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Explaining gaps by parental education in children's early language and social outcomes at age 3–4 years: evidence from harmonised data from three countries

Anna Volodina[1] · Sabine Weinert[1] · Elizabeth Washbrook[2] · Jane Waldfogel[3] · Sarah Jiyoon Kwon[3] · Yi Wang[3] · Valentina Perinetti Casoni[2]

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Abstract

Child outcomes vary by family's socioeconomic status (SES). Research on explanatory factors underlying early SES-related disparities has mainly focused on specific child outcomes (e.g., language skills) and selected influencing factors in single countries often with a focus on individual differences but not explicitly on early SES-related gaps. This study uses harmonised data from longitudinal large-scale studies conducted in the United Kingdom, United States, and Germany to examine parental education-related gaps in early child language and social skills. Twelve theoretically proposed family-, child-, and childcare-related factors were systematically evaluated as explanatory factors. In all countries, parental education-related gaps were particularly pronounced for early child language compared to social skills. In the decomposition analyses, the home learning environment was the only measure that significantly explained gaps in all child outcomes across all countries. Early centre-based care attendance, family income, and maternal age at childbirth contributed to gaps in child outcomes with the specific pattern of results varying across outcomes and countries. Maternal depressive feelings significantly contributed only to explaining gaps in children's social skills. Thus, while some mechanisms found to underpin early parental education-related gaps can be generalized from single-country, single-domain studies, others are outcome- and context-specific.

Keywords Parental education · Language skills · Social skills · Cross-country comparisons · Harmonisation

Early language development is associated with subsequent cognitive skills as well as with academic and labor market success (e.g., Schoon et al., 2021), and is related to the development of socio-emotional skills (e.g., Rose et al., 2018). Children's poor socio-emotional skills are not only predictive of poorer health and behavioural outcomes in adulthood (e.g., Althoff et al., 2010), but also of comparatively lower academic achievement (e.g., Becherer et al., 2021). Although language and socio-emotional skills are acquired from early on through adolescence and even adulthood, individual differences appear to stabilize rather early, with considerable predictive power throughout childhood and into adulthood (e.g., Ebert et al., 2013; Fergusson, 1998).

Many studies have documented a substantial relation between families' socioeconomic status (SES) and children's language development. Further, adults from different social strata differ in their use of language, joint activities such as book reading as well as in their knowledge about child development and their sensitive and cognitive-verbally stimulating behaviour when interacting with their children (e.g., Attig & Weinert, 2020; Hoff, 2003). SES is also related to children's socio-emotional development (e.g., Huang et al., 2022a; Schoon et al., 2021), although the strength of such relations may vary widely between cultures (Bradbury et al., 2015). Previous studies on SES-related disparities in early child development mainly explore the relations between SES and specific child outcomes, e.g., either in the language or in the socio-emotional domain, and only within one country (e.g., Becker, 2011; Wirth et al., 2020). Thus, most of these studies do not address different outcome measures using the same set of predictors. Furthermore, they often focus on

✉ Anna Volodina
anna.volodina@uni-bamberg.de

[1] Department of Developmental Psychology, University of Bamberg, Markusplatz 3, 96047 Bamberg, Germany

[2] University of Bristol, Bristol, UK

[3] Columbia University, New York, NY, USA

explaining individual differences, while SES-related gaps are only tapped indirectly (e.g., by observing whether SES-effects are reduced or whether a direct path remains in addition to indirect paths). Based on these studies, a systematic evaluation of factors explaining SES-related gaps in early child development is problematic as different studies use different sets of predictors; in addition, the included samples may differ with respect to the social grading of predictors and outcome measures. Overall, these studies seem to imply that some explanatory factors, such as centre-based care, maternal health, or certain parenting behaviours, have different associations with child language versus socio-emotional outcomes (e.g., Ansari, 2018; Huang et al., 2022a), suggesting that the processes underlying SES-related disparities in early childhood may differ by child outcome. Yet, this has hardly been tested directly and theoretical accounts, such as the family investment models (FIMs) and family stress models (FSMs; Conger & Donnellan, 2007; Masarik & Conger, 2017), suggest both common and specific mechanisms. As influencing factors and processes may also vary according to country context, an international comparative perspective is important (e.g., Bradbury et al., 2015).

Although research conducted in various countries has shown that SES-related gaps in different developmental outcomes can be substantial before formal school enrolment, comparative research on the effects of social inequalities on young preschool children's early language and especially their socio-emotional skills is sparse. One reason is the lack of international studies that facilitate comparative research. However, there is a growing number of country-specific large-scale cohort studies that offer opportunities for comparative research on early child development. These studies allow for the investigation of a comprehensive range of child, maternal, and family factors as well as early childcare-related variables on children's early language and socio-emotional development. Identification of protective and risk factors is particularly relevant in the early years as the early childhood period is considered to be foundational for social mobility (e.g., Duncan & Murnane, 2011) and knowledge about these factors is important to the development and targeting of appropriate interventions.

In our study, we focus on parental education-related gaps in child language as well as in social skills at the age of 3/4 years in the United Kingdom (UK), the United States (US), and Germany, aiming to investigate the specificity of certain mechanisms, i.e., the effects of explanatory factors, such as the home learning environment (HLE) and attendance at centre-based care, for different developmental domains across countries differing, e.g., in their welfare systems. With regard to social skills, we focus on two facets, i.e., prosocial behaviour and peer relationships. It is important to investigate early prosocial behaviour as its expressions are related to developmental outcomes such as school performance and low levels of aggression (e.g., Eisenberg et al., 2015). Regarding peer relationships, early problems with peers are associated with increased risk for a range of interpersonal and school-related difficulties in adolescence; in turn, these experiences and behaviours seem to reduce the educational and employment opportunities for children with early peer problems (Woodward & Fergusson, 2000).

With the aim to investigate mechanisms underlying parental education-related gaps in early child outcomes, we use decomposition analyses (Washbrook et al., 2014) within a harmonised framework to analyse the contribution of a broad range of process-, structural-, health-, and child-related variables, which have been suggested by theoretical models and empirical results as factors in explaining gaps in early child development. Thereby we explicitly address the social gradients in both the predictors and child outcome variables and analyse to what extent the different predictors account for parental education-related gaps in children's early language and social outcomes. To test for the effects of macro-structural variables, these results are compared across countries differing in their welfare systems and sociocultural contexts.

SES-related disparities in children's early language and socio-emotional outcomes

SES refers to the relative position which an individual, a family, or a group holds within a societal hierarchy according to its access to or control over valued goods (e.g., wealth, knowledge, social recognition); it is a multidimensional construct, including, amongst other indicators, parental education and parental occupation (e.g., Eriksson et al., 2021).

Previous studies have documented significant relations between SES and children's language skills, with associations generally being stronger compared to those with socio-emotional skills (e.g., Bradbury et al., 2015; Huang et al., 2022a). For instance, the well-known study by Hart and Risley (1995) reported a significant early SES-related gap in children's vocabulary, with children from high-SES families having larger vocabulary compared to children from working-class families; children from welfare families had the most limited vocabulary. In general, previous research suggests that SES-related gaps in vocabulary initially widen from 16 months to approximately age 3 (e.g., Fernald et al., 2013); after that time SES-related gaps seem to stabilize (e.g., Ebert et al., 2013) and to remain rather constant from preschool into school age. At the same time, differences in SES are associated with the quality and quantity of language exposure (e.g., Ebert et al., 2020). On average, parents with a comparatively higher SES present their children with a richer language-stimulating environment by talking more, using more different words, more complex and varied sentence structures, as well as a larger proportion

of conversation-eliciting questions in comparison to lower SES parents (Golinkoff et al., 2019). Furthermore, differences in joint picture book reading as well as in sensitive and stimulating parent–child interactions have been documented (e.g., Attig & Weinert, 2020). As a result, children from high-SES families develop language at a faster rate compared to children from low-SES families (Hoff, 2003). Parental education is considered to be the component of SES that is most closely linked to child vocabulary (e.g., Huang et al., 2022a; Huttenlocher et al., 2007).

Studies on the association between measures of the family's SES and children's socio-emotional development often use global measures of children's socio-emotional skills and relate them to aggregated or single SES-indicators (e.g., Violato et al., 2011). In her systematic review Reiss (2013) reported that, amongst all the SES indicators across studies, low parental education and a low household income were the strongest predictors of low socio-emotional skills among children and adolescents. Recently, Reiss et al. (2019) found parental education to be the strongest predictor of problem behaviour in children and adolescents at a 2-year follow-up compared with the other SES indicators used in their study (i.e., household income and parental unemployment). Strong effects of parental education on child behaviour have been attributed to the fact that, amongst others, high education helps parents to make more rational decisions about parenting and to provide their children with more sensitive and stimulating social interactions (Oreopoulos & Salvanes, 2011).

