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ABSTRACT

Where to Put the Kids? Effects of Type of Non-parental Child Care on Pre-teen Skills and Risky Behavior*

This paper investigates pre-teenage effects of the choice of type of non-parental child care at age three (preschool relative to more informal family day care). We exploit a Danish panel data child survey merged with administrative records along with a pseudo-experiment that generates variation in the take-up of preschool across municipalities. As outcomes, we consider measures of overall and risky behavior in addition to objective and self-evaluated abilities. We find no strong evidence that one type of non-parental care outperforms the other, though children who have been placed in preschool tend to like school better.

JEL Classification: J13

Keywords: child care, skills, risky behaviors, evaluation

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1. Introduction

It is becoming increasingly clear that childhood experiences and interventions are pivotal for the development of both cognitive and behavioral skills. A large literature focuses on the effects on child development of non-parental versus parental care. See Almond and Currie (forthcoming), Blau and Currie (2006), Currie (2001) and Ruhm (2004) for excellent surveys and Baker et al. (2008) and Havnes and Mogstad (forthcoming) for recent studies that exploit plausible exogenous variation in access to non-parental care. For many parents, however, the relevant choice is not *whether* to place the child in non-parental care but *which type* to choose. We bring evidence from a regime with large-scale publicly provided universal care. 85 % of the three-year-old Danish children considered in this paper are enrolled in some type of non-parental care, and when enrolled spend around 33 hours per week in non-parental care. In comparison, Blau and Currie (2006) report that 75 % of US children aged 0-4 whose mothers were employed in 1999 were in some form of non-parental care.

Expensive early childhood programs aimed at disadvantaged children have proven to be effective, whereas remedial programs introduced later in life are not; see e.g. Heckman (2008). But what do we know about the effectiveness of the kind of non-parental care for the population of children as a whole? Though there is not complete agreement with regards to the results and though most work compare non-parental care to parental care, recent literature (Bernal and Keane (2008); Datta Gupta and Simonsen (2010); Gregg, Washbrook, Propper, and Burgess (2005); Magnuson, Ruhm, and Waldfogel (2007)) suggests that it is important to distinguish between different types of non-parental care. Except for the paper by Datta Gupta and Simonsen (2010) none of these papers have access to variation that drives the mode of non-parental child care but not outcomes. Most of these studies also investigate effects on cognitive outcomes, although recent literature (see for example

Heckman et al. (2006) and Grönquist, Öckert and Vlachos (2010)) suggests that non-cognitive outcomes may be just as important.

Our paper contributes to the literature investigating the question of mode of non-parental care by following up on the short-term analysis by Datta Gupta and Simonsen (2010). Specifically, we consider the effects at age 11 of being enrolled at age three in relatively high quality formal center based child care vis-à-vis more informal care[1] (family day care) where a child-minder in her own home cares for a small group of children from several families, comparable to an out-of-home nanny.[2] In contrast to Datta Gupta and Simonsen (2010) who only consider behavioral outcomes at age seven and find that preschool is beneficial, we analyze both objective and self-reported measures of cognitive and non-cognitive skills as well as risky behavior such as smoking, drinking, petty theft and vandalism. In contrast to most of the existing literature, we exploit plausible exogenous variation in the take-up of preschool that stems from a pseudo-experiment generating waiting lists for preschool in some municipalities while guaranteeing open slots in others.

Estimations are carried out using a longitudinal representative survey following children born in September and October of 1995. The survey holds information about children, mothers, and fathers and is linked to highly reliable administrative registers providing us with crucial background information about the parents and their labor market behavior. We interpret the estimated effects as those of early child care enrollment including any indirect effects that arise because children in one

[1] Bernal and Keane (2008) uses the term informal care about care by relatives or non-relatives in non-center-based settings.

[2] Blau and Currie (2006) report that 28 % of US children aged 0-4 whose mothers were employed were in non-relative care that includes family day care, nannies, and baby sitters.

type of care follow different paths or are exposed to different environments and types of upbringing than children in other types of care, after the age of three. Roughly speaking, because children enrolled in informal care shift into preschool later on, we measure the effect of enrolling in preschool at age three rather than at age four. We find that eleven-year-old children who have been enrolled in informal family day care at age three fare just as well as children who have been in preschool but tend to like school less. In particular, our results indicate that the age-seven-gaps in behavioral outcomes due to choice of type of child care are closed at age eleven. Families are either fully capable of dealing with these initial behavioral differences or exposure to primary school and after-school care for up to five years equalizes (or institutionalizes) children, which dilutes the initial effects.

The paper is organized as follows: Section 2 describes our data and the institutional framework and Section 3 discusses the empirical framework. Results are shown in Section 4, Section 5 provides sensitivity analyses, and Section 6 concludes.

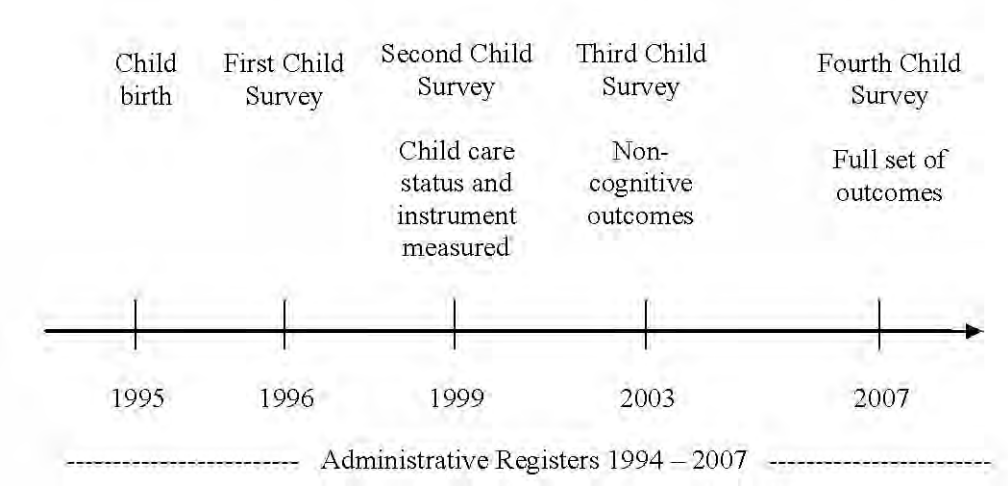
2. Data and Institutional Framework

We exploit a panel dataset on children's outcomes, modes of care, and parental background information, known as the Danish Longitudinal Survey of Children (DALSC). The data consist of repeated surveys of the primary parent of initially roughly 6,000 children born between 15 September and 31 October 1995. The first survey took place when the children were 6 months old (1996), the second when they were around 3½ (1999), the third at age 7½ (2003) when the children are expected to have started first grade (age 7 in Denmark), and the fourth at age 11½ (2007). The fathers of these children were surveyed separately in some of these waves. In addition, a special segment on children's health and welfare was added to the mother survey in 2003 and 2007 and the

children themselves were surveyed in the 2007 wave. The surveyed individuals, be it mothers, fathers, or children, are alone with the interviewer during the interview. This is obviously important for the validity of the survey information. Unfortunately, as is common with surveys, the data suffer from attrition. Appendix A discusses this at length.

FIGURE 1

TIMING OF SET-UP



The survey data have been merged to administrative registers holding information on parents' educational attainment, labor market status, hours of work, wages and income for the period 1994-2007. Self-reported child care enrollment status is measured in 1999 and child outcomes are recorded in 2003 and 2007. Unfortunately, the sets of child outcomes are not fully overlapping; cognitive measures are, for example, only available in the 2007 survey round. Furthermore, our instrument for child care choice is available in 1999 only, which precludes an analysis of the effects of the timing of different types of care. Figure 1 above shows the timing of our set-up. In what follows, we will consider exposure to child care at age three and focus on the subsequent child outcomes measured at age eleven.

2.1 Child Care in Denmark

Danish child care is for the major part publicly provided, paid for, and organized within the 271 municipalities. Municipalities provide *nurseries* for children 0-2 year old children, *preschools* for children 3-6 year old children and *after-school programs* for school children, all of which are center based. In addition, municipalities organize *family day care* that takes place in private homes for children below the age of 14.[3] The municipality is free to decide on the distribution of the different types of care but must cover 'local needs' in terms of number of slots at a given age. Here we focus on care for three-year-olds: preschool and family day care. At age three, about 66 % of children are enrolled in preschool and 16 % are in family day care. About 15 % of the children are taken care of at home. In the following, we will ignore the small fraction of children participating in private and other specialized care.

Preschool programs in Denmark (along with other Nordic countries) are characterized both by high quality and expenditure levels per capita compared to other countries and usage, see Datta Gupta, Smith and Verner (2008). Requirements of qualifications of child care staff are extensive compared to other EU (and OECD) countries and the number of children per staff member is much lower, see OECD's Family Database. In Danish preschools, the average staff:child ratio is 1:7, whereas in the US and Canada, for example, the corresponding ratio is 1:12 (1:14 for teaching staff), in Spain 1:13, and France 1:19. In fact, according to OECD's Family Database for 2007, Denmark has the lowest average number of children per staff member in preschools among all OECD countries.

