

## **Do Effects of Center-Based Care and Education on Vocabulary and Mathematical Skills Vary with Children's Sociocultural Background? Disparities in the Use of and Effects of Early Childhood Services**

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### **Abstract**

Using data from a survey on cognitive proficiency levels of first graders in Switzerland ( $N = 1.830$ ), this study analyzes (1) who has access to institutional childcare, (2) whether institutional childcare affects cognitive skills of children who differ in terms of socioeconomic status, home literacy, native country, and home language, and (3) how duration and intensity of childcare affect children's skills. The findings indicate sociocultural disparities in access to childcare. Multiple hierarchical regression analyses suggest that childcare experience did not enhance children's outcomes when social and cultural background characteristics were held constant. For childcare attendees, however, a longer duration of attendance had a positive effect on vocabulary and a higher intensity was related negatively to vocabulary. Children who did not speak German at home benefitted more from childcare in terms of vocabulary skills than German-speaking children. Social background was a significant predictor of vocabulary and math skills. Cultural background additionally impacted on vocabulary skills when social background was controlled for. Implications for policy are discussed.

### **Keywords**

Early childhood care and education, social and cultural background, cognitive proficiency, equal educational opportunity, access, duration and intensity.

### **Introduction**

This study analyzes three major questions: First, does access to early childhood care and education services vary with children's sociocultural background? Second, do early care and education services affect cognitive skills of children from different backgrounds in primary school? Third, how do duration and intensity of attendance in such services affect the skills of children? The study relies on data from a survey on children's proficiency in various cognitive domains. It uses statistical estimation models (such as regression analyses) to account for the relationships between children's experience in center-based care and education and their vocabulary and mathematical skills in primary school.

Research suggests that early center-based care and education can improve children's development. In many instances, children—particularly those from socioeconomically disadvantaged backgrounds—who attended early childhood facilities enter school more ready to learn, with domain-specific language, literacy and numeracy skills being further developed than those of their counterparts who were not exposed to any comparable facility (e.g. Barnett 1995). A majority of studies into the effects of early childhood care and education have analyzed children who entered care and education facilities and programs at about four years of age (see Burger 2010). However,

less is known about the effects of institutional care and education that is geared to children below that age although a few studies have been carried out (e.g. Belsky et al. 2007; McCartney 2010; NICHD 2002, 2003, 2007). In addition, while the empirical evidence about benefits of early care and education can be generalized potentially to various populations, it may suffer from country-specific biases as most of the major research has been conducted in the U.S. and in the U.K. Yet country-specific differences exist with regard to auspices, access, provision and quality of services as well as with regard to context factors such as fertility rates, child poverty rates, and parental leave policies (OECD 2006). Thus, it can be hypothesized that children's experiences in early childhood institutions vary across countries (cf. Tietze et al. 1996). To date, no study has analyzed the effects of early care and education on direct measures of children's vocabulary and mathematical skills in primary school in Switzerland. The present analysis attempts to overcome this shortcoming by estimating such effects – as well as effects of duration and intensity of exposure to care and education – on children from diverse sociocultural backgrounds in the first grade of primary schools.

Evidence supports the idea that early childhood care and education can help overcome social inequalities among children from different social backgrounds (e.g. Burger 2010; Schütz and Wössmann 2005a; Spiess et al. 2003). It is therefore important to assess who has access to care and education provision and how exactly this provision as well as sociocultural background characteristics affect children's skills. Drawing on data from a survey of first graders' cognitive proficiency carried out by Moser et al. (2005), the current study addresses these questions. It uses a cross-sectional design, retrospectively assessing effects of care and education in nurseries on children's competencies.

In Switzerland, nurseries target children before the age of kindergarten (i.e. from birth to about four years). The term nursery refers to a center-based care and education service as distinguished from parental care and informal care by relatives, nannies, or babysitters in private homes. Insofar, this term can be used interchangeably with the terms early childhood care and education, early childhood program, or childcare facility for children from birth to four years of age in related studies.

## **Previous Research**

### **Access to Early Childhood Care and Education Programs**

Children who are most at risk of adverse development are often the least likely to participate in early care and education programs (Hofferth et al. 1994; Zigler et al. 2006). Children's access to programs varies with factors such as ethnicity, parents' education and employment, socioeconomic status, and choice processes of a family (e.g. Jamieson et al. 1999; Kagan 2006, Leseman 2002; Shin 2005). In Germany, for instance, children whose parents have higher degrees in education tend to be more likely to attend early childhood institutions (Konsortium 2006; Meier 2008) while children from migrant families and less wealthy parents often have lower rates of use of early childhood facilities (Becker and Tremel 2006). Moreover, access to quality institutions is related to family resources across many countries, with low-income children being under-enrolled (Eurydice 2009; Zigler et al. 2006) and centers serving predominantly higher-income families providing higher-quality care and education than centers serving less advantaged populations (Phillips et al. 1994). Given the shortage of early care and education spaces in Switzerland as well as the high costs that parents have to pay for these spaces as compared to other European countries (Flitner 2009), it can be assumed that disparities in access to early care and education facilities exist in Switzerland as well.

### **Effects of Early Childhood Care and Education on Child Development**

Apart from access to programs, researchers have investigated effects of programs on child development. A number of longitudinal studies in different national contexts provided evidence for positive effects on outcomes such as class repetition rates, special education placement, school achievement, educational attainment in adulthood, health, psychiatric symptoms, delinquency, employment ratio, and occupational status (Barnett 1995, 2008; Büchel et al. 1997; Caughy et al. 1994; Kagitcibasi et al. 2009). Other studies, however, revealed only minor or no beneficial effects (Becker and Tremel 2006; Dollase 2007; Driessen 2004) or a fading out of effects after the end of a program (Magnuson et al. 2007a; Zigler and Styfco 1994).

