.401*		5	1	0.204
		2	0.129			2	0.106
		3	-0.19			3	0.179
		4	-0.073			4	0.402

Note: All values are from SPSS based on estimated marginal means. Values indicates significant mean-level differences within EAL groups

* = $p < .05$; ** = $p < .01$; *** = $p < .001$

Chapter 5. Discussion

5.1 Nursery Children's Language Performance

The present study has so far investigated the association between social deprivation (determined by IDACI and EAL ratings) and nursery children's language development (measured by the LanguageScreen assessment). Accordingly, the three research questions are: (1) whether school-level social deprivation affects children's language performance; (2) whether the home language environment influences children's language skill development; (3) whether interactions between neighborhood contextual factors and home environment factors account for more variance in children's language scores. In response to these questions, this chapter will present an interpretation of the findings listed in the previous chapter and connect the study results to the existing literature. The previous chapter was structured to address the three learning barriers raised in the questions mentioned above: firstly, nursery children's language performance was compared with different home language and school-level poverty contexts; secondly, the joint effect of home and neighborhood factors was addressed, and the findings of the home-school connection contributed to the broader literature and yielded policy and intervention implications; thirdly, the adaptability of using digital assessment in measuring children's language skills was discussed in light of the current Covid-19 pandemic; finally, the limitations of the study were discussed, and a direction for future studies was suggested.

5.2 Influence of Neighborhood Deprivation

The ANOVA model illustrated IDACI as having the most prominent effect on children's language scores ($p < .01$). Though IDACI ranking alone explained only a small variance in factor scores ($\eta^2 = .01$; Field, 2017), there was a significant language gap between children from different neighborhoods. Children attending nursery schools in the 20% most deprived neighborhoods achieved significantly lower language scores than children attending schools in the wealthier areas. The language gap between the most disadvantaged and the most privileged group was about 0.5 standard deviation units, which was educationally substantial. Moreover, children from the second-lowest deprived

background, which was ranked to be the most deprived 20% to 40% school areas, also obtained a significant 0.17 standard deviation lower mean score than those from the top 20% neighborhoods. On the other hand, necessary resources for language development seemed to be provided for children in the top three quantiles (40th -100th). These groups of children demonstrated similar levels of language skills during assessment.

These findings support the previous literature and conclude that there is a substantial language gap between children from socially deprived and enriched environments (e.g., Hart & Risley, 1995). The findings also align well with the former conclusion that children in the most deprived 10th decile experience disadvantages in development (Janus & Duku, 2007), yet extend the at-risk group to the most deprived 40th deciles. Similarly, neighborhood-level economic resources, determined by relative income levels of school neighborhoods, has a more profound effect on children's language development than the neighborhood-level educational environment, measured by neighborhood higher-education participation rate. Yet the small effect size obtained also confirms Janus and Duku's (2007) previous conclusion that singular contextual variable, no matter how robust, can only predict a small portion of the variance in children's language development.

The findings from research into the language gap could be explained by several pathway models discussed in Chapter 1. Regarding the neurological development of young children, high-quality childcare in nurseries located in deprived districts is not guaranteed (Gambaro, Stewart & Waldfogel, 2015); the consideration of less community cohesion and more impoverished and uncertain neighborhood environments (De Marco & Vernon-Feagans, 2013) supports this idea. Within both school and household environments, living in a deprived area limits children's access to enriched learning resources, for example, magazines, television, and storybooks (Bradley, Corwyn, McAdoo & García Coll, 2001; Sénéchal & LeFevre, 2002). These reading materials are crucial for developing children's vocabulary and oral language skills; a delayed vocabulary growth and a lack of exposure to diverse stimulations could impact children's neurological development and further influence their cognitive, language, and learning abilities (Huttenlocher, 1990; Perry, 2000).

In addition, according to Dodge, Daly, Huyton and Sanders's (2012) model of well-being, a persistent deprivation in both residential community and school environment could lead to a malfunctioning household and neighborhood society. These conditions restrict a neighborhood's ability to provide essential support for children to solve challenges and develop. Not to mention that children from deprived backgrounds might not be given many opportunities to explore challenges through experience, because they are not often asked to express their thoughts or make decisions for themselves (Bradley, Corwyn, McAdoo & García Coll, 2001). Another difference in early language resources has been found in parental involvement. Due to a lack of knowledge about language development in most deprived households and neighborhoods (Rowe, 2008), parents or caregivers might produce less effective communication with children and increases the receptive vocabulary gap between children from deprived and privileged backgrounds (Weisleder & Fernald, 2013). It is possible that these disadvantages are accumulated and result in a considerable disadvantage to language development by nursery age.

5.3 Influence of Home Language Environment

In terms of the home language environment, the ANOVA model demonstrated EAL as having a profound effect on language development ($p < .001$). Children from English-only backgrounds significantly outperformed children from families who speak English as an additional language. There was a 0.77 difference in the mean score between EAL and non- EAL children, measured in standard deviation units, and the EAL results explained 12.7% of the variance in children's language factor scores. Partial eta squared, as a measurement of effect size frequently used in ANOVA research on children's development, indicated a medium to large effect of EAL on children's language development (Field, 2017).

These findings yield contrasting evidence to Lindsey, Manis and Bailey's (2003) hypothesis that cross-language transition of precursor language skills occurs in bilingual children. These fundamental skills include phonological awareness, letter-sound knowledge, and word concepts. The failure to cope with two linguistic systems might

suggest that EAL children based in the UK are speaking a first language that is dissimilar in vocabulary, phoneme and grammar structure to English.

