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Association between speech production and ECEC intensity: differences by family background

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ABSTRACT

Participation in early childhood education and care (ECEC) has been shown to improve the cognitive outcomes of children from disadvantaged backgrounds. Nevertheless, the role of ECEC intensity in shaping children's developmental outcomes remains insufficiently understood. This study examines how ECEC intensity, measured by the number of weekly hours children spend in ECEC, is associated with the speech production of 4-year-old children in the relatively high-quality ECEC context of Finland. Further, we explore whether this association is moderated by parental education. We analyze the well-being of young children and their families based on survey data collected in Finnish child health clinics in 2018 that includes responses from parents and nurses regarding 4-year-old children. Our logistic regression results show no overall differences in speech production by average weekly hours in of ECEC. However, among children of parents with lower levels of education, the likelihood of having atypical performance in speech production tests decreased as the average weekly hours in ECEC increased. In contrast, among children of parents with higher levels of education, differences in speech production performance across ECEC intensity levels were smaller.

KEYWORDS

Day care; Early childhood education and care; Family background; Intensity; Speech production

SUSTAINABLE DEVELOPMENT GOALS

SDG 4: Quality education; SDG 10: Reduced inequalities

Introduction

Participation in early childhood education and care (ECEC) is seen as a worthwhile investment in the accumulation of children's human capital; in particular, high-quality ECEC can narrow the achievement gap in the educational outcomes that exist between children from different family backgrounds in both US and European ECEC settings (Burger 2010; Dietrichson, Kristiansen, and Viinholt 2020; Melhuish et al. 2015; Van Huizen and Plantenga 2018). Further, extensive access to ECEC increases employment rates for mothers and thus promotes gender equality (Esping-Andersen 2008; Kosonen 2014). Therefore, it is little wonder that the European Commission (2013) has set a target for 90% participation in ECEC for children over the age of 3 years. In recent

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decades, ECEC has acquired an institutionalized status in the Western world and has become a topic of interest within the public and political discourse.

Children can spend long hours in non-parental care, particularly when both parents work full-time. Previous studies have found ECEC participation to be associated with externalizing behavior problems, such as aggression, defiance, and disruptive behavior toward others (Baker, Gruber, and Milligan 2008; Belsky et al. 2007; Loeb et al. 2007). Additionally, the average number of hours per week in ECEC has been found to be a significant predictor of social and behavioral adjustment (Jacob 2009). However, previous research on the association between ECEC intensity, usually measured by weekly hours in ECEC, and children's cognitive development has been limited, and the results have been partly contradictory (Melhuish et al. 2015). Some studies have found that ECEC intensity has a positive association with children's development (Loeb et al. 2007; Robin, Frede, and Barnett 2007), while others have not found differences in children's cognitive outcomes based on intensity (Howes et al. 2008; NICHD 2000). Moreover, it is poorly understood how the relationship between ECEC intensity and children's cognitive outcomes varies by family background, although there is some indication that intensity may particularly benefit disadvantaged children (Loeb et al. 2007). Comparing results across countries is challenging, as ECEC systems can differ significantly between countries (Kulic et al. 2019). In this study, we examine universal ECEC in the context of Finland and ask:

- (1) How are weekly hours in ECEC associated with the speech production of 4-year-old children?
- (2) Does the relationship between weekly hours in ECEC and children's outcomes vary according to parents' level of education?

We employ the 'Well-being of young children and their families' survey data, which was collected in Finnish child health clinics in 2018. The data consist of nurse and parent questionnaires concerning 4-year-old children and their families. We examine test results on speech production from neurological development assessments for pre-school-aged children and the association with weekly ECEC hours using logistic regression models with a rich set of covariates to account for the selection of ECEC intensity.

Childcare in Finland

The data examined in this study was collected in 2018, when the parental allowance period ended when the child was approximately 9-10 months old. Following the parental allowance period, parents have the option to take care of their children at home, or the children can participate in ECEC, which is legally defined as 'planned and goal-oriented whole of the child's education, upbringing and care, with particular emphasis on pedagogy' (Act on Early Childhood Education and Care 2018). According to the law, municipalities are required to provide ECEC for all families who need it. Public funding is the primary source of support for ECEC, and the majority of private ECEC services are purchased by municipalities. The Finnish ECEC system is considered high-quality due to its integrated governance under a single leading authority, universal entitlement to early

childhood education and care for every child, ECEC staff holding a bachelor's degree in education and working with all age groups, and the presence of consistent educational guidelines throughout the entire ECEC phase (Motiejunaite-Schulmeister et al. 2025).

Children can participate part-time or full-time in ECEC, which is primarily organized in day care centers or family day care units; some open ECEC is available for children who are registered in neither a day care center nor family day care. In 2023, among children aged 3–5 who participated in ECEC, 80% attended for more than 25 h per week (Vipunen 2025). Since 2015, the Finnish Day Care Act was replaced by the Act on Early Childhood Education and Care (ECEC), and the term 'ECEC' has gradually replaced 'day care' in official use. The forms of ECEC include: (1) center-based care provided in day care centers; (2) family day care provided in family day care homes; and (3) open early childhood education activities organized in suitable facilities (Act on Early Childhood Education and Care 2018). Throughout this article, we use the term ECEC to refer to child care provided in either day care centers or family day care environments.