***Effects of duration and intensity of programs on cognitive skills.*** A number of studies evaluated the effects of duration and intensity of programs on cognitive skills, as indexed mostly by variables like number of years and months (for duration) and days per week as well as hours per day (for intensity). Thorough analyses thereby took account of family background variables such as socioeconomic status or country of origin.

***Effects of duration on cognitive skills.*** Several analyses suggest that a longer duration of early care and education yields better academic readiness in kindergarten (Gullo and Burton 1992) as well as greater educational attainment (Büchner and Spiess 2007; Caille 2001) and more developed reading skills in subsequent school years (Bos et al. 2007). The Effective Preschool and Primary Education project found that the number of months a child attended an early childhood institution was related positively to cognitive attainment at the beginning of primary school over and above the effects of family socioeconomic status, income, mothers' qualification levels, and ethnic as well as language background until the start of primary school (Sammons et al. 2004). According to the Chicago Longitudinal Study, children who were exposed to an extended care and education service up to nine years in addition to preschool and kindergarten alone displayed higher cognitive achievement levels until 23 years of age (Reynolds et al. 2001). However, some studies found that longer lasting programs do not necessarily bring about more beneficial cognitive development (Driessen 2004; EPPE 2008a) whereas others yielded findings that varied with academic domains (NICHD 2007) or established that an ideal length of time should not be exceeded in order to produce the greatest academic benefits for children (Loeb et al. 2007).

***Effects of intensity on cognitive skills.*** Drawing on data from the Early Childhood Longitudinal Study, Loeb et al. (2007) found that the intensity of exposure to a preschool center—as measured by the number of hours per day—was associated with greater intellectual gains for children. This effect depended on family income and race. Higher intensity exposure was associated with better reading and math skills for low-income children, but not for children from high-income families, and English-proficient Hispanic children benefitted more than white or black children. According to a study based on the Socio-Economic Panel in Germany, higher-intensity childcare in the preschool years was related to a decreasing likelihood of attending the highest secondary school track as of twelve years of age, irrespective of the duration of childcare (Landvoigt et al. 2007). But intensity is not related systematically to cognitive outcomes (e.g. NICHD 2000). Love et al. (2003) point out that quality may be a moderator between the amount of time spent in childcare services and child outcomes. That is, the quality of childcare may affect the strength of the association between the intensity of childcare and child outcomes. However, since numerous studies into the effects of intensity on academic achievement have focused on children in kindergartens (Cryan et al. 1992; Plucker et al. 2004; Votruba-Drzal et al. 2008), it is difficult to determine clear patterns of results for children below kindergarten age.

In sum, the studies into the effects of duration and intensity of early care and education have yielded somewhat ambiguous findings. The inconsistency in the evidence might be attributable to differences in the quality of program evaluations (Allen 2008). Alternatively, contradictory results

may be explained by the fact that family risk factors and child characteristics can moderate the association between childcare and child outcomes. For instance, non-maternal childcare can have opposite effects on child development as a function of family risk background (Côté et al. 2008). However, such moderating effects of family background (i.e., effects of family risk factors on the relationship between childcare and child development) have not been analyzed sufficiently yet. Finally, differing findings might be a result of different social and policy contexts or of the fact that the programs analyzed in various studies differ in respect of their quality. Small-scale, high-quality (model) programs with favorable staff-to-child ratios and various additional services such as health care and nutritional interventions typically produce greater and longer-term effects than large-scale public programs (Barnett and Belfield 2006). Various studies into the effects of programs of outstanding quality exist (Barnett 1995). However, the results of well-designed larger-scale analyses are more generalizable than those of studies focusing on such high-quality programs. The current study therefore draws on a large data set in order to assess cognitive effects that can be generalized to a larger population of children.

### **Nursery Provision in Switzerland**

Outcomes of care and education may vary with context and regulatory systems (Love et al., 2003). Policy and legal context as well as characteristics of care and education that may act as determinants of child development therefore need to be elucidated. Differences between nurseries and kindergartens in Switzerland must be taken into account.

In Switzerland, kindergarten pertains to the administrative system of education (ISCED 0). Although kindergarten is not compulsory in every canton, the vast majority of children attend kindergarten, the mean duration of attendance being somewhat below two years (EDK 2010). Kindergarten curricula emphasize the advancement of socio-emotional, psychomotor, and cognitive development (CIIP 1992). Nurseries, on the other hand, offer collective care and education to children prior to kindergarten age.

***Guidelines of the federal association of nurseries.*** According to the guidelines of the Swiss association of nurseries, the pedagogical approach in nurseries includes care, fostering of early skills, integration, and education (KiTaS 2008). The guidelines stipulate minimum standards. While they do not specify criteria pertaining to process quality such as the quality of teacher-child interactions, they focus on structural quality determinants.

