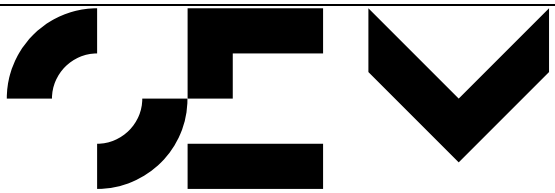

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Effects of Universal Child Care Participation on Pre-teen Skills and Risky Behaviors

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Abstract:

This paper uses 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 to investigate pre-teenage effects of child care participation at age three (either parental care, preschool, or more informal family day care) in a regime with large scale publicly provided universal care. As outcomes, we consider measures of overall and risky behavior in addition to objective and self-evaluated abilities. We find that eleven-year-old children who have been in non-parental care at age three perform just as well as children who have been in parental care. Furthermore, there is no evidence that one type of non-parental care outperforms the other.

Access to the Danish Longitudinal Survey of Children was granted us by the Danish National Centre for Social Research. We thank Mette Lausten for data assistance and Niels Glavind from Bureau 2000 for supplying crucial information on child care guarantees.

1. Introduction

It is becoming increasingly clear that childhood experiences and interventions are pivotal for the development of both cognitive and behavioral skills. 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). In this respect, it is interesting to know whether and to what degree the provision of universal publicly subsidized care might be a worthwhile policy for the population as a whole. Our paper investigates this.

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. Unfortunately, not much is known about the effects of universal care on child outcomes.

A few studies do consider the effects of introducing universal care. Baker, Gruber and Milligan (2008) evaluate a recent large scale change in the child care system in Quebec, Canada. The policy change implied that the out-of-pocket price for child care for 0-4 year old children cannot exceed $5 per day. While exploiting the before-after Quebec-versus-other regions variation, the authors find that the effects on cognitive and non-cognitive child outcomes at ages 2-4 and 6-11 (in addition to parental outcomes) of the transition to a regime with large-scale highly-subsidized child care are clearly negative.

In contrast, Havnes and Mogstad (2009) study a large-scale expansion of child care in Norway in the mid 1970s yet find strong positive effects on children's long-run outcomes as adult. Children of

mothers with low levels of education and girls in general benefit considerably more. The authors find no effects on maternal employment and argue that the expansion caused parents to move children from informal to formal care. Havnes and Mogstad's paper exploits variation in child care coverage across time and between municipalities.

Datta Gupta and Simonsen (2010) instead investigate the effects on child care enrollment at age three on non-cognitive skills at age seven using Danish data. Here the focus is on a regime where universal care is already in place – and has been in place since the 1970s. This is potentially a very different setting compared to one where universal care is being instituted, and the estimated effects are probably more informative about what happens when universal care is established rather than it its infancy. The paper exploits a rich panel data child survey combined with register-based data along with differences in access to types of care across municipalities. The authors find that, compared to home care, being enrolled in preschool at age three does not lead to significant differences in child behavior at age seven no matter the gender or the mother's level of education. More informal care (family day care), on the other hand, seems to significantly deteriorate behavior. This is especially so for boys whose mothers have a lower level of education. High quality pre-school also outperforms family day care for the group of children enrolled in care.

This paper provides further insights into universal care and medium term effects of child care in general. We follow up on the short term analysis in Datta Gupta and Simonsen (2010) and consider effects at age eleven on a much wider range of outcomes. These 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. Implicitly, we are investigating whether the observed early differences in non-cognitive skills caused by differences in child care enrollment are important for

the formation of other skills later in life as is the claim, for example, in Cunha and Heckman (2008). While the studies are not directly comparable, we can to some extent speak to the mechanisms behind the positive long term outcomes found by Havnes and Mogstad (2009) and address the gap between the short- and long-term results from the existing literature on universal care. Contrary to Havnes and Mogstad (2009), we know whether children are actually enrolled in care, and we can also distinguish between types of care.

Estimations are carried out using a longitudinal 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 exploit these rich data along with plausible exogenous variation in the take-up of pre-school that stems from a pseudo-experiment generating waiting lists for pre-school in some municipalities while guaranteeing open slots in others. As pointed out by Datta Gupta and Simonsen (2010), because reliable instruments are difficult to come by, only very few studies of the effects of child care on child outcomes use this type of strategy, see e.g. Blau and Grossberg (1992), James-Burdumy (2005), and Bernal and Keane (2008). Furthermore, according to Bernal and Keane (2008), the instruments used in the two first-mentioned studies are extremely weak.

We interpret the estimated effects as those of early child care enrollment including any indirect effects that arise because children in one 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. Our findings indicate that the age-seven-gaps in behavioral outcomes due to choice of type of child care are closed at age eleven. In fact, whether children are enrolled in municipality provided

care or are being taken care of at home at age three does not matter much for outcomes at age eleven. There are definitely no signs that enrollment in municipality provided care is harmful. On the other hand, nothing points to large positive effects either. This implies that large long-term effects on level of education or income are implausible in our setting. Families are either fully capable of dealing with these initial behavioral differences or exposure to universal 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 discusses the production of skills in childhood, Section 3 describes our data and the institutional framework, and Section 4 discusses the empirical framework. Results are shown in Section 5, Section 6 provides sensitivity analyses, and Section 7 concludes.

