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Dynamics of Inequality Across the Lifecourse: structures and process

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Abstract

Social inequality is a persistent global issue which many countries, governments, and policymakers aim to address. The development of language and communication skills during the early years of a child's life are vital for school readiness, educational success, and later life outcomes. As part of a collaborative research project we sought to bring together data from cohort studies in three European countries; Germany, the Netherlands and the UK. Firstly, with the aim of applying a social classification system (CASMIN) to harmonise the measure of maternal education across the different countries, and then exploring child language skills outcomes prior to entering formal education based on maternal education. Maternal education was successfully harmonised using CASMIN, but the measures of child language within the studies were not directly comparable. Descriptive analysis of maternal education and child language skills by each country was conducted and showed a consistent significant difference between children's language skill scores based on their mother's level of education (children with the lowest scores had mothers with a low education level). These findings add to the existing body of evidence demonstrating the persistence of inequalities in early childhood and highlight the continued need for dedicated initiatives in the early years of a child's life. More broadly we successfully applied CASMIN to education data in all three cohorts demonstrating for future

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cross-cohort research the potential of CASMIN to harmonise measures of education.

Keywords: Maternal education; language skills; cohort studies; data harmonisation; early child development

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Introduction

The SEED project (Social InEquality and its Effects on child Development) is a European collaborative research project that aims to explore the mechanisms by which social inequalities affect the development of young children, in particular child language. The programme of research utilises data from large-scale cohort studies. Using such data sources brings both benefits and challenges, with one of the challenges being the identification of common measures, or the ability to harmonise data, across the datasets. Therefore, this paper sought to achieve two objectives; the first being the identification of potential social inequality and child development measures across datasets and to successfully harmonise this data, the second to make an initial exploration through analysis of the relationship between social inequality and child development. The aim was to conduct analyses within each of the studies, but through the harmonisation/comparability of data we ultimately sought to make cross-national comparisons and improve the understanding of child development and social inequalities at a multi-country and potentially European level.

Background

Child development, the attainment of cognitive and communication skills in the early years of life are vital for educational progress and later life outcomes. The link between social inequalities in the early years, intergenerational factors, and later life outcomes, of which children's development of language and communication skills is a key component, is clear and well-evidenced (Maggi et al. 2010; Mani et al. 2013; Hartshorne 2007; Schleicher 2014). For example, a social gradient has been found in oral language skills among children aged 5 years, with children from the most socially disadvantaged groups being twice as likely to experience language delays compared to their more affluent peers (Law et al. 2013). Socio-economic factors, in particular parental education and income have been the most enduring and strongest predictors for children's cognitive, social, and educational outcomes (Hartas 2012; De Coulon, Meschi, and Vignoles 2008; Reilly et al. 2010; Blanden and Machin 2010; Erola, Jalonen, and Lehti 2016).

Studies and interventions have shown how improvements to family, economic, and school circumstances can have a positive impact and contribute to narrowing the variation between children of different socio-economic groups (Macbeath, Bangs, and Galton 2010; King et al. 2017; Education Endowment Foundation 2018; Mowat 2018). However, this variation has not been eliminated and we continue to see that once children fall behind their peers they rarely make this difference up (Hutchinson et al. 2019; Feinstein 2003), suggesting that further investigation on the early years of a child's life, their development, and the socio-economic circumstance they are born into is needed.

All previous studies have needed to identify measures of social status, class, and background as these are vital to establish and understand socio-economic differences and inequalities. These measures can be multi-faceted and complex, with measures often interacting and/or overlapping, but also variations in the definitions and methods applied, and differences in how measures have evolved overtime and adapted (or not) to changing social contexts. As such there are numerous classification systems and methods for social researchers to choose from when looking to measure social inequality, which can make the comparison of studies both nationally and internationally difficult (Gayle, Connelly, and Lambert 2015; Rose and Pevalin 2001; Bukodi and Goldthorpe 2016; Pearlman 2019).

The value of cross-national comparisons

While reflecting on the national picture of individual countries is important and necessary to understand national changes and progress, or lack thereof, it is by putting these reflections into a wider context that we can gain added perspective. Through comparisons with other countries we can also gain understanding and knowledge about areas of effectiveness and what areas require change. International comparisons by a range of factors such as education, social and economic outcomes are well-established, for example the TIMSS and PIRLS assessments (Boston College; IEA and Boston College; Lenkeit et al. 2015) and the Organisation for Economic Co-operation and Development (OECD).

One approach to cross-national comparisons is to look at similar countries where comparability, such as the existence of comparable cohort datasets, can be hypothesised and the potential existence of common trends or potential differences can be explored. In order to do this, the case has also to be made for the comparability of the measures used in addressing the question of interest.