The staff-to-child ratio in center-based day care is 1:4 for children under the age of 3 years and 1:7 for older children. In family day care, the staff-to-child ratio is 1:4, but there can also be one preschool-aged child per staff member. The main differences between day care centers and family day care are that, instead of attending a center, children in family day care are typically cared for in the caregiver's own home. Group sizes in family day care are smaller, and unlike some staff in center-based care, family day care providers are not required to hold a university degree. In 2018, 76% of children in ECEC in Finland attended municipal day care centers, 7% were in family day care, and the remaining 17% received either a service voucher or private care allowance, which are primarily used to cover the costs of private ECEC services (Statistics Finland 2024).

Parents can apply to the municipality for either public or private day care for their children. In the case of private day care, families can be granted a service voucher that covers most of the costs of the ECEC. In addition, it is possible to apply for a private day care allowance, which can be used to cover the costs of private ECEC. The private day care allowance does not fully cover ECEC expenses and is more commonly used in high-socioeconomic-status (SES) families (Räsänen and Österbacka 2024). Support for private care can also be requested if the children are cared for at home, for example, by a nanny. In 2023, a family's ECEC costs would not exceed 295€ per month per child, but the fees are subsidized and ECEC is free for low-income families.

In Finland, home care for young children is relatively common due to the child home care allowance, a cash benefit that is paid for the home care of children under the age of 3. In addition, families may receive a home care allowance for the care of older siblings if the family has a child under 3 years of age who receives a home care allowance. Some municipalities also pay an additional municipality supplement for the home care of children, as paying a home care allowance for families is much cheaper compared to the costs of ECEC (Haataja 2012). In 2022, 36% of children under the age of 3 were cared for using this allowance (Kela 2024).

Theoretical framework

Family background is connected to children's development and educational outcomes. Children from high-SES families perform better in school and pursue education

further than their low-SES peers (Breen and Jonsson 2005; Duncan, Magnuson, and Votruba-Drzal 2015; Sirin 2005). Early investments are crucial for children's outcomes (Heckman and Masterov 2007), and differences in children's skills based on family background are noticeable even before school age (Skopek and Passaretta 2021).

The day-to-day care of young children primarily takes place at home or in ECEC, making both the home learning environment and the learning environment in ECEC significant for children's learning and development. The quality of both environments is socially divided; according to the perspective that emphasizes family resources, high-SES families have more social, cultural, and economic resources to support children's learning (Conger and Brent Donnellan 2007). For example, high-SES families can invest more in developing the at-home learning environment, including nutrition (Kulic et al. 2019), and they generally use higher quality ECEC compared to low-SES children (Drange and Telle 2020). According to the stress theory, poor employment and financial circumstances can cause stress in families (Conger and Brent Donnellan 2007). In such cases, parents may lack the resources to focus on their children, which weakens the parent-child relationship and negatively affects children's development and learning.

High-quality ECEC creates an environment that supports learning and is positively linked to children's cognitive and socio-emotional development, thereby aiding their transition to formal schooling (Burchinal et al. 2002; Carr et al. 2019; Howes et al. 2008; Mashburn et al. 2008). ECEC quality is commonly divided into two components: structural quality, which includes features like curriculum, staff qualifications, group size, and child – staff ratios (Howes et al. 2008; Slot et al. 2018), and process quality, which refers to children's everyday experiences, such as interactions with peers and educators (Wysłowska and Slot 2020). ECEC quality in the Nordic countries has been found to be comparatively high. For example, in 2023/2024, only seven countries in Europe had fully integrated ECEC systems – defined as having integrated governance under a single authority, universal entitlement to a place from an early age, staff with bachelor's degrees in education working with all child groups, and consistent educational guidelines throughout the ECEC phase. Four of these countries were Nordic: Denmark, Finland, Norway, and Sweden. (Motiejunaite-Schulmeister et al. 2025)

Children in ECEC engage in play that supports their social skills and learning, and ECEC particularly supports the cognitive outcomes of low-SES children (Burger 2010; Schmutz 2023; Van Huizen and Plantenga 2018) since they gain access to an educationally supportive growth environment already experienced by their high-SES peers at home (Ghirardi et al. 2023). Therefore, ECEC can compensate for the lack of resources faced by low-SES families in children's development and learning, thus making ECEC an opportunity to tackle social inequality and a means to accumulate human capital (Heckman and Masterov 2007; Schmutz 2023).

ECEC attendance can be meaningful for children's language development as early language interventions can significantly improve children's reading comprehension in later school years (Hjetland et al. 2020). Firstly, pedagogical practices that support teacher-child interactions in ECEC play a key role in fostering children's vocabulary growth (Justice, Jiang, and Strasser 2018). Secondly, in ECEC settings, children learn from one another (Ghirardi et al. 2023), and disadvantaged children in particular can benefit from the presence of their more advantaged peers. ECEC can especially

support children's language development, as peer interactions provide valuable opportunities for language learning – particularly for children who enter ECEC with weaker language skills (Justice et al. 2011; Mashburn et al. 2009). Thirdly, ECEC staff engagement with parents, such as communication about the child and advice given to support learning at home, may improve the quality of the home learning environment, especially for low-SES families (Barnett et al. 2020). This is important because parental involvement in home learning activities plays a key role in children's cognitive development (Ansari and Gershoff 2016).