In 1999 (when the children in our sample were three years old), the average yearly expenditures for a slot in center-based preschool for three-year-olds were approximately $8,000. This is significantly higher than the expenditures for, for example, the American Head Start Program aimed at low-

[3] In reality, though, children in family day care are much younger than 14, see below.

income families which costs around $5,000 per year, see Currie (2001), and roughly the same as the expenditures for the universal Canadian child care program, see Baker, Gruber, and Milligan (2008). Family day care is more expensive than center-based preschool; the average yearly costs are about $10,000.[4] This is presumably because staff-to-child ratios are higher (minimum of 1:5) for this type of care for the age group in question. Prices are set at the municipality level once a year and hold throughout the municipality for a given type of care.[5]

Preschool and family day care

The average *preschool* (that may be integrated with nursery centers for 0-2 year olds) facilitates about 60 children who are split into smaller groups of about 20 children. Each of these preschools employs around 9 permanent teachers plus a number of assistants and other staff, thus allowing for considerable specialization of labor. About 9 % of preschool teachers are male. Preschool teachers in permanent positions must have a degree in teaching (medium length tertiary education or 15-16 years of education) and specialize in young children. The municipalities are required by law to monitor the institutions closely regarding educational content as well as safety and hygiene. Regulation of the former requires ensuring that the personnel have the necessary qualifications, whereas regulation of the latter includes accident-preventing measures, play-grounds, transport, sleeping facilities, toys, hygiene, and insurance schemes. Importantly, institutions are child-centered and focus on socialization rather than a basic skills curriculum. The maximum number of children

[4] For 0-2 year olds, family day care is the cheaper option.

[4] Parents pay a maximum of 33% of the total costs of providing care, and the price is reduced with lower income and number of siblings enrolled in public care, for either type of care. See Simonsen (2010) for a detailed description of the pricing scheme. In the empirical analysis we condition on the determinants of parental income to account for selection into types of care based on income.

per preschool teacher is determined through collective bargaining between the municipalities and the preschool teachers' trade union (BUPL). The norm for 1999 was set at the 1997 collective bargaining. These institutional details will turn out to be important for our identification strategy described below.

In contrast, non-center-based *family day care* is care where a child-minder in her home cares for a small group of children from several families, comparable to an out-of-home nanny. 99 % of the child-minders are female. The caregivers are directly employed by the municipality. Again, the municipalities must approve the facilities and the qualifications of the caregiver. There may be up to five children in each home, and in some municipalities the caregiver's own children under the age of three enter into the total number of children in the family day care. The caregiver will then receive compensation from the municipality for taking care of her own children. Caregivers in charge of family day care are not required to have a degree in teaching but are offered shorter (3-week) vocational courses.

Allocation of slots in child care

All children are eligible for municipality child care, including children born to unemployed parents.[6] It is in fact *illegal* to exclude certain groups of children from participating. This means that children's right to child care enrollment is not affected by their parents' transitions in and out of the labor market. Presumably, if child care does contribute to the development of social and academic skills, we may expect such disruptions to be detrimental to learning.

[6] The only exception occurs if one of the parents takes formal publicly supported maternity or child care leave aimed at the child in question.

Parents apply for child care (either preschool or family day care) by sending an application to the municipality; the child care institutions are not involved in the allocation process. Thus there is no institutional selection bias. The application process is exactly the same no matter whether parents apply for preschool or family day care. Parents enter the date from which care is needed. Upon application, children enter the waiting list. The municipality can decide whether birth date or date of application determines seniority and slots are assigned accordingly. 'Degree of need' is specifically not taken into consideration but certain exceptions are made to accommodate special social or pedagogical circumstances such as disabilities and immigrant status. Additionally, a child can jump the waiting list if he or she has older siblings enrolled in municipality provided care. Therefore, we include whether the child is physically disabled, whether the mother is a non-native speaker and the number of older siblings as controls in the analyses below.

Parents may indicate whether they prefer preschool or family day care. However, children with the highest seniority are assigned the *first* open slot. If possible, municipalities will accommodate parents' preferences, but parents do not have the right to a specific slot. Parents may decline the offer they are given.[7] If birth date is used to determine seniority, the only consequence of declining a slot is a delay in the time until the child can enter child care, i.e., once the parents reapply, children will get the same position on the waiting list. It is clearly uncertain when the next slot is available and whether it will be of the preferred type. If seniority is determined based on time on the waiting list, the municipality may decide to blacklist parents for a limited period.[8] Once the child is enrolled in care, he or she will no longer appear on the waiting list for alternative slots. This means

[7] We only have information about the type of slot accepted by the parents, not the slot offered at the outset.

[8] Unfortunately, we do not know which municipalities choose which seniority criterion.

that once a child is enrolled in, for example, family day care, he or she does not have the right to move to preschool (but some municipalities may allow moves anyway).

This system generates four potential groups of parents: 1) Those who were granted a slot in the preferred type of care, 2) those who were granted a slot in the non-preferred type of care and declined the offer, 3) those who are indifferent, and 4) those who were granted a slot in the non-preferred type of care and accepted the slot (i.e. those who weakly prefer to accept the non-preferred slot now compared to declining in order to wait for another slot that may be of the preferred type). It is therefore unlikely to be – unconditionally – random which children end up in which types of care. Presumably, parents who have strong preferences for a given type of care and are willing and capable of waiting for a slot are different from parents who accept a non-preferred slot. Hence, their children may differ as well.

Guaranteed access to preschool (GAPS)

Because of the likely non-random selection into types of care, we look for variation in the take-up of preschool that is unrelated to child outcomes. We exploit the fact that the municipality must provide the 'necessary' number of slots in day care but are free to decide on the distribution of slots in preschool vs. family day care. Therefore, some municipalities are capable of providing *guaranteed access to preschool* (GAPS). This means that all children have the right to a preschool slot within the municipality (but not to a specific slot).[9] This policy generates potential variation in the take-up of preschool across municipalities. If parents on average value preschool over and above family day care, we should expect *GAPS* to increase the take-up of preschool. The instrument

[9] More precisely, the policy guarantees access to center based care (nurseries and preschools). For our purposes, the important feature is access to preschool.

is measured in 1999. This corresponds to the point in time when the parents decide whether or not to enroll their child into preschool.

Two sets of agents can affect whether parents face *GAPS*: the local government and the parents themselves. What determines whether a municipality provides *GAPS*? We will argue that it is optimal from the local government's point of view to aim for exactly meeting demand for slots in preschool: Having open slots is clearly costly in terms of teacher salaries and rent which the municipality (by definition of open slots) is already committed to paying. On the other hand, providing too few slots causes dissatisfaction among municipality inhabitants and may affect voting behavior in the future. Further, remember that, as described above, prices as well as the maximum number of children per preschool teacher in a municipality, the dominant quality parameter, are *fixed* within a given year. Municipalities can therefore not guarantee access to preschool in a calendar year by lowering quality, and there are large fixed costs associated with establishing new preschools. Nor can parents, in the short run, be forced to cover the costs of a lower-than-predicted number of children enrolled in preschool.

Therefore, *GAPS* information provides us with variation in the take-up of preschool which is not a parental choice variable, and it has, arguably, no causal effect on child outcomes by itself. Of course, parents with more to gain from *GAPS* settle accordingly. Firstly, according to Simonsen (2010), there is very limited movement to and from municipalities providing advantageous child care policies. Secondly, there *is* municipality specific variation in child care policies over time, for example driven by changes in the age structure and composition of the population. A couple can therefore not be sure that a municipality will not change its policy. This does not, of course, exclude the possibility that people settle because of child care policies, but it decreases the probability.

Thirdly, it is unlikely that the child care policy is the main driver for settlement when compared to job opportunities and prices of real property. Furthermore, in our empirical analyses we condition on the number of siblings, which is expected to capture part of the expected gains from living in a municipality with *GAPS*.

We realize, of course, that child care policies are likely to be correlated with other municipality specific characteristics which may affect, on the one hand, the parents' decision of where to live and, on the other hand, the municipality's capability of and preferences for providing services in general. To counter this, our conditioning set includes municipality characteristics, see below. The critical feature is whether provision of *GAPS* is correlated with child outcomes. To shed light on this and the degree of selection into *GAPS*-municipalities, Datta Gupta and Simonsen (2010) estimate a probit for living in a *GAPS*-municipality conditioning on the variables from their main analyses. In general, very few coefficients are significant at the 5 % level indicating that selection on observable characteristics is a minor problem. There is also no clear evidence that for example highly able parents locate themselves in municipalities providing *GAPS*.

Interpretation of treatments: Enrollment patterns

It is important to keep in mind that most children in family day care and preschools have been enrolled in care before the age of three – and they continue in care during school ages (after-school programs). To gain more insights into the enrollment patterns, we augment our survey data with administrative data from Statistics Denmark (the Day Care Register). Unfortunately, these data only cover 80% of Danish children enrolled in child care which causes some discrepancies between our

survey data and the register data and makes the latter unsuited for our formal analyses.[10] Furthermore, the timing of the two data sources is not exactly the same; the survey is collected from February to April, while the register data are from March. From 2004 and forward, the register data are collected in the fall. The data do, however, give a rough picture of prior and later enrollment.