The current study looks at Germany, the Netherlands and the United Kingdom, three countries that are part of Europe and the western world and as such share many similarities. All three countries are part of the OECD which for over 50 years has drawn together data and examined socio-economic development across the countries in the OECD. The OECD and similar organisations, like the European Commission, highlight and benchmark the performance of countries and are influential in shaping government decision and policy. Germany, the Netherlands, and the UK, historically and presently, have varying outcomes on different aspects of social equality, the governments of each country have made policy changes to address issues of inequality to varying degrees of success, but all have experienced a widening in social inequality in recent years (Schlicht, Stadelmann-Steffen, and Freitag 2010; Parker et al. 2018; OECD 2018a). It is through these comparisons, such as the OECD and PIRLS, that we see some countries are more successful than others in making progress towards shared goals such as reducing inequality, and therefore bringing these data and the findings together is important to provide insight into potential directions and changes for policy and practice (Schleicher 2014; Parker et al. 2018).

Education inequality and policy in Germany, the Netherlands, and the UK

The countries for this study have many similarities, all are considered part of Western Europe, founding or early members of the European Union (EU), and affluent “first world” nations.

However, there is variation in the ways each country has sought to tackle issues of educational and socio-economic issues and responded to wider European and International guidance.

Germany

The results of the 2000 PISA study showed that the performance of German students in reading, science and mathematics were below the OECD average (Baumert, Stanat, and Demmrich 2001). Further results documented that the attainment of German students differed substantially according to their family background. In 2003, the second round of PISA demonstrated that students' socio-economic background explained around 23% of the variance of students' mathematical achievement (PISA-Konsortium Deutschland 2004). After this so-called 'PISA shock', measures to improve the German education system were introduced.

Prior to PISA 2000 there had already been reforms in early education, since 1993 children from age 3 years onward have had a legal right to institutional childcare in Germany. In 2013, this right was expanded to 1 year old children highlighting the importance ascribed to early education and institutional child care.

However, nearly 20 years after the first PISA study and many reforms, the OECD report (2018) clearly demonstrates that, across all OECD countries, students with low-educated parents are doing worse compared to students from higher-educated families, e.g. in participation in early childhood education as well as in completing upper secondary school. With regard to Germany, the OECD report (2018) documented an increase of the percentage of children enrolled in Early Childhood Education and Care (ECEC) from 2005 to 2016 of around 20% percent. In 2016, 37% of children under the age of 3 years were in ECEC. Yet the report also showed that 49% of children with tertiary-educated mothers participate in ECEC below the age of 3 years compared to only 37% of children whose mothers have not attained tertiary education (OECD 2018a); from 3 years onward most of the kids attend ECEC in Germany.

Netherlands

The Netherlands has historically been a top performing country in the OECD and PISA outcomes. Annual snapshots and PISA scores consistently show better than average outcome on most measures, however many of these have been declining gradually over time, such as reading at primary school level, or performance has remained stable while other countries have seen increases (Inspectorate of Education 2018; PISA 2015). Education outcomes by social background are around the OECD average, but on a national level several organizations have expressed concerns that the gap in educational opportunities for students from parents with low and high education backgrounds is widening despite equal cognitive capacities (Inspectorate of Education 2018, OESO 2016). The National Institute for Social Research (SCP) has warned that social inequality and polarisation are increasing over the recent years due to segregation of different educational groups (SCP 2014).

There have been several policy initiatives and interventions to support students and schools which are low performing and/or disadvantaged (Rijksoverheid, n.d.; SLO: National institute for curriculum development 2015). To tackle serious delays, especially in language development, investments in preschool, stricter educational requirements of staff and

interventions that stimulate reading practices of parents with lower language skills have been implemented (CPB, 2016).

Similar to the UK and Germany recent reports have highlighted geographic variation in education outcomes in the Netherlands, this variation has been linked to socio-economic factors (Inspectorate of Education 2018; Dutch News 2018).

UK

In the UK social inequality and social mobility have been at the centre of government public policy for over 20 years. Reviews of social mobility in the UK have found that progress was made to reduce the attainment gap and representation of low socio-economic groups in the late 1990s and early 2000s. However, following the recession which began in 2008 there has been an increasing social divide and inequality within the UK (Social Mobility Commission 2017; Sutton Trust 2017).

Since the recession the UK has had a mixed standing in OECD measures, performing badly compared to similar countries in overall aspects of inequality and in specific areas such as low income mobility, but in areas such as educational mobility the UK performs better than expected (OECD 2015; Causa and Johansson 2011). It should be noted that, while the UKs performance in certain measures may be good, that the overall trends for countries in the OECD have fallen overtime, i.e. an average score on an OECD measure now is lower than the average score 5+ years ago. Within the UK, while there have been improvements overall in certain education areas these are not equally distributed across the UK. For example, there has been dramatic improvements in educational outcomes and attainment for pupils in London for disadvantaged (low socio-economic groups) however this is not reflected across the rest of the country, in Wales education attainment continues to be lower on average compared to England and in areas of England such as the North East there is an increasing difference in educational attainment compared to areas such as London (Children's Commissioner 2018; Hutchinson et al. 2019).

Research aims and question(s)

This study aims to achieve a level of data harmonisation between three child cohort studies in different European countries and to explore the language skills of children based on their mother's level of education.

The research questions are therefore:

- Can a unifying measure of education (CASMIN) be applied to different, recent, large-scale cohorts?