Participation in ECEC also involves social stratification. For example, in most European countries, high-SES families use ECEC more frequently than low-SES families (Pavolini and Van Lancker 2018), and this is also true for Finland (Karila, Kosonen, and Järvenkallas 2017). However, these differences are not so much due to families' attitudes towards childcare but rather structural factors related to ECEC provision (Pavolini and Van Lancker 2018). High-SES children are at a double advantage compared to their low-SES peers due to earlier participation, greater intensity, and higher-quality ECEC, in addition to experiencing a more conducive home learning environment (Ghirardi et al. 2023). Thus, participation in high-quality ECEC can compensate for the, on average, less supportive home learning environment of disadvantaged children in terms of their educational outcomes. Exposure can be viewed as having a 'dosage' effect; children attending more hours per week may experience greater benefits compared to those attending fewer hours (Loeb et al. 2007), indicating that the intensity of ECEC can have a significant impact on children's outcomes.

Previous research and research questions

In their extensive review of the relationship between universal ECEC and children's outcomes, Van Huizen and Plantenga (2018) found that full-time universal ECEC programs yield more positive results than part-time programs across various child outcomes. In contrast, in a review by Schmutz (2023), the intensity of ECEC was not linked to the outcomes of low-SES children and indicated a negative association with the outcomes of high-SES children. This was attributed to the possibility that high-SES children might experience higher-quality home environments compared to the ECEC environment. However, these review papers did not differentiate between cognitive and non-cognitive outcomes when studying ECEC intensity.

Even when focusing on cognitive outcomes, past research findings have been somewhat inconsistent. A US-based study found that average weekly hours in ECEC were not associated with cognitive or language development of children in various types of early care at the ages of 15, 24 or 36 months (NICHD 2000). Similarly, another US study reported no differences in 4-year-old children's cognitive outcomes when comparing those attending part-day versus full-day pre-kindergarten programs designed to strengthen preschoolers' academic skills and school-related behaviors before formal schooling begins (Howes et al. 2008). Alternatively, a randomized controlled trial focusing on children living in low-income urban area in the US found that 4-year-olds enrolled in full-day preschool programs performed better on vocabulary and math tests than their peers in part-day programs. The characteristics of the programs included teachers with college degrees, a low child–teacher ratio, and the programs used the same

curriculum. (Robin, Frede, and Barnett 2007.) Furthermore, it has been observed that 5-year-old children attending center-based ECEC (various types of center-based care) for 15–30 h or more than 30 h per week benefited equally in reading and math scores, as measured during preschool in the US (Loeb et al. 2007). Studies that have examined participation in kindergarten before the start of primary school in the US have consistently found that children attending full-day kindergarten perform better in literacy and math compared to their peers in half-day programs (Lee et al. 2006; Yan and Lin 2005; Zvoch, Reynolds, and Parker 2008), but these benefits have not been long-lasting (Cooper et al. 2010; Votruba-Drzal, Li-Grining, and Maldonado-Carreño 2008).

In the UK, researchers found that the intensity of group-based ECEC between the ages of 0 and 51 months was positively associated with cognitive ability scores (Barnes and Melhuish 2017). The intensity of ECEC has also been positively linked to children's cognitive and language development in several Asian countries (Rao et al. 2019). Moreover, an Australian study discovered that increased intensity of center-based early ECEC was associated with higher matrix reasoning skills – reflecting nonverbal and fluid intelligence – but not with children's academic or vocabulary skills (Coley, Lombardi, and Sims 2015).

A study conducted in Germany found that although more hours in ECEC had a negative effect on children's socio-emotional well-being, full-day ECEC had a positive impact on immigrant children's school readiness (Felfe and Zierow 2018). These differences between native and immigrant children could be linked to structural disparities in the contexts in which they live. Consequently, the observed differences may partly reflect SES disparities among children. In contrast, an Australian study found no evidence that the relationship between increased ECEC intensity and children's outcomes varied by SES (Coley, Lombardi, and Sims 2015). Research in the US found that greater ECEC intensity primarily benefited the literacy scores of children from low-income families, while children from high-income families did not gain from attending ECEC for more than 30 h per week (Loeb et al. 2007).

ECEC systems vary greatly across countries, making it difficult to compare outcomes (Kulic et al. 2019). For example, the type of ECEC and the curricula used can differ significantly. This study focuses on examining a universal ECEC country, where the organization of ECEC is largely standardized.

This study addresses the following research questions:

- (1) How are weekly hours in ECEC associated with the speech production of 4-year-old children?
- (2) Does the relationship between weekly hours in ECEC and children's outcomes vary according to parents' level of education?

Data and methods

We employ data from the 'Well-being of young children and their families' survey data collected by the Finnish Institute for Health and Welfare in 2018 (Finnish Institute for Health and Welfare 2018). Data was accessed thru Kapseli remote system which is a secure processing environment of data on individuals. Kapseli is provided by Findata which is the Finnish social and health data permit authority. Following the ethical code of the *European Early Childhood Education Research Journal* (Bertram et al.

2025), participation in the survey was voluntary and the analyses within the study were performed in such a way that individual respondents could not be identified from the results.