TABLE 2[a]

ENROLMENT PATTERNS

			Self-reported	
			Children in preschool in 1999 Age 3½	Children in family day care in 1999 Age 3½
Register data	1997 Age 1½	Nursery	0.13	0.02
		Family day care	0.36	0.58
		Missing (incl. home care)	0.43	0.40
	1998 Age 2½	Nursery	0.32	0.02
		Family day care	0.40	0.74
		Missing (incl. home care)	0.43	0.43
	1999 Age 3½	Preschool	0.75	0.17
		Family day care	0.03	0.66
		Missing (incl. home care)	0.17	0.17
	2000 Age 4½	Preschool	0.82	0.80
		Family day care	0.00	0.02
		Missing (incl. home care)	0.17	0.17
	2001 Age 5½	Preschool	0.81	0.80
		Missing (incl. home care)	0.17	0.18
	2002 Age 6½	Preschool	0.11	0.19
		After school care	0.66	0.61
		Missing (incl. home care)	0.23	0.20
	2003 Age 7½	After school care	0.71	0.73
	2004 Age 9	After school care	0.67	0.63
	2005 Age 10	After school care	0.53	0.44
	2006 Age 11	After school care	0.40	0.24

[a]Until 2004, enrolment in register data was recorded in week 10 (March), from 2004 and forward during the fall. Self-reported enrolment in 1999 was recorded in the spring.

[10] Prior enrollment is included as a conditioning variable. Whether we include this information or not does not change that conclusions from the empirical analyses.

Table 2 shows enrollment from age 0-11. Here it is clear that the majority of children in family day care at age 3½ were also in family day care earlier on, whereas children in preschool at age 3½ have been placed in both family day care and center based nurseries. At age 4½, most children are in preschool regardless of type of care at age 3½ but preschool children are more likely to enroll in after school care until the age of 11. Conditional on prior enrollment, therefore, the treatment "participation in preschool relative to family day care at age 3½" roughly corresponds to evaluating the effect of about one extra (early) year of preschool combined with a slightly higher propensity to enroll in after school care at ages 10-11. One might argue that an extra early year of preschool is a relatively weak treatment. See, however, the recent work by Chetty et al. (2010) that documents that a single year of high quality early childhood classroom education has long-lasting impacts.

There is a weak tendency for children in family day care at age 3½ to stay in preschool at age 6½ and consequently delay school start. This is possibly a consequence of the treatment, though it may also indicate that family day care children are weaker children. Because the register data are suboptimal in our context, it is difficult to make hard conclusions. To account for this, our conditioning set includes a number of child related characteristics.

2.3 Child Outcomes

In our empirical analysis we consider a range of outcomes, all measured at age 11½ when the children are expected to be in fifth grade. It should be stressed that all outcomes, therefore, are measured at different (later) points in time than our treatment. Had this not been the case, or had the two types of information been linked in the survey, one may have feared that parents would be inclined to rationalize their choice of child care and overestimate good child behavior, which could bias our results below. Also, survey responses may be biased – children may, for example,

overestimate their abilities – but as long as the bias is unrelated to the treatment we will still get unbiased treatment effects. Table 3 shows means of all outcomes across types of care.

Our first outcome measure is the *Strength and Difficulties Questionnaire* (*SDQ*), a behavioral measure known from the child development literature, cf. Goodman (1997). To avoid confusion, denote *SDQ* measured in 2003 *SDQ2003* and *SDQ* measured in 2007 *SDQ2007*. The *SDQ* index is based on emotional symptoms, conduct problems, hyperactivity/inattention problems, and peer relationship problems. In addition to these subscales, a subscale measures pro-social behavior. Parents are asked 25 questions about the child's behavior. Response categories are "not true", "somewhat true" and "certainly true". The five items in each subscale are scored 0 to 2 (where a higher score indicates worse behavior, except for the positive subscale for which the scoring is reversed), giving scores ranging from 0 to 10 for each subscale, summing up to the total difficulties scores ranging from 0 to 40. See www.sdqinfo.com for further details including a list of the questions used to construct the *SDQ* index.

Although the Strengths and Difficulties Questionnaire is a relatively new instrument, it has already seen widespread use for psychiatric screening of children and adolescents (i.e., Hawes and Dadds, 2004; Klasen et al., 2000; Koskelainen et al., 2000; Mathai et al., 2002; Woerner et al., 2004). Research finds that the *SDQ* and Rutter questionnaires correlate highly and do equally well in terms of classifying behavior, see Goodman (1997). A closely related measure, the *Behavior Problem Index* is used in Cunha and Heckman (2008) to investigate the production of cognitive and non-cognitive skills. Table 3 indicates that there are no significant differences in *SDQ2007* across types of care. Also, Figure 2 shows the distribution of the *SDQ2003* and *SDQ2007* indices in our sample.

We see that the distribution of *SDQ2007* is shifted to the left compared to the distribution in 2003. Thus children encounter fewer behavioral problems as they grow older.[11]

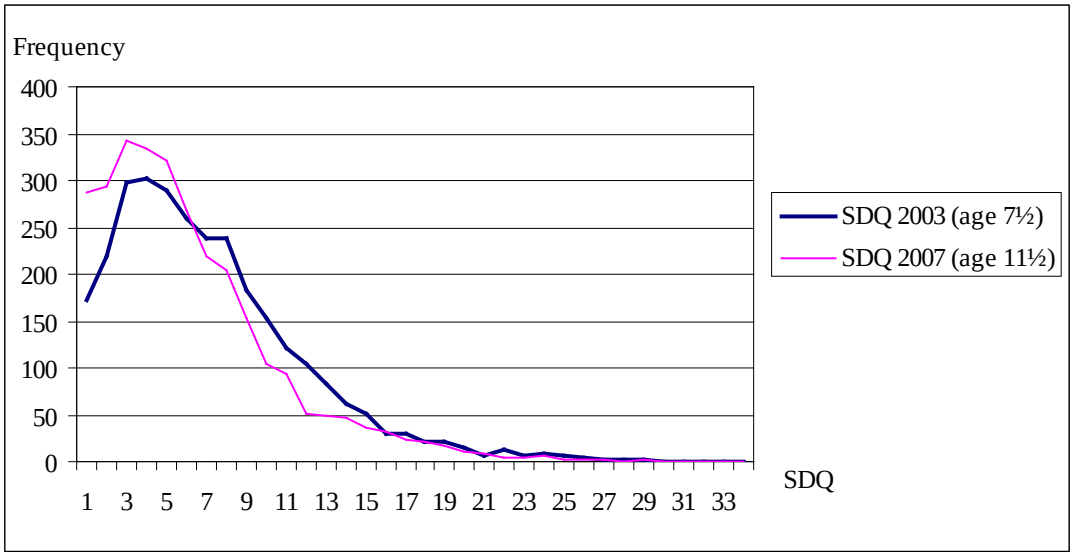
Our second set of outcomes consists of objective performance measures. One is a multiple choice language test consisting of 34 questions. The other is a multiple choice test of cognitive skills consisting of 40 questions called the Children's Problem Solving or CHIPS test. The test is a non-math test of logic that asks children to choose among a range of possible figures to complete a logical sequence. The language test thus allows for a maximum of 34 points while students can attain a maximum of 40 points in the CHIPS test. The third measure indicates whether school enrollment has been delayed or grades have been repeated.[12]

[11] This is true in other countries as well, see www.sdqinfo.org.

[12] Remember that children are expected to be in grade 5 at age 11 ½. About four per cent are ahead and 23 % are delayed in terms of progression.

FIGURE 2

DISTRIBUTION OF SDQ INDICES



Source: Data used for estimation purposes. SDQ below 14 is 'normal', between 14-16 is borderline, and above 16 is 'abnormal. Danish mean for 11½ year olds 5.23, US mean for 11-14 year olds 7.1, UK mean for 11-15 year olds 8.2. See www.sdqinfo.org.

This latter measure includes 'academic redshirting'; the phenomenon that school enrollment is postponed in order to allow extra time for socio-emotional or intellectual growth. Preschool experiences are likely to be important for this outcome; a recent paper by Elder and Lubotsky (2009) exploits state-variation in kindergarten entrance age to show that the positive association between late school enrollment and achievement test scores reflects skills accumulation prior to kindergarten. Table 3 indicates that preschool children do significantly better than children in family day care both in terms of the language and the cognitive test. Consistent with the enrollment patterns discussed above, they are also less likely to have experienced late school enrollment or grade repetition.

The third set of outcomes measures self-evaluated school performance. Children are asked a series of questions about school: "How well do you think you fare academically?",[13] "How much do you like to go to school",[14] "You are good at math. To what extent do you agree?" and "You are good at Danish. To what extent do you agree?".[15] We form four binary outcome measures based on these questions: "Excellent academic performance", "Likes school very much", "Strongly agree: Good at math", and "Strongly agree: Good at Danish". Clearly these subjective outcomes should be interpreted as a mixture of self-perceived cognitive skills, self-confidence, and ability to adapt to a school environment and demands from authorities. As seen from Table 3, children in preschool at age three have significantly higher self-evaluated math performance at age eleven when compared to children enrolled in family day care. This resonates with the objective performance measures.

[13] Responses: "excellent", "good", "fair", "poor", "do not know".

[14] Responses: "very much", "quite a lot", "average", "not much", "not at all", "do not know".

[15] Responses to the latter three questions: ""strongly agree", "agree", "disagree", "strongly disagree", "do not know".