- Does the pattern of children's language skills at age 5 years differ based on the education level of mothers, and is that pattern similar across the three countries?

Methods

Outline of the cohorts

The data for this study comes from cohort studies in three European countries. All three studies collect detailed social data, such as family employment, income and education, through regular interviews with the parent(s) of children in the cohort. Children also complete a range of assessments, such as behaviour and cognition.

In Germany the National Educational Panel Study (NEPS) is a study carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg and uses a multi-cohort sequence design. Starting in 2009 data collection began for different educational and life phase groups, ranging from new-borns, to children in Kindergarten, students starting Higher Education, and adults respectively (Blossfeld, von Maurice, and Schneider 2011). In the present paper, for Germany the Kindergarten cohort (NEPS-Starting Cohort 2, SC2), which started when children were around 5 years old, is used. In the Kindergarten cohort, parent interviews, (paper-pencil-) interviews with educators and head of Kindergarten facilities as well as competence tests with the children were applied (Berendes et al. 2019). The survey is conducted with a representative sample of about 3.000 children from day-care facilities in Germany who were supposed to start formal schooling in school year 2012/2013 (for more information on the sampling strategy see (Aßmann et al. 2011). Data are taken from the first assessment wave in spring 2011.

In the Netherlands Generation R is a large scale population-based cohort study investigating the growth, development and health of nearly 10,000 children born in Rotterdam, Netherlands. Starting in 2002 Generation R collects a range of social, behavioural, and health data from parents and children at different time points (Jaddoe et al. 2007; Kooijman et al. 2016).

In the UK, the Millennium Cohort Study (MCS) is a multi-disciplinary research project following the lives of around 19,000 children born in 2000-01. The MCS collects a diverse range of data from children, their siblings, and parents (Hansen, Joshi, and Dex 2010). Data sweeps are held every couple of years, a more detailed outline can be found at: https://cls.ucl.ac.uk/cls-studies/millennium-cohort-study/. The MCS sample design aimed to provide a proper representation of the total population, and a sample boost in the second sweep (2003-4) intentionally over-sampled those in lower socio-economic circumstances and ethnic minority backgrounds (Plewis 2007). There are a small sub-group of twins and triplets within the MCS and these were excluded from the present analysis because of their known anomalous language outcomes (McMahon, Stassi, and Dodd 1998).

Measuring inequality - Maternal education and CASMIN

In reviewing available and commonly used variables to measure socio-economic status and inequality we found few that were eligible across the cohorts. While data for measures such as occupation and household income were collected across all cohorts it was not consistent, for example, measures of income were banded at a household level, were estimations of income etc. which made harmonisation difficult. Measures such as occupation bring added complexity when considering the large differences in policies around parental leave, again making

harmonisation difficult especially as family and household structures varied between the cohorts.

The highest education level in a household is a commonly used measure of socio-economic status and details of parental educational qualifications were available in all three studies. However, looking at a measure such as education level, for the cohorts this is most frequently reported by the mother and they provide responses for both them and their partner which could introduce inaccurate or biased data. Previous research has also highlighted that it is the mother's education level (maternal education) that is the strongest measure for predicting child development and later outcomes therefore we focused on mother's education (Erola, Jalonen, and Lehti 2016; Chevalier et al. 2013).

Given the variation between education systems and qualifications for each of the countries, we then looked for a way of classifying different levels of education so that cross-cohort comparisons could be made. Year in education is a commonplace method but this information was not available in all of the cohorts, equally a binary measure of whether a parent has a university/degree level education is frequently used. However, we wanted to classify mother's education into a more detailed variable.

Comparative Analysis of Social Mobility in Industrial Nations (CASMIN) is a classification system of education which enables cross-country comparisons of education levels and social class (Brauns, Scherer, and Steinmann 2003). While originally developed during the 1970s, there have been a number of revisions and updates to the system which is beneficial as it means educational reforms within countries and global changes are reflected in the current categories and hierarchy (Forster & Bol, 2018).

Currently, CASMIN contains nine categorical levels, differentiating between different levels of qualifications in terms of academic and vocational qualifications. It has previously been applied to the data within NEPS and other cross-country surveys such as the International Adult Literacy Survey and European Social Survey, which include the UK and Netherlands (Kerckhoff, Ezell, and Brown 2002; Schneider 2010). While national based frameworks have been applied to data, we are not aware of any studies to date where cross-national frameworks such as CASMIN have been applied to parental education data within Generation R and the MCS. In order to apply CASMIN to these data, we used the qualification frameworks from previous research, primarily Kerckhoff, Ezell, and Brown (2002), for coding the data within Generation R and the MCS updating where appropriate as some qualifications had been renamed. As data was coded, we found that there were low numbers within certain education level groups. This is not surprising and is reflective of wider educational and qualification trends but creates issues for analysis and so we sought possible solutions to groups with small sample sizes. We found recent research (Linberg et al. 2019, Baier, 2019) where CASMIN categories had been successfully condensed into three categories; high education level (qualifications of university degree or higher, and equivalent professional qualifications), middle education (this was usually an average or national standard education), and low education level (no qualifications or below average qualifications). This resolved the issue to low numbers within certain groups, while retaining comparability, and also providing distinction between different education levels below university/degree level.