***Structural quality standards.*** The guidelines of the Swiss association of nurseries specify a benchmark of ten to twelve children of varying age per group. At least two educators have to be present per group. A one-to-one ratio between educators with a federally accredited diploma and educators without official training is requested. The resulting quota approximately corresponds to the staff-to-child ratios recommended by the European Commission Network on Childcare (1996) and by the Committee on Early Childhood, Adoption, and Dependent Care of the American Academy of Pediatrics (2005). The guidelines of the Swiss association further stipulate that the professional staff is federally accredited as infant educators. 43% of the staff in nurseries does not have an official degree (BSV 2010). As compared to the standards of the European Commission Network on Childcare (1996), the standards in Switzerland are relatively rigorous. However, the extent to which these standards are adopted in practice has not been assessed empirically.

***Federal investments in nurseries.*** Federal investments in the early childhood care and education sector amount to 0.2% of the gross domestic product (Wolter et al. 2007). Thus, Switzerland invests less than most other European countries where investments vary between 0.3% (Poland) and 2.0% (Denmark) or the United States where investments add up to 0.4% (OECD

2006). As a consequence, the demand for nurseries exceeds the supply. In the canton of Zurich, only 4.1 nurseries exist per 1.000 children at the age before compulsory schooling (Wolter et al. 2007).

**Use of nurseries.** In 2007, 32.5% of two-parent families used nurseries for their 0-to-6-year-old children (Stamm et al. 2009). 27.0% of children aged three and four years were enrolled in early care and education facilities including nurseries in Switzerland whereas 71.2% were enrolled in the OECD countries on average (OECD 2009). Out of the families who use nurseries for their children, about 20% use a nursery for one day, about 33% for two days, and about 20% for three days per week. 64% of the children spend the whole day in a nursery whereas 33% spend half a day in a nursery (BSV 2010).

### **Objectives of the Study and its Contribution to Research**

This study attempts to identify the influence of sociocultural background and nursery experience on vocabulary and mathematical proficiency of children at the beginning of the first grade, thereby analyzing whether effects of nursery experience differ as a function family backgrounds. A number of studies into the effects of early-years provisions have been completed in the United States (for reviews see Burger 2010; Currie 2001; Karoly et al. 1998; Karoly et al. 2005; Shonkoff and Meisels 2006; Waldfogel 2002; Yoshikawa 1995) as well as in other national contexts (UNESCO 2007). In Switzerland, however, only one study into the effects of nurseries was conducted (Lanfranchi 2002). It established that children who had been in extra-familial care and education settings experienced fewer problems on entry to primary school. Yet while Lanfranchi's study used teacher-reported proficiency levels, the present study evaluates direct measures of children's skills.

Mere exposure to a nursery is not the sole factor responsible for improvements in children's skills. Various child and family background factors—including socio-economic status, immigration background, and language spoken at home—contribute to child development (Bridges et al. 2004; Esser 2006; Jung and Stone 2008; Karoly et al. 1998; Melhuish and Petrogiannis 2006; NCES 2003; Siraj-Blatchford 2009). In addition, the early home learning environment is an important predictor of child outcomes. Home literacy is one aspect of the home learning environment.<sup>1</sup> A summary of research suggests that there are associations between home literacy and socioeconomic background although there is wide variability in home literacy across different families (Phillips and Lonigan 2009). A number of analyses further indicate relationships between home literacy and children's development of literacy skills and vocabulary (Huttenlocher et al. 1991; Sénéchal 2006; Tabors et al. 2001). Consequently, it is important to assess empirically not only how participation in a nursery affects children's competencies, but also to what extent social and cultural background factors play a role in the acquisition of competencies. The current study addresses these questions. In addition, it makes a specific new contribution to the research literature by evaluating whether effects of nursery as well as duration and intensity of attendance in a nursery vary for children who differ in terms of socioeconomic status, home literacy, native country, and home language in Switzerland.

### **Research Questions**

Three major questions are addressed: (1) Do nursery attendees differ from non-attendees in respect of social and cultural background characteristics? (2) Do effects of nursery experience vary with children's socioeconomic status, home literacy, native country, and home language? And (3) how do duration and intensity of nursery attendance affect children's proficiency levels?



## Method

### Study Design

Data were derived from a survey on cognitive proficiency levels of children conducted in the Swiss canton of Zurich (Moser et al. 2005). Children's skills were assessed immediately after the beginning of the first grade of primary school. During one-on-one testing sessions, two cognitive dimensions—vocabulary and mathematics—were explored. At the same time, a parent questionnaire was distributed to collect retrospective data on children's nursery attendance and to assess social and cultural background characteristics of each child's family. The study adopts a cross-sectional design. Correlations between nursery attendance, family variables, and children's skills are carried out. In addition, multiple linear regression analyses are performed as they allow controls for intervening (background) factors.

### Sample

In the summer of 2003, 11,118 children entered the first grade in the canton of Zurich. The sample included 120 school classes, containing 1,830 children with a mean age of 7.00 years. That corresponds to 16.5% of all children who entered the first grade. 49.5% of the children in the sample were female.

***Languages spoken at home.*** Children who always spoke either Swiss German or High German at home constituted 73.3% of the sample. The remaining 26.7% never or only sometimes spoke German at home. German is the official language in the canton of Zurich. While Swiss German is the spoken language and High German is the written language of Swiss residents, High German is both the spoken and the written language of the residents of Germany. As Swiss German and High German are similar languages, they are grouped together and distinguished from any other, foreign language.

***Native country.*** Within the sample, 86.7% of children had lived in Switzerland since birth while 55.9% of mothers and 55.1% of fathers had lived in Switzerland since birth. The proportion of parents who had not lived in Switzerland since birth exceeded the 22.7% of the resident population (from 15 years upwards) who were not born in Switzerland (BfS 2002).