The survey focused on the well-being of 4-year-old children and their families. The data were collected in 290 municipalities (98%) of mainland Finland between February 1 and October 31, 2018. Nurses in child health clinics recruited families to participate in the study when children presented for their comprehensive health check at the age of 4. The families that participated in the study were slightly more highly educated than the average Finnish family. In addition, families with an immigrant background were underrepresented, and the nurses stated that they did not recruit families for the study whom they believed lacked the resources to answer the survey. Therefore, the survey did not successfully reach the most disadvantaged families, which is typical of survey studies.

The survey respondents were parents of 4-year-old children and nurses in child health clinics. The study included a total of 17,009 children; parents' answers are available for 8,720 children. The sample for this study comprised those children who were in ECEC and for whom at least one parent had completed the parental questionnaire. After accounting for missing answers and excluding children without parental answers, the final analytical sample size was 6,218 children, which represents 37% of the total sample and approximately 17% of all children who participated in the comprehensive health check for 4-year-olds during the time frame of the data collection (Finnish Institute of Health and Welfare 2023). The data indicate little difference in the prevalence of atypical performance in speech production tests between children who were included in the sample (12%) and those who were excluded (14%).

The study variables are presented in Table 1. The explanatory variable is speech production, based on nurses' assessments conducted at child health clinics that evaluated the child's performance in a speech production test as a part of the LENE (Neurological Development of Preschool-Aged Children) test battery. In some cases, the test may also be conducted by a doctor, depending on local arrangements. In Finland, public health nurses hold a four-year bachelor's degree from a university of applied sciences, and child health clinic nurses receive specific training for working with children. The full LENE assessment for 4-year-olds takes approximately 30 min and evaluates not only speech production but also vision, hearing, gross motor skills, abnormal movements, turn-taking skills, attention and motivation, speech comprehension and concepts, auditory perception, eye-hand coordination, play, and independence (Valtonen, Mustonen, and Ahonen 2000). In this study, the focus is on speech production, as it most closely aligns with the language development measures used in previous research. Additionally, findings from the speech production section of the LENE test have shown that clear difficulties in speech production at age four are a 100% predictor of significant language development challenges in language development assessments at age five (Valtonen, Ahonen, and Lyytinen 2004). Moreover, differences in cognitive skills resulting from family background are mainly visible in the language domain (Schmutz 2023). Performance on individual tasks in the LENE assessment is rated using the following criteria: 0 (normal performance), 1 (slightly atypical or uncertain), 2 (clearly atypical), and K (refusal to participate). We categorized the responses using a binary variable (0 = not at all, 1 = a little or a lot); thus, any indication of concern by the

Table 1. Descriptive statistics.

	Atypical performance in speech production tests					
	No		Yes		Total	
	N	%	N	%	N	%
Weekly ECEC hours						
1–10	604	88.30	80	11.70	684	11.00
10.5–20	811	85.55	137	14.45	948	15.25
20.5–30	1051	87.29	153	12.71	1204	19.36
30.5–40	2235	87.78	311	12.22	2546	40.95
41 or more	747	89.35	89	10.65	836	13.44
Child care type						
Center day care	4593	87.74	642	12.26	5235	84.19
Family day care	782	86.99	117	13.01	899	14.46
Other	73	86.90	11	13.10	84	1.35
Gender						
Boy	2661	83.78	515	16.22	3176	51.08
Girl	2787	91.62	255	8.38	3042	48.92
Parental education						
Low	1901	84.79	341	15.21	2242	36.06
High	3547	89.21	429	10.79	3976	63.94
Health						
No	4879	88.20	653	11.80	5532	88.97
Yes	569	82.94	117	17.06	686	11.03
Development						
No	4739	92.85	365	7.15	5104	82.08
Yes	709	63.64	405	36.36	1114	17.92
Upbringing						
No	4806	88.79	607	11.21	5413	87.05
Yes	642	79.75	163	20.25	805	12.95
ECEC staff evaluation						
Yes	3981	87.32	578	12.68	5448	87.62
No	1467	88.43	192	11.57	770	12.38
Total	5448	87.62	770	12.38	6218	100

nurse – no matter how slight – was recorded as a deviation in speech production. In this study, children who refused to participate in the speech production test were excluded from the analysis. LENE test is described in more detail in Appendix 1.

Information regarding the child's form of care was based on parents' answers to the question: *How is the care of the 4-year-old child currently organized?* For some children, answers from both parents were available. If parents' answers differed, we used the mother's answers because mothers, on average, bear greater responsibility for children's affairs, such as contact with the ECEC staff (Attila et al. 2018). The value for average weekly hours in ECEC was based on parents' answers; if both parents answered the relevant question, we used the mean of the parents' answers. On average, parents' answers differed by 1.4 h. We categorized ECEC intensity into five categories: 1–10, 10.5–20, 20.5–30, 30.5–40, and 40.5 or more hours per week, allowing us to account for potential non-linearities in the relationship between ECEC intensity and speech production.

Other variables included in the study were the child's gender, physical health, age-appropriate development, family upbringing practices, parents' level of education, type of ECEC, and information on whether an ECEC staff assessment of the child's functioning and well-being in ECEC was available during the health check-up. Information regarding the child's physical health, age-appropriate development, and the family's upbringing practices was based on the nurses' evaluation at the child health clinics. These covariates take into account child and family characteristics that might correlate

both with speech production and ECEC intensity. These aspects were addressed by the nurse through the following question: ‘Does the family, in your overall assessment, need support due to any of the following?’ The response options concerning the child’s physical health, age-appropriate development, and the family’s parenting practices were: (1) Not at all, (2) A little, (3) A lot, and (4) I don’t know. Based on these responses, a dummy variable was created, coded as (0) Not at all and (1) A little or a lot. Responses marked as ‘I don’t know’ were rare and were coded as missing observations. Information on whether an ECEC staff assessment of the child’s functioning and well-being in ECEC was available during the health check-up was included as a dummy variable, coded as (0) No and (1) Yes.