2. The Production of Skills

To set the scene for the empirical analysis, we sketch a simple model for the production of skills during childhood. We follow Heckman (2008) . The model consists of three periods, $t = 1,2,3$, corresponding to early and late childhood and early youth. Parents invest in their children in period one and two. The investment of interest for this paper pertains to the choice of child care in period one, I_1.

One can easily think of choice of child care as a type of parental investment; since Danish children spend roughly 30 hours per week in non-parental care, this is potentially one of the more influential investment choices. Recent literature clearly suggests that it is important to distinguish between different types of non-parental care; a strategy we follow in this paper. Bernal and Keane (2008),

using the NLSY, investigate the effect on cognitive ability of participating in formal care (center-based care and pre-school) and informal care, both compared to home care, for children of single mothers. For identification purposes, they instrument maternal employment (but not choice of type of child care) using benefit termination time limits and state variation in welfare policy rules. Their findings suggest that this group of children benefit from being enrolled in the former but experience adverse outcomes when participating in the latter, less expensive, option. Gregg, Washbrook, Propper, and Burgess (2005) use regression techniques on UK data (ALSPAC) to similarly investigate the effects of early maternal employment on cognitive outcomes for children age 4-7. They distinguish between formal and informal care and find negative effects of informal care, while formal care does not significantly affect child outcomes. Using the Early Childhood Longitudinal Study, Magnuson, Ruhm, and Waldfogel (2007) consider the effect of participating at age four in teacher-directed early education (Prekindergarten) versus other types of care. Identification is based on regression analyses combined with family fixed effects. The results show that Prekindergarten leads to significantly better cognitive outcomes (measured at age five) but also increased levels of aggression and decreased self-control. Also, the results of Stipek, Feiler, Byler, Ryan, Milburn, and Salmon (1998) suggest that employing structured, teacher-directed approaches at the preschool level results in relatively negative social climates and therefore negative effects on both cognitive and motivation outcomes.

For disadvantaged children the literature suggests that participation in (expensive) programs aimed directly at this group is beneficial to participating children; in fact considerably more so than giving the families of these children unrestricted cash transfers (Currie (1994)). One example of a

successful intervention is the Head Start Program, see e.g. Carneiro and Ginja (2008),[1] Currie (2001), Currie and Thomas (1995, 1999), and Currie, Garces, and Thomas (2002). Others are the Perry Preschool Project, the Abecedarian Program, and the Chicago Child-Parent Centers; see Blau and Currie (2006) and Heckman and Masterov (2007).

Not only does the type of care potentially affect child outcomes, abilities also develop over time and are multiple in nature, see e.g. Heckman (2008). To address this, we consider a range of cognitive as well as non-cognitive ability measures. Furthermore, capabilities attained in one period potentially augment and raise the productivity of investments at subsequent stages (self-productivity and dynamic complementarity). Thus a behavioral gap between children in formal and informal care established early in life may affect a range of outcomes later in life. Parental investments in late childhood could, of course, improve on earlier deficiencies. This emphasizes the need to interpret estimated effects of early child care enrollment measured later in childhood as the effects of enrollment *including* indirect effects stemming from parents' remedial investments.

The technology of skill production in period t can be summarized in the following way:

$$O_{t+1} = f_t(h, O_t, I_t),$$

where O indicates ability outcomes, f is the production function, h measures initial conditions such as parental abilities, and I indicates parental investments.

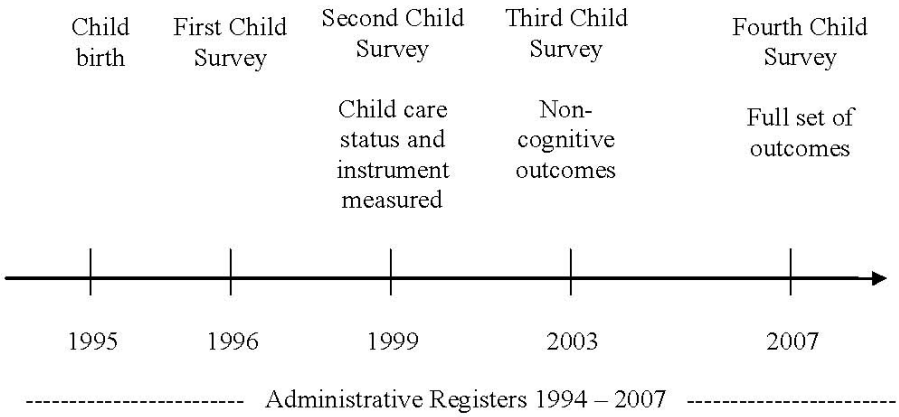
3. Data and Institutional Framework

[1] Carneiro and Ginja (2008) find that Head Start is more effective for children from smaller and relatively richer households.

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 about 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, register based child care

enrollment status is available from birth and onwards, and child outcomes are recorded in 2003 and 2007. Unfortunately, the set of child outcomes is 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. 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.