***Parental education.*** The educational background of the parents in the sample tended to be lower than the educational background of the (25- to 64-year-old) resident population of Switzerland in 2003 (BfS 2009). Within the sample, 28.1% of fathers and 38.1% of mothers had completed only nine years of compulsory schooling. This compares with figures of 11.0% for men and 19.9% for women in Switzerland overall. Moreover, while 22.5% of men and 12.4% of women resident in Switzerland hold university degrees, none of the parents in the sample had obtained a university degree.

***Housing conditions.*** Apart from educational background, the number of rooms per person in a household can be interpreted with caution as a rough indicator of a family's socioeconomic background (Galobardes et al. 2006). The families in the present sample had an average of 1.14 rooms per person at home (SD = 0.35).

***Use of nursery and nursery attendance patterns.*** Of the 1,830 children in the sample, 472 attended a nursery before entering kindergarten (25.8%). For 408 children information about the duration of attendance was given: 218 children (53.4%) attended a nursery for one to two years whereas 190 children (46.6%) attended a nursery for over two years. For 411 children information about the intensity of nursery attendance was provided: 288 children (68.1%) had been in a nursery

for one to three days a week and 123 children (29.1%) had been in a nursery for more than three days a week. Duration and intensity of nursery attendance were interrelated. Relative to children who attended a nursery for one to two years, children who attended nursery for more than two years were significantly more likely to be enrolled for more than three days a week,  $\chi^2(1) = 8.574, p = .003$ .

## Measures and Variables

**Cognitive skill measures.** A test of cognitive skills developed by Moser et al. (2003) was used. This test measures a child's vocabulary, that is, the ability to name objects and activities as well as comprehension of mathematical concepts including quantities, series, numbers, addition, and subtraction. The items assessing vocabulary are presented as pictures showing objects such as a cable car or activities such as a boy peeling an apple. The items evaluating mathematics are presented both as pictures and in a written form. For instance, pictorial items show a number of objects and five different numerals. The task for the child consists in determining the numeral (among the five alternatives) which correctly denotes the number of objects shown in the picture.

This cognitive test shares important features with measures used in related studies. As the British Ability Scales II (Elliott et al. 1997; Hill 2005), it is composed of specific subscales. Both tests assess vocabulary and number skills. The subscale assessing vocabulary is modeled upon the Peabody Picture Vocabulary Test (Dunn and Dunn 1997). However, in the Peabody test the examinee selects a picture that best illustrates a spoken word's meaning, whereas in the test by Moser et al. (2003) the examinee names objects and activities illustrated in pictures.

The scale measuring vocabulary consists of 20 items and the scale measuring mathematics consists of 46 items. Children's answers were rated (and coded) as wrong (0) when objects and activities were named incorrectly or mathematical concepts were not properly understood. They were rated as correct (1) when children's responses were accurate. The raw scores of the sum of the ratings of all items of a scale were standardized. Cronbach's  $\alpha$  internal consistency reliability of the two scales amounted to .913 and .912, respectively. A confirmatory factor analysis established the loadings of each individual item on the scales. These loadings ranged between .444 and .749 on the vocabulary scale and between .210 and .670 on the mathematics scale. The Pearson inter-correlation between the vocabulary and the mathematics scales amounted to .280\*\*\* ( $n = 1.592$ ).

**Sociocultural background and nursery variables.** A parent questionnaire assessed social and cultural background characteristics of each child's family and thus provided information used to create seven predictors for the regression analyses: (1) socioeconomic status (SES), an aggregate metric measure consisting of the number of years of mother's and fathers' education and the number of rooms per person in a family's household; (2) home literacy, operationalized as the number of books at home (0-200 vs. >200),<sup>ii</sup> (3) native country, that is, whether a child had lived in Switzerland 'since birth' as opposed to 'not since birth,' and (4) home language German, that is, whether a child 'always' spoke Swiss or High German at home as opposed to 'sometimes or never.'<sup>iii</sup> Finally, three variables relating to nursery experience were used: (5) nursery attendance, that is, whether a child attended a nursery or not; (6) duration of nursery experience (1-2 years vs. >2 years) and (7) intensity of nursery experience (1-3days/week vs. >3 days/week).

**Interaction terms.** A number of interaction terms are added to the regression models to determine whether the effects of nursery experience differ for diverse groups of children. Specifically, product terms are analyzed between each of the four background variables (1 to 4) and the three nursery-related variables (5 to 7).

## Data analytic approach

Aside from correlations, multiple linear regression models are performed as they allow for the inclusion of potential intervening variables as covariates. By controlling for SES, home literacy, language spoken at home and native country, background factors known to be associated with educational aspirations and use of early care and education provision for the offspring are held constant (Becker and Lauterbach 2007; Bridges et al. 2004; Magnuson et al. 2004; NCES 2003). Controlling statistically for factors which might affect skill development increases the likelihood of excluding parental selection effects. Furthermore, the influence of kindergarten in the years following nursery attendance is held constant.<sup>iv</sup> Families who indicated that they had not used nursery may have used informal care by relatives or babysitters, for instance, but were assumed to have used no center-based care comparable to a nursery for their children.