Below each of the three countries education systems and resulting qualifications are outlined along with where they fit within both the full and condensed CASMIN categories.

Maternal education and CASMIN in NEPS

The education system in Germany is complex and varied. It has been subject to various reforms over the last 30 years. Although each federal state (Länder) can regulate their schooling, vocational trainings and higher education to some degree autonomously (resulting in different types of schools and different minimal requirements to enter the higher level (tertiary) qualification system), the basic structure of vocational or academic paths are almost same. As recommended by the EU, the German Qualification Framework (GQF) has been developed (https://www.dqr.de/index.php). Through the comparison tool of the European Commission for national qualification framework further information on the GQF in English (https://ec.europa.eu/ploteus/en/compare).

Unlike the UK-NVQ, the GQF serves only as a transparency and orientation tool, it doesn't have any legal effect. Most of the qualifications in Germany (but not all) have been already matched to GQF. However, to our knowledge, there have not been any previous attempts to match GQF with the CASMIN categorisation.

Table 1. German qualifications and CASMIN categories.

Reduced categories	**CASMIN full code and description**	**German qualifications**
Low	1a Inadequately completed general elementary education	no qualification
	1b Inadequately completed general elementary education	secondary general school certificate without vocational training (*Hauptschulabschluss*): 9 years of general education, GQF Level 2
	1c Basic vocational qualification or general elementary education and basic vocational qualification	secondary general school certificate and vocational training: 9 years of general education + 2 years of vocational training in the dual education system, GQF Level 3
	2b Intermediate general qualification	intermediate general qualification (*Mittlerer Schulabschluss*): 10 years of general education, GQF Level 3
Middle	2a Intermediate vocational qualification or intermediate general education plus basic vocational qualification	Intermediate general qualification and vocational qualification (*Mittlere Reife und berufliche Ausbildung*): 10 years of general education + 3 or 3,5 years of vocational high school, GQF Level 4

	2c (Vocational) Full general maturity certificate (vocational)	Full maturity for universities of applied sciences / full general maturity and vocational qualification: (*Fachhochschulreife/Abitur und berufliche Ausbildung*) 12/13 years of education, the last years after the 10th being in different kinds of vocational high schools and/or via second-chance education/evening schools GQF Level 4+5
	2c (General) Full general maturity certificate (academic)	Full maturity for universities (without vocational qualification) (*Fachhochschulreife/Abitur ohne berufliche Ausbildung*) 12/13 years of education (most likely) in a *Gymnasium,* GQF Level 4
High	3a Lower tertiary certificate	Degree from a University of applied sciences with vocational emphasis, GQF Level 6, 7, 8
	3b Higher tertiary certificate	Degree from a university, GQF Level 6, 7, 8

Maternal education and CASMIN in Generation R

In the Generation R Study mothers were asked to indicate their highest completed educational level (vocational or academic). The categories are based on the Standard Education Classification (SOI, 2003) which classifies all educational tracks based on educational level and area of education. The SOI was developed to aid in the coding and classification of educational tracks for research and administration purposes and is also used by the Central Bureau of Statistics to process educational information. It is updated regularly as educational tracks change yearly. It should be noted that this classification is not purely categorized by education level but represents more a classification of educational tracks in a specific order that can sometimes overlap. In the Netherlands the educational system is arranged in such a way that it is relatively easy to continue their educational track at a higher level after finishing a lower level, which is reflected in the categorization of the SOI.

The SOI has never been linked to the CASMIN, but it is developed to be aligned with the International Standard Classification of Education (ISCED, 1997) categories of UNESCO. Extensive information about the interpretation of the classification system for the purpose of international comparability is given in a manual that was provided by the OECD (OECD, 1999).

Table 2. Dutch qualifications and CASMIN categories.

Reduced categories	CASMIN full code and description	Dutch qualifications
Low	1a Inadequately completed general elementary education	no qualification
	1b Inadequately completed general elementary education	primary education completed and primary education for children with special needs (ZMOK, MLK, ZMLK, BLO, LOM), SOI Level 2
	1c Basic vocational qualification or general elementary education and basic vocational qualification	
	2b Intermediate general qualification	secondary education for children with special needs (VSO-LOM, VSO-MLK), SOI Level 2
Middle	2a Intermediate vocational qualification or intermediate general education plus basic vocational qualification	pre-vocational education (VBO) junior secondary vocational education (VMBO Pre-Vocational Secondary Education) / Junior general secondary education (MULO Advanced Elementary Education, MAVO Lower General Secondary Education), SOI Level 3
	2c (Vocational) Full general maturity certificate (vocational)	General secondary education (HAVO Higher General Secondary Education, HBS Modern Grammar School, MMS Secondary School for Girls) Senior vocational education (MBO, day release training), SOI Level 3,4
	2c (General) Full general maturity certificate (academic)	General Secondary Education (VWO, Pre-University Education, lyceum, Grammar School, Pre-University School), SOI Level 4
High	3a Lower tertiary certificate	Higher professional education (HBO), SOI Level 5
	3b Higher tertiary certificate	University Education and Post-Higher Professional Education(WO), SOI Level 5, 6, 7