The results from the present study are in line with Bowyer-Crane et al.'s (2017) conclusion that EAL children have weaker expressive, receptive, and oral language skills than native peers of the same age. In the present study, children's expressive skills were thoroughly evaluated using expressive vocabulary and sentence repetition tasks. Therefore, the results could fully represent children's developmental stage of expressive aspect of language and further strengthen Bowyer-Crane et al.'s (2017) findings. Additionally, the findings of the present study confirm Babayiğit and Shapiro's (2020) previous conclusion, which documents a weakness in EAL children's ability to extract semantic information from narratives. In the present study, listening comprehension was included as a language measurement to examine children's capacity to understand both explicit and implicit messages delivered by stories. Therefore, the ability to speak multiple languages might delay language development.

Language development delays found in EAL children might be explained by their home language environment. According to Rowe (2012) and Anderson et al. (2021), children's early language development is achieved through the quantity and quality of parental speech. In the early stages, the number of words spoken by parents has a profound effect on development. For EAL households, it might be challenging to produce a lot of daily conversations and interactions in English. In addition, EAL parents are less likely to use child-directed speech in a language they are less familiar with. However, according to Fernald (1985), infants would prefer to listen to child-directed language because it is easily structured and more attractive to the ear. As a result, children in EAL families tend to hear and process fewer English words at an early stage. EAL households may not be capable of increasing the diversity and complexity of their speech; their most sophisticated speech might occur in their native language but not in English. Therefore, the influence of parental speech might become more significant as children grow and enter the later stage of language development.

To summarize, EAL status could contribute to a family's inability to provide suitable speech quality for nursery-age children who have not yet received comprehensive lessons in language from native speakers with advanced vocabulary and grammatical structure. It is worth mentioning that the expressive vocabulary task used in the present study for measuring language included advanced vocabulary for nursery-age children. For example, children were shown a picture of an item and asked to produce the correct word, such as scarecrow, wheelbarrow, handcuffs, stethoscope, and pliers. The difficulty of the task increased as it progressed, and the target vocabulary became more complex. Therefore, the gap in language scores between EAL and non-EAL children could be explained by the increased difficulty and use of high-level vocabulary. EAL children knew fewer uncommon words than non-EAL children and were less able to provide correct answers. This might also be the case for the receptive vocabulary task. The evaluation of vocabulary could suppress EAL children's overall language scores. Nevertheless, these findings provide supporting evidence for Anderson et al.'s (2021) hypothesis considering the quality of vocabulary and speech on children's language development.

5.4 Interaction of Home and Neighborhood Environment

The present study conducted a multi-level analysis to investigate the joint effect of the home language environment and neighborhood poverty. Results illustrated that the influence of both home and neighborhood was statistically significant ($p < .001$). The assessment using both the IDACI and EAL factor was more robust and explained a wider variance in children's language scores than the IDACI alone. The results of the simple effect test suggested that, for non-EAL children, the effect of neighborhood poverty is significant across all levels. In particular, native children who attend school in the most underprivileged neighborhood had the poorest language skills compared to other native peers, while those attending average and beyond average neighborhood schools achieved high performance at a similar level. In contrast, for EAL children, the effect of neighborhood deprivation was not significant. Surprisingly, EAL children from the fourth quintile, those attending nursery schools in the wealthiest 60th to 80th percentile, achieved the lowest language scores among EAL pupils. EAL children attending school in the top 20th neighborhood displayed the most advanced language skills than other English as

secondary language children. Nevertheless, regardless of neighborhood deprivation level, non-EAL children showed a significantly higher level of proficiency in language than EAL children.

Using data from the NELI-N program, this study found that children from EAL families enter nursery school at a more disadvantaged starting point, and this disadvantage continues to impact their school experience and vocabulary growth. This finding is in line with the previous Dickinson and Tabors' (2001) theory that home-school interaction is associated with children's literacy and language development. The current study evaluated a novel joint effect of home language environment and school neighborhood poverty, contributing to the child, home and neighborhood/school model suggested by Leventhal & Brooks-Gunn (2000) and Mashburn and Pianta (2006). The findings further demonstrate that children who experience resource deprivation in both home and school environments might have double the disadvantage when beginning to learn expressive and oral language development. Low performance in the most deprived EAL group may suggest additional language support and intervention is required within below-average nursery schools.

Non-EAL children's performance, however, displayed a non-linear relationship, and children from the above-average 60th to 80th band had lower language scores than expected from a linear function. There are several possible explanations for this. First of all, nursery schools in the fourth quintile are likely to be overlooked when selecting schools to provide beneficial language programs. Parents with privileged backgrounds might invest more in their children's education to ensure the environment can stimulate language learning (Yeung, Linver & Brooks-Gunn, 2002). Nevertheless, children from upper-middle neighborhoods may have varying experiences; depending on their parents' proficiency at speaking English, they could learn the language at different stages to their peers. Bradshaw and Main (2011) found that children from Indian and Chinese families in the UK are unlikely to live in poverty. It is possible that these households are first-generation migrants who came to the UK as skilled workers. Children from these families might have average or better living conditions, yet they may not have had many English learning opportunities during early childhood. Unfortunately, this group of children were

not frequently targeted or thoroughly evaluated, so it remains unclear which factors lead to their below standard language performance.

5.5 Implications of Digital Assessment for Future Research

The increase in using digital devices in both educational settings and personal spaces laid the groundwork for moving standardized and individually administered early language assessments to a digital format. This section discusses the practical considerations such as feasibility and acceptability to create and carry out digital tests in the field, targeting various constructs and domains in a single assessment. The discourse of paper versus paperless digital assessment feeds into the wider discussion on climate change; reducing the use of paper slows further deforestation, which contributes to critical global warming issues (Bala et al., 2007). Another practical influence lies in the recent Covid-19 pandemic; many research studies have been interrupted because of it, giving us time to develop and support digital research methods going forward.