To summarize, overall, parental education seems to show the strongest associations with children's language and socio-emotional skills compared to other SES indicators. In addition, parental education is considered to be a more stable, reliable, and valid indicator of SES compared to, for instance, family income (Bradbury et al., 2015).

Specific factors influencing children's early language and social outcomes

Factors influencing the development of individual differences have been suggested to also account for SES-related differences in child development. In particular, FIMs and FSMs conceptualize the relation between family background variables and proximal factors influencing child development.

Relations between SES and child development as suggested by family investment and family stress models

According to FIMs, resources (e.g., money, time) which are at parental disposal, and their use (e.g., joint picture book reading) are considered investments that have the potential to enhance a range of children's skills. In line with FIMs, a stimulating HLE was found to be associated with both children's language as well as their social skills (e.g., Attig & Weinert, 2020; Rose et al., 2018). According to FSMs, low SES predicts less-than-optimal parenting behaviour through family stress. In line with this model, previous studies documented that especially maternal mental health problems (e.g., depressive feelings during the first years of a child's life) show the largest contribution in explaining effects of SES inequalities on children's socio-emotional skills (e.g., de Laat et al., 2018).

Taking both models simultaneously into account, it is assumed that parents with high SES can buy or provide higher quality resources (e.g., high quality childcare, stimulating learning materials and activities), which may promote their children's development. At the same time, it is likely that high-SES parents are less prone to negative stress and financial strains than low SES-parents, with lower levels of stress and financial strains making it easier to practice parenting behaviour that is conducive to child development (e.g., Khanam & Nghiem, 2016; Yeung et al., 2002).

Thereby, FIMs and FSMs suggest partly overlapping and partly distinct factors that might contribute to SES-related gaps in children's early language and socio-emotional development. Overall, they point to the following groups of SES-related variables that are particularly important for child development and may explain SES-related gaps in early childhood: (a) proximal factors such as parenting behaviour and various process characteristics in the family, which may be influenced by (b) more distal (structural) variables such as family income, maternal age at childbirth, family structure, and migration background, which could affect family investment and/or stress as well as by (c) health-related variables such as maternal mental health; (d) in addition, SES-related differences in child development might be influenced by SES-related maternal health behaviours during pregnancy (e.g., smoking) as well as by SES-related child health endowments such as preterm birth.

To briefly summarize some important results: as mentioned before, various indicators of parenting behaviour and the HLE have been shown to be related to both parental education and child development. With respect to structural factors, especially family income is significantly related to children's language skills and problem behaviour (e.g., Baydar & Akcinar, 2015; McNally et al., 2019). Furthermore, low maternal age at childbirth is associated with children's low language and socio-emotional skills (e.g., Duncan et al., 2018), while older maternal age at childbirth is often related to higher language and better socio-emotional skills compared to children born to mothers who were 20 years old or in their twenties (e.g., Goisis et al., 2017; Tearne, 2015). With regard to family structure, children residing with both parents tend to have advanced language and better

socio-emotional skills compared to children living with a single parent (e.g., Downey et al., 2015). Furthermore, previous research has documented significant positive relations between having siblings and the ability to form better relationships with peers and learning to solve conflicts (e.g., Downey et al., 2015). However, children with no or only one sibling usually outperform children with two or more siblings on standardised language tests (e.g., Downey & Condron, 2004). Having foreign-born parent(s) is associated with less advanced language skills in the majority language of the society and a comparatively higher amount of problem behaviour (e.g., Washbrook et al., 2012; Weinert & Ebert, 2013). Health-related variables associated with SES as well as with a range of cognitive and socio-emotional outcomes in children include maternal and the child's initial endowment of health and health-relevant behaviour, captured by mother's drinking and smoking during pregnancy, birth weight and gestational age, as well as maternal depressive feelings during the first year of a child's life (e.g., McNally et al., 2019; Washbrook et al., 2014). Notably, till now, a systematic, comparative evaluation of contribution of aforementioned factors to explaining SES-related gaps in different domains of early child development is missing.

Bioecological models of human development: societal effects on child development and SES-related gaps in child development

As already mentioned, both FIMs and FSMs are usually applied in studies on children's language and socio-emotional skills within one country (e.g., Baydar & Akcinar, 2015; Khanam & Nghiem, 2016). Yet, bioecological models of human development suggest that child development is affected not only by proximal and structural factors at the level of the family, but also by more distal factors at the level of the society (Bronfenbrenner & Morris, 2006). In particular, such models emphasise that more distal factors at the community and societal levels also shape the proximal environments experienced by children, which in turn affect their development (Bronfenbrenner & Morris, 2006). For instance, the ecobehavioural model of early language development (Ford et al., 2020) proposes that caregivers' knowledge, beliefs, and behaviour, resources, and the policies of communities in which they live affect rates and quality of caregiver-child interactions and, in consequence, are related to child language skills.

Cross-country differences

Effects of national context on early child development may be driven, for example, by differences in childcare attendance or maternal employment (Bronfenbrenner & Morris, 2006). By comparing effects across countries differing in policy settings and practices, the generalizability of effects and their dependence on different settings can be tested. The countries included in this study differ in various ways that could be relevant to the effects of parental education on early child development. For instance, Germany belongs to a different category of welfare state than American and Anglo-Saxon countries. Measured by the Gini coefficient, the disposable income distribution is less unequal in Germany, belonging to the Continental welfare regime, more unequal in the UK, and most unequal in the US, classified as a liberal welfare regime (Förster & Pearson, 2002, p. 38). The US has high levels of child poverty (Förster & Pearson, 2002; OECD, (n.d.), Family data base), while, in the UK, families with children experience far greater protection from income poverty than families in the US (Bradbury et al., 2015). As to migration, Germany is characterized by the OECD as long-standing immigrant destination with many low-educated migrants, whereas the US and the UK are considered to be long-standing destinations with many recent and highly educated migrants along with low-educated migrants (OECD, 2018). Furthermore, in the UK, families with children also have access to both universal and means-tested unconditional cash benefits and to universal external childcare and education for 3- to 4-year-old children, which is not available in the US. In the UK and in Germany, more than 30% of children already attend centre-based care settings before three years of age (OECD, (n.d.), Family data base). Many studies show positive effects of the attendance at early educational institutions on children's language skills (e.g., Berger et al., 2021; van Huizen & Plantega, 2018). For instance, Luijk and colleagues (2015) found associations between centre-based childcare and language development of preschool children, with more time spent in centre-based childcare at ages 2 and 3 years being associated with more advanced language skills even when controlling for ethnicity, gender, SES, and parity. Furthermore, attendance at centre-based care seems to be especially relevant for children's social development, as child interactions with peers tend to increase in the absence of children's parents (e.g., Linberg et al., 2019a). Yet, results are controversial with respect to the effects of very early attendance at centre-based care. In particular, previous research underlines the importance of the time of entrance in centre-based care and the intensity/amount of time spent there, showing that children who start to attend centre-based care from a very early age and/or spend a large amount of hours in care from early on appear to be at an increased risk for behavioural problems (e.g., Berger et al., 2021; Bradley & Vandell, 2007). Especially in the very first years of life, attendance at centre-based care might be a risk factor as the early years represent a period in which different social skills start to develop (Howes, 1987). Larger group sizes with

less supervision by adults which is common in centre-based care settings may be stressful for young children and even promote less adequate socio-emotional behaviour (Votruba-Drzal et al., 2013). For instance, Belsky et al. (2007) found that 54-months old children who spent more hours in centre-based care had higher levels of externalising problems compared to children who spent less hours in centre-based care. In line with this finding, using data from the Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), Loeb and colleagues (2007) found negative behavioural effects to be greater the younger the age of starting attendance at centre-based care was. Also using the ECLS-K data, Ansari (2018) reported that children who attended preschool exhibited less optimal psychosocial skills from age 5 through early adolescence compared to children who did not attend centre-based care, but only informal care at age 4. In both studies (i.e., Ansari, 2018; Loeb et al., 2007), especially more hours per day at centre-based care were related to negative effects on (later) behavioural outcomes.

However, results are conflicting. For instance, Peter et al. (2016) found centre-based care entry later than at the age of 2;5 years in the UK to be associated with lower prosocial behaviour and increased peer problems at the age of 7 years. Furthermore, Linberg et al. (2019a) found more years spent in early centre-based care under the age of 3 years to be significantly related to lower rates of peer problems in Germany. In a study of Portuguese preschoolers (M_{age} = 4;5 years), Torres et al. (2015) found, amongst others, no significant associations of prosocial behaviour with the age of entry into centre-based care or the number of hours in centre-based care.