The study adopts a quasi-experimental research strategy. Children who attended a nursery are contrasted with children lacking this experience. Sequential regressions are performed to estimate the association between children's exposure to nursery and children's skills in the first grade. Two models are analyzed for both outcome variables. The basic equations summarize the conceptual approach:

$$\text{Model 1: } Y_i = \beta_0 + \beta_1 SB + \beta_2 CB + \beta_3 NA + \beta_4 NA \times SCB + \varepsilon$$

$$\text{Model 2: } Y_i = \beta_0 + \beta_1 SB + \beta_2 CB + \beta_3 DA + \beta_4 IA + \varepsilon$$

In model 1, the outcome (Y) of child (i) is a function of social background (SB) and cultural background (CB) of the child's family, nursery attendance (NA), interaction effects between nursery attendance and sociocultural background (NA x SCB), and a random and normally distributed error term ( $\varepsilon$ ). Model 2 focuses exclusively on children who attended a nursery, not on the total sample of children. It attempts to answer the research question about the extent to which duration and intensity of nursery attendance affect skill levels of children by including the predictors 'duration of attendance' (DA) and 'intensity of attendance' (IA) in a nursery instead of the predictor nursery attendance (NA). Thus a two-stage approach to regression analyses was chosen with model 1 focusing on the whole sample and model 2 focusing on the subsample of children with nursery experience.

The sequential regressions are calculated with increasing numbers of predictors: model 1 consists of four consecutive steps. The first step entails the analysis solely of the effect of social background on children's proficiency levels. In the second step, the effects of cultural background variables are added. Step three additionally includes the effects of nursery attendance and step four includes the effects of the interaction terms. Model 2 consists of three steps: social background (step 1), cultural background (step 2), and duration as well as intensity of nursery attendance (step 3).<sup>v</sup> This sequence corresponds to the natural order of influences on child development as sociocultural background variables impact on children prior to nursery experience. The increase in the variance explained ( $\Delta R^2$ ) will be the crucial test to evaluate the effect of nursery experience. The different blocks of predictors are entered according to the entrance criteria  $PIN = .05$  and  $POUT = .10$ .

## Results

### Sociocultural Differences between Nursery Attendees and Non-Attendees



As shown in table 1, children with nursery experience differed from comparison group children with regard to a number of background factors. Relative to the comparison group, nursery attendees' mothers and fathers had completed significantly more years of formal schooling (12.52 and 13.27 years vs. 10.85 and 12.46 years) and they had more rooms per person in the household on average (1.24 vs. 1.13). Thus the socioeconomic status was higher for children in the nursery group. A significantly greater percentage of nursery attendees lived in households with more than 200 books as opposed to fewer than 200 books (44% vs. 30.6%). Nursery attendees were less likely than non-attendees to always speak Swiss German or High German at home (69.3% vs. 75.9%). The nursery group and the comparison group did not differ significantly in regard to sex and native country.

**Table 1. Selected sample characteristics and differences between children with nursery experience and children without nursery experience (comparison group)**

Variable	Nursery group (n = 423)		Comparison group (n = 1200)		Test statistics		p
	M	SD	M	SD	t	df	
Years of maternal education	12.52	3.70	10.85	3.53	-7.990	685.917	.000
Years of paternal education	13.27	3.99	12.46	4.04	-3.391	1528	.001
Number of rooms per person	1.238	0.41	1.126	0.32	-5.054	599.411	.000
Socioeconomic status	0.349	1.01	-.0603	0.37	-6.909	600.400	.000
	n	%	n	%	$\chi^2$	df	
Sex					0.004	1	.951
Female	209	49.4	595	49.6			
Male	214	50.6	605	50.4			
Number of books at home					24.956	1	.000
0-200	234	56.0	825	69.4			
>200	184	44.0	363	30.6			
Native country					0.007	1	.934
In Switzerland since birth	378	91.7	1071	91.6			
In Switzerland not since birth	34	8.3	98	8.4			
Home language German					6.437	1	.011
Always spoken	269	69.3	831	75.9			
Never or sometimes spoken	119	30.7	264	24.1			

Note - All the children investigated attended kindergarten for two years. When counts do not add up to the total number of children, the respective missing numbers correspond to the proportion of missing values in the according variables. Percentages are presented for a column total of 100%. T-Tests for independent samples were calculated for metric variables, Pearson  $\chi^2$ -tests were computed for categorical variables.

## Correlations

Pearson correlations were calculated to determine bivariate associations between the metric predictor SES and the metric outcome variables. Point-biserial correlations established the relations between the dichotomous predictors and the metric outcomes. This section highlights the most important results: Nursery attendance did not correlate significantly with the vocabulary and mathematics outcomes. Duration of nursery attendance correlated positively with vocabulary ( $r = .284^{***}$ ), but not with mathematics. Intensity of nursery attendance correlated negatively with the vocabulary measure ( $r = -.303^{***}$ ). The vast majority of the social and cultural background variables correlated significantly with both outcome variables. Overall, the significant correlations ranged from  $r = .110^{***}$  (between German as home language and mathematical skills) to  $r = .627^{***}$  (between German as home language and vocabulary).

### Effects of Sociocultural Background and Nursery Experience on Children's Skills

Tables 2 and 3 display coefficients from hierarchical multiple regressions of children's cognitive and social proficiency on social background, cultural background, nursery experience, and interactions. They present the standardized regression coefficients ( $\beta$ ) and the change in the explained variance ( $\Delta R^2$ ), the intercept (constant) of the complete model with all four blocks of predictors entered, the coefficient of determination  $R^2$ , the  $F$ -value, the adjusted  $R^2$ , and the number of cases analyzed in each step of the regression.