The present study supports the evidence that well-developed digital assessments can achieve a higher level of reliability and validity in practice (West et al., 2021). In addition, the present study demonstrates the suitability of using the LanguageScreen assessment to identify children with language difficulties. Firstly, the factor analysis shows an appropriate correlation level between each subtest, which ensures a reliable language factor extraction. Secondly, the outcome scores for 1,500 children aged 2-5 indicate a suitable difficulty of tasks. No ceiling effect or difficulty issues are detected in the dataset. More importantly, it has also been confirmed in a former NELI study that a strong relationship was found between children's LanguageScreen scores and a set of other traditional standardized assessments (West et al., 2021). Hence, the use of digital language assessment in recent studies may provide supporting evidence for the paper to digital transition within early language development research.

Strengths and Weaknesses

The LanguageScreen assessment method has many strengths. Firstly, tasks are scored automatically, and the standardized score is calculated for examiners. The computer

system allows the program to mark the answer of the child and automatically calculates a standardized score at the end of the test based on the child's age and raw score. This not only simplifies the assessment, it also reduces the risk of calculation errors. Secondly, essential instructions are pre-programmed into the device, making the whole administration process more rigorous while retaining the consistency of the traditional process. For example, it will prevent assessors from providing undesirable feedback to a child during the assessment. Fourthly, both the research team and school examiners can follow the standardized protocol with ease and reduce the necessity for excessive training sessions; LanguageScreen can provide a fast, efficient and reliable tool for collecting data from a large sample of young children. Fourthly, LanguageScreen has been designed using the British English language, but the software could be adapted to suit other languages, making this method of assessment available worldwide. The LanguageScreen app is more easily accessible than other paper-based assessments, and user-friendly learning materials, such as the instruction manual and demonstration videos, are available on the website and can be easily accessed worldwide. This publication aims to provide useful information for researchers and encourage more in-depth discourse in order to improve and transfer the assessment process into digital format and give voice to the possibility of evolving the software to incorporate different language versions.

Contrastingly, one concern about the use of LanguageScreen is a difficulty to determine the appropriate tests included in the assessment. Pre-programed language assessments have a decreased flexibility to deal with variations of participants and contexts. This issue was recognized in a recent modification of the LanguageScreen App; the research team removed the Non-word Repetition task from language tests, which mostly addresses children's phonological working memory instead of language abilities by asking children to repeat some combinations of non-word syllables. The task was excluded from the subtest list, considering its difficulty to younger children and limited relevance to the assessment as a whole. Evidently, it might be a challenging process to select language tasks to address multiple aspects of language. It is also important to include tasks that yield the most representative data for what it is measuring, while taking into account the characteristics of the target population.

Other concerns about digital assessments are related to the design and application of the LanguageScreen app. For example, the RIGHT and WRONG buttons on the top of the screen may potentially provide visual feedback to the child. In the expressive and receptive vocabulary tasks, the assessment uses culturally specific words that may only target children speaking British English. Similarly, the voice chosen may also represent the accent of an English speaker from a specific region. These elements may advantage or disadvantage some children over others. Many paper-based language assessments indicated that it might be practical to record incorrect answers produced by children for future use. For example, for the sentence repetition task, children need to reproduce the sentence verbatim to get the question correct. Hence, the same score could not imply the same performance. These differences in narratives and words may potentially lead to surprising findings, but this information is hard to be technically retained. Finally, one general weakness of digital assessment is that it is reliant on technology and Wi-Fi access. This may limit its use in contexts where electricity is not widely or reliably available.

In conclusion, using digital technology for language assessment is a sensible attempt. LanguageScreen not only reinforces a reliable and standardized administration process that introduces less bias to the research process, but it also promotes the worldwide discourse about improving and transferring existing language evaluation methods into more practical formats.

5.6 Limitations and Suggestions for Future Research

The present study supports the argument for the digital language assessment and high-quality language instruction in neighborhood nursery schools, but it should be viewed in light of some limitations. The original NELI-N study has a long-term interventional design, but unfortunately, the Covid-19 pandemic has disrupted the school-based assessments and subsequent gathering of data. Therefore, the present study did not include the post-assessment data that reflects the children's language performance after the initial assessments. It is yet to be known whether additional language instruction has a significant and sustainable effect on the groups of children identified in the present study.

Limitations of Social Deprivation Measures

Regarding the social deprivation measures used in the study, previous research has considered the level of parental education as an important aspect of children's social deprivation (e.g., Janus & Offord, 2007). Therefore, a comprehensive measurement of social deprivation should include educational factors as predictors. However, it was found in the analysis that children's POLAR scores, an indicator of higher education participation rated by the local district, were poorly correlated to IDACI's scores based on the same local area. To ensure the reliability of results, the educational factor was removed from the present study. This falls in line with recent evidence reported by Jerrim (2021), who also found that POLAR indicated a fairly poor correlation with neighborhood-level socioeconomic disadvantage. One explanation by Jerrim (2021) is that area-based educational factors might be biased towards minority ethnic students living in the region. Indeed, racial segregation may significantly increase or decrease the average score of a district, which might not necessarily reflect the social resources in a geographical area, but the resources within ethnic groups. Nevertheless, parental education levels and the general academic levels of the neighborhood might still be important aspects to consider in future research, if a more representative indicator can be identified.