Early attendance at centre-based care is often related to SES (e.g., Felfe & Lalive, 2018; van Huizen & Plantega, 2018), with children from low-SES families being less likely than those from middle- or high-SES to receive centre-based care in toddlerhood (e.g., Borge et al., 2004). Importantly, attendance at centre-based care may differentially affect children's developmental outcomes as a function of SES. However, empirical evidence is controversial and effects on SES-related gaps in child development may vary by country-specific conditions. For instance, some evidence suggests that centre-based care attendance may have positive or even compensatory effects on language and social development in children from low-SES families (e.g., Becker, 2011; Felfe & Lalive, 2018). In fact, children from low-SES families may profit more from centre-based care because it might provide cognitive-verbal stimulation and opportunities for learning that may not be available at home (e.g., Bradley et al., 2011; Votruba-Drzal et al., 2013). Yet, based on his systematic review, Burger (2010) suggested that early childhood education and care cannot compensate completely for developmental restrictions due to unfavorable learning conditions in disadvantaged milieus. Whether this holds true for language and socio-emotional development to the same extent is not evident at all from the literature.

Also for children from high-SES families, attendance at centre-based care may be potentiating, whereby those who come from higher resource home environments reap greater benefits from experiences in (high quality) centre-based care settings (e.g., Burger, 2010). However, centre-based care attendance of children from high-SES families could also lead to no additional effects (e.g., Votruba-Drzal et al., 2013) or even represent a loss of resources otherwise available at home (e.g., Bradley et al., 2011).

A further factor associated with SES, early centre-based care attendance, and child development is maternal employment. Yet, interrelations and effects are by no means clear-cut. First, centre-based care attendance and maternal employment are only partially overlapping constructs (e.g., Côté et al., 2013). While the majority of mothers who use external childcare for their children are in the labor market, a minority is not (Côté et al., 2013). Whilst around a half of the mothers return to work within a year after a child's birth in the UK, a similar figure as in the US, return dates are usually later and at shorter hours of work in the UK in comparison to the US (Gregg et al., 2005). While maternal and paternal leaves are unpaid in the US, the length of paid maternal and paternal leave in weeks is the highest in Germany and lower in the UK (OECD, 2019). Second, effects of maternal employment on child development may differ according to SES, the type of job, reasons for returning to work and so on (e.g., Waldfogel, 2002). Thus, there is no simple association between maternal employment and child development. Overall, reported effects of maternal employment on child outcomes are often small or even negligible (e.g., Gregg et al., 2005; Waldfogel et al., 2002) and hypotheses on the effects of employment on SES-related disparities are not straightforward. For instance, the earnings from maternal employment may be particularly beneficial when income from other sources is low (e.g., Gregg et al., 2005) and the increased economic security due to maternal employment may outweigh other effects produced by it (Vandell & Ramanan, 1992). However, in low-SES families, maternal employment may represent an additional risk factor (i.e., the „dual risk hypothesis"; Côté et al., 2013). This may be due to various reasons (e.g., mothers in low-SES families, who return to work shortly after childbirth, may experience greater financial stress and hardship which might reduce childcare quality; e.g., Hill et al., 2005; Waldfogel et al., 2002). Regarding children from high-SES families, maternal full-time employment could reduce the stimulation and learning opportunities available to children (i.e., the „loss of resources hypothesis"; Côté et al., 2013).

Research questions

With our study, we extend comparative research on effects and early roots of socioeconomic inequalities by drawing on three datasets from countries with different contextual characteristics relevant to early education and development to explore how the predictor variables considered contribute to explaining parental education-related gaps in language and social skills in early childhood. In particular, in our analyses, we focus on the following research questions: (1) How large are parental education-related gaps in language and social skills in early childhood and does the observed pattern vary across the three countries under study? (2) Do the effects of explanatory factors differ according to the developmental domain under study, particularly early language skills and facets of social skills? (3) To what extent do explanatory factors considered within the frameworks of various theoretical approaches (e.g., bioecological models, FIMs, and FSMs) account for parental education-related gaps in early child outcomes across different cohort studies representative of different countries, namely the UK, the US, and Germany?

The study uses a harmonised framework, i.e., predictors and outcome variables were coded in as similar way as possible across cohorts and the very same predictors were used for explaining gaps in the different developmental domains at age 3 to 4 that lay an important ground for future development. Note that contrary to many studies, our focus is not on factors accounting for individual differences in general, but explicitly on factors accounting for parental education-related gaps in early child development.

As parental education has been suggested to be the most significant SES-indicator relevant to early child development, we focus on the mechanisms underlying the association between parental education and early child development across developmental domains and countries. In particular, we expect to find parental education-related gaps in both early language and social skills (e.g., Bradbury et al., 2015; Schoon et al., 2021). Yet, in line with previous studies, we expect to find gaps in language outcomes to be larger than those for different facets of social skills even when being tested within the same samples in a harmonised framework. Based on existing results, we expect gaps in early child language to be largest in the US.

With respect to explanatory factors for parental education-related gaps, we consider process characteristics (i.e., HLE, the language spoken at home, early attendance at centre-based care), structural characteristics of the family (i.e., family income, maternal age at childbirth, family structure, number of children in the household, history of migration); further, we include health-related variables (i.e., maternal health behaviour during pregnancy, child birth weight, and gestational length) and maternal depressive feelings. All aforementioned factors have been suggested to be related to child language and social skills by various theoretical approaches (e.g., the bioecological models of development, FIMs and FSMs) and have previously been found to be associated with SES-related gaps in child language and social skills. Yet these factors have not been evaluated simultaneously in one and the same large-scale samples using harmonised data that allows for comparing them across developmental domains and countries.

On the basis of theoretical approaches and results of previous studies, we expect factors capturing process characteristics (in particular, HLE and attendance at centre-based care) to be associated with parental education-related gaps in both language and social skills (e.g., McNally et al., 2019; Rose et al., 2018). With regard to attendance at centre-based care, we expect its positive effects for language skills to play a role in explaining gaps across countries; for social skills, positive effects are expected for the UK and Germany (e.g., Linberg et al., 2019a; Peter et al., 2016) and negative or no effects are expected for the US (e.g., Ansari, 2018; Belsky et al., 2007; Loeb et al., 2007) even when considering harmonised indicators across countries. Furthermore, we expect to find structural characteristics of the family to (statistically) explain gaps in child outcomes across countries. In particular, income and maternal age at childbirth are expected to contribute to gaps in the child outcomes under study (e.g., Duncan et al., 2018; Yeung et al., 2002). Notably, we expect that the strength of association between some variables and child outcomes will vary as a function of county context. For instance, Linberg et al. (2019b) found family income to be one of the most important factors in explaining gaps by parental education in language skills of 6-year-old children in the US, whereas aspects of migration history were most important in explaining gaps in children's language skills in Germany. As to health-related factors and maternal depressive feelings, these variables might show stronger associations particularly with parental education-related gaps in children's early social rather than their language skills (e.g., de Laat et al., 2018; Schoon et al., 2010).

In our analyses, we additionally consider maternal employment and child gender when investigating associations between parental education-related gaps and children's early language and social skills as both have been shown to be related to both outcomes (e.g., Becker, 2011; Waldfogel, 2002; Wirth et al., 2020) – yet without specific hypotheses concerning their contribution to explaining SES-related gaps.

Method

Participants

Our study draws on data from three large-scale longitudinal studies used in the project "The Development of

Inequalities in Child Educational Achievement: A Six Country Study" (DICE). The main aim of the project is to advance the understanding of disparities in child development according to SES by using rich cohort and administrative data from six countries in a harmonised framework.

The UK sample The Millennium Cohort Study (MCS) is a longitudinal, nationally representative cohort study of children living in the UK that began in 2000–2001 (Joshi & Fitzsimons, 2016). The initial sample of MCS included 18,818 children. In our analyses, we used data from 14,826 children with available scores on dependent variables (M_{age} = 37.72 months, SD = 2.54, min_{age} = 26.0, max_{age} = 55.0).

The US sample The Early Childhood Longitudinal Study-Birth Cohort (ECLS-B) is a nationally representative study following children born in 2001 from infancy through kindergarten. Approximately 14,000 children were recruited from all ethnic and socioeconomic backgrounds, and from all regions of the nation. In our analyses, we used data from 8,250 children with available scores on dependent variables (M_{age} = 52.96 months, SD = 4.20, min_{age} = 44.0, max_{age} = 65.30). In line with requirements of the National Center for Education Statistics, all sample sizes for the ECLS-B are rounded to the nearest 50.