Parents’ level of education was divided into four categories: (1) elementary, (2) secondary, (3) lower tertiary, and (4) tertiary education. We used the education level of the parent who answered the parent survey; if both answered, we used the highest education level achieved by either parent. However, few parents indicated elementary education as their highest level achieved, so we dichotomized the education variable into (1) less than tertiary education and (2) tertiary education. ECEC type was based on parents’ answers; the variable was categorized into three groups (1) center day care, (2) family day care, and (3) other.

Our main analyses were based on logistics regression analyses in which we account for the selection of ECEC intensity by the child’s gender, parental education level, the child’s health, the child’s development, the family’s upbringing practices, ECEC type, and information on whether an ECEC staff assessment of the child’s functioning and well-being in ECEC was available during the health check-up as control variables within the models. In the regression tables, we show our results as OR coefficients. Further, we plot our results showing the predicted probabilities of having atypical performance in speech production tests.

The analyses were performed with Stata version 16; the do-files for data analyses are available online (Laaninen 2025).

Results

As the descriptive statistics in [Table 1](#) indicate, 12% of the children in our sample were reported to have atypical performance in the speech production test. The majority of children, 41%, were in ECEC between 30.5–40 h, whereas only 11% were in ECEC for 1–10 h per week. Notably, more than half of the children (54%) could be described as participating in full-day ECEC, with their weekly hours amounting to 30.5 or more. While [Table A1](#) shows that there were relatively small differences in ECEC intensity between children based on their parents’ level of education, children of highly educated parents did spend on average slightly more time in ECEC.

Results from our logistic regression models are presented in [Table 2](#). We can see from Model 1 that overall average weekly ECEC hours are not associated with atypical performance in speech production tests. These results remain unchanged even when other covariates are taken into account (Model 2). In Model 3 without and Model 4 with other covariates, we examine whether parental education moderates the association between ECEC intensity and speech production test results. Our findings confirm this moderation, as the interaction effect between ECEC intensity and parental education



Table 2. Logistic regression models on the association between atypical performance in speech production tests and ECEC intensity. Coefficients as odds ratios.

	Model 1			Model 2			Model 3			Model 4		
	OR	Se	P value	OR	Se	P value	OR	Se	P value	OR	Se	P value
ECEC hours												
0–10	1.000			1.000			1.000			1.000		
10.5–20	1.275	0.192	0.106	1.286	0.208	0.119	1.038	0.219	0.860	1.060	0.243	0.799
20.5–30	1.099	0.162	0.521	1.178	0.186	0.300	1.048	0.213	0.819	1.043	0.230	0.848
30.5–40	1.051	0.140	0.712	1.104	0.158	0.488	0.816	0.154	0.283	0.790	0.162	0.251
40.5 or more	0.900	0.147	0.517	0.926	0.162	0.658	0.622	0.157	0.060	0.567	0.153	0.036
Parental education												
Low				1.000			1.000			1.000		
High				0.804	0.068	0.010	0.455	0.110	0.001	0.501	0.129	0.007
Gender												
Boy				1.000			1.000			1.000		
Girl				0.611	0.053	0.000	0.611	0.053	0.000	0.611	0.053	0.000
ECEC type												
Center day care				1.000			1.000			1.000		
Family day care				1.073	0.124	0.544	1.074	0.124	0.539	1.074	0.124	0.539
Other				0.877	0.309	0.709	0.873	0.310	0.703	0.873	0.310	0.703
Health												
No				1.000			1.000			1.000		
Yes				0.904	0.111	0.411	0.903	0.111	0.404	0.903	0.111	0.404
Development												
No				1.000			1.000			1.000		
Yes				6.785	0.605	0.000	6.825	0.610	0.000	6.825	0.610	0.000
Upbringing												
No				1.000			1.000			1.000		
Yes				1.000	0.111	0.998	0.997	0.111	0.976	0.997	0.111	0.976
ECEC staff evaluation												
Yes				1.000			1.000			1.000		
No				0.941	0.090	0.520	0.943	0.090	0.536	0.943	0.090	0.536
ECEC hours X Parental education												
10.5–20 X High							1.527	0.464	0.164	1.484	0.483	0.226
20.5–30 X High							1.153	0.343	0.633	1.295	0.412	0.416
30.5–40 X High							1.716	0.466	0.047	1.884	0.547	0.029
40.5 or more X High							2.061	0.698	0.033	2.392	0.862	0.016
Intercept							0.200	0.032	0.000	0.129	0.024	0.000
N	0.132	0.016	0.000	0.102	0.015	0.000	0.200	0.032	0.000	0.129	0.024	0.000
	6218			6218			6218			6218		
McFadden R²	0.001			0.132			0.008			0.134		
Model P value	0.166			0.000			0.000			0.000		

is statistically significant. [Figure 1](#), based on Model 4, depicts the association between speech production tests and ECEC intensity by parents' level of education. We can see that the difference between low and high parental education groups in the probability of having atypical performance in speech production tests diminishes as the average weekly hours in ECEC increases.