Maternal education and CASMIN in the MCS

The education system in the UK is complex and varied, with each country within the UK operating and governing its own education system, for example, the qualifications and curriculum that are delivered in Scottish schools differ from that of England, Wales and Northern Ireland. Further details of each education system can be found through the relevant department for education but all qualifications in the UK fit under the National Vocational Qualification (NVQ) framework, which groups together equivalent qualifications into a tiered framework (https://www.gov.uk/what-different-qualification-levels-mean/list-of-qualification-levels). In the MCS parents are asked about their highest vocational and academic qualifications. These are stored as separate variables, the highest of which is then converted within the MCS into the equivalent NVQ level (further details about the MCS and NVQ grouping can be found in the technical derived variables documents on the CLS website).

NVQ levels, and UK qualifications, have previously been matched to the different CASMIN categories (Schneider, 2010). CASMIN categories are then further condensed into low/middle/high education levels as outlined in the below table.

It should be noted that where mothers held an overseas qualification that did not have an equivalent NVQ level then these were excluded from analysis (n = 555).

Table 3. UK qualifications and CASMIN categories.

Reduced categories	CASMIN full code and description	UK qualifications
Low	1a Inadequately completed general elementary education	None of these qualifications (this excludes any overseas qualifications) No qualifications
	1b Inadequately completed general elementary education	GCSE grades D–G (academic)
	1c Basic vocational qualification or general elementary education and basic vocational qualification	NVQ SVQ GSVQ level 1 (vocational)
	2a Intermediate vocational qualification or intermediate general education plus basic vocational qualification	NVQ SVQ GSVQ level 2 (vocational)
Middle	2b Intermediate general qualification	O level GCSE grade A-C (academic)
	2c (Vocational) Full general maturity certificate (vocational)	NVQ SVQ GSVQ level 3 (vocational)

	2c (General) Full general maturity certificate (academic)	A AS S Levels (academic)
High	3a Lower tertiary certificate	Diplomas in higher education, nursing or other medical qualifications, NVQ level 4
	3b Higher tertiary certificate	First degree, Higher degree, professional qualifications at degree level, NVQ level 5

Missing data

NEPS – The Kindergarten Cohort (SC2) recruited the participating children at preschool level. In other words, 4 to 5 year old children who visited a target kindergarten (see Steinhauer et al., 2016 for details on the sampling strategy) were firstly enrolled in the study. In wave 1, 2340 family interviews were conducted and 2317 mothers (99%) provided their education level (missingness level of original sample: 1%). Of these 2317 cases, 96.9% (N = 2245) children completed the vocabulary test at age 5 years (missingness level of original sample: 4.1%).

Of the 9778 pregnant mothers who were enrolled in the Generation R Study, 8305 participated when their child was 6 years old. However, participation could include either questionnaires and/or a visit to the research centre. Only 6690 children came to the research centre and were thus able to be tested for their language comprehension. In total, 5684 of their children had data available at age 6. Since there are multiple children who participated, siblings were randomly removed from the same family which left 4748 children available for analysis. Overall, not many mothers were classified as having a low education level at the start of the study (n=995), and of these mothers, 52.6% (n=523) were not present at the later data collection. Lost to follow up rates were slightly lower for mothers with a middle education level, 45.1% (n=1689) and for mothers who had a high education level, 40.7% (n=1524).

The Millennium Cohort Study over sampled particular groups, pre-empting the loss of families from the study and the likelihood that these would more likely be from lower socio-economic groups. Of the mothers at the start of the study who are classified as having a low education level, n=4520, 30% (n=1354) of these were not present at wave 3 of data collection (when the child was age 5). For mothers who had middle and high education levels at the start of the study there were a number of families who left the study but in lower proportions. For the middle education group 21.7% (n=1701 missing) of mothers are not present, and for high education group 15.5% (n=819 missing).

Language skill tests

NEPS-SC2 – A vocabulary test analogous to the PPVT (Dunn and Dunn 1981) was conducted to measure 5-year-old children's receptive vocabulary in the NEPS-Kindergarten Cohort. The test included 77 items selected via IRT analyses and arranged by increasing difficulty (item selection based on a German research version of the PPVT originally used in the ECCE study (European Child Care and Education (ECCE)-Study Group, 1997) and later adapted for the BiKS study (Roßbach, Tietze, and Weinert 2005). Children are presented with a predetermined

word and a set of four pictures successively and had to select the picture that best matched the meaning of the respective word. If a child gives six consecutive wrong answers the test stops.