**Vocabulary skills.** Table 2 summarizes the findings of regression models predicting vocabulary. Model 1 suggests that all social and cultural background variables were significant predictors of children's vocabulary scores. Social background (SES and home literacy) explained 24.9% and cultural background (native country and home language) additionally explained 25.5% of variance in the vocabulary scores. There was no significant  $R^2$  increase when the variable 'nursery attendance' was entered additionally into the model. However, the interaction between 'nursery attendance' and German as home language was significant. A split file regression analysis showed that the regression model for children who always spoke German at home accounted for 16.5% of variance ( $F = 31.997, p = .000, \text{adjusted } R^2 = .160, N = 977$ ) in children's vocabulary scores whereas the regression model for children who never or only sometimes spoke German at home accounted for 23.4% of variance ( $F = 16.226, p = .000, \text{adjusted } R^2 = .220, N = 324$ ). The overall model accounted for an adjusted variance of 50.5%.

**Table 2. Hierarchical regressions predicting vocabulary in the first grade from social background, cultural background, nursery experience, and interactions**

Predictor	Model 1		Model 2	
	$\Delta R^2$	$\beta$	$\Delta R^2$	$\beta$
<i>Social background</i>	.249***		.288***	
SES		.230***		.270***
Home literacy		.121***		.099*
<i>Cultural background</i>	.255***		.195***	
Native country		.109***		.084*
Home language German		.545***		.413***
<i>Nursery experience</i>	.000		.022**	
Attendance in a nursery		.099*		
Duration of attendance				.145***
Intensity of attendance				-.100*
<i>Interactions</i>	.005*			
Nursery x SES		.023		
Duration of attendance x SES				
Intensity of attendance x SES				
Nursery x Home literacy		.001		
Duration of attendance x Home literacy				
Intensity of attendance x Home literacy				
Nursery x Native country		.004		
Duration of attendance x Native country				
Intensity of attendance x Native country				
Nursery x German		-.139**		
Duration of attendance x German				
Intensity of attendance x German				
(Constant)	.435		.502	
Total $R^2$	.508		.505	

F	156.681***	58.159***
Adjusted R <sup>2</sup>	.505	.496
Number of cases for steps 1, 2, 3, 4	1372, 1370, 1369, 1365	346, 344, 342

Note – All children attended kindergarten for two years. Missing values were excluded pairwise.  $\Delta R^2$ : change in amount of variance explained ( $R^2$ ),  $\beta$ : standardized coefficients; <sup>+</sup>  $p < .10$ , \*  $p < .05$ , \*\* $p < .01$ , \*\*\*  $p < .001$ . Constant and standardized coefficients  $\beta$  are reported for the complete model with all predictors entered.

Model 2 analyzes the effects of social and cultural background as well as of duration and intensity of nursery attendance in the subsample of children with nursery experience. A higher SES, greater home literacy, Switzerland as native country, and German as home language predicted significantly higher vocabulary scores. With social and cultural background variables held constant, a longer duration of nursery experience predicted higher scores whereas a higher intensity predicted lower scores in vocabulary. Model 2 accounted for 49.6% of adjusted variance in the outcome.

**Table 3. Hierarchical regressions predicting mathematical skills in the first grade from social background, cultural background, nursery experience, and interactions**

Predictor	Model 1		Model 2	
	$\Delta R^2$	$\beta$	$\Delta R^2$	$\beta$
<i>Social background</i>	.026***		.038**	
SES		.082*		.120 <sup>+</sup>
Home literacy		.085*		.064
<i>Cultural background</i>	.002		.009	
Native country		-.011		.084
Home language German		.048		.043
<i>Nursery experience</i>	.001		.002	
Attendance in a nursery		-.007		
Duration of attendance				-.024
Intensity of attendance				-.028
<i>Interactions</i>	.002			
Nursery x SES		.023		
Duration of attendance x SES				
Intensity of attendance x SES				
Nursery x Home literacy		-.014		
Duration of attendance x Home literacy				
Intensity of attendance x Home literacy				
Nursery x Native country		-.048		
Duration of attendance x Native country				
Intensity of attendance x Native country				
Nursery x German		-.003		
Duration of attendance x German				
Intensity of attendance x German				
(Constant)	.503		.444	
R <sup>2</sup>	.031		.048	
F	4.926***		2.888**	
Adjusted R <sup>2</sup>	.025		.032	
Number of cases for steps 1, 2, 3, 4	1372, 1370, 1369, 1365		346, 344, 342	

Note - All children attended kindergarten for two years. Missing values were excluded pairwise.  $\Delta R^2$ : change in amount of variance explained ( $R^2$ ),  $\beta$ : standardized coefficients; <sup>+</sup>  $p < .10$ , \*  $p < .05$ , \*\* $p < .01$ , \*\*\*  $p < .001$ . Constant and standardized coefficients  $\beta$  are reported for the complete model with all predictors entered.

The high determination coefficients  $R^2$  might be a sign of multicollinearity among the predictors. However, the lowest tolerance value in model 1 was found for the interaction term Nursery x

German (.219). That suggests that this interaction term correlates most strongly with all the other predictors and is therefore the least independent among the predictors. Nevertheless, the value does not fall below the critical threshold of .10 (Urban and Mayerl, 2006). In model 2, the lowest tolerance value was identified for SES (.659) and was thus not critical either.

**Mathematical skills.** Table 3 combines the results of regressions of mathematical competency on social and cultural background, nursery experience, and interaction variables. Model 1 suggests that mathematical competency is affected significantly by social background but not by cultural background, nursery attendance, or interactions. Model 2 indicates that among children with nursery experience, the block of social background variables explains a significant amount of variance in mathematical skills whereas cultural background has no significant effect. Duration and intensity of nursery attendance and interactions prove unrelated to mathematical competencies when social and cultural background variables are held constant. Altogether, the predictors in the two models account for only a small proportion of adjusted variance (2.5% and 3.2%) which suggests that various other factors influence mathematical competencies apart from the ones included in the analysis.