Regarding the children of parents with a low level of education, the probability of having atypical performance in speech production tests was lower among those who spent more time in ECEC. For children who spent 1–30 h per week in ECEC, the probability of having atypical performance in speech production tests was around 15–16%. However, for children who spent more than 30 h in ECEC per week, the probability was around 10–13%. The 6 percentage-point difference is statistically significant when comparing children in the 1–10-, 10.5–20-, and 20.5–30-hour groups to those in the 41-or-more-hour group ([Table 3](#); [Figure 1](#)).

Regarding the children of highly educated parents, for those who attended ECEC over 11 h per week, the probability of having atypical performance in speech production tests was around 11–12%. However, for children of parents with a high level of education and who spent on average 1–10 h per week in ECEC, the probability was lower, around 9%; the difference of around 3 percentage points is statistically significant compared to the 11–20 – and 30.5–40-hour groups ([Table 3](#)).

As an additional analysis, we examined the interaction between the average weekly hours in ECEC and parental education level, using a more detailed education variable consisting of four categories. The results (see [Tables A2](#) and [A3](#)) are consistent with the findings from Model 4 presented in [Table 2](#). However, [Table A3](#) provides a more

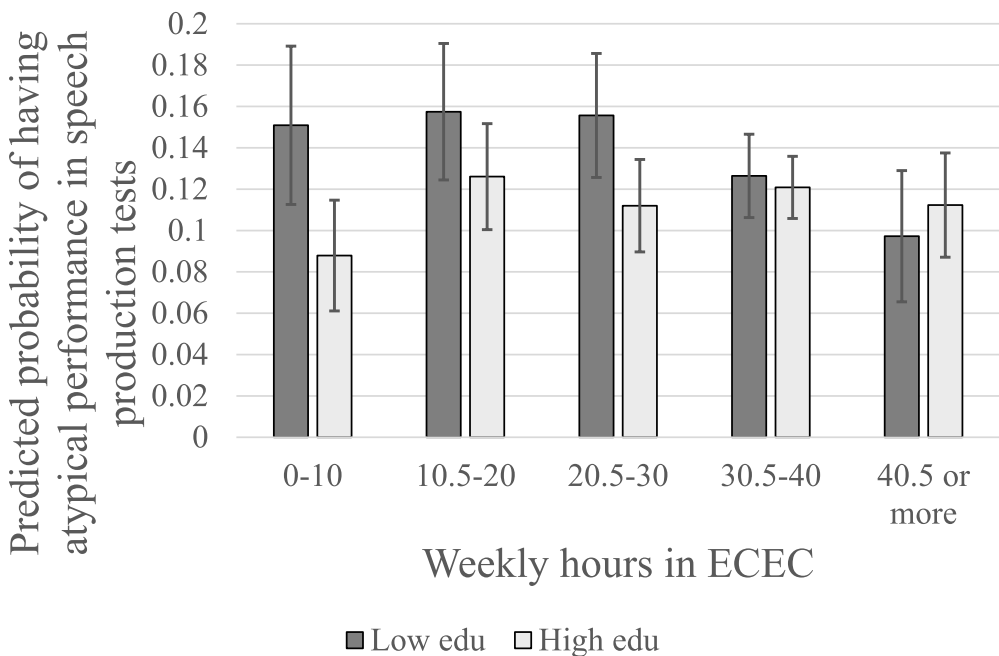


Figure 1. Predicted probability of having atypical performance in speech production tests by ECEC intensity and parental education. Figure is based on Model 4 in [Table 2](#).

Table 3. Difference in predicted probability of having atypical performance in speech production tests by ECEC intensity and parental education. Differences in percentage points.

	Difference	SE	95% confidence interval		P value
			Low	High	
Parental education Low					
0–10 vs 10.5–20	0.007	0.028	–0.047	0.061	0.799
0–10 vs 20.5–30	0.005	0.026	–0.047	0.057	0.848
0–10 vs 30.5–40	–0.026	0.024	–0.073	0.020	0.265
0–10 vs 40.5 or more	–0.058	0.027	–0.112	–0.004	0.034
Parental education High					
0–10 vs 10.5–20	0.036	0.018	0.001	0.071	0.044
0–10 vs 20.5–30	0.023	0.017	–0.010	0.056	0.175
0–10 vs 30.5–40	0.031	0.015	0.002	0.060	0.035
0–10 vs 40.5 or more	0.023	0.018	–0.012	0.058	0.193

nuanced view, showing, for example, that among children whose parents have basic education, the difference in speech production outcome between those attending ECEC for 0–10 h per week and those attending for over 40 h per week is 13 percentage points. It is important to note, however, that the group of children with basic educated parents is very small, and therefore these results should be interpreted with caution.

Discussion

Although there exists extensive research on the relationship between ECEC and children's cognitive development, there remains a need for further study, especially outside the US context. There is little research that offers insight into how SES moderates the association between ECEC intensity and children's cognitive outcomes. Therefore, the purpose of this study was twofold. First, we examined how ECEC intensity is associated with the speech production of 4-year-old children. Second, we investigated whether the relationship between intensity and children's outcomes varies according to the parents' level of education.