Generation R - At age 6 years, children's language was assessed with a comprehension test of a Dutch battery, called the Taaltest voor Kinderen (TvK). To reduce the burden on the children, 27 difficult items were selected from the full battery consisting of 40 items (Ghassabian et al. 2014). By choosing the correct alternative from two pictures that matches a given word, information about children's comprehension vocabulary skills are obtained. Outcomes of the TvK have been previously published in relation to early childhood sleep patterns and cognitive development (Kocevska et al. 2016) and non-parental childcare and language development (Luijk et al. 2015), but no studies have reported on maternal education and TvK outcomes.

MCS – Selected sub tests of the British Ability Scales (BAS) 2nd edition are delivered at different ages. At age 5 children are given the BAS naming vocabulary test (Elliott, Smith, and McCulloch 1996) to measure their expressive vocabulary. The naming vocabulary test items consist of a booklet of coloured pictures of objects which the child is shown one at a time and asked to name. Items in the booklet are ordered with increasing difficultly (easiest first) but the test is designed for children between the ages of 2:6 – 17:11, meaning that depending on the age of the child affects which item number they start at (a younger child will start at earlier items while an older child will start with items later in the booklet). Partway through the test there is another decision point that if a child finds items too easy they may skip to more difficult items and vice versa. As such children generally do not see the same items or complete the same number of items making raw score totals incomparable. The test items have been analysed using the Rasch model of item response theory to develop a conversion of the childs raw score, based on the number and difficulty of items they answered, so that scores are comparable between children.

Further rationale for not using the raw score and applying this adjustment is that there is a wide age range when the children are tested in wave 3 of the data collection (4:4 – 6:1), meaning there is greater variability on the item children started on. Further details on the test and this process can be found in Connelly 2013.

Differences in the language tests and how they were administered meant that data could not be successfully harmonised for direct comparison, in particular the adaptive natures of the TvK and the BAS naming vocabulary meant raw score and item level comparisons could not be made. For example, two children could have the same number of correct answers (raw score) but one child may have answered more difficult items. Despite these variations, the language measures all tap into the same construct.

We had also sought to utilise the longitudinal nature of the cohort datasets and include a language measure at a later time point but this was not possible. For example, in the MCS at age 11 years, children completed a verbal similarities test, but children in the NEPS-SC2 cohort have not yet reached this age, and those in Generation R while they have completed a vocabulary test at a later time point it is too different from the earlier measure.

Results

Initially, the frequency and distribution of the maternal education data was examined, with table 4 presenting the group sizes of maternal education in each of the cohorts. Within Germany and the UK, there was a similar distribution, with the majority of mothers having a middle level of education, equivalent to a national standard/compulsory level education. Around 23% had achieved a low level of education, thereby either not reaching this standard of qualification or having no qualifications. In the Generation R Study, a lower proportion (10%) had achieved a low level of education and the remaining almost evenly split between the middle and high levels of education.

Table 4. Frequency table of the maternal education group sizes in each of the cohorts.

	Germany	Netherlands	UK
Low	527	472	3166
Middle	1273	2058	6155
High	445	2218	4460
Total	2245	4748	13781

These distributions do vary from more recently reported OECD (2014) statistics on the population qualification levels of these countries. However, it should be noted that OECD figures are for all females aged 25-64 while the education level from these datasets are just for those with children. In the study sample for Germany, the proportion of mothers with a low level of education was higher than the OECD average (16% compared to 23%), and for the UK the proportion in the study sample with a high level of education was lower than the OECD average (42% compared to 32%). For the Generation R sample, the proportion of mothers with a low level of education was lower than the OECD average (10% compared to 28%).

Language

Children's language scores were then examined, grouped by maternal education, and we observed a similar pattern across all three cohorts. Children whose mothers have the lowest level of education had the lowest language scores, followed by children of mothers with middle level education, while children of mothers with the highest levels of education had the highest average language scores.

Table 5. Descriptive statistics of language skill performance (PPVT sum score) at age 5 in NEPS

Mothers education level	Count	Mean	Minimum	Maximum	Standard Deviation
Low	527	38.87	0	68	15.85
Middle	1273	50.20	0	72	11.78
High	445	54.53	0	73	10.01

Table 6. Descriptive statistics of language skill performance (TvK weighted sum score) at age 6 in Generation R

Mothers education level	Count	Mean	Minimum	Maximum	Standard Deviation
Low	472	20.38	9.75	26	3.45
Middle	2058	21.75	8	26	3.08
High	2218	22.69	7	26	2.67

Table 7. Descriptive statistics of language skill performance (BAS naming vocabulary T-scores) at age 5 in the MCS

Mothers education level	Count	Mean	Minimum	Maximum	Standard Deviation
Low	3166	48.2	20	80	11.38
Middle	6155	54.09	20	80	10.28
High	4460	58.39	20	80	10.14