The German sample For Germany, we used data of the Newborn Cohort Study of the German National Educational Panel Study (NEPS-SC1; Blossfeld et al., 2011). In the NEPS-SC1, a representatively drawn national sample of about 3,500 infants born from February to June 2012 is followed longitudinally from 7 months of age onwards (Weinert et al., 2016). In our analyses, we used data from 2,319 children with available scores on dependent variables (M_{age} = 38.48 months, SD = 0.88, min_{age} = 36.30, max_{age} = 41.65).

Measures

Children's social skills In both the MCS and the NEPS-SC1, at age 3, children's socio-emotional skills were measured using an age-appropriate version of the SDQ (Goodman, 1997); in the ECLS-B, the items for assessing children's social skills were taken at age 4 from the Preschool and Kindergarten Behaviour Scales-Second Edition (PKBS-2), the Social Rating Scale (SRS), and ECLS-K behavioural assessment. In our study, we used two subscales with highly similar items across countries (i.e., prosocial behaviour and peer problems; see Table S1 for items used). For the aims of our study, we reversed the items assessing peer relationship problems, renaming the subscale peer relationships. The three items per scale were answered by the parent. Items are scored on a 3-point Likert scale (1 = *not true*, 2 = *somewhat true*, 3 = *certainly true*) in the MCS and the NEPS-SC1 and on a 5-point Likert scale (1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *often*, 5 = *very often*) in the ECLS-B. For our analyses, we z-standardised items and total mean scale scores to z-scores using country-specific weights. A two-factors tau-equivalent model with the data from the MCS, ECLS-B, and NEPS-SC1 with item loadings constrained to be equal showed good fit (CFI = 0.935, RMSEA = 0.068; see Czerwiński & Atroszko, 2021, for measurement invariance testing of three-items scales).

Children's language skills In the data sets included in our study, early language skills were measured by slightly different scales with a focus on receptive or expressive vocabulary. We use the term 'language skills' in line with previous studies which have shown that different aspects of language skills typically load onto one general language factor, especially in young children (e.g., Tomblin & Zhang, 2006). In the MCS, early language skills were assessed by the subtest 'naming vocabulary' from the 'British Ability Scales' (BAS; Hansen, 2008) at age 3. This scale measures the expressive vocabulary of children who are presented with 36 colored pictures of objects and asked to name them. In the NEPS-SC1, receptive language skills were measured at age 3 using a German version of the Peabody Picture Vocabulary Test (PPVT-IV; Lenhard et al., 2015) presented by a tablet-computer. The test includes 228 items in ascending difficulty. For each item, the child is presented with four pictures and has to identify which of these matched an orally presented word. Within the ECLS-B children's language skills were assessed at age 4. The compound score provided includes 15 items on receptive vocabulary, 35 items on early literacy, such as items on phonological awareness, letter and sound knowledge, print concepts, and word reading (see Najarian et al., 2010, for an in-depth description of scale development). We age-standardised all language outcomes using country-specific weights.

Parental education Our study includes a measure of parental education based on the highest level of education attained by a parent who is co-resident with the child at the age 3/4 survey wave. The International Standard Classification on Education (ISCED) is commonly used for the purpose of harmonisation of different systems of national qualifications but in the specific case of the countries focused in the DICE project, ISCED levels tend to equate qualifications that have quite different implications for life chances and family resources in the different countries. To harmonise the coding for the countries included in the project, *high education* is defined as a first/bachelor's university degree or higher, requiring 3–4 years of full-time study at the tertiary level, in all countries. The definition of *low education* considers and accounts for differences between countries

with comprehensive systems (i.e., little or no tracking below age 16; the US and the UK) and those with early tracking and a high degree of academic/vocational specificity (i.e., Germany). For the first group, low education is defined as no qualification beyond the 'expected standard', i.e., the target of the education system for all children in compulsory education (i.e., a high school diploma in the US and attainment of at least a grade C qualification at the end of compulsory schooling in the UK). In Germany (belonging to the second group), low education is defined as no attainment beyond the lower/junior secondary track. The *medium education* group includes all those who do not fall in either the high or low category.

Home learning environment (HLE) We considered the frequency of joint book reading and teaching songs to the child at age of 3/4 years as indicators of the HLE. In the ECLS-B, parents were asked how often they or someone else in the family read books or sing songs to their child on a 4-point Likert scale ranging from *not at all* to *every day*. In the MCS, parents reported how often they or someone else at home read to the child (6-point Likert scale from *not at all* to *every day*) or tried to teach songs, poems, or nursery rhymes to the child (8-point Likert scale from *not at all* to *7 times a week/constantly*). In the NEPS-SC1, parents were asked how often they or someone else in their home jointly engage in picture book reading with the child and in teaching songs, nursery rhymes, or poems to their child (8-point-Likert scale ranging from *never* to *several times a day*). In our analyses, we used variables "reading to the child" (1 = *every day/several times a day/once a day*, 0 = *all other categories*) and "songs/poems/rhyming activities with the child" (2 = *every day/7 times a week/constantly/several times a day/once a day*, 1 = *3 to 6 times/once or twice/6 times a week/5 times a week/ 4 times a week/3 times a week/1–2 days per week/several times a week/once a week*, 0 = *all other categories*).

Language spoken at home We used a binary indicator for whether any language other than the main country language is spoken in the child's home (0 = *only the majority language is spoken at home*, 1 = *other language(s) than the majority language is spoken at home/majority and other language(s) than the majority language is/are spoken at home*).

Centre-based care We created an indicator for exposure to centre-based care (i.e., any arrangement that is not located in a private home, including daycare centres, playgroups, nurseries, and preschools) in the second year of a child's life in all three countries (0 = *no centre-based care attendance*, 1 = *centre-based care attendance between 1 and 15 hours per week*, 2 = *centre-based care attendance 16 hours per week or more*).

Income We used a continuous measure of household income post-tax and transfers. Surveys differ in the way income was collected, e.g., in bands, including or excluding certain taxes or transfers. Existing (in the MCS and NEPS-SC1) or derived (in the ECLS-B) measures of net household income were adjusted in all countries as follows: (1) converted to 2017 values using a national price index; (2) converted to US dollars using the OECD PPP index for 2017; and (3) equivalized for household size by dividing through by sqrt(number of persons in the household) × 0.5. This adjustment provides incomes calibrated to those for a family of four in 2017 US dollars. We log transformed the adjusted household income to allow for non-linear associations between income and child outcomes.

Maternal age at childbirth We categorised mothers' age at childbirth into four categories (1 = *under 25 years*; 2 = *25–29*; 3 = *30–34*; 4 = *35 or more years*).

Family structure We distinguish between children who live in a single parent or two parent household (0 = *the parent is not single*, 1 = *the parent is single*).

Number of children This variable counts the number of children aged under 18 co-resident with the cohort child (1 = *only a single child in the household* [the cohort child]; 2 = *two children*; 3 = *three children*; 4 = *four or more children*) regardless of their relationship (i.e., it includes full, half, step siblings, etc.).

History of migration To assess children's migration background, we used information provided by parents on their own country of birth to construct a dummy variable for whether any parent who co-resides with the child was born abroad (0 = *none of the parents born abroad*, 1 = *a parent was born abroad*).

Health-related variables We considered maternal smoking during pregnancy, coded as a dummy variable for whether child mother smoked during pregnancy (0 = *no*, 1 = *yes*), birth weight of the child in kilograms, and gestational length (0 = *37 weeks or more*, 1 = *less than 37 weeks*).

Maternal depressive feelings In the ECLS-B, when the child was approx. 9 months old, mothers were asked how often during the past week they felt depressed or sad (0 = *rarely or never*, 1 = *some or a little of the time*, 2 = *occasionally or a moderate amount of time*, 3 = *most or all of the time*). We combined both variables (i.e., score 0 was given in case one or both variables had the score of 0, score 1 was given in all other cases). Within the MCS, the variables "mother often feels miserable/depressed" at 9 months of child age and "mother felt low or sad for two weeks or more between birth and 9 months" were combined (0 = *neither*, 1 = *either*

or both). In the NEPS-SC1, mothers were asked about the frequency of feeling depressed or sad over the last four weeks (0 = *never*, 1 = *seldom*, 2 = *sometimes*, 3 = *often*, 4 = *always*) when children were between 6 and 8 months old. In our analyses, we used a dummy variable (0 = *never/seldom*, 1 = *sometimes/often/always*).

Maternal employment As indicator of maternal employment, we used information on whether the child's mother had worked during the second year of the child's life (in the NEPS-SC1 and ECLS-B), and at the age of 9 months in the MCS (0 = *yes*, 1 = *no*).