TABLE 3[a]

OUTCOME MEASURES AT AGE 11 ½

	Mode of child care, age 3 ½			
	Family Day Care		Preschool	
	Mean	# obs	Mean	# obs
Behavioral measure:				
SDQ2003	6.79	806	6.49	3,237
	(5.19)		(5.04)	
SDQ2007	5.35	533	5.18	2,038
	(4.45)		(4.53)	
Objective performance measures:				
Language test	20.34	740	**21.22**	3,000
	(5.38)		(4.97)	
Cognitive skills test	28.84	750	*29.25*	3,031
	(5.52)		(5.26)	
Delayed school entry (or progress) (0/1)	0.26	760	**0.22**	3,083
Self-evaluated school performance:				
Excellent academic performance (0/1)	0.36	727	0.37	2,930
Likes school very much (0/1)	0.25	727	0.24	2,931
Strongly agree:				
Good at math (0/1)	0.37	727	**0.43**	2,929
Good at Danish (0/1)	0.50	727	0.50	2,930
Risky behavior measures:				
Ever smoked (0/1)	0.05	727	0.04	2,930
Ever drunk alcohol (0/1)	0.08	727	0.08	2,929
Petty theft and vandalism (0/1)	0.14	727	0.14	2,930

[a]Bold indicates that means are significantly different at 5% level from that of family day care, while italic indicates significance at 10% level Std. dev. for non-binary outcomes in soft brackets.

Our final set of outcomes relates to risky behavior such as smoking, drinking and petty theft and vandalism. There is a large body of research showing that both smoking and drinking increases the likelihood of poor health and economic outcomes later in life. Similarly, smoking and drinking may induce large social costs. In the survey, children are asked "Have you ever smoked?" and "Have you ever drunk alcohol" and we use these outcomes directly in the analyses. To estimate petty theft and vandalism, we exploit that children are asked whether they have stolen money or smaller objects from parents, friends or shops and whether they have ever painted graffiti or destroyed other

people's property on purpose. On the outset, there are no significant differences in responses across types of care. Of course, some children may be more honest than others and the implicit assumption is that the degree of honesty does not depend on child care enrollment at age three (though it might since child care enrollment affects behavior at age seven, see Datta Gupta and Simonsen (2010)).

3. Empirical Framework

This section first discusses our parameter of interest and then considers identification. We consider the effects on child outcomes at age eleven of participating at age three in preschool compared to family day care. Note that family day care and preschool are policy relevant in the sense that the majority of Danish three-year-old children are enrolled in these particular types of care. We also only include children whose *mother* filled in the questionnaire.[16,17]

Effects of type of child care

Consider participation in preschool, *PS*, relative to family day care for the group of children enrolled in some municipality provided program. Let $PS = 1$ indicate preschool participation, whereas $PS = 0$ indicates family day care. Let O_1 be the potential outcome in family day care and

[16] This is the case for 99% of the children in the survey.

[17] The 15 % of children who are in home care and excluded from the analysis have parents with slightly lower education and a looser connection to the labor market. Their mothers are more likely to smoke, be single, and to be non-native speakers. OLS regressions comparing preschool and family day care to home care show no association between family day care enrolment (relative to home care) and outcomes but preschool children perform significantly better than children in home care in terms of self-reported math and Danish skills.

O_1 be the potential outcome in preschool. We consider the average effect of preschool participation for the group of children enrolled in preschool:

(1) $$E[O_1 - O_0 \mid PS = 1].$$

Our parameter of interest (1) should be interpreted as the effects of preschool relative to family day care, *including* any effects arising via parents' different labor market behavior and income in the two states in the year of treatment. Given that we condition on enrollment in non-parental care, we are, however, not too worried about such indirect effects here. Still, the estimated impacts include the effects of concomitant variables affected by the treatment between the age of three (when enrollment is measured) and eleven (when outcomes are measured). For example, if preschool enrollment affects children's later skill formation differently compared to family day care enrollment, this will be captured by (1).

Consider now a random coefficient model a la Björklund and Moffit (1987). Let O^i indicate observed outcome and X^i observable characteristics for child *i*.

(2) $$O^i = X^i\beta + \alpha^i PS^i + \varepsilon^i$$

or alternatively

(3) $$O^i = X^i\beta + \bar{\alpha}PS^i + \left[PS^i(\alpha^i - \bar{\alpha}) + \varepsilon^i\right]$$

where the term in the squared brackets is the error term. Clearly, *PS* may be correlated with ε if, for example, an omitted variable such as child quality leads to an increased likelihood of enrolling in preschool relative to family day care. Also, *PS* may be correlated with α if parents enroll children in preschool based on expected gains. For this reason, we pursue an instrumental variables strategy and exploit plausible exogenous variation in the take-up of preschool relative to family day care. In particular, we utilize the fact that some municipalities provide guaranteed access to pre-school (*GAPS)*, should parents wish to enroll their children in this type of care, whereas others do not. We

argue above that, conditional on observables, *GAPS* does not affect child outcomes and we can test whether *GAPS* affects the take-up of preschool.

The local average treatment effects (*LATE*) (Angrist, Imbens, and Rubin (1996)) is defined by the variation of the instrument that we are exploiting. Here, the *LATE* associated with the instrument is

(1') $$E\left[O_1 - O_0 \mid PS(GAPS) - PS(no\ GAPS) = 1\right],$$

i.e. the difference in child outcome with and without pre-school exposure for the group of children who would be enrolled in pre-school if they live in a municipality that guarantees access to pre-school but not otherwise. They would be children of parents who are either indifferent or are granted a slot in the non-preferred type but accepted the slot (Groups 3 and 4 in Section 3.1). Hence, these are children of parents who are truly affected by a limited supply of slots. In this sense, this is the policy relevant group. Clearly, some children may not enroll in preschool under either regime, for example, if their parents are very selective in their choice of center or, along the same lines, if one of the parents has strong preferences for staying at home. Similarly, some children may always be enrolled in preschool. This may occur by sheer luck because there is a probability that a child is always granted a slot. (They would be children of parents in Groups 1 and 2 in Section 3.1). Always- and never-takers in the terminology of Angrist, Imbens, and Rubin (1996) do not contribute with any variation and therefore do not affect the parameter estimate.

Furthermore, for the *LATE* presented in (1) above, we need to assume monotonicity; see Angrist, Imbens, and Rubin (1996) and Vytlacil (2002). This assumption implies that the instrument must affect individuals' behavior in one direction only. Otherwise, the estimated *LATE* becomes un-interpretable. Since all *GAPS* does is to ease access to preschool, we only expect parents to be more likely to choose preschool when exposed to the policy and not vice-versa. However, because we

have excluded the group of parents choosing home care from our analysis, we need an extended version of monotonicity, see Froelich (2004) for intuition and Datta Gupta and Simonsen (2007) for a formal proof. In particular, we need it to be the case that

1) parents who use preschool under a *GAPS* regime must not use home care in the absence of *GAPS*,
2) parents who use preschool in the absence of *GAPS* must use neither family day care nor home care under a *GAPS* regime,
3) parents who use family day care under a *GAPS* regime must use neither preschool nor home care in absence of *GAPS*,
4) parents who use family day care in the absence of *GAPS* must not use home care under a *GAPS* regime.

This essentially corresponds to monotonicity combined with independence of irrelevant alternatives assumed in a multinomial logit model. See Datta Gupta and Simonsen (2010) who argue that it is likely to hold in our setting: firstly, because the share of children in home care only varies slightly across municipalities with and without *GAPS* (12 versus 16 per cent) and secondly because a Hausman-McFadden test, see Hausman and McFadden (1984), of IIA cannot reject the hypothesis that the coefficient to *GAPS* in the equation comparing family day care and preschool is the same in a multinomial logit including all alternatives and one in which we only include family day care and preschool (t-statistic is 0.01). Since all *GAPS* does is to ease access to preschool, we only worry about case 1). If it is the case, for example, that more able parents who prefer a slot in preschool choose to keep their child at home instead of sending her to family day care, we will expect the IV results to be upwards biased. See also Deaton (2010), Heckman (2010), and Imbens (2010) for a recent discussion of common threats to the validity of IV estimates.

Estimation

We treat *SDQ2007* as well as the language and cognitive test scores as continuous outcomes and model average treatment effects and local average treatment effects using 2SLS. Thus, we incorporate covariates by assuming that they enter the conditional expectation in a linear fashion and allow for heterogeneity in the effect of care holding other covariates fixed, see e.g. Angrist et al. (2000).

The remaining outcomes considered in this paper are binary in nature and this gives rise to an interesting problem when instrumenting. We know that with both a binary outcome and a binary treatment, two stage procedures where the first stage is estimated in a non-linear fashion after which the fitted values are inserted into a non-linear second stage yield inconsistent treatment effects, see e.g. Angrist (2001), Bhattacharya et al (2006), and Altonji, Elder, and Taber (2005). The reason is that such a procedure fits a misspecified model in the second stage. Also, as demonstrated in an empirical example by Altonji, Elder, and Taber (2005) and in a Monte Carlo study by Bhattacharya et al. (2006), using 2SLS often results in very imprecise and sometimes implausible estimated treatment effects in such a context. A bivariate probit, on the other hand, seems to work better, also when the data generating process is not normal, see Bhattacharya et al. (2006). Note, of course, that these conclusions and recommendations are based on the specific examples given by Altonji et al. (2005) and Bhattacharya et al. (2006). We therefore choose to implement a bivariate probit model and additionally show 2SLS results in the sensitivity analyses, see Section 5.

Choice of conditioning set

In our analysis, we condition on a rich set of variables that explains both outcomes and the choice of child care. We need information about initial conditions, determinants of earlier ability outcomes,

and parental investments. In particular, we include information about the child measured at time of birth (birth weight, breast fed, gender, disabilities, number of siblings etc.), parents (income, labor market history, geographic location, level of education, smoking behavior, immigrant status, whether the father took leave, whether the mother experienced post-partum depression[18]), and municipalities (level of unemployment, number of immigrants, winner of most recent local government election, share of households with children out of all households in municipality). See Table B1 for a detailed description of the variables and Table B2 for means of selected variables across modes of care.