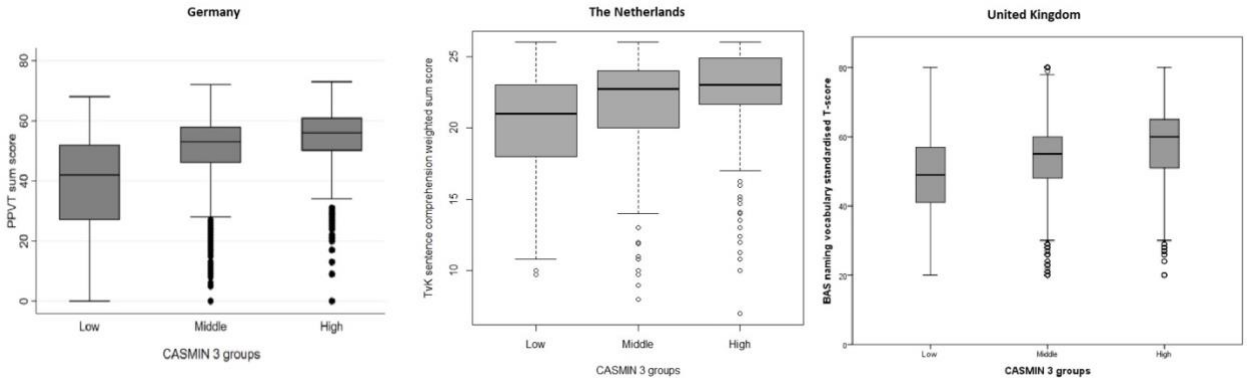

Figure 1. Language skills at age 5-6 across the three cohorts, by mothers educational background at first measurement point (Germany, Netherlands, and UK).

Given the distribution of the data, shown earlier in table 4, a Kruskal-Wallis test was conducted to see if the differences in children's language scores were significant across the groups. Significant differences were found within each of the countries between the different maternal education groups, confirming that children of mothers with the lowest level of education has significantly lower language scores compared to children of middle and higher level education mothers etc.

For Germany the significance across the three groups was: ($H(2) = 333.66$, $p < 0.0001$), the Netherlands: ($H(2) = 244.3$, $p < 0.0001$), and the UK; ($H(2) = 1467.7$, $p = < 0.0001$).

Discussion

Finding common variable measures and achieving a level of data harmonisation is a challenge for any social research using multiple data or cohort data sources. We sought to utilise an existing education and social classification system (i.e. CASMIN), applying it to three different European cohort studies, with the aim to make cross-national comparisons. While we were able to harmonise the data relating to parent social background (maternal education level), we were not able to harmonise data relating to child language skills. Tests of child language skills differed across the cohorts in their administration and standardisation mean scores were not directly comparable, but a descriptive comparison of analysis findings was possible. What we found were similar significant trends across all three countries: at the age children are due to start or have just started school, there are significant differences in children's language scores based on their mother's education level at the first measurement point (this was at birth in two of the cohorts and at age 5 in one of the cohorts). Specifically, those whose mothers have the lowest levels of education have lower language scores on average at ages 5-6 years old.

We anticipated such results, given the findings of previous research which have found similar variations in children's language skills by different socio-economic groups (Reilly et al. 2010; Hartas 2012; King et al. 2017; De Coulon, Meschi, and Vignoles 2008; Sullivan, Moulton, and Fitzsimons 2017). The findings of this study therefore contribute to the wider body of evidence and continue to highlight the impact of social inequality (as measured by maternal education) in the early years of a child's life. In addition, this study utilises data from three European countries, where most frequently previous research has generally focused on one data source or country, and we found the same pattern in each country.

The countries in this study have delivered a number of interventions and introduced policy changes to address social inequality in the last 20 years. This finding could suggest that as yet none of these countries have been able to achieve a level of social change that has been of benefit to early child development. However, there has been continued response across Europe to these issues, particularly in the last 3 years most countries have placed increasing importance on addressing social inequality and the early years of children's lives. For example, governments in both the UK and the Netherlands have assigned millions of pounds/euros towards programmes to address this issue and give all children the best start in life (Department for Education 2018; Rijksoverheid 2018). More broadly the European Commission in May 2018 proposed a detailed initiative focused on early childhood education and care (ECEC) (European Commission, 2018b) and in the development of the proposal stated that:

> "Investing in high quality early childhood education is a smart and efficient investment as it provides the foundation for successful lifelong learning. It is also an effective social investment addressing inequality and the challenges faced by disadvantaged children, while having positive impacts on labour market participation of parents".
> (European Commission 2018a)

Maternal education plays a pivotal role in the early years' and it is a unique element of this paper that we have harmonised maternal education across the three cohorts using CASMIN, something that has not previously been done. Many papers looking at maternal education, particularly across cohorts, have used binary measures (usually whether mothers have a university level education or not) rather than looking across the full spectrum of educational qualifications. We have taken steps towards addressing this by investigating the differences in those with a low and intermediate level education, rather than combining these together. While we found that children of the most highly educated mothers had significantly higher language scores on average, we importantly found across all three cohorts that children whose mothers had an intermediate level education had significantly higher scores than those whose mothers had the lowest levels of education. This highlights the progressive nature of the inequalities, rather than focusing on a specific point at the upper end of educational qualifications. It also raises issues of practicalities, where on a population and policy level it is not practical for everyone to attain a university level of education. However, by distinguishing between low and intermediate level education (often with intermediate level education being the national standard and target), we can see the benefit to children by ensuring mothers are able to attain an intermediate/standard level education.