Child gender We used information on children's sex (0 = *boy*, 1 = *girl*).

Descriptive statistics for overall samples and high-low parental education-related gaps are shown in Table 1 (see Table S2 for descriptive statistics by parental education).

Statistical procedures

Decomposition analyses We employed a method for decomposing the unconditional education-related gaps in child outcomes into components associated with different sets of explanatory factors. The decomposition coefficients summarize whether and to what extent predictors contribute to the gaps in early child outcome measures in a way that can be easily compared across different outcomes and datasets. Specifically, the decomposition coefficients are the product of two estimates: the raw gap in the means of the explanatory variable between education-related groups; and the effect of the explanatory variable on the outcome, holding all other explanatory variables and parental education constant. Hence each decomposition coefficient summarizes the joint relation of a) the degree of education-related grading in an explanatory factor and b) the degree to which the explanatory factor predicts the outcome (Washbrook et al., 2014). Detailed description of decompositions is provided in Supplemental Material S3.

A negative decomposition coefficient means that the gap in the particular outcome variable would be larger than it is observed in reality if differences in the respective factor were non-existent. For example, a negative decomposition coefficient for the high-low gap in a particular outcome variable would mean that in the group of low educated parents the composition of this factor is relatively protective for the particular outcome, i.e., the developmental gap between social groups would rather more, rather than less, pronounced when the effect of this factor is controlled for. Where there are sub-sets of variables that jointly capture a single construct (i.e., reading to the child and singing songs to the child for HLE; maternal smoking during pregnancy, birth weight, and gestational length for health-related variables), their decomposition coefficients can be summed up so that the contribution of the set is summarized in a single number. With regard to categorical variables, the decomposition coefficients for each category are also summed up (with the reference category being omitted). The interpretation of decomposition coefficients for sets of categorical variables (i.e., which particular category contributes to the decomposition coefficient or to the differences between social groups) and by variables which jointly capture specific constructs (i.e., HLE, health-related factors) is possible by referring to the underlying regressions.

Missing data Deletion of cases due to missing data can lead to substantial bias (Hill et al., 2005). Multiple imputation replaces missing values with predictions based on all the other information included in the analyses and has an advantage over other techniques of missing data treatment as it accommodates many different patterns of missing data (Huque et al., 2018). We used multiple imputation as implemented in STATA (Raghunathan et al., 2001; 20 datasets) to account for missing information in the independent variables. We included our dependent variables in the imputation process and then deleted cases with originally missing values on the dependent variables (i.e., multiple imputation, then deletion; von Hippel, 2007) as "random variation in the imputed *Y* values adds nothing but noise to the estimates" (von Hippel, 2007, p. 85). The results of the subsequent analyses with 20 imputed datasets were automatically combined in STATA in accordance with Rubin's formulas (1987), using *mi estimate*.

Weights All surveys which we used provide longitudinal weights and survey design variables that can be used to adjust estimates for complex sampling and attrition since baseline. Estimates from the MCS and the ECLS-B apply the recommended adjustments for the age 3/4 wave throughout. Estimates from the NEPS-SC1 use weights constructed by the DICE team. These augment the official longitudinal weights provided by NEPS with calibration against characteristics of the national population derived from 2016 microcensus data (the raking procedure was used to adjust the official NEPS-SC1 weights). Weighting adjustments were made via the *svy* command in STATA in all analyses.

Results

Parental education-related gaps in language and social skills in early childhood

There were significant associations between parental education and children's early language and social outcomes at

Table 1 Descriptive statistics for explanatory variables

Variables	Millennium Cohort Study (MCS)		Early Childhood Longitudinal Study -Birth Cohort (ECLS-B)		National Educational Panel Study (NEPS-SC1)	
	Weighted %/*M*	High/ low gap	Weighted %/*M*	High/ low gap	Weighted %/*M*	High/ low gap
Parental education						
high	33.5	-	32.8	-	30.8	-
medium	28.5	-	33.4	-	49.2	-
low	37.9	-	33.6	-	19.9	-
Reading to the child						
several times a day	59.5	30.57*	38.5	37.40*	71.4	38.19*
Teaching songs to the child						
never/several times a month	8.0	−6.14*	3.9	−3.62*	26.8	−16.8
1–2 to 6 days a week	38.1	−0.14	46.4	−1.97	36.8	15.39
7 times a week/constantly	53.9	6.27*	49.7	5.59*	36.5	1.41
Language spoken at home						
only majority language	89.5	1.65	81.5	19.06*	67.5	18.98*
Centre-based care						
mode not used at all	83.3	−20.54*	82.9	−10.18*	52.0	−27.36*
used 1–15 h per week	6.5	5.42*	3.6	3.96*	7.8	1.56
used 16 h + per week	10.2	15.13*	13.5	6.22*	40.2	25.8*
Annual income	49,929	44,570*	56,028	53,539*	53,797	38,237*
Log income	10.6	1.00*	10.8	0.96*	10.8	0.76*
Family structure						
parent non-single	82.4	29.17*	78.2	31.71*	85.0	37.68*
Maternal age at childbirth						
less than 25	24.6	−33.52*	36.4	−45.57*	11.9	−31.24*
25–29 years	27.6	0.58	26.4	6.24*	25.9	−16.58*
30–34	30.6	19.55*	23.4	23.14*	35.2	29.23*
35 +	17.2	13.40*	13.9	16.19*	27.0	18.58*
Number of children						
1	24.8	−2.03*	18.5	−2.96*	54.4	−3.20*
2	46.8	14.28*	42.5	14.96*	31.4	11.16
3	18.8	−2.81*	24.5	−1.34	9.4	−4.49
4	9.6	−9.43*	14.6	−10.66*	4.9	−3.46
History of migration						
none of parents born abroad	85.8	−3.95*	80.3	14.31*	63.5	17.15
Maternal smoking during pregnancy						
no	78.2	30.25*	87.1	15.27*	87.0	39.39*
Gestational length						
less than 37 weeks	7.3	−1.59*	11.0	−3.21*	5.9	−3.32
Child birth weight	3.4	0.14*	3.3	0.14*	3.4	0.12*
Maternal depressive feelings						
no	64.6	13.38*	60.3	16.84*	69.2	15.53*
Maternal employment						
yes	47.9	32.75*	53.1	11.88*	54.3	27.1*
Child gender						
female	49.2	0.34	48.7	0.66	47.5	11.75

Note. For binary variables, only one category is presented. High-low gap is the difference in weighted %/mean between the high and low parental education groups. *$p < .05$

age 3/4 years (Fig. 1). While in all three countries parental education-related gaps were most pronounced in children's language skills, there was no overall pattern for the two facets of children's social skills (Fig. 1). In particular, gaps in the UK and in Germany are lower in prosocial behaviour compared to those in peer relationships, while the reverse is true for the US. Comparing gaps across countries, in terms of social skills, gaps are slightly but significantly smaller in the US in terms of early peer relationships compared to the UK and to Germany, while, in terms of language skills, these are significantly higher in the US than those in either the UK or Germany. It is therefore not possible to identify a pattern of gaps over the two different facets of social development included in the study; nor do we find a consistent pattern of differences across domains of development between countries.

Results of decomposition analyses

Results of the decomposition analyses are shown in Table 2. We report only the results for high-low parental education-related gaps, as they represent the sum of high-medium and medium–low gaps (Table S4; see Table S5 for the results of respective regression analyses). Note that all explanatory variables included in decomposition analyses except child gender are socially graded (Table 1). The statistical significance level was generally set at 5%, which is indicated by an asterisk in the corresponding tables.

Overall, explanatory variables accounted for a large amount of parental education-related gaps in children's early language and social skills. In four of six cases, the unexplained gaps in social skills that remained when explanatory factors were accounted for were not significantly different from zero (both facets of social skills in Germany, prosocial skills in the UK, and peer relationships in the US). Hence conditional on the included measures, no significant differences were predicted between children in high- and low-educated families on social skills. With regard to language skills, the explanatory factors in total accounted for between 48 and 64% of the overall gaps across the surveys, although here significant unexplained components remained.