We found that overall, ECEC intensity is not associated with the speech production of 4-year-old children. This finding is in line with some previous research that has also found no association between ECEC and children's cognitive development (Howes et al. 2008; NICHD 2000). We also found that parental education moderates the association between speech production and ECEC intensity. Among children of parents with low levels of education, the likelihood of atypical performance in speech production tests decreased as the intensity of ECEC increased. In contrast, among children of highly educated parents, differences in speech production performance across ECEC intensity levels were smaller. However, children in this group who experienced the lowest ECEC intensity were the least likely to show atypical performance in speech production tests. These interaction results echo the results of Loeb et al. (2007), who also found that more hours in ECEC could benefit disadvantaged children.

According to our results, intensive ECEC may be beneficial for the speech development of children from low-SES families. Reflecting on resource and stress theories, children from low-SES backgrounds may gain developmental advantages from intensive ECEC that support their speech development, as they may not have access to similar

benefits – such as educational play – at home. In contrast, children from high-SES families may already be exposed to similar developmental stimuli at home, meaning they may not benefit from ECEC to the same extent as their low-SES peers. Our findings suggest that among children from high-SES families, those with the lowest ECEC intensity were the least likely to show atypical performance in speech production tests. This could be some sort of selection effect as it might be that the most affluent families, who can support their children’s development most effectively, may be able to afford to take care of their children at home without both parents having to work (see discussion by Schmutz 2023, 10).

Children from low-SES backgrounds participate in ECEC less frequently on average compared to children from high-SES backgrounds across Europe (Pavolini and Van Lancker 2018). However, several studies – including our own – have shown that children from low-SES backgrounds could particularly benefit from participating in ECEC. Therefore, it is important to consider ways to increase ECEC participation among low-SES children. One approach could be to encourage parents to transition their children to full-time ECEC through child health clinics, where children attend regular health check-ups until school age. Further, particularly in Finland, the appeal of home care could be reduced by cutting the child home care allowance, a cash benefit that pays for the home care of young children.

In addition to encouraging ECEC participation, it would be beneficial to support parents in engaging in educational play with their children. ECEC staff have the opportunity to encourage more educational parent–child interactions at home, which could be particularly beneficial for children from disadvantaged backgrounds. It is also important to note that high-quality ECEC has been shown to support children’s cognitive outcomes, and in Finland, ECEC is generally of high quality. If the political goal is to increase the average number of weekly hours in ECEC, this must not come at the expense of quality, such as reducing education standards of staff.

This study was based on cross-sectional data, which introduces certain limitations. Although we controlled for several covariates related to both speech development and ECEC intensity, the results remain vulnerable to bias from unmeasured confounding. Additionally, it is possible that parents may choose to care for their children at home more often if they suspect atypical development in their child (reverse causality). Our dataset also lacked information on the quality of ECEC, which is a crucial factor in child development and would have added value to our analyses. Furthermore, the sample used in this study likely underrepresents the most disadvantaged families. For example, it is possible that families whose children might benefit the most from ECEC – and whose resources are generally the most limited – did not respond to the parental questionnaire. This underrepresentation should be taken into account when interpreting the results. Due to this underrepresentation, we may have underestimated the positive association between weekly hours in ECEC and children’s speech development for children of parents with low educational attainment. Additionally, the explanatory power (McFadden’s Pseudo R Squared) of the interaction between weekly hours and parental education in our results is relatively low, and therefore does not account for much of the variation in speech production. It could be that, even though we account for a large set of covariates in our model, a moderate amount of unexplained variance or random noise still remains in the data. This highlights the need for additional research on the topic.

Previous research on the relationship between ECEC intensity and children's cognitive outcomes has been limited, especially regarding how family background moderates this relationship. This area of research clearly requires further investigation. In the future, researchers should examine children with immigrant backgrounds, as early exposure to the majority language may be particularly beneficial for their later educational outcomes. Unfortunately, information on immigration background was not available in our dataset.

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Declaration of generative AI and AI-assisted technologies in the writing process

In preparing the revised version of this work, the author(s) utilized Microsoft Copilot, an AI based on the GPT-4 architecture, to support fluent academic writing. All content generated with the assistance of this tool was reviewed and edited by the author(s), who take full responsibility for the final publication.

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Appendix

Table A1. ECEC intensity by parental education.

	Parental education					
	Low		High		Total	
	N	%	N	%	N	%
Weekly ECEC hours						
1–10	276	12.31	408	10.26	684	11.00
10.5–20	384	17.13	564	14.19	948	15.25
20.5–30	456	20.34	748	18.81	1204	19.36
30.5–40	855	38.14	1691	42.53	2546	40.95
41 or more	271	12.09	565	14.21	836	13.44
Total	2242	100	3976	100	6218	100

Table A2. Logistic regression model on the interaction of average weekly hours in ECEC and parental education on atypical performance in speech production tests. Coefficients as odds ratios. Note: Parental education treated as continuous variable.

	Model 5		
	OR	Se	P value
ECEC hours			
0–10	1.000		
10.5–20	1.004	0.542	0.995
20.5–30	1.236	0.654	0.689
30.5–40	0.559	0.274	0.235
40.5 or more	0.231	0.148	0.022
Parental education	0.766	0.100	0.042
Gender			
Boy	1.000		
Girl	0.614	0.053	0.000
ECEC type			
Center day care	1.000		
Family day care	1.066	0.124	0.579
Other	0.880	0.311	0.718
Health			
No	1.000		
Yes	0.900	0.110	0.391
Development			
No	1.000		
Yes	6.815	0.609	0.000

(Continued)

Table A2. Continued.