4. Estimation results

This section presents our estimation results. Table 4 presents regression type analyses and IV analysis exploiting *GAPS*.[19] Remember that the results should be interpreted as the effect of enrolling in preschool at age three rather than at age four. As a point of comparison, we first show the main results (SDQ2003) from Datta Gupta and Simonsen (2010). They find that the average child benefit in terms of behavior from being enrolled in preschool relative to family day care. In line with this, the regression analyses show some positive effects of preschool enrollment relative to family day care: children in preschool do slightly better in the language test (0.4 points compared to a mean of about 22) and are less likely to experience delay school enrollment or progression (-4 percentage points relative to a mean of 23 %), i.e., academic redshirting seems to be less prominent for this group. Preschool children are also significantly more likely to state that they are good at most things at school (5 percentage points relative to mean of 48 %), and at math in particular (8

[18] Maternal mental health has been found to be significantly linked to ADHD symptoms in children (e.g. Lesesne et al. (2003)).

[19] The full set of estimation results is available on request.

percentage points relative to 42 %). Overall, the sizes of the effects are small relative to mean outcomes.

Regarding the IV analysis, note first that the instrument is highly significant in the first stage (OLS of take-up of pre-school on *GAPS*) and works in the right direction. The t-statistic clearly passes the Staiger and Stock (1997) rule of thumb that suggest that for the first stage to be sufficiently strong, the t-statistic should be above $\sqrt{10}$. Here, only the indicator for whether or not the child likes school is statistically significant and most point estimates are small. The beneficial effects on language skills, timing of school entry, and self-perceived math skills seem to be due to selection on unobservables rather than causal effects. It is, of course, not unimportant that preschool children enjoy school more but viewed broadly, there are no strong signs that preschool outperforms informal care.[20] As is usual, standard errors are much larger than those of the simple regression analysis. Because of that, we cannot reject that there are some differences in outcomes between children in preschool and family day care. Note also that we are identifying off of a different population in the IV analysis, namely the group of compliers.

[20] There is also room for Type 1 errors when many outcomes are considered simultaneously.

TABLE 4[a]

SELECTED MARGINAL EFFECTS

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcomes	Means	# Obs	Regression type analyses		IV analyses		t-test
			Preschool		Preschool		statistic
			Marg. Eff.	Std. Error	Marg. Eff.	Std. Error	equality OLS vs. IV
Behavioral measure:							
SDQ2003	6.55	4,022	**-0.421**	0.213	*-2.533*	1.33	1.568
SDQ2007	5.21	2,571	-0.200	0.252	-0.314	1.468	0.076
Objective performance measures:							
Language test	21.96	3,742	*0.414*	0.245	-1.853	1.439	1.553
Cognitive skills test	29.17	3,783	0.243	0.255	-0.729	1.551	0.618
Delayed school entry (or progress)	0.23	3,824	*-0.041*	0.023	-0.060	0.227	0.086
Self-evaluated school performance:							
Excellent academic performance (0/1)	0.36	3,653	0.001	0.024	-0.053	0.062	0.808
Likes school very much (0/1)	0.25	3,656	0.028	0.020	**0.107**	0.039	-1.789
Strongly agree:							
Good at most things at school (0/1)	0.48	3,653	*0.046*	0.025	-0.013	0.061	0.890
Good at math (0/1)	0.42	3,654	**0.077**	0.024	-0.029	0.060	1.633
Good at Danish (0/1)	0.50	3,653	0.018	0.025	-0.026	0.060	0.661
Risky behavior measures:							
Ever smoked (0/1)	0.04	3,639	-0.003	0.007	-0.118	0.075	1.526
Ever drunk alcohol (0/1)	0.08	3,633	-0.010	0.013	0.001	0.027	-0.375
Petty theft and vandalism (0/1)	0.14	3,637	0.007	0.017	-0.004	0.035	0.284
First stage: GAPS					**0.149**	0.012	
t-statistic					12.417		

[a]Italic indicates significance at the 10% level, bold at the 5% level. Robust standard errors, clustering at the municipality level. Models for SDQ, language and cognitive skills tests 2SLS. Binary outcomes modeled using bivariate probits. Marginal effects evaluated at the mean. Conditioning set described in B1. Results for SDQ2003 are taken from Datta Gupta and Simonsen (2010).

5. Heterogeneous treatment effects and sensitivity analyses

Effects of enrollment may vary across subpopulations. This section first shows results for each gender and next presents a set of sensitivity analyses where we exclude particular groups. We

finally investigate the sensitivity of our results for the binary outcomes to the choice of bivariate probit model versus 2SLS.

Tables 5 and 6 give the results for boys and girls. The IV results show that preschool mainly affects boys' attitudes towards school: only preschool boys are significantly more likely to like going to school. Also, in contrast to the pooled results, preschool girls are less likely to strongly agree that they are good at most things in school. Interestingly, the estimated effect on behavior at age 11 is large and negative for boys suggesting that they benefit from being enrolled in preschool, whereas the corresponding estimate for girls is large and positive. This is in line with the results from Datta Gupta and Simonsen (2010). On the other hand, boys who have been in preschool seem significantly more likely to engage in risky behavior such as petty theft and vandalism. Unfortunately, the samples are too small to make strong conclusions across gender; some estimates become inflated but so do the standard errors. It does seem that boys are more likely to benefit from preschool relative to girls.

One might hypothesize that labor markets in larger cities are different from those of the provinces, and that this may affect child care policies as well. For example, the county of Copenhagen that includes the Danish capital and largest city with 500,000 inhabitants may be different from the rest of the country. We therefore re-estimate all models above excluding the county of Copenhagen. As seen in the first set of estimations in Table 7, all results are robust to this exclusion

TABLE 5[a]

SELECTED MARGINAL EFFECTS FOR BOYS

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcomes	Means	# Obs	Regression type analyses		IV analyses	
			Preschool		Preschool	
			Marg. Eff.	Std. Error	Marg. Eff.	Std. Error
Behavioral measure:						
SDQ2007	5.63	1,308	-0.307	0.361	-2.845	1.897
Objective performance measures:						
Language test	20.50	1,904	**1.027**	0.411	3.431	2.974
Cognitive skills test	28.58	1,925	0.361	0.439	0.415	2.380
Delayed school entry (or progress)	0.33	1,946	-0.056	0.037	0.064	0.083
Self-evaluated school performance:						
Excellent academic performance (0/1)	0.35	1,859	0.021	0.036	-0.024	0.079
Likes school very much (0/1)	0.21	1,861	0.043	0.027	**0.158**	0.048
Strongly agree:						
Good at most things at school (0/1)	*0.48*	1,859	**0.080**	0.039	-0.035	0.078
Good at math (0/1)	0.49	1,860	**0.078**	0.035	-0.097	0.075
Good at Danish (0/1)	0.44	1,859	0.003	0.038	-0.053	0.083
Risky behavior measures:						
Ever smoked (0/1)	0.06	1,852	-0.008	0.012	-0.157	0.110
Ever drunk alcohol (0/1)	0.12	1,849	0.013	0.018	0.022	0.043
Petty theft and vandalism (0/1)	0.12	1,851	0.011	0.023	*0.054*	0.031
First stage: GAPS					**0.121**	0.03
t-statistic					4.033	

[a]Italic indicates significance at the 10% level, bold at the 5% level. Robust standard errors, clustering at the municipality level. Models for SDQ, language and cognitive skills tests 2SLS. Binary outcomes modeled using bivariate probits. Marginal effects evaluated at the mean. Conditioning set described in B1

TABLE 6[a]

SELECTED MARGINAL EFFECTS FOR GIRLS

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcomes	Means	# Obs	Regression type analyses		IV analyses	
			Preschool		Preschool	
			Marg. Eff.	Std. Error	Marg. Eff.	Std. Error
Behavioral measure:						
SDQ2007	4.78	1,263	-0.005	0.327	3.041	2.199
Objective performance measures:						
Language test	21.62	1,838	-0.073	0.344	0.163	1.968
Cognitive skills test	29.79	1,858	0.118	0.333	-1.019	2.031
Delayed school entry (or progress)	0.12	1,878	-0.016	0.021	-0.053	0.067
Self-evaluated school performance:						
Excellent academic performance (0/1)	0.37	1,794	-0.021	0.031	-0.111	0.097
Likes schoolvery much (0/1)	0.29	1,795	0.009	0.028	0.051	0.092
Strongly agree:						
Good at most things at school (0/1)	0.48	1,795	0.019	0.034	-0.019	0.086
Good at math (0/1)	0.33	1,795	**0.067**	0.030	0.012	0.082
Good at Danish (0/1)	0.57	1,797	0.033	0.034	0.007	0.093
Risky behavior measures:						
Ever smoked (0/1)	0.03	1,787	0.002	0.006	-0.017	0.057
Ever drunk alcohol (0/1)	0.04	1,784	**-0.028**	0.014	-0.014	0.034
Petty theft and vandalism (0/1)	0.12	1,786	-0.002	0.021	-0.125	0.093
First stage: GAPS					**0.150**	0.028
t-statistic					5.357	

[a]Italic indicates significance at the 10% level, bold at the 5% level. Robust standard errors, clustering at the municipality level. Models for SDQ, language and cognitive skills tests 2SLS. Binary outcomes modeled using bivariate probits. Marginal effects evaluated at the mean. Conditioning set described in B1.