## **Discussion**

This study addressed three main questions: first, whether social and cultural differences exist between nursery attendees and non-attendees; second, whether effects of nursery experience vary with children's sociocultural backgrounds; and third, how duration and intensity of nursery attendance affect children's skills.

### **Differences between Attendees and Non-Attendees**

Social disparities in children's access to nursery were identified. On average nursery attendees came from socially more privileged families than did non-attendees, as indicated by differences in socioeconomic status and home literacy. This finding is in line with the evidence of other studies (Jamieson et al. 1999; Kagan 2006; Meier 2008; PACE 2002; Shin 2005) and may encourage policy makers to take measures that facilitate the access to early childhood education and care provisions for socially disadvantaged children growing up in impoverished environments.

### **Do Effects of Nursery Experience Vary with Children's Sociocultural Backgrounds?**

In order to scrutinize differential effects of nursery on children from varying backgrounds, a more general question needs to be addressed first: did sociocultural background affect the skills of children in the present sample?

***Effects of sociocultural background on children's skills.*** Regression analysis—a statistical technique used to examine the relationship between children's sociocultural background and their cognitive proficiency in primary school—indicated that children from socially more privileged families began their lives with higher skills than their more disadvantaged peers. Specifically, a higher SES and greater home literacy impacted positively on children's mathematical and vocabulary skills. With social background characteristics held constant (in order to rule out spurious relationships between variables), cultural background influenced vocabulary. Children who always spoke German at home and children whose native country was Switzerland attained higher vocabulary scores than children who only sometimes or never spoke German at home and children with a different native country.

Although the regression models predicting vocabulary might be to some extent tautological—as some of the predictors and the outcome vocabulary are relatively closely related to each other—the result concerning the influence of cultural background on vocabulary is consistent with findings that established adverse effects of various family background variables on children’s emergent skills and achievement (Barnett and Belfield 2006; Karoly et al. 1998; Ramey and Ramey 2004). The findings support the idea that social disadvantage can have a detrimental impact on children’s competencies (Duncan et al. 1994; Lee and Burkam 2002; Niles et al. 2008). According to previous studies, low socioeconomic status can be harmful mainly when it is coupled with unfavorable home learning experiences (Melhuish et al. 2008) and other social risk factors such as exposure to violence since these factors can mediate the association between socioeconomic status and children’s cognitive functioning and social well-being (Foster et al. 2005), that is, socioeconomic status can influence social risk factors which in turn can affect child outcomes.

Familiarity with a society’s cultural background appears to be of importance for skill development. The results of the present study corroborate evidence of associations between a child’s command of a society’s language and the child’s school achievement and educational success (Esser 2006). Children from immigrant families often perform poorer than their native peers on a wide range of standardized measures of competencies (Dubowy et al. 2008) although the ‘depth of immigration’ may have an influence on such measures (Hakuta and D’Andrea 1992). Policies that encourage the acquisition of a country’s official language might help children with a migration background to develop capacities required to be competitive in achievement-oriented knowledge societies.

### **Effects of Nursery and Effects of Duration and Intensity of Nursery**

This study identified a number of effects of nursery experience including an important differential effect on children from diverse linguistic backgrounds.

***Nursery attendance.*** Neither vocabulary nor mathematical skills were enhanced by exposure to a nursery when social and cultural background was controlled for. However, it has to be noted that children who attended a nursery came from better educated and assumedly better earning families within the sample. As children from lower educated and less earning families might benefit more from attending childcare, the present result must not be interpreted as a general rule. Moreover, the insufficient supply of nurseries in the canton of Zurich might have lowered the overall quality of care and education in nurseries. Thus, in theory, the results might also be a consequence of a low quality of nurseries.

Although nursery attendance proved to have no significant effects on children’s vocabulary and mathematical skills when background variables were held constant, the analysis of interactions (which determine whether the effects of nursery experience differ for different groups of children) revealed an interesting result: the impact of nursery on vocabulary was smaller for children who always spoke German at home than for children who never or only sometimes spoke German at home.

***Duration of attendance.*** The assumption that duration of exposure to a nursery influences child development was confirmed only for the vocabulary outcome. A longer duration was more likely to be associated with higher scores, suggesting that the number of years children spend in early childhood services contribute to the development of their active knowledge of words and nouns.

***Intensity of attendance.*** A higher intensity of nursery attendance was related negatively to vocabulary scores. This finding is consistent with some previous studies showing that risks are associated with intensity of childcare although these studies primarily point to risks related to parent-



child relationships, social adjustment, levels of aggression, and distress during separations from the mother (Bates et al. 1994; Belsky 2006; Loeb et al. 2007; NICHD 1997).