Among process characteristics, the HLE accounted for significant amounts of the gaps in language and both facets of social skills under study across countries. In fact, in Germany, this was the only variable which significantly accounted for gaps in both children's language and prosocial skills. The implied reduction in the high-low gaps from the elimination of group differences in HLE measures ranged from 0.03 *SD* in the gap in peer relationships in the UK to 0.10 *SD* in the gap in peer relationships in Germany. In

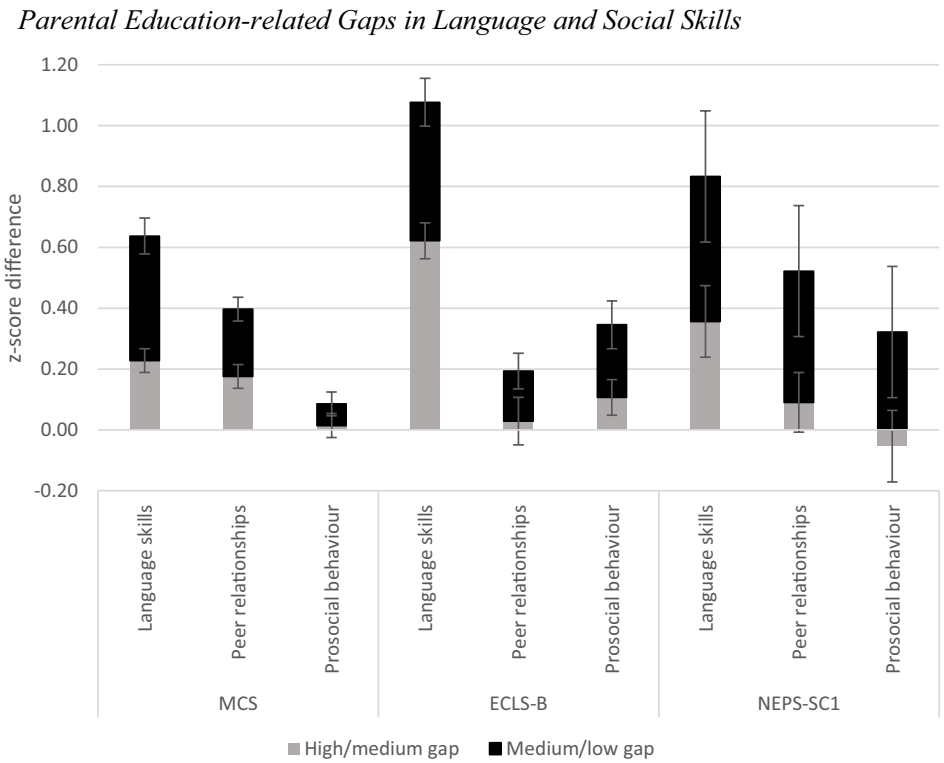

Fig. 1 Parental education-related gaps in language and social skills

Note. Error bars represent 95% confidence intervals. MCS = Millennium Cohort Study; ECLS-B = Early Childhood Longitudinal Study – Birth Cohort; NEPS-SC1 = National Education Panel Study – Starting Cohort 1.

Table 2 Results of decomposition analyses for imputed data: high-low parental education-related gap

	Millenium Cohort Study (MCS)						Early Childhood Longitudinal Study -Birth Cohort (ECLS-B)						National Educational Panel Study (NEPS-SC1)					
	Language skills		Peer relationships		Prosocial behavior		Language skills		Peer relationships		Prosocial behavior		Language skills		Peer relationships		Prosocial behavior	
	Est	%	Est	%	Est	%	Est	%	Est	%	Est	%	Est	%	Est	%	Est	%
Raw coefficient	0.64*	100	0.40*	100	0.09*	100	1.08*	100	0.19*	100	0.35*	100	0.83*	100	0.52*	100	0.27*	100
Home learning environment	0.09*	14	0.03*	8	0.04*	44	0.09*	8	0.07*	37	0.08*	23	0.08*	10	0.10*	19	0.09*	33
Language spoken at home	0.01	2	0.00	0	0.00	0	0.05*	5	0.01	5	0.02*	6	0.03	4	0.02	4	0.00	0
Centre-based care	−0.02*	−3	0.04*	10	0.03*	33	0.00	0	0.00	0	0.00	0	0.02	2	0.05*	10	0.00	0
Income	0.11*	17	0.12*	30	−0.02	−22	0.31*	29	0.13*	68	0.16*	46	0.12	14	0.00	0	−0.03	−11
Maternal age at childbirth	0.06*	9	0.06*	15	−0.01	−11	0.07*	6	−0.04*	−21	−0.02	−6	−0.02	−2	0.04	8	−0.03	−11
Family structure	0.02*	3	−0.03*	−8	0.00	0	0.01	1	−0.02	−11	−0.01	−3	−0.03	−4	0.07	13	0.02	7
Number of children	0.03*	5	0.00	0	0.00	0	0.03*	3	0.01	5	0.00	0	0.00	0	0.00	0	−0.01	−4
History of migration	−0.01*	−2	0.00	0	0.00	0	0.00	0	0.01	5	−0.01	−3	0.02	2	0.01	2	−0.02	−7
Health-related factors	0.01	2	0.04*	10	0.01	11	0.01	1	0.01	5	0.01	3	0.06	7	0.04	8	−0.03	−11
Maternal depressive feelings	0.00	0	0.02*	5	0.00	0	0.00	0	0.02*	11	0.02*	6	0.00	0	0.03	6	0.03	11
Maternal employment	0.03*	5	0.01	3	0.00	0	0.00	0	0.00	0	0.00	0	0.01	1	−0.01	−2	0.03	11
Child gender	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.01	1	0.02	4	0.03	11
Unexplained	0.32*	50	0.11*	28	0.02	22	0.52*	48	−0.02	−11	0.10*	29	0.53*	64	0.15	29	0.20	74
N	14,569		14,823		14,826		7,650		8,250		8,250		1,839		2,319		2,319	

Note. Est. = Estimate. The home learning environment is a set of indicators relating to the frequency the main carer reads to the child and the frequency someone at home helps the child learn songs/rhymes. Language spoken at home is a binary variable (only majority language/minority language(s)). Centre-based care at the age of 2 years is captured by indicators of the use of centre-based care 1–15 hours per week or 16 hours per week and more; reference: not used at all). Family structure is a binary variable (parent-single/parent non-single). Maternal age at childbirth is a categorical variable (less than 25 years, 30–34 years, 35 years or more; reference: 25–29 years). Number of children at home is coded as 2, 3, 4 (reference: 1). History of migration is a binary variable (no parent born abroad/at least one parent born abroad). Health-related factors are captured by maternal smoking during pregnancy (yes/no), gestational length (37 weeks and more/less than 37 weeks) and child birth weight in kilograms. Maternal depressive state after pregnancy is a binary variable (yes/no). Maternal work (yes/no) is measured at 9 month in the MCS and at 2 years in the ECLS-B and in the NEPS-SC1.*$p < .05$

percentage terms, HLE accounted for a minimum of 8% and a maximum of 44% across the nine gaps. Thus, less stimulating HLE accounted for deficits in language and social skills of children with low-educated parents. Differences in language spoken at home accounted for significant amounts of gaps in language skills and in prosocial behaviour in the US only. This is unsurprising in the UK as high- and low-educated families do not differ significantly on this variable (Table 1). However, language spoken at home is similarly socially graded in Germany as in the US, but it appears less consequential for children's development in the former case.

Attendance at centre-based care had differential effects on gaps in children's early language and social outcomes. Table 1 shows that children in high-educated families are more likely to access centre-based care than their counterparts in low-educated families in all three countries. Results of decomposition analyses reveal that centre-based care attendance was associated with improved peer relationships in the two European countries (and also with prosocial behaviour in the UK), with lower attendance among children of low-educated parents accounting for 10% of the overall gaps in peer relationships in both countries. However, in the UK, the gap in children's language skills would be larger than it is observed in reality (as denoted by a negative coefficient) without differences in attendance at centre-based care at 2 years, as in this country centre-based care attendance was linked with lower, rather than higher, language scores (but note that this effect is very small – equalizing centre-based care attendance is predicted to reduce the gap by just 0.02 *SD*). In particular, inspection of the underlying regression coefficients in Table S5a shows that the contribution to the gaps is primarily driven by differences in exposure to long hours of centre-based care (16 hours or more), as part-time care is both less socially graded and less strongly linked to differences in child outcomes compared to no centre-based care, meaning that differences in attendance at centre-based care for 16 hours per week or more between children from low- vs. high-educated families dampen the gap in language skills in the UK. Notably, gaps in attendance at centre-based care of 16 hours and more are larger in the UK and in Germany than in the US with children from low-educated families attending centre-based care less frequently for 16 hours per week or more compared to children from high-educated families.