It is also worth noting that IDACI, as an indicator of social deprivation, is unable to record disadvantages on an individual level. IDACI scores measure the proportion of children in a local area receiving social support and benefits based on the household's income level, for example, Income Support, Working Tax Credit, Child Tax Credit, Pension Credit, and Income-Based Jobseeker's Allowance (Bradshaw & Main 2011, p. 40). This measurement is a possible indicator of children's living conditions, suggesting the probability of a child living in a deprived household (Gambaro, Stewart & Waldfogel, 2015). The present study reports IDACI scores based on the child's nursery school address. Therefore, the index could only give a proxy of children's school neighborhood poverty conditions. This approach does not capture individual-level poverty, and children living in the same area might have varying childhood experiences. Also, according to Mashburn et al. (2008), the quality of the nursery environment and learning support are two critical elements for children's language development. Though school-level

deprivation could suggest a school's overall environment, it doesn't represent the teaching quality or the level of learning support offered. The same limitation applies to the EAL factor. EAL families are not identical. Bridges and Hoff (2014) suggest that bilingual children with older siblings have more advanced English language skills. Evidence shows that the presence of older siblings at home not only promotes the English interaction between toddlers and their siblings but encourages the whole family to speak more English at home (Bridges & Hoff, 2014), suggesting that EAL children from such households will have more exposure to the English language than EAL children without older siblings. Therefore, the present secondary analysis should be compensated with other micro-level case studies to provide a comprehensive picture of the pathways that shape children's language learning and early development.

Identification of Poor Decoders and Poor Comprehenders

Another limitation of the present study is the generality of children's language outcomes. In the present study, the language factor was extracted to measure children's overall language ability. This approach is practical and valuable for the large-scale study design. According to the Simple View of Reading theory (Gough & Tunmer, 1986), children with language difficulties could be classified as poor decoders and poor comprehenders. Poor decoders are those who struggle with phonological processing, such as children with developmental dyslexia (Bishop & Snowling, 2004), and poor comprehenders are children who do not have difficulty reading but struggle with specific deficits in comprehension (Catts, Adlof & Weismer, 2006). These classifications are crucial for both intervention program design and implementation. Future research investigating contextual influence on children's language development would benefit from using different sets of measurements to evaluate children's decoding and linguistic comprehension skills separately. The influence of social deprivation on specific aspects of language could provide useful information for educational instruction and policy development, which are effective in promoting high-quality language outcomes in nursery children.

5.7 Conclusions

The aim of the present study was to investigate the association between social deprivation and language development in nursery children by evaluating 1,497 children from the NELI-N program using LanguageScreen assessments. The research questions investigated the influence of both home life and school neighborhood environment, and the results of the ANOVA tests provide strong evidence for both independent and joint effects of home language environment and school neighborhood poverty on language development. The findings have demonstrated that children from socially deprived areas are presented with multi-level risk factors. Neighborhood-level deprivation leads to reduced language performance, especially for native children when compared with other native pupils. EAL conditions are indicative of children's language scores in preschools, supporting the hypothesis that early childhood represents a critical period during which quantity and quality of language exposure leads to gaps in language development. Although the effect of the school neighborhood is not significant for EAL children with a level of 0.01, there is a trend to suggest that attending top-ranking nurseries improves language deprivation in the home environment. Nevertheless, EAL children underperformed regardless of neighborhood deprivation levels. To conclude, the research suggests that the combination of disadvantaged home and school neighborhood experiences can negatively impact children's language learning processes and result in under-developed language skills by nursery ages.

This study contributes to existing literature and research by using standardized language measurements for the research of social deprivation. The assessments have provided valid and reliable scores that are representative of nursery children's language ability, and the use of the LanguageScreen tools also provides a number of insights for future studies in a digital era. The study also provides supporting evidence for a dynamic model of deprivation (e.g., Brooks-Gunn & Duncan, 1997; Smith, Brooks-Gunn, & Klebanov, 1997). The results have demonstrated that the effects of home-life and neighborhood environment on children's language development combine to reinforce the idea that poverty is a contributing factor, and children can be deprived of the necessary learning resources over a significant period of time. These multi-level factors also provide evidence of joint effect as reported by Leventhal and Brooks-Gunn (2000) in their

individual, home, and neighbourhood connection model. Furthermore, the present findings suggest that children who experience constant resource deprivation during early childhood are at high risk of developmental delays. This observation is consistent with the development process defined by the terminological model of well-being (Dodge, Daly, Huyton & Sanders, 2012). This model highlights the importance of maintaining an equal balance of resources and challenges in order to stimulate development. However, for children from socially deprived backgrounds, an imbalance will begin to impact their ability to learn effectively and solve challenges as early as their nursery-age years.