TABLE 7[a]

SELECTED MARGINAL EFFECTS, SENSITIVITY ANALYSES

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcomes	Exclude Copenhagen (# obs left 2,425)				Exclude weak children (# obs left 1,080)				Exclude children with siblings aged 4-6 (# obs left 1,788)			
	Regression type analyses Preschool		IV analyses Preschool		Regression type analyses Preschool		IV analyses Preschool		Regression type analyses Preschool		IV analyses Preschool	
	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error
Behavioral measure:												
SDQ2007	-0.230	0.257	-0.235	1.446	-0.509	0.371	-2.771	1.913	*-0.582*	0.304	-0.532	1.811
Objective performance measures:												
Language test	0.397	0.259	-1.441	1.848	0.223	0.373	-1.374	2.072	*0.573*	0.320	-0.996	2.144
Cognitive skills test	0.333	0.249	-0.130	1.549	-0.293	0.367	-1.702	2.088	0.383	0.272	1.518	1.834
Delayed school entry (or progress)	**-0.046**	0.024	-0.056	0.053	-0.021	0.028	-0.005	0.091	*-0.084*	0.029	-0.019	0.058
Self-evaluated school performance:												
Excellent academic performance (0/1)	0.001	0.025	-0.050	0.063	-0.008	0.040	-0.022	0.098	0.005	0.030	-0.108	0.077
Likes school very much (0/1)	0.024	0.021	**0.096**	0.040	0.008	0.033	**0.131**	0.051	*0.045*	0.024	**0.112**	0.049
Strongly agree:												
Good at most things at school (0/1)	*0.045*	0.027	-0.020	0.064	*0.072*	0.038	0.051	0.089	*0.053*	0.030	-0.041	0.082
Good at math (0/1)	**0.080**	0.025	-0.035	0.056	0.043	0.040	-0.034	0.085	**0.079**	0.028	-0.069	0.076
Good at Danish (0/1)	0.022	0.026	-0.016	0.069	0.053	0.038	0.097	0.086	0.024	0.030	-0.074	0.074
Risky behavior measures:												
Ever smoked (0/1)	-0.003	0.006	-0.135	0.084	0.001	0.010	**-0.269**	0.041	-0.003	0.007	-0.100	0.088
Ever drunk alcohol (0/1)	-0.012	0.012	-0.005	0.027	0.018	0.011	-0.025	0.059	-0.007	0.015	0.027	0.015
Petty theft and vandalism (0/1)	0.005	0.016	-0.017	0.036	0.035	0.022	-0.013	0.052	0.013	0.018	-0.021	0.048
First stage: GAPS			**0.134**	0.027			**0.148**	0.033			**0.128**	0.027
t-statistic			4.963				4.485				4.741	

[a]Italic indicates significance at the 10% level and bold at the 5% level. Robust standard errors, clustering at the municipality level. # obs refers to SDQ model. Conditioning set described in Table B1.

TABLE 8[a]

SELECTED MARGINAL EFFECTS

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcomes	Means	# Obs	IV analyses 2SLS		IV analyses Bivariate probits	
			Preschool		Preschool	
			Marg. Eff.	Std. Error	Marg. Eff.	Std. Error
Objective performance measures:						
Delayed school entry (or progress)	0.23	3,824	-0.058	0.138	-0.060	0.227
Self-evaluated school performance:						
Excellent academic performance (0/1)	0.36	3,653	-0.146	0.142	-0.053	0.062
Likes school very much (0/1)	0.25	3,656	0.008	0.123	**0.107**	0.039
Strongly agree:						
Good at most things at school (0/1)	0.48	3,653	-0.072	0.156	-0.013	0.061
Good at math (0/1)	0.42	3,654	**-0.277**	0.144	-0.029	0.060
Good at Danish (0/1)	0.50	3,653	-0.098	0.173	-0.026	0.060
Risky behavior measures:						
Ever smoked (0/1)	0.04	3,639	-0.084	0.055	-0.118	0.075
Ever drunk alcohol (0/1)	0.08	3,633	-0.059	0.078	0.001	0.027
Petty theft and vandalism (0/1)	0.14	3,637	-0.036	0.017	-0.004	0.035

[a]Italic indicates significance at the 10% level and bold at the 5% level. Robust standard errors, clustering at the municipality level. Conditioning set described in Table B1.

The second set of estimations in Table 7 shows the results from dropping particularly disadvantaged children from the sample: children who have not been breast fed, children who have low birth weight, children who are physically disabled, immigrants and children brought up in single parent households affects significance but renders our results largely unchanged. The only major change is that preschool has a significantly reducing effect on smoking for the more advantaged group.

Since having older siblings (aged 4-6) enrolled in care allows a younger child to jump waiting lists, and one may worry that conditioning on sibling information does not sufficiently account for this, we exclude the part of the sample with siblings in the 4-6 age range. The third section in Table 7

presents the results. Again, parameter estimates are robust, though levels of significance are affected slightly because the sample is reduced considerably.

Finally, Table 8 investigates whether our IV results are robust to choosing a 2SLS procedure over a bivariate probit for binary outcomes. As argued above, the latter is more appropriate. Table 8 demonstrates that 2SLS estimates are generally more negative than those from the bivariate probits of Table 4 but the standard errors are also larger. In fact, none of the estimates in Table 8 are significantly different across model type.

6. Conclusion

This paper contributes with rare evidence on the effects of modes of early child care given that a child is placed in non-parental care. Specifically, we investigate whether children benefit from being enrolled for roughly an extra year in preschool at age three relative to non-center-based care in a regime with universal access to care. Outcomes are measured at age eleven and include both objective and self-reported measures of cognitive and non-cognitive skills as well as risky behavior such as smoking, drinking, petty theft and vandalism. We use a longitudinal survey of children born in 1995 that is linked to administrative registers and exploit plausible exogenous variation in the take-up of preschool for identification purposes. Our instrument is a policy that guarantees access to preschool. We therefore estimate a local average treatment effect of the effect of preschool relative to non-center-based care for the group of children whose parents choose preschool when there is unlimited access but not otherwise.

We find no strong evidence that one type of non-parental care outperforms the other. Children put in preschool from an early age appear to do just as well as children looked after in smaller, more

informal non-center-based settings in terms of objective academic performance, self-evaluated school performance, overall behavior and engagement in risky health behaviors and petty crime, all measured at the age of 11.[21] This is rather different from some of the evidence from e.g. the US and Canada that showed deleterious short run effects of institutionalized childcare for children under 3 in terms of increased aggression and disobedience. The only significant result is that children enrolled in preschool at age three seem to like school more than their counterparts in informal care – and this tendency is particularly strong for boys.

The findings from Datta Gupta and Simonsen (2010) that short term behavior was significantly positively affected by preschool enrollment relative to family day care enrollment could be a result of earlier socialization of preschool children which is reflected in their greater emotional and social competence at school-entering age, but there is no significant gap by age eleven. By that age, most children have been enrolled in public schools and made use of common after-school programs, and the exposure to a wide spectrum of peers from different family backgrounds may tend to reduce the variance of skills in the long-run (Esping-Andersen (2006)). The literature investigating effects of early (Kindergarten) classroom and teacher characteristics may also aid our understanding of this result: here it is typically found that teacher experience but not degree impact on child outcomes (e.g. Krueger (1999) and Chetty et al. (2010)) and that smaller class size[22] is preferable both in the

[21] As is usual, however, standard errors from the IV analysis are large. Because of that, we cannot reject that there are some differences in outcomes between children in preschool and family day care.

[22] In the STAR Project analyzed in Krueger (1999) and Chetty et al. (2010), class sizes of on average 15 students were compared to class sizes of roughly 22 students. This is clearly a different margin than the one we consider in this paper.

short and very long run. Given these results, it is not ex ante obvious which type of non-parental care is the better option. Whether there will be longer run effects of type of non-parental childcare remains an open question. Several papers find long-term effects of early interventions despite a fade out in the medium term (e.g. Chetty et al. (2010) for the STAR project, Heckman et al. (2010) for the Perry Preschool Project, and Currie and Thomas (1995) for the Head Start Program), though this is argued to be because of persistent effects on behavior, which we do not find much evidence of in this paper.

Of course, one could argue that Danish child care is universal, highly regulated and of relatively high quality, at least in terms of staff per child, and as such not representative of preschool elsewhere. Yet universal publicly subsidized child care effective in e.g. the Nordic countries is an important policy on the political agenda in many countries. Universal care was recently introduced in Quebec, Canada, and similar programs are in place in the US states of Georgia, New York, and Oklahoma. The European Union is also pushing for increases in access to child care among its member countries. The Nordic countries, in our case Denmark, provide a unique laboratory in which one can evaluate the effects, not only of the introduction of such a regime as in Havnes and Mogstad (forthcoming) but also of an established version of universal care. Furthermore, one can think of our estimates as upper bounds on the effects of preschool relative to (regulated) non-center-based care in a setting with universal care: if relatively high quality preschool does not matter much for child outcomes compared to informal non-center-based care, there is no reason to expect lower quality preschool to improve on child outcomes either, given the same quality of non-center based care.

Given the limited work in this area, more work is clearly needed. In particular, it would be interesting to explore the extent of heterogeneity in effects using larger samples than the one available in this paper.

References

Almond, D. and J. Currie (forthcoming), 'Human Capital Development Before Five' in Handbook of Labor Economics, David Card and Orley Ashenfelter (eds.)