With regard to structural characteristics of the family, few of them explained gaps in both children's language and social outcomes. Income explained a large proportion of the gaps in language skills and social skills in the UK and in the US (both facets of social skills in the US and peer relationships in the UK). Furthermore, composition of low-educated families in terms of maternal age at childbirth (i.e., high proportion of comparatively young mothers) was disadvantageous for language skills in the UK and in the US, as well as for peer relationships in the UK (this was primarily driven by higher rates of birth to mothers under 25 in the low-educated groups, which was strongly linked to poorer outcomes) while, for peer relationships in the US, composition of low-educated families in terms of maternal age at childbirth was rather advantageous. Thus, in the US only, the relative age profile of mothers in low-, as opposed to high-, educated families was associated with better children's peer relationships and acted to offset disadvantages in other characteristics. Associations between disparities in the number of children and gaps emerged in language skills in the UK and in the US. This was primarily driven by the disadvantages experienced by children with three or more siblings, which is much more common in low- than high-educated families. Further, maternal depressive feelings accounted for social deficits of children from low-educated families in the US and in the UK (both facets of social skills in the US and peer relationships in the UK only). In the UK only, disparities in family structure were related to language skills and peer relationships, and differences in maternal employment were associated with parental education-related gap in language skills.

Discussion

Our study addressed parental education-related gaps in early child development at the age of 3/4 years and, thus, well before school entry. These early gaps have been suggested to be the early roots of social inequality. We explicitly focused on explanatory factors for these early gaps by using three cohort studies, representative for different countries, with large sample sizes and longitudinal data. In particular, we harmonised a broad range of potentially influencing variables that have been suggested to account for SES-related differences in child development. In the following, we discuss our results following the sequence of our research questions. Thus, we first focus on the extent of parental education-related gaps in language and social skills and then discuss the effects of explanatory factors. We first review effects which showed up in both developmental domains across countries (i.e., HLE) and in at least two countries (i.e., attendance at centre-based care, family income, maternal age at childbirth), and proceed with those which were relevant for only one domain (i.e., maternal depressive feelings, number of children). Finally, we briefly discuss effects of explanatory factors which were relevant only in one country (i.e., family structure, language spoken at home, maternal employment).

In line with previous studies (e.g., Bradbury et al., 2015; Schoon et al., 2021), gaps in child language were larger than those in early social skills, with the largest gaps in early language skills being observed for the US. As language is

of special importance to other developmental domains, to knowledge acquisition and socio-cognitive as well as socio-emotional development (e.g., Weinert, 2022, for an overview), these differences may lay the foundation for early educational inequality and – in the long run – lead to the reproduction of social inequality. It is important to note that our results also show that this gap in early child language is not just due to an association between SES and children learning another language than the majority language. In particular, our results point out – in line with the assumptions of FIMs which particularly focus on the importance of parental investments for child development – the importance of HLE for gaps in both language and social skills. In fact, it proved to be the only factor accounting for gaps across the different developmental domains and countries, which aligns with the *commonality principle* (Malti & Cheah, 2021). From the HLE variables, especially the more frequent reading to the child in families with high-educated parents turned out to account for SES-related differences in children's language and social skills. Through shared picture book reading, children do not only learn words and improve their language skills; they additionally learn how characters in storybooks behave and how they solve social problems; these characters may serve as models for prosocial behaviour and patterns of interaction (e.g., Rose et al., 2018).

In addition, in line with the assumptions of bioecological models on effects of structural factors on child development, attendance at centre-based care was significantly related to the observed parental education-related gaps in social skills in the UK and Germany, suggesting that children who attend centre-based care at the age of 2 years tend to show better peer relationships, or, more precisely, that the parental education-related differences in attending early centre-based care contribute to parental education-related differences in peer relationships at age 3/4. In the UK only, centre-based care attendance of 16 hours per week or more showed a negative effect in the decomposition analyses indicating that the language gap would have been even larger without the social gradient in this explanatory factor. However, note that in the UK, centre-based care attendance of 16 hours per week or more is related to low language skills in all children. These findings on the effects of early centre-based care attendance are interesting in many ways: First, they show that centre-based care per se is not reducing the effects of social inequality on child development across countries. Second, contrary to expectations, parental education-related differences in centre-based care attendance proved to account less for the language gap and more for the gaps in social skills. Notably, many previous studies have not simultaneously considered language and social skills and rarely used harmonised explanatory factors. Third, rates of early centre-based care attendance seem to differentially affect child language and social skills. For instance, higher rates of centre-based care attendance among children from high-educated families help to account for why they have stronger peer relationships than children from low-educated families but, at least in the context of the UK, lower rates of attendance are linked to better language outcomes. Furthermore, results suggest that differences in the early centre-based care attendance are relevant to gaps particularly in the UK. This, of course, is not easily explained and deserves further investigation. Importantly, we could not include measures of centre-based care quality in our study. A recent meta-analysis of 30 quasi-experimental studies (van Huizen & Plantega, 2018) documented that centre-based care quality is a key factor related to child development. Furthermore, various previous findings support the assumption that higher quality centre-based care may have an important role in helping to reduce developmental gaps in both cognitive and socio-emotional outcomes for children from low-SES families (e.g., Dearing et al., 2009; Gialamas et al., 2015; Votruba-Drzal et al., 2004).

Importantly, in our study, we could not evaluate effects of specific intervention programmes to reduce early disadvantage. The evidence for the potential of preschool education and care comes from intervention programmes in the US, often conducted and evaluated as randomised control trials. For example, large gains in cognitive development were found by the evaluation of the Carolina Abecedarian Project (Ramey & Campbell, 1984) and the High/Scope pre-school educational intervention (Schweinhart, 2002). Another well-known intervention programme developed in the US is Head Start (HS), created as an anti-poverty programme which as such serves only children in poverty (with a few slots reserved for children with disabilities) aged 3 and 4 (with a very small Early HS programme serving children aged 0–2). A large body of research investigating effects of HS on child development documented, amongst others, significant short-term effects on vocabulary and prereading test scores for 3- and 4-year-old children and mixed results for socio-emotional skills (see a short overview in Lee et al., 2014, and in Zhang & Dobbs-Oates, 2019). Using the ECLS-B data, Lee et al. (2014) compared a range of outcomes (e.g., language, math, socio-emotional skills) of HS participants with those in other types of care arrangement (i.e., pre-K, other types of centre-based care, other nonparental care, and parental care) at prekindergarten entry and found HS children to have lower language scores than comparable children in pre-K, but similar scores in all outcomes to children who attended other centre-based care. Furthermore, Lee et al. (2014) reported that HS children of less-educated parents – compared to children in pre-K or other centre-based care – obtained at least similar gains in all outcomes from HS participation, while HS children of more-educated parents had significantly lower language scores than children who attended pre-K or other centre-based care. In our data, HS attendance is included in the definition of centre-based care

and the existence of this programme helps to explain why the gap in attendance between children of high- and low-educated parents is more muted in the US than in the other two countries (a difference of 6 percentage points compared with 15 and 26 percentage points in the UK and Germany respectively; Table 1).

In the UK, the largest initiative for disadvantaged children has been Sure Start (SS), which set up more than 500 local programmes for under four-year-olds and their families from 1999 to 2005 (Eisenstadt, 2011). In 2003, Children's Centres were launched to build on SS and another key programme for disadvantaged children at that time – the Neighbourhood Nurseries Initiative. The children from the MCS cohort were affected by these initiatives. In particular, when the children of the MCS cohort attended centre-based care at the age of 3 and 4 years, integration of early education and care was already well-advanced (Roberts et al., 2010). However, only a small minority were born early enough and in the right places to reap the full benefit of SS from birth (Roberts et al., 2010). Aiming to measure the impact of SS, in their study, Melhuish et al. (2008) compared a sample of children and their families who used SS Local Programmes (SSLP) with a group of children and their families from similarly deprived areas in England who participated in the MCS. Results of the study by Melhuish et al. (2008) showed, amongst others, better social development of three-year-old children attending SS than children from the comparison group, which appeared to be a consequence of improved parenting behaviour of parents participating in SS (Melhuish et al., 2008). Notably, although Melhuish et al. (2008) investigated if effects of SSLP varied between groups and did not find substantial variation across demographic subgroups (e.g., income deprivation, workless or working household), they did not examine two-way interaction of SLLP with parental education. Based on findings of beneficial effects of SS attendance for social development, SS attendance might reduce parental education-related gaps in social skills. In Germany, at the beginning of 2010s, no comprehensive, integrated strategy aimed to support poor families and children existed (Hanesch, 2013). However, there are various regional support programmes. Starting from 2016, the "Bremen Initiative to Foster Early Childhood Development" (BRISE) Study systematically investigates the effects of a coordinated 'chain' of early childhood interventions on different areas of child development (including cognitive and socio-emotional development; Schütte & Köller, 2022). In particular, BRISE accompanies families with children born in and after 2016 who have certain characteristics (e.g., low income, migration background; Schütte & Köller, 2022). By linking BRISE to both the NEPS-SC1 (Weinert et al., 2016) and the Socio-Economic Panel (SOEP; Goebel et al., 2019), BRISE can draw on high-quality data to evaluate intervention effects. Thus, intervention programmes were in place in all three countries and are likely to have boosted the development of children from low-educated families relative to their levels in absence of programmes. Despite this, children of low-educated parents were still less likely to experience the type of care linked to improved social outcomes in the UK and Germany than their counterparts with higher-educated parents. Systematic between-country analyses could shed light on whether those systematic programmes affect early child development in the same way independent or partially dependent on special contextual circumstances.