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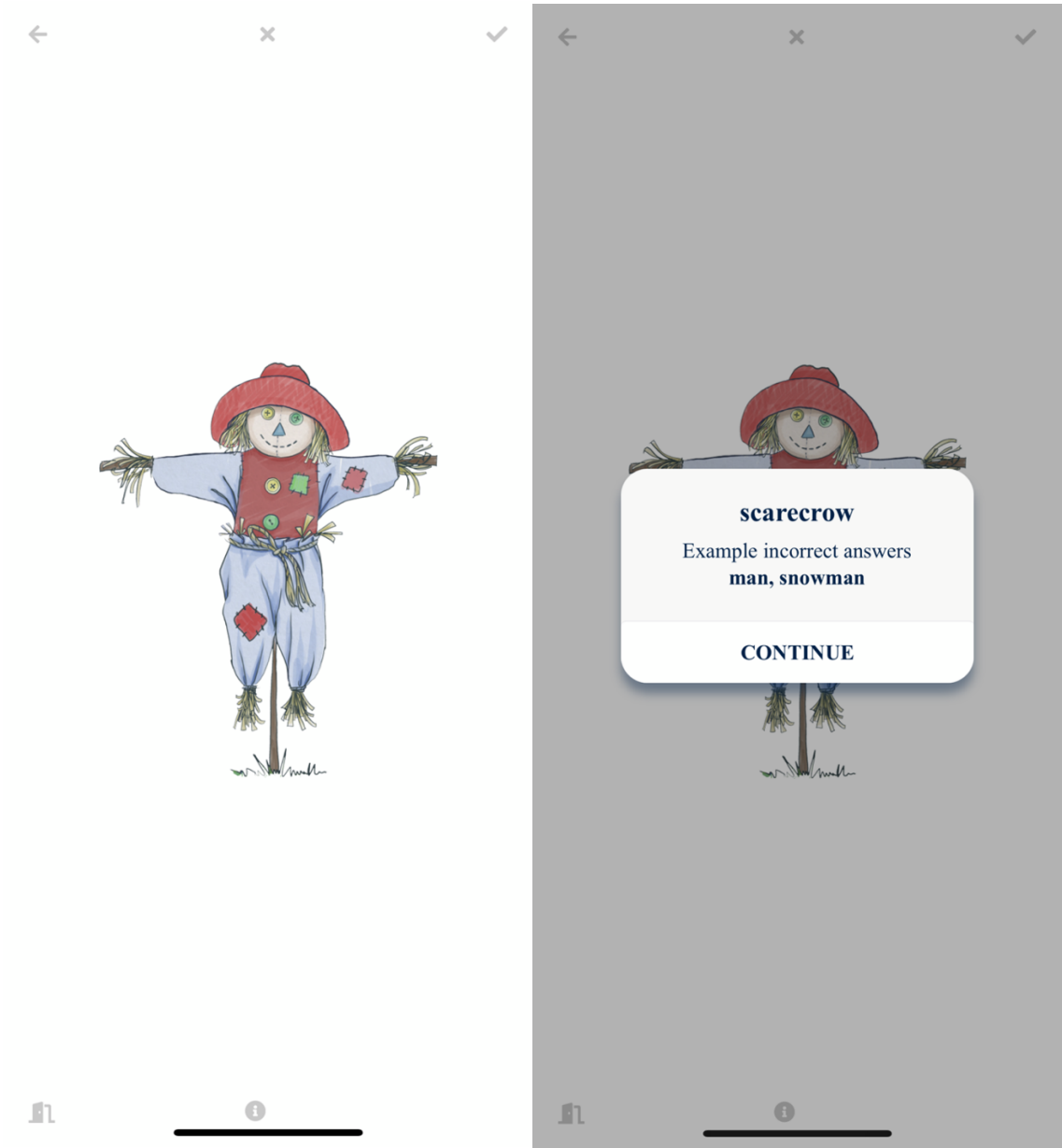
<https://explore-education-statistics.service.gov.uk/find-statistics/school-pupils-and-their-characteristics>

LanguageScreen Assessment Official Website: <https://languagescreen.com/>

Appendices

Appendix 1 – Example Tasks from the LanguageScreen Assessment

1.1 Expressive Vocabulary



1.2 Listening Comprehension

Who did Tilly go out with today?

CORRECT

WRONG

Accept: Her **granny** OR **grandmother** OR **nana** OR **grandma**.

Incorrect Answers: Mum, mummy, sister, friend.

NB: Where an answer is shown in bold the exact word/meaning must be given for it to be scored as correct.

Why did Beth not want to go home?

✓ CORRECT

WRONG

DONE

Accept: Because she has had a **happy** time OR has **enjoyed** herself (any answer that indicates enjoyment/excitement at being at the park or on the swings).

Incorrect Answers: Because she wants to stay at the park OR Because she likes the park.

NB: Where an answer is shown in bold the exact word/meaning must be given for it to be scored as correct.

1.3 Receptive Vocabulary



1.4 Sentence Repetition



✓ CORRECT

WRONG

DONE

Cats love to chase mice just for fun

The sentence must be repeated verbatim (perfectly) to be scored CORRECT.

CORRECT

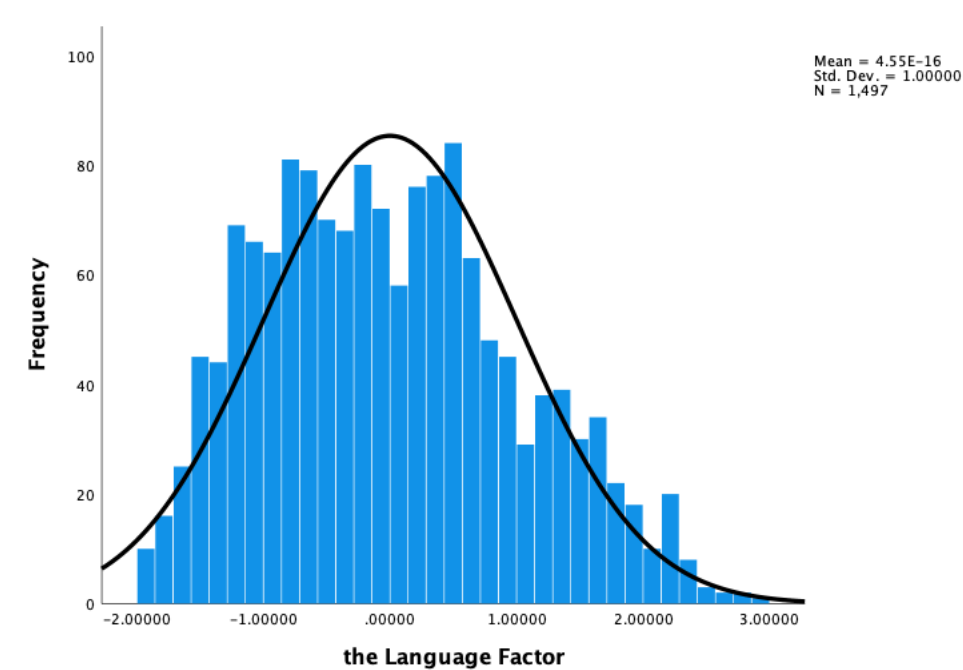
WRONG

The teacher promised the boy a sticker

The sentence must be repeated verbatim (perfectly) to be scored CORRECT.