	Model 5		
	OR	Se	P value
Upbringing			
No	1.000		
Yes	0.991	0.111	0.939
ECEC staff evaluation			
Yes	1.000		
No	0.943	0.090	0.538
ECEC hours X Parental education			
10.5-20	1.081	0.179	0.639
20.5-30	0.986	0.160	0.930
30.5-40	1.236	0.183	0.152
40.5 or more	1.523	0.287	0.025
Intercept	0.211	0.091	0.000
N	6218		
McFadden R2	0.135		
Model P value	0.000		

Table A3. Difference in predicted probability of having atypical performance in speech production tests by ECEC intensity and parental education. Differences in percentage points.

	Difference	SE	95% confidence interval		P value
			Low	High	
Parental education Basic					
0-10 vs 10.5-20	0.0127239	0.060426	-0.105709	0.1311567	0.8332
0-10 vs 20.5-30	0.0315262	0.0597912	-0.085662	0.1487148	0.598
0-10 vs 30.5-40	-0.053596	0.0526987	-0.156883	0.0496919	0.3091
0-10 vs 40.5 or more	-0.131748	0.0578524	-0.245137	-0.01836	0.0228
Parental education Secondary					
0-10 vs 10.5-20	0.0189877	0.0292154	-0.038273	0.0762487	0.5157
0-10 vs 20.5-30	0.0220567	0.0285862	-0.033971	0.0780846	0.4404
0-10 vs 30.5-40	-0.017276	0.0252355	-0.066737	0.0321845	0.4936
0-10 vs 40.5 or more	-0.060534	0.0287417	-0.116866	-0.004201	0.0352
Parental education Lower tertiary					
0-10 vs 10.5-20	0.0247955	0.0169325	-0.008392	0.0579827	0.1431
0-10 vs 20.5-30	0.0173925	0.0162273	-0.014413	0.0491974	0.2838
0-10 vs 30.5-40	0.0055618	0.0144416	-0.022743	0.0338669	0.7001
0-10 vs 40.5 or more	-0.018681	0.0171055	-0.052207	0.0148452	0.2748
Parental education Higher tertiary					
0-10 vs 10.5-20	0.0258457	0.0176115	-0.008672	0.0603636	0.1422
0-10 vs 20.5-30	0.0120697	0.0164875	-0.020245	0.0443846	0.4641
0-10 vs 30.5-40	0.0217566	0.0146881	-0.007032	0.0505448	0.1385
0-10 vs 40.5 or more	0.0174799	0.0176579	-0.017129	0.0520887	0.3222

Appendix 1. LENE assessment for four-year-old.

In Finland, the child health clinic program includes a comprehensive health check-up for 4-year-old children conducted jointly by a public health nurse and a doctor. This examination covers a wide range of aspects related to the health and well-being of the child, the parents, and the family. The child’s neurological development is assessed using the LENE test (Neurological Development of Preschool-Aged Children), which has different versions tailored to various age groups. Given the importance of collaboration between child health clinics and ECEC, especially in the early identification of developmental concerns, the health check-up may also include an assessment by ECEC staff regarding the child’s functioning and well-being in early education settings.

Development of the LENE assessment began in 1994 with the aim of creating a method that would comprehensively evaluate key areas of a child’s neurological development, including subtle and narrowly defined difficulties that may later manifest as learning challenges. The LENE test was compiled from both long-used and newly developed screening-type tasks (Valtonen

and Mustonen 1999). The most intensive development phase of the LENE test occurred between 1994 and 1999 (Valtonen, Mustonen, and Ahonen 2000). The LENE test has been found to be an effective tool for identifying early developmental disorders. For example, in a follow-up study launched in 2001 involving 4–5-year-old children, the LENE test proved effective in screening for neurological disorders (Valtonen, Ahonen, and Lyytinen 2004). Moreover, the test has demonstrated good concurrent and predictive validity (Valtonen, Mustonen, and Ahonen 2000).

The full LENE assessment for 4-year-olds takes approximately 30 min and evaluates the following areas: speech production, vision, hearing, gross motor skills, abnormal movements, turn-taking skills, attention and motivation, speech comprehension and concepts, auditory perception, eye-hand coordination, play, and independence (Valtonen, Mustonen, and Ahonen 2000). The order of tasks is individually adapted to each child and four-year-old children are preferably assessed without a parent present, as this improves the reliability of the test (Valtonen and Mustonen 1999).

In the speech production task for 4-year-olds, the child is shown an interesting and detailed picture and encouraged to describe it freely. For example, the examiner may sit at a distance without eye contact and ask the child to explain the picture in more detail. If the child refuses to describe the picture, they are gently encouraged to engage in free conversation, and if necessary, parents may be asked about the child's speech development.

Performance in speech production is evaluated using the following criteria:

0: The child describes the picture using complete sentences of at least 3–4 words. Speech is easily understandable. One phoneme substitution is allowed.

1: The child describes the picture using short, incomplete sentences. Speech is understandable, but there are errors in several phonemes.

2: The child's expression is clearly limited, and speech is difficult to understand.