### **Limitations of the study**

The original study was carried out meticulously and it provided a wide range of information including careful one-on-one assessments of children's abilities. However, it did not collect data about the quality of nursery and family learning environments and it sourced information about nursery experience retrospectively. Thus, instead of a treatment effect, a selection effect might be found.<sup>vi</sup> For this reason, important sociocultural background variables were held constant in the present regression analyses. They can be understood as indicators of the quality of a family learning environment since they were found to be linked with informal learning in the family and were hypothesized to be to a large extent responsible for children's developmental progress (Gauvain 1998; Hoff 2006; Hoff and Tian 2005; Lee and Burkam 2002; Leseman 2002). This procedure and the estimation models used are consistent with the method and estimation models of important related studies (e.g. Loeb et al. 2007; Spiess et al. 2003). Note also that the children in the present sample were grouped in different primary school classes when their cognitive skills were tested. Individual test results might thus be related to particular characteristics of school classes. Intraclass correlations were performed and suggest that multilevel models could be conducted. Yet as the data set did not provide information about the characteristics of individual school classes, the present study refrained from using multilevel modeling (a technique frequently used to deal with data of children who are grouped together in classes).

### **Contextualizing the findings in research and implications for policy**

In accordance with previous studies (Jordan et al., 1992; Magnuson et al., 2004; 2007b), the present study highlights that mathematical skills vary to a lesser degree with family environment variables than language skills. However, the current study yielded smaller effects of background variables and early intervention on mathematical skills than two previous analyses that were based on similar study designs (Magnuson et al. 2004, 2007b). The main reason for this discrepancy might be the fact that the previous regression models which accounted for greater variance included a larger set of measures of child and family characteristics including income-to-needs ratio, family structure and size, race and ethnicity, birth weight and weight at the time of measurement, home learning environment, and quality of the child's neighborhood and school environment (ibid.).

In view of different recent studies, the evidence about the effects of participation in early care and education services on cognitive skills ultimately remains inconsistent. In this study, nursery attendance did not explain any significant unique variance in vocabulary or mathematical skills over and above social and cultural background variables. This finding is in line with the result of a study from Turkey – based on a sample of families with low socioeconomic standing in terms of parental income, education levels, and housing conditions – which found no effects of early intervention on mathematics skills as measured at age seven (Kagitcibasi et al. 2001). However, the finding contradicts evidence from the Effective Preschool and Primary Education study (conducted in the UK) whereby preschool attendance impacted positively on mathematics skills of children from diverse social and ethnic backgrounds in primary school (EPPE, 2008a). It must be noted that the size of the impact of preschool in the EPPE study depended on the quality of the center. This suggests that differences in the results can be traced to variations in the quality of early childhood services (cf. Burchinal et al. 2000; Early et al. 2007; ECCE 1999; NICHD 2002). In addition, further predictors of child outcomes have been described and might account for differing results, notably curriculum (Guimarães and McSherry 2002; Schweinhart and Weikart 1998; Siraj-Blatchford and

Sylva 2004; Stipek et al. 1995) and timing, breadth, and flexibility of programs (Bos et al. 2007; Gullo and Burton 1992; Ramey and Ramey 1998). So far, no study has taken into account all of the potentially significant explaining variables simultaneously.

**Establishing equal educational opportunity.** Early care and education programs frequently aim to establish equal educational opportunity for children by compensating for disadvantage and vulnerability resulting from factors such as poverty, ethnicity, gender, minority status, or religion (UNESCO 2007). However, as long as discrepancies persist in access to early childhood services for children from different social backgrounds, these goals will remain purely theoretical. Where basic early childhood care and education is not accessible, educational attainment is likely to remain associated with the family backgrounds of children (e.g. Schütz and Wössmann 2005b). Evidence of disparities in access might stimulate policymakers to facilitate the access of children from socially disadvantaged backgrounds to early childhood institutions. Although political measures supporting underprivileged children will be unlikely to destroy social inequality entirely, they might prevent social, cultural, and economic background—which now contribute considerably to inequality and disadvantage (e.g. McLoyd 1998; Votruba-Drzal 2003)—from determining children’s development to the same distinct extent as nowadays.

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<sup>i</sup> Home literacy has been operationalized as a measure of frequency or exposure to literacy experiences, ranging from the mere counting of the number of books in a family's household to more sophisticated attempts to estimate the amount of time spent on literacy events such as shared book reading (Leseman and De Jong 1998).

<sup>ii</sup> The cut off score of 200 books divided the sample best into two groups of children: 65.7% of children had 0-200 books and 34.3% of children had more than 200 books.



<sup>iii</sup> These background measures must not be interpreted as direct indicators of the quality of an early family learning environment. The empirical evidence concerning the associations between sociocultural background and child development (see studies cited above) merely justifies the assumption that such background variables can be understood as approximate estimates of the preconditions for children's learning processes.

<sup>iv</sup> Out of 472 children with nursery experience, 423 children attended kindergarten for two years (89.9%). As this was the overwhelming majority, the analyses were carried out on data for these children only so that the duration of kindergarten attendance could not function as an intervening variable. In the resulting sample ( $n = 1.623$ ), all children had two years of kindergarten experience. In Switzerland, kindergarten is a government-run institution and its pedagogical approaches as well as opening hours are relatively homogeneous in most institutions. It can therefore be assumed that the kindergarten experience was comparable with regards to curricula, educational aims, and intensity for all the children in the present sample. In 2003, the mean duration of kindergarten attendance was slightly less than two years in Switzerland (Wolter et al. 2007) suggesting that the sample can be considered as representative in this respect.

<sup>v</sup> Interaction terms were not included in order to avoid multicollinearity.

<sup>vi</sup> A selection effect means that parents who decide to use a nursery for their child might hypothetically be those who care more about the conditions in which the child can acquire important competencies. Consequently, a superior test performance of children with nursery experience might be due to more extensive parent support—which would represent a selection effect—rather than to nursery attendance itself (see Spiess et al. 2003).