Altonji, J. G., T. E. Elder, C. R. Taber (2005), 'An Evaluation of Instrumental Variable Strategies for Estimating the Effects of Catholic Schooling, *Journal of Human Resources* 40, 791-821.

Angrist, J. D. (2001), 'Estimation of Limited Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice, *Journal of Business and Economic Statistics* 19, 2-16.

Angrist, J. D., K. Graddy, and G. W. Imbens (2000), 'The Interpretation of Instrumental Variables Estimators in Simultaneous Equations Models with and Application to the Demand for Fish', *Review of Economic Studies* 67, 499-527.

Angrist, J. D., G. W. Imbens, and D. B. Rubin (1996), 'Identification of Causal Effects Using Instrumental Variables', *Journal of the American Statistical Association* 91, 444-455.

Baker, M., J. Gruber, and K. Milligan (forthcoming): 'Universal Childcare, Maternal Labor Supply and Family Well-being', *Journal of Political Economy*.

Bhattacharya, J., D. Goldman, and D. McCaffrey (2006), 'Estimating Probit Models with Self-Selected Treatments', *Statistics in Medicine* 25, 389-413.

Belsky, J., D.L. Vandell, M. Burchinal, A.K. Clarke-Stewart, K. McCartney, M.T. Owen and the NICHD Early Child Care Research Network (2007): 'Are Their Long-Term Effects of Early Child Care?', *Child Development* 78, Issue 2, 681-701.

Bernal, R. and M. Keane (2008): Child Care Choices and Children's Cognitive Achievement: The Case of Single Mothers', mimeo, Universidad de los Andes.

Björklund and Moffit (1987), 'The Estimation of Wage Gains and Welfare Gains in Self-Selection Models', *The Review of Economics and Statistics* 69, 42-49.

Blau, D. and J. Currie (2006), 'Who is Minding the Kids', The Handbook of Education Economics, F. Welch and E. Hanushek eds, New York: North Holland.

Carneiro, P. and R. Ginja (2008), 'Preventing Behavior Problems in Childhood and Adolescence: Evidence from Head Start', mimeo University College London.

Chetty, R., J. N. Friedman, N. Hilger, E. Saez, D. W. Schanzenbach and D. Yagan (2010), 'How Does Kindergarten Classroom Affect Your Earnings? Evidence from Project Star', NBER working paper # 16381.

Cunha, F. and J. Heckman (2008), 'Formulating, Identifying, and Estimating the Technology of Cognitive and Non-cognitive Skill Formation', *Journal of Human Resources* 43, 738-782.

Currie, J. (2001), 'Early Childhood Intervention Programs: What Do We Know?', *Journal of Economic Perspectives* 15, 213-239.

Currie, J. (1994). 'Welfare and the Well-being of Children: The Relative Effectiveness of Cash and in-kind Transfers', in James M. Poterba eds, Tax Policy and the Economy Vol. 8, MIT Press.

Currie, J. and D. Thomas (1995), 'Does Head Start Make a Difference?', *The American Economic Review* 85, 341-364.

Currie, J. and D. Thomas (1999), 'Does Head Start Help Hispanic Children?', *Journal of Public Economics* 74, 235-262.

Currie, J., E. Garces, and D. Thomas (2002), 'Longer Term Effects of Head Start', *The American Economic Review* 92, 999-1012.

Datta Gupta, N. and M. Simonsen (2010), 'Non-cognitive Child Outcomes and Universal High Quality Child Care', *Journal of Public Economics* 94, 30-43.

Deaton, A. (2010), 'Instruments, Randomization, and Learning about Development', *Journal of Economic Literature* 48, 424-455.

Elder, T. E. and D. H. Lubotsky (2009), 'Kindergarten Entrance Age and Children's Achievement', *Journal of Human Resources* 44, 641-683.

Esping-Andersen, G. (2006). 'Families, Government and the Distribution of Skills', mimeo, Universitat Pompeu Fabra.

Goodman, R. (1997), 'The Strengths and Difficulties Questionnaire: A Research Note.' *Journal of Child Psychology and Psychiatry* 38, 581-586.

Grönquist, E., B. Öckert and J. Vlachos (2010), 'The Intergenerational Transmission of Cognitive and Non-cognitive Abilities, CEPR DP 7908.

Havnes, T. and M. Mogstad (forthcoming), 'No Child Left Behind: Subsidized Child Care and Children's Long-Run Outcomes, *American Economic Journal: Economic Policy*.

Hawes, D. J. and M. R. Dadds (2004), 'Australian Data and Psychometric Properties of the Strenghts and Difficulties Questionnaire', *Australian and New Zealand Journal of Psychiatry* 38, 644-651.

Heckman, J. J (2010), 'Building Bridges between Structural and Program Evaluation Approaches to Evaluating Policy', *Journal of Economic Literature* 48, 356-398.

Heckman, J. J., S. H. Moon, R. Pinto, P. Savelyev and A. Yavitz (2010), 'The Rate of Return to the High Scope Perry Preschool Program' *Journal of Public Economics* 94, 114-128.

Heckman, J. J. (2008), 'Schools, Skills, and Synapses', NBER working paper # 14064.

Heckman, J. J. and D. Masterov (2007), 'The Productivity Argument for Investing in Young Children', NBER working paper # 13016.

Imbens, G. (2010), 'Better LATE than Nothing: Some Comments on Deaton (2009) and Heckman and Urzua (2009)', *Journal of Economic Literature* 48, 399-423.

Klasen H., W. Woerner, D. Wolke, R. Meyer, S. Overmeyer, W. Kaschnitz, A. Rothenberger and R. Goodman, (2000). 'Comparing the German Versions of the Strengths and Difficulties Questionnaire (SDQ-Deu) and the Child Behavior Checklist.' *European Child & Adolescent Psychiatry* 9, 271-276.

Koskelainen, M., A. Sourander and A. Kaljonen, (2000). 'The Strengths and Difficulties Questionnaire among Finnish School-aged Children and Adolescents.' *European Child & Adolescent Psychiatry* 9, 277-284.

Lesesne, C.N., Vissner, S.N., and C.P. White (2003), 'Attention-Deficit/Hyperactivity Disorder in School-Aged Children: Association with Maternal Mental Health and Use of Health Care Resources', *Pediatrics* 111, 1232-1237.

Magnuson, K. A., C. Ruhm, and J. Waldfogel (2007), 'Does Prekindergarten Improve School Preparation and Performance?', *Economics of Education Review* 26, 33-51.

Mathai, J., P. Anderson and A. Bourne, (2002). 'The Strengths and Difficulties Questionnaire (SDQ) as a screening measure prior to admission to a Child and Adolescent Mental Health Service (CAMHS).' *Australian e-Journal for the Advancement of Mental Health* 1, 1-12.

Simonsen, M. (2010), 'Price of High Quality Child Care and Female Employment', *Scandinavian Journal of Economics* 112, 570-594.

Staiger, D. and J. H. Stock (1997), 'Instrumental Variables Regression with Weak Instruments', *Econometrica* 65, 557-586.

Stipek, D. J., R. Feiler, P. Byler, R. Ryan, S. Milburn, and J. M. Salmon (1998), 'Good Beginnings: What Difference Does the Program Make in Preparing Young Children for School?', *Journal of Applied Developmental Psychology* 19, 41-66.

Woerner W., A. Becker and A. Rothenberger (2004), 'Normative Data and Scale Properties of the German Parent SDQ' *European Child & Adolescent Psychiatry* 13, ii3-ii10.

Appendix A

As in almost all surveys, there is significant attrition in the data.[23] Table A1 shows attrition patterns. We analyze SDQ since this is the outcome observed in both 2003 and 2007. On average 36% of the families surveyed in 2003, where the first set of child outcomes is observed, are not re-interviewed in 2007. Attrition is similar in family day care and preschool.

TABLE A1[a]

DATA ATTRITION

			# obs			#obs 2007/
	SDQ2003	SDQ2007	Only SDQ2003	Only SDQ2007	Both	#obs 2003
Family day care	806	533	293	20	513	0.66
Preschool	3237	2038	1301	102	1936	0.63

[a]Source: Own calculations, data used in empirical analyses

Table A2 first presents mean *SDQ2003* for the 2003 and 2007 sample. First note that *SDQ2003* is significantly lower for the 2007 sample compared to the 2003 sample. This suggests that it is the high-*SDQ* children who leave the sample.[24] Table A2 next presents mean *SDQ2003* and *SDQ2007*

[23] In Belsky et al. (2007), who use longitudinal data to investigate the effects of early day care on outcomes measured at age twelve, only 293 out of 1,364 families (22%) has complete data on all predictors and outcomes. In Magnuson, Ruhm, and Waldfogel (2006), who consider the effects of prekindergarten on school readiness, 7,388 out of 17,612 children (58%) have complete data.

[24] Another way of seeing this is by running a probit using an attrition indicator as outcome variable. Here we see that both mother's length of education and labor market experience decrease attrition. Similarly, children with low birth weight born to single mothers who smoke are more likely attrit.

for the 2007 sample. In general, children become better behaved over time. This was also demonstrated in Figure 2 above. Still, we observe that children in family day care and preschool experience similar changes in behavior.

TABLE A2[a]

DATA ATTRITION AND SDQ

	SDQ2003			2007 sample		
	2003 sample	2007 sample	Difference	SDQ2003	SDQ2007	Difference
Family day care	6.79	6.25	**-0.54**	6.25	5.27	**-0.98**
	(5.19)	(4.85)		(4.84)	(4.42)	
Preschool	6.49	6.15	**-0.34**	6.15	5.13	**-1.02**
	(5.04)	(4.75)		(4.75)	(4.50)	

[a]Bold indicated significance the 5% level.