Appendix 2.1 – Normality Checks for the Language Factor



Statistics

the Language Factor

N	Valid	1497
	Missing	64038
Skewness		.345
Std. Error of Skewness		.063
Kurtosis		-.570
Std. Error of Kurtosis		.126

Note: Skewness and kurtosis of the language factor were checked in the graph and table above

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
REGR factor score 1 for analysis 1	1497	-1.93539	2.91955	.0000000	1.0000000
Valid N (listwise)	1497				

Note: The Mean of the factor scores is 0, and the SD is 1

Appendix 2.2 – Selected Factor Analysis Outputs (Language Factor)

KMO and Bartlett's Test

Kaiser–Meyer–Olkin Measure of Sampling Adequacy.		.810
Bartlett's Test of Sphericity	Approx. Chi-Square	3113.478
	df	6
	Sig.	.000

Communalities

	Initial	Extraction
Expressive Vocabulary	1.000	.779
Listening Comprehension	1.000	.721
Receptive Vocabulary	1.000	.717
Sentence Repetition	1.000	.703

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.920	73.004	73.004	2.920	73.004	73.004
2	.480	11.993	84.996			
3	.335	8.381	93.377			
4	.265	6.623	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix^a

	Component 1
Expressive Vocabulary	.883
Listening Comprehension	.849
Receptive Vocabulary	.847
Sentence Repetition	.839

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Component Score Coefficient Matrix

	Component 1
Expressive vocab_ATLAS subtest (24 items)	.302
Listening Comprehension_ATLAS subtest (LC1 to LC3: 16 items)	.291
Receptive vocab_ATLAS subtest (23 items)	.290
Sentence Repetition_ATLAS subtest (14 items)	.287

Extraction Method: Principal Component Analysis.

Descriptive Statistics

	Mean	Std. Deviation	N
IDACI (5 bands)	2.9579	1.26933	1497
the Language Factor	.0000000	1.00000000	1497

Appendix 2.3 – The correlation between *IDACI* and *Language Scores***Correlations^b**

		IDACI (5 bands)	the Language Factor
IDACI (5 bands)	Pearson Correlation	1	.130**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	2410.349	246.892
	Covariance	1.611	.165
Language Factor	Pearson Correlation	.130**	1
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	246.892	1496.000
	Covariance	.165	1.000

** . Correlation is significant at the 0.01 level (2-tailed).

b. Listwise N=1497

Coefficients^a

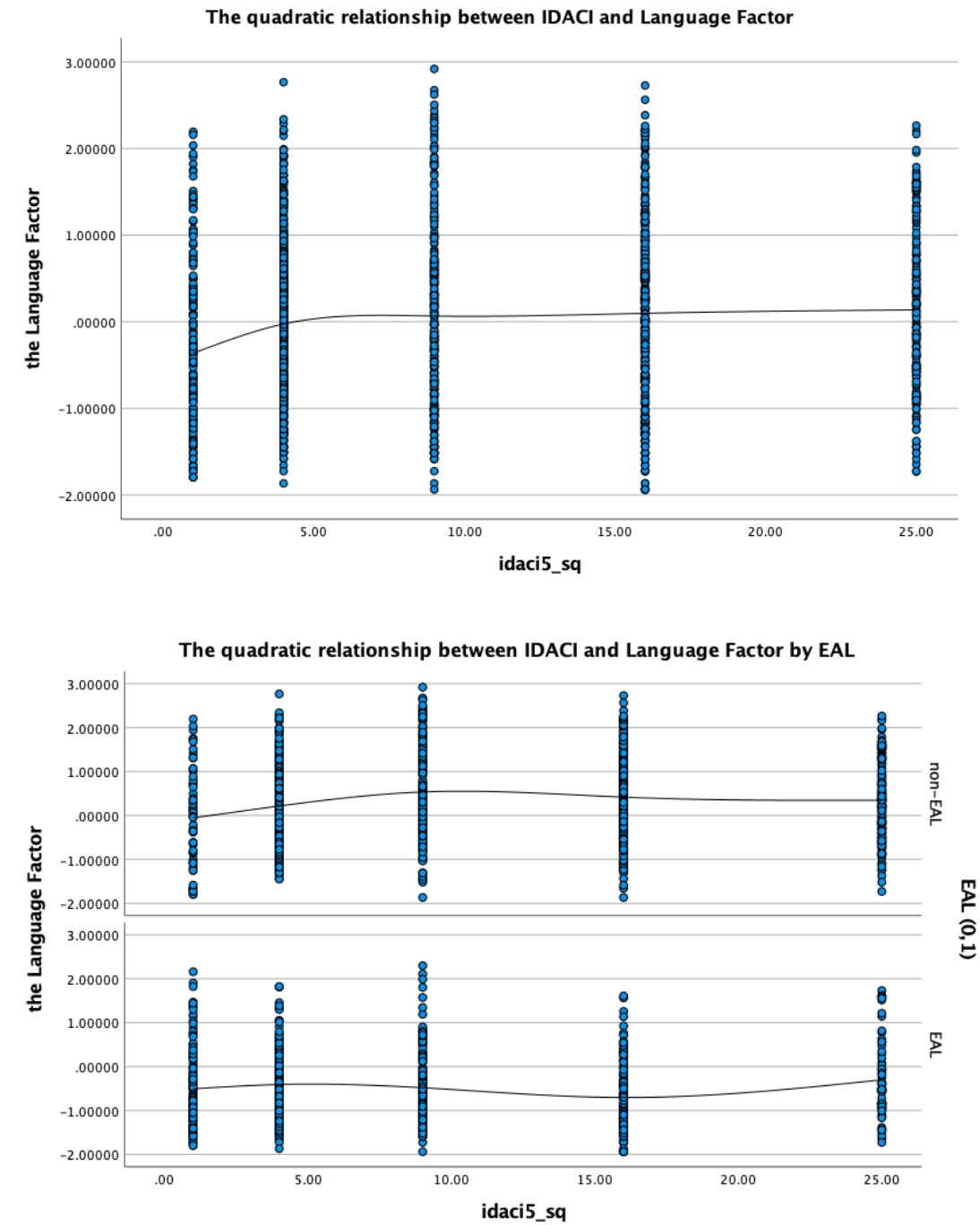
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-.489	.116		-4.231	.000	-.716	-.262		
	Social depr. IDACI rating (decile)	.151	.046	.385	3.269	.001	.060	.242	.047	21.171
	idaci_sq	-.009	.004	-.268	-2.271	.023	-.017	-.001	.047	21.171