Given our descriptive focus, we have not explored the underlying mechanisms in the link between maternal education and children's language skills. Previous research suggests that, during the early years when the child is most likely to spend the majority of time with their mother, their language skills will be shaped by those interactions and the language skills of the mother. There has also been evidence of strong and enduring intergenerational effects between parents and their children. Analysis of later vocabulary data from wave 6 of the MCS, when children are aged 14 years, both children and parents (primarily mothers) are given a word ability test and a significant link is found between the word ability/vocabulary range of parents and their children (Sullivan, Moulton, and Fitzsimons 2017). There is also a significant association between parents' education level and their performance in the word ability test; parents with a lower level of education scoring lower than parents with a higher level of education.

As well as the potential transfer of language there are also differences in behaviour and decision making between mothers of different educational backgrounds. In the OECD report for Germany (2018) of children under the age of 3 years who were in ECEC 49% of children with tertiary-educated mothers participated in ECEC compared to only 37% of children whose mothers with lower education levels (OECD 2018a). An early intervention programme in England was Sure Start which set out to improve ECEC but one of the issues highlighted in the evaluations was that the programme was not reaching and engaging with the most disadvantaged parents (the group most likely to have the lowest level of education) (Bate and Foster 2015). We also see an intergenerational link in behavior as well, in Germany children with low-educated parents (29% of the 25-64 year-olds) turned out to be less likely to have a tertiary degree than those with at least one tertiary-educated parent (58%) and we see this trend in both the Netherlands and UK (OECD 2018b).

The cohorts and data we have used is some of the most up-to-date cohort data available in the countries represented. While it can be argued that there is not a lot of difference in the

starting periods of these cohorts they were started at different political points and periods of change for social equality in the countries concerned. This adds interest and potential relevance to wider evidence, as while children in the MCS were initially recruited in 2000-2001 and from Generation R in 2002, a time period in which the wider trend observed was improvements in social equality. Data from NEPS-SC2 is more recent with the children in this cohort being born in 2005-2007, a time period in which wider trends observe the start of rising social inequality. Despite this variation in the timings of data collection and different social equality climates that the children were born into, there continues to be the same trends across all three countries.

Limitations

Large cohort studies can have issues with drop-out, representation etc. and these have been previously documented in other papers and summaries (Hansen, Joshi, and Dex 2010; Berendes et al. 2019; Kooijman et al. 2016). Given the size of some of the cohorts, data collection cannot happen in a short time period and therefore a wide age range can develop at these collection points. This is a particular problem for the MCS where there is an age range of approximately 18 months at each wave and the nature of the BAS naming vocabulary test means children's raw scores can vary widely. However, this is addressed by the application of conversions that standardise the scores by ability and age.

In the Kindergarten cohort of the NEPS, there is also a wide age range, participants in the Kindergarten Cohort was from 50 months to 77 months. In both the MCS and NEPS there is a small sub-sample of the children who may have started schooling and any potential positive effects of this cannot be clearly accounted for.

An initial aim of this research had been to also utilise the longitudinal aspect of the data and cohorts. While we were able to find similar language skills measures at age 5/6 we were unable to find another time or data collection points where similar measures were used. Both the MCS and Generation R had earlier language skill tests but the NEPS cohort did not as they started data collection at age 5. As the MCS and Generation R studies have been running for longer they also had later language skill measures but these were too different from the earlier measures. This was a limitation for the current research but for future research may be possible as more data is collected or by utilising other datasets.

Although, some of the datasets used in the current study are drawn as national representative samples (e.g. NEPS), our descriptive analysis based on unweighted and non-imputed sample and should be interpreted with caution.

Implications for policy

While the primary aim of this paper was methodological, the application of CASMIN across different cohorts, the findings of this study add to a wider body of evidence. Highlighting the continued existence of inequalities in young children's language skills across different European countries, with children entering school with significant differences in their language abilities. This has clear implications for policy as initiatives focused on the early years and giving children the best start in life have been a key part of global education policy.

These differences upon entering school are a looming priority and reflect the increasing concern around the school readiness of children (Hallam and Parsons 2013; Williams and

Lerner 2019; Moulton et al. 2018). The future outcomes for children who start behind their peers are not positive, and for schools facing varying level of readiness and abilities it can be a challenge. Particularly in times of austerity, for example in the UK since the referendum in 2016, there has been a lack of political focus on early years alongside heavy cuts to child and education services. When social mobility and educational equality is discussed it is generally focused on later educational stages, such as university access and graduate outcomes.

The findings of this study highlight that inequality starts early in a child's life and that maternal education level is a contributing factor to that. Furthermore this inequality may well feed into the relative lack of social mobility in the UK at least. Therefore it will not be enough to simply shift the focus and responsibility onto parents, rather resources and opportunity need to be provided. Policy needs to remain focused and invested in early years but also on those families who have low levels of education to break these intergenerational effects.

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