Table A3 compares the regression and IV results with SDQ2003 as outcome using the full and the reduced sample. The estimates from the full and reduced samples are not significantly different from each other.

TABLE A3[a]

SELECTED OLS AND IV ESTIMATES

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcome	Full set of obs		Attrited sample	
	Preschool		Preschool	
	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error
SDQ2003				
OLS	**-0.421**	0.213	-0.164	0.240
IV	*-2.533*	1.330	-2.629	1.709

[a]Italic indicates significance at the 10% level and bold at the 5 % level. Robust standard errors, clustering at the municipality level. Conditioning set described in Table B1

Appendix B

This appendix shows details about the conditioning set.

TABLE B1

DETAILED DESCRIPTION OF VARIABLES

Variable	Description	Variable	Description
Child Care at age three:		*Degree of year employed in 1996*	Fraction of year employed one year after giving birth
Home care, H	Taken care of by parents or grandparents at home (0/1)	*Degree of year employed in 1997*	Fraction of year employed two years after giving birth
Municipality family day care, FC	Enrolled in family day care in taken care of by parents or	*Degree of year employed in 1998*	Fraction of year employed three years after giving birth
Municipality preschool, PS	Enrolled in preschool in 1999 (0/1)	*Hourly wage 1995*	Hourly wage in 1995
Municipality provided program, MP	Enrolled in either *FC* or *PS* in 1999 (0/1)	*Senior management level 1995*	Employed at senior management level in 1995 (0/1)
# prior non-parental care facilities	Number of different care facilities enrolled in before the current at age three	*Higher management level 1995*	Employed at higher management level in 1995 (0/1)
GAPS	Living in municipality providing guaranteed access to kindergarten	*Medium level employee 1995*	Employed at medium level in 1995 (0/1)
Preschool teachers	Number of pre-school teachers per 100 children enrolled (municipality level)	*Lower level employee 1995*	Employed at lower level in 1995 (0/1)
Care arrangements at age six months	Had care arrangements at age six months (0/1)	*Lowest level employee 1995*	Employed at lowest level in 1995 (0/1)
Waiting list in municipality at age six months	Subject to waiting list for child care at age six months (0/1) (may occur even within GAPS municipality)	*Smoker*	Smoker (0/1)
		Single	Single mother (0/1)
		Non-native speaker	Non-native speaker (0/1)
		Breast fed	Breast fed child in question (0/1)
Nursery 1997	Enrolled in nursery in 1997 (0/1)	*Postpartum depression*	Experienced postpartum depression (0/1)
Nursery 1998	Enrolled in nursery in 1998 (0/1)	*Disposable income in 1996*	Income after tax in 1996
Family Day Care 1997	Enrolled in family day care in 1997 (0/1)	*Disposable income in 1997*	Income after tax in 1997
		Disposable income in 1998	Income after tax in 1998
Family Day Care 1998	Enrolled in family day care in 1998 (0/1)	**Father's Characteristics:**	
		High school or below	Has a high school degree or less education (0/1)
Child Characteristics:			
Girl	Girl (0/1)	*Vocational degree*	Has vocational degree (0/1)
Birth month September	Born in September relative to October (0/1)	*Short tertiary*	Has a short further education (13-14 years) (0/1)
Siblings	Number of siblings		
Birth weight (in 1000 grams)	Birth weight in 1000 grams	*Medium tertiary*	Has a medium length further education (15-16 years) (0/1)
# hospitalizations	Number of hospitalizations before age three	*Long tertiary*	Has long further education (17 years or more) (0/1)
Physically disabled	Physically disabled (0/1)		
Full term birth	Full term birth (0/1)	*Labor market experience*	Experience before giving birth (1995) measured in years
Mother's Characteristics:			
Age	Age in years	*Hourly wage 1995*	Hourly wage in 1995
High school or below	Has a high school degree or less education (0/1)	*Senior management level 1995*	Employed at senior management level in 1995 (0/1)
Vocational degree	Has vocational degree (0/1)	*Higher management level 1995*	Employed at higher management level in 1995 (0/1)
Short tertiary	Has a short further education (13-14 years) (0/1)	*Medium level employee 1995*	Employed at medium level in 1995 (0/1)
Medium tertiary	Has a medium length further education (15-16 years) (0/1)	*Lower level employee 1995*	Employed at lower level in 1995 (0/1)
Long tertiary	Has long further education (17 years or more) (0/1)	*Lowest level employee 1995*	Employed at lowest level in 1995 (0/1)
Labor market experience	Experience before giving birth (1995) measured in years	*Leave*	Leave in connection with child birth (0/1)

TABLE B1 CONTINUED

DETAILED DESCRIPTION OF VARIABLES

Variable	Description	Variable	Description
Municipality and Regional Characteristics:		*Unemployment rate*	Share of unemployed among women in municipality, 16-49 years of age, 1999
Region 1	Residing in county of Copenhagen, 1999 (0/1)		
Region 2	Residing in counties of Frederiksborg and Roskilde, 1999 (0/1)	*Single parent children*	Share of single parent children 0-17 years old in municpality, 1999
Region 3	Residing in counties of Western Sealand and Storstrøm, 1999 (0/1)	*Asylum seekers*	# of asylum seekers per 10,000 inhabitants in municipality, 1999
Region 4	Residing in county of Fuen, 1999 (0/1)	*Third world immigrants*	# of third world immigrants per 10,000 inhabitants in municipality, 1999
Region 5	Residing in counties of Southern Jutland and Ribe, 1999 (0/1)	*Social Democrats*	Largest party in 1997 municipality election social democrats (0/1)
Region 6	Residing in counties of Vejle and Ringkøbing, 1999 (0/1)	*Conservatives*	Largest party in 1997 municipality election conservatives (0/1)
Region 7	Residing in counties of Aarhus and Viborg, 1999 (0/1)	*Liberals*	Largest party in 1997 municipality election liberals (0/1)
Region 8	Residing in county of Northern Jutland, 1999 (0/1)	*Child families*	Share of families with children among all households within municipality

TABLE B2[a]

MEANS OF SELECTED VARIABLES BY MODE OF CARE

	Preschool		Family Day Care	
	Mean	Std. Dev.	Mean	Std. Dev.
Child Care at age three:				
Hours in non-parental care	33.02	7.14	**34.37**	7.21
# prior non-parental care facilities	2.75	0.80	**1.95**	0.71
Preschool teachers	17.23	2.57	**16.75**	3.54
Arranged for care at age six months	0.32	0.47	0.34	0.47
Waiting list in munipality at age six months	0.22	0.41	0.20	0.40
Child Characteristics:				
Girl	0.48	0.50	0.49	0.50
Birth month September	0.39	0.49	**0.34**	0.47
Siblings	0.77	0.83	0.81	0.85
Birth weight (in 1000 grams)	3.50	0.60	3.53	0.58
# hospitalizations	0.88	0.32	**0.91**	0.28
Physically disabled	0.04	0.19	0.04	0.20
Full term birth	0.45	0.50	0.46	0.50

[a]Bold numbers indicate that means for family day care children are significantly different from those in preschool (5 % level)

TABLE B2 CONTINUED[a]

MEANS OF SELECTED VARIABLES BY MODE OF CARE

	Preschool		Family Day Care	
	Mean	Std. Dev.	Mean	Std. Dev.
Mother's Characteristics:				
Age	28.37	4.61	28.23	4.34
High School or below	0.33		0.33	
Vocational degree	0.37	0.48	**0.42**	0.49
Short further	0.23	0.42	0.20	0.40
Long further	0.07	0.26	**0.05**	0.21
Labor market experience	7.37	5.81	7.15	5.50
Degree of year employed in 1996	0.55	0.35	0.57	0.34
Degree of year employed in 1997	0.64	0.40	0.65	0.39
Degree of year employed in 1998	0.67	0.39	0.70	0.38
Hourly wage 1995	134.42	73.93	**127.34**	60.72
Senior management level 1995	0.01	0.07	0.00	0.05
Higher management level 1995	0.10	0.30	**0.07**	0.26
Medium level employee 1995	0.21	0.41	**0.17**	0.38
Lower level employee 1995	0.34	0.47	**0.40**	0.49
Smoker	0.30	0.46	0.31	0.46
Single	0.04	0.19	**0.02**	0.15
Non-native speaker	0.02	0.13	**0.00**	0.07
Breast fed child in question	0.96	0.20	0.95	0.21
Postpartum depression	0.01	0.10	0.01	0.10
Income 1996 (1,000 DKK)	118	35	119	36
Father's Characteristics:				
Vocational degree	0.43	0.50	**0.50**	0.50
Short further	0.15	0.36	0.13	0.33
Long further	0.10	0.30	**0.06**	0.23
Labor market experience	11.11	5.73	11.35	5.41
Hourly wage 1995	171.22	87.75	166.60	75.64
Senior management level 1995	0.03	0.18	**0.02**	0.13
Higher management level 1995	0.14	0.35	**0.09**	0.28
Medium level employee 1995	0.12	0.32	**0.09**	0.28
Lower level employee 1995	0.40	0.49	**0.47**	0.50
Leave	0.25	0.43	**0.19**	0.39

[a]Bold numbers indicate that means for family day care children are significantly different from those in preschool (5 % level)