a. Dependent Variable: REGR factor score 1 for analysis 1

Appendix 2.4 – Relationship between IDACI and Language Measures

	IDACI	Expressive vocabulary	Listening Comprehension	Receptive vocabulary	Sentence Repetition
IDACI	1.00	0.15***	0.07**	0.15***	0.05*
Expressive vocabulary	0.15***	1.00	0.65***	0.73***	0.63***
Listening Comprehension	0.07**	0.65***	1.00	0.59***	0.67***
Receptive vocabulary	0.15***	0.73***	0.59***	1.00	0.58***
Sentence Repetition	0.05*	0.63***	0.67***	0.58***	1.00

Note: All parameter estimates are from SPSS. Determinant = .12; *** = p<.001; ** = p<.01; * = p<.05



Appendix 2.5 – Two-way ANOVA Model Additional Outputs

Tests of Between-Subjects Effects

Dependent Variable: the Language Factor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	269.376 ^a	9	29.931	36.276	.000	.182
Intercept	10.378	1	10.378	12.578	.000	.008
IDACI_5bands	12.850	4	3.213	3.894	.004	.010
eal_code	176.535	1	176.535	213.961	.000	.127
IDACI_5bands * eal_code	20.509	4	5.127	6.214	.000	.017
Error	1212.041	1469	.825			
Total	1481.429	1479				
Corrected Total	1481.416	1478				

a. R Squared = .182 (Adjusted R Squared = .177)

Note: main and interaction effects

Levene's Test of Equality of Error Variances^{a,b}

		Levene Statistic	df1	df2	Sig.
the Language Factor	Based on Mean	2.431	9	1469	.010
	Based on Median	2.382	9	1469	.011
	Based on Median and with adjusted df	2.382	9	1420.458	.011
	Based on trimmed mean	2.505	9	1469	.008

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: the Language Factor

b. Design: Intercept + eal_code + IDACI_5bands + eal_code * IDACI_5bands

Note: homogeneity test

Appendix 2.6 – Selected Outputs of Main Effect of *IDACI* and Contrast Tests

Descriptive Statistics

Dependent Variable: the Language Factor

IDACI (quintile)	Mean	Std. Deviation	N
most deprived	-.3626456	1.01128284	198
2.00	-.0250936	.89861668	445
3.00	.0663572	1.08954866	275
4.00	.0982280	1.01908966	380
least deprived	.1376663	.95913425	199
Total	.0000000	1.00000000	1497

Test Results

Dependent Variable: the Language Factor

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	12.850	4	3.213	3.894	.004	.010
Error	1212.041	1469	.825			

Note: this table shows the main effect of IDACI

Tests of Between-Subjects Effects

Dependent Variable: the Language Factor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	179.411 ^a	6	29.902	33.840	.000	.120
Intercept	133.473	1	133.473	151.053	.000	.092
age	139.034	1	139.034	157.346	.000	.096
gender	6.188	1	6.188	7.003	.008	.005
IDACI_5bands	36.433	4	9.108	10.308	.000	.027
Error	1316.589	1490	.884			
Total	1496.000	1497				
Corrected Total	1496.000	1496				

a. R Squared = .120 (Adjusted R Squared = .116)

Note: this table shows that the main effect of IDACI remained when controlling for children's age and gender

Appendix 2.7 - Selected Outputs of Main Effect of *EAL***Contrast Results (K Matrix)**

EAL (0,1) Simple Contrast ^a		Dependent Variable the Language Factor
Level 2 vs. Level 1	Contrast Estimate	-.771
	Hypothesized Value	0
	Difference (Estimate - Hypothesized)	-.771
	Std. Error	.053
	Sig.	.000
	95% Confidence Interval for Difference	
	Lower Bound	-.874
	Upper Bound	-.667

a. Reference category = 1

Test Results

Dependent Variable: the Language Factor

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	176.535	1	176.535	213.961	.000	.127
Error	1212.041	1469	.825			

Appendix 2.8 – Selected Outputs of *EAL* × *IDACI* Interaction Effect

Univariate Tests

Dependent Variable: the Language Factor

EAL (0,1)		Sum of Squares	df	Mean Square	F	Sig.
non-EAL	Contrast	20.699	4	5.175	6.272	.000
	Error	1212.041	1469	.825		
EAL	Contrast	8.372	4	2.093	2.537	.038
	Error	1212.041	1469	.825		

Each F tests the simple effects of IDACI (quintile) within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