Concerning other important explanatory factors, our results show differences in family income to be significantly related to parental education-related gaps in all child outcomes under study in the US and in language skills as well as in children's peer relationships in the UK. In these cases, the effects were particularly high compared to other effects. These findings are in line with the assumptions of FIMs that emphasise ability of parents to invest material resources and of FSMs, which highlight the detrimental effect of income poverty on child development. The present results show that the effect of family income is not restricted to children's social development (particularly considered in FSMs) but applies to the same or even greater extent for their language development. Thus, our findings align with effects of income on child outcomes found in previous studies (e.g., Linberg et al., 2019b; Washbrook et al., 2014), and also with the fact that the US is considered to be more unequal with regard to income compared to the UK and Germany. Note that FIMs and FSMs suggest at least a partial mediation of income effects via differences in HLE which was significantly related to all parental education-related gaps in all child outcomes and all countries in the present analyses. Studies using structural equation modelling support this assumption and also document that the learning environment at home can be influenced by early support programmes. For instance, analyses by Linberg et al. (2020) using the German NEPS data suggest that attending parent–child courses enriched various (socially graded) dimensions of the HLE and in turn child development. Yet, this study only indirectly addressed the reduction of the parental education-related gap in child development. Also in line with previous empirical results, in our study, low maternal age at childbirth was associated with differences in maternal education and significantly accounted for low language and social skills in children from low-educated families (e.g., Duncan et al., 2018) in the UK and the US, even when controlling for a set of other measured proximal influences on child development. This is particularly interesting, as our results show that other factors, such as maternal depressive feelings are specifically related to gaps in children's social development only (e.g., Schoon et al., 2010). Furthermore, in line with previous studies (Downey & Condron, 2004), we found that the high number of children in low-educated

families is disadvantageous for children's language skills (in the UK and in the US) only. Thus, our findings align with the *complementarity principle* in child development, which suggests that different outcomes might simultaneously be affected by common and specific factors (Malti & Cheah, 2021). Disparities in family structure and in language spoken at home were only related to language and social skills in the UK and in the US, respectively, which might result from country-specific differences in these factors. Finally, differences in maternal employment were only associated with parental education-related gap in language skills in the UK, which might be due to our measure of maternal work in the UK (i.e., in the UK, we used information on whether the child's mother had worked at the age of 9 months, while in the US and in Germany, the measure referred to the second year of the child's life).

With regard to explanatory factors, in contrast to many previous studies (e.g., Linberg et al., 2019b; Weinert & Ebert, 2013), we did not find significant effects of typical indicators of migration background (i.e., language spoken at home, history of migration) on parental education-related gaps in Germany. This might be primarily due to the fact that we focused on factors which reduce or increase these gaps (additionally including other explanatory factors such as income, HLE, centre-based care attendance) and not on the prediction of language and social skills themselves. In fact, in case of language skills, results of linear regression analyses show significant effects of language spoken at home on child language at the 5%-level and of history of migration at 10%-level even when including all other predictor variables. This shows, amongst others, that the prediction of education-related gaps in child skills should not be equated with the prediction of children's skills.

As already mentioned, our study is not without limitations. This paper focused on parental education-related gaps in child language and social skills in three countries. As indicators of child language, measures of receptive or expressive vocabulary were available. Although these measures tend to be moderately to highly associated (e.g., Conway et al., 2017), SES-related gaps in vocabulary have been reported to be larger regarding receptive compared to productive vocabulary at age 3 (e.g., Dollaghan et al., 1999). Thus, the differences in indicators might partially explain the lowest gap in child language in the UK which we found in our study. Furthermore, the fact that the indicator in the US included receptive vocabulary as well as early literacy skills, assessed at age 4, might explain the largest gap in language skills being observed in the US. In our study, the gap observed in language skills in Germany was lower than that observed in the US and higher than that observed in the UK.

With regard to social skills, it was possible to identify a small set of items that were rather identical across cohorts. Future studies may benefit from using more items with more differentiated scales. Interestingly, the two scales on social skills which we used were not only differentiable, but also affected by different SES-related gaps and partly different explanatory factors for these gaps. This suggests that early social development is not a unitary construct (see also Rose et al., 2018) and should be studied more broadly and in-depth.

We applied decomposition analyses when studying parental education-related gaps in child language and social outcomes. This method allows to explicitly focus on factors which reduce or increase gaps in child language and social skills. All factors which we considered in the decomposition analyses were socially graded and the explanatory variables accounted for a large amount of gaps in children's early language and social skills; yet, at the same time, in case of language skills, a relatively high amount of parental-education related gaps remained unexplained. Thus, future studies might include additional explanatory factors when explaining gaps in early child development. In particular, more differentiated measures of the HLE and of the quality of centre-based care might be helpful as different facets of the learning environments have been shown to differentially impact child development (e.g., Huang et al., 2022a; Linberg et al., 2020; Seiler et al., 2022). With regard to parental education-related gaps in social skills, in our study, we could only consider a dummy variable to assess maternal depressive feelings. This variable is considered to be an important one in FSMs and is socially graded. Future studies might consider more extensive measures of maternal depressive symptoms (e.g., Rutter's Malaise Inventory [Rutter et al., 1970]) or the Kessler 6 scale [Kessler et al., 2003]) and, in addition, – acknowledging the role of fathers in child development – take into account paternal depressive feelings – which are also common in the first year of child life and socially graded (e.g., Nath et al., 2016). Furthermore, according to FSMs and FIMs, low SES is associated with less-than-optimal parenting behaviour through family stress and/or less knowledge about child development; parenting behaviours are in turn related to child development. Previous studies documented differential impacts of specific parenting behaviours (e.g., cognitive-verbally stimulating and socio-emotionally supportive parenting behaviours) on children's language and socio-emotional development (e.g., Bornstein et al., 2008; Huang et al., 2022a). In our study, specific parenting behaviours could not be considered due to data availability across all three countries. As parenting behaviours are highlighted in the FSMs and FIMs and are, in addition, socially graded (e.g., Attig & Weinert, 2020; Huang et al., 2022a; Linberg et al., 2020), consideration of various dimensions of parenting behaviour in future studies on parental education-related gaps in language and social skills is warranted. In a two-country comparison (the UK and Germany), Huang et al. (2022b) found parental education and distress to be associated with parent's sensitive

interaction behaviour as well as with their disciplinary practices with direct and indirect paths to child language and children's behavioural problems. Yet, this study addressed education-related gaps only indirectly. Finally, our study relied on samples from Western, Educated, Industrialised, Rich, and Democratic (WEIRD) countries. However, these five characteristics represent just 12% of the world's population (Henrich et al., 2010). Thus, future studies might use samples from the non-WEIRD countries to investigate the generalisability or context sensitivity of our results.

Overall, the findings show some similarities but also significant differences between the three countries. As these are not uniformly related to different facets of child development, more specific models need to be developed to account for the differences on a macro level. Furthermore, our findings on the effects of explanatory factors in reducing gaps for specific outcomes, while others were related to gaps across domains, might have implications for intervention practices. In particular, these might consider common alongside specific strategies tailored to particular factors aimed to reduce differences between children from high- vs. low-educated families.

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United Kingdom: The United Kingdom results are based on data from the Millennium Cohort Study (MCS) conducted by the Centre for Longitudinal Studies. We would like to thank the MCS families for their time and cooperation as well as the MCS team at the Institute of Education, University College London.

Germany: This paper uses data from the National Educational Panel Study (NEPS): Starting Cohort 1 – Newborns, https://doi.org/10.5157/NEPS:SC1:6.0.0. From 2008 to 2013, NEPS data were collected as part of the Framework Programme for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, the NEPS survey is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network.

Data availability The data used are available for research at the NEPS Research Data Centre in Bamberg, Germany (http://dx.doi.org/10.5157/NEPS:SC1:6.0.0), the UK Data Archive in Essex, United Kingdom (http://doi.org/10.5255/UKDA-SN-5795-5), and at the National Center for Education Statisitics in Washington, United States.

Declarations

Conflicts of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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