Pairwise Comparisons

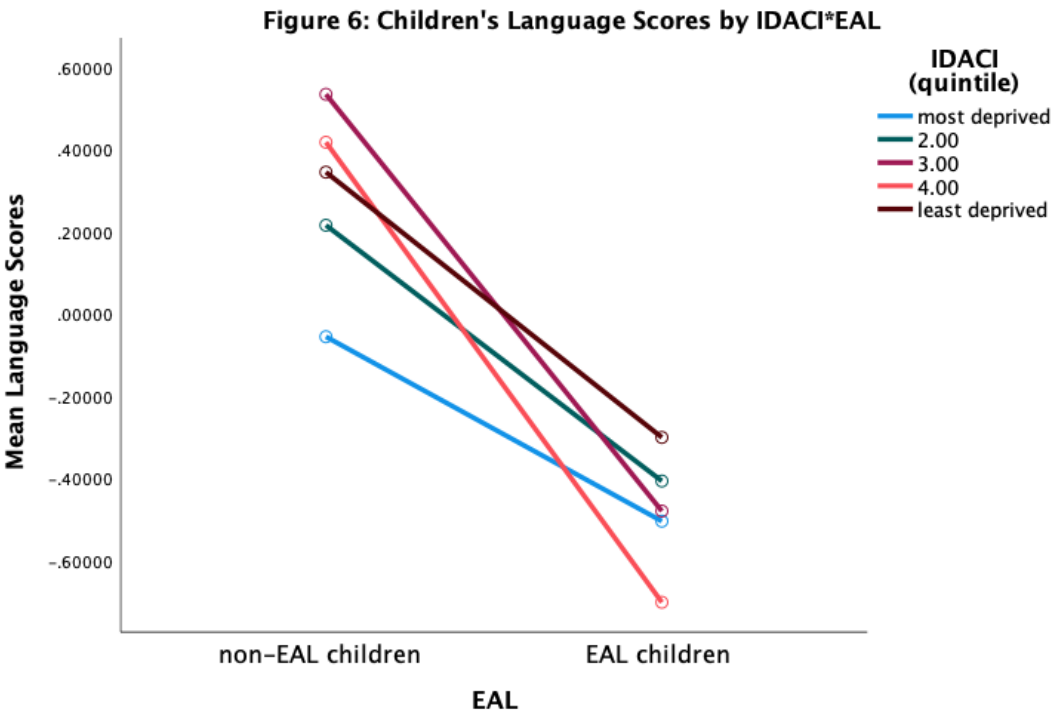
Dependent Variable: the Language Factor

EAL (0,1)	(I) IDACI (quintile)	(J) IDACI (quintile)	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
non-EAL	most deprived	2.00	-.271	.130	.363	-.636	.093
		3.00	-.591 [*]	.138	.000	-.979	-.202
		4.00	-.474 [*]	.129	.002	-.835	-.112
		least deprived	-.401 [*]	.140	.043	-.795	-.007
	2.00	most deprived	.271	.130	.363	-.093	.636
		3.00	-.319 [*]	.094	.007	-.583	-.055
		4.00	-.202	.079	.110	-.425	.021
		least deprived	-.129	.097	1.000	-.401	.143
	3.00	most deprived	.591 [*]	.138	.000	.202	.979
		2.00	.319 [*]	.094	.007	.055	.583
		4.00	.117	.093	1.000	-.144	.378
		least deprived	.190	.108	.794	-.114	.494
	4.00	most deprived	.474 [*]	.129	.002	.112	.835
		2.00	.202	.079	.110	-.021	.425
		3.00	-.117	.093	1.000	-.378	.144
		least deprived	.073	.096	1.000	-.196	.342
	least deprived	most deprived	.401 [*]	.140	.043	.007	.795
		2.00	.129	.097	1.000	-.143	.401
		3.00	-.190	.108	.794	-.494	.114
		4.00	-.073	.096	1.000	-.342	.196
EAL	most deprived	2.00	-.098	.104	1.000	-.390	.195
		3.00	-.025	.113	1.000	-.341	.292
		4.00	.198	.118	.942	-.134	.529
		least deprived	-.204	.138	1.000	-.592	.184
	2.00	most deprived	.098	.104	1.000	-.195	.390
		3.00	.073	.105	1.000	-.223	.369
		4.00	.295	.111	.079	-.017	.607
		least deprived	-.106	.132	1.000	-.478	.266
	3.00	most deprived	.025	.113	1.000	-.292	.341
		2.00	-.073	.105	1.000	-.369	.223
		4.00	.222	.119	.625	-.113	.557
		least deprived	-.179	.139	1.000	-.571	.212
	4.00	most deprived	-.198	.118	.942	-.529	.134
		2.00	-.295	.111	.079	-.607	.017
		3.00	-.222	.119	.625	-.557	.113
		least deprived	-.402	.144	.052	-.805	.002
	least deprived	most deprived	.204	.138	1.000	-.184	.592
		2.00	.106	.132	1.000	-.266	.478
		3.00	.179	.139	1.000	-.212	.571
		4.00	.402	.144	.052	-.002	.805

Based on estimated marginal means

*. The mean difference is significant at the .050 level.

b. Adjustment for multiple comparisons: Bonferroni.



Appendix 2.9 – *Syntax* for Tests of Simple Effects

UNIANOVA ZLang_factor_regression by eal_code IDACI_5bands

/PRINT = DESCRIPTIVE HOMOGENEITY

/PLOT = PROFILE (eal_code*IDACI_5bands)

/EMMEANS = TABLES (eal_code*IDACI_5bands) comp (eal_code) adj

(BONFERRONI)

/EMMEANS = TABLES (eal_code*IDACI_5bands) comp (IDACI_5bands) adj

(BONFERRONI)