3.1 Child Care in Denmark

Danish child care is for the major part publicly provided and organized within the 271 municipalities.[2] 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, 16 % are in family day care, and 15 % in home care. In the following, we will ignore the small fraction of children participating in private and other specialized care.

Day care and preschool programs in Denmark (along with other Nordic countries) are characterized both by high quality 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

[2] The average municipality has 50,000 inhabitants. The municipality of Bornholm is excluded from the analysis because it underwent a municipality reform during this period.

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

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, 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-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:child ratios are higher (minimum of 1:5) for this type of care for the age group in question.[5]

The regulations of municipality provided child care institutions are described in the Law of Service (*Serviceloven*). The Law of Service offers general guidelines as to the content of municipality provided care, yet the specific details are decided by the institutions. Overall, institutions must supply care, education, and opportunities to play, all in co-operation with parents. The educational content of municipality provided care involves development of personal, linguistic, and physical

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

[5] In the empirical analysis we condition on the determinants of parental income to account for selection into types of care based on income.

skills. Furthermore, children must develop their understanding of nature and culture. Importantly, institutions are child-centered and focus on socialization rather than a basic skills curriculum.

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. 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. Opening hours may vary across municipalities but again must 'cover local needs'. In general, opening hours in preschool during week days are between 6.30 am and 5.00 pm. The maximum number of children 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, *family day care* takes place in private homes, and 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. Family day care is more flexible in terms of hours. It can be arranged on an individual basis but typically has a ceiling at 48 hours per week.

Table 1 compares the educational level and the gender distribution of staff in preschools and family day care. Staff in preschools also includes assistants, managers, cleaning and kitchen personnel etc., whereas staff in family day care only consists of the caregiver herself. From this table, it is clear that children enrolled in preschools are met with higher qualified staff even when non-teaching staff is included; staff in preschools is much more likely to have a degree in teaching than caregivers employed in family day care. Furthermore, there are nine times as many men employed in preschools as in family day care. Even so, preschool caregivers are predominantly female.

Prices are set at the municipality level once a year and hold throughout the municipality for a given type of care. 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. Parents with a yearly family income above around $ 60,000 (about 60 % of parents) pay the full price of child care, while parents with a yearly family income below $ 20,000 (about 1 % of parents) do not pay for child care. See Simonsen (2005) for a detailed description of the pricing scheme. The subsidy scheme is the same for both preschool and family day care. As indicated above, the average yearly total costs (for three-year-olds) of family day care are higher than those of preschool. The maximum total yearly price for family day care (33% of total costs) is $ 3,500, while the corresponding maximum for preschool is $ 2,600.

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.

TABLE 1

STAFF CHARACTERISTICS

	Family Day Care Mean	Preschool Mean
High school or below	0.38	0.29
Vocational degree	0.54	0.16
in paedagogics	0.00	0.01
Medium length further education	0.07	0.53
in paedagogics	0.02	0.50
Long further education	0.01	0.01
in paedagogics	0.00	0.00
Male	0.01	0.09

Source: 10% representative sample of the Danish population

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. Note that the application process is the same in each case, so it is not the case that children of parents who are disorganized and file late end up in family 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. Only if a child is

[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. Siblings can still be placed in child care during formal leave, though.

disabled, is an immigrant, *or* if the child has older siblings enrolled in municipality provided care can he jump the waiting list. 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 our 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 they 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 doing so is delaying 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 that once a child is enrolled in, for example, family day care, he or she does not have the right to move to preschool.

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-

[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.

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.

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

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

behavior in the future. Further, remember that, as described in 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. Thus if funds are available (i.e. conditional on municipality characteristics), we expect most of the variation in the provision of *GAPS* to stem from unexpected variations in demand, for example due to variations in cohort size.

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 (forthcoming), 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 providing services in general. To counter this, our conditioning set includes municipality characteristics, see below. To shed light on 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. 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. The data do, however, give a rough picture of prior and later enrollment.

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

[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.

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.

TABLE 2[a]

ENROLMENT PATTERNS

			Children at home in 1999 Age 3½	Self-reported Children in preschool in 1999 Age 3½	Children in family day care in 1999 Age 3½
Register data	1997 Age 1½	Nursery	0.15	0.13	0.02
		Family day care	0.23	0.36	0.58
		Missing (incl. home care)	0.62	0.43	0.40
	1998 Age 2½	Nursery	0.20	0.32	0.02
		Family day care	0.28	0.40	0.74
		Missing (incl. home care)	0.62	0.43	0.43
	1999 Age 3½	Preschool	0.38	0.75	0.17
		Family day care	0.08	0.03	0.66
		Missing (incl. home care)	0.51	0.17	0.17
	2000 Age 4½	Preschool	0.64	0.82	0.80
		Family day care	0.01	0.00	0.02
		Missing (incl. home care)	0.34	0.17	0.17
	2001 Age 5½	Preschool	0.69	0.81	0.80
		Missing (incl. home care)	0.29	0.17	0.18
	2002 Age 6½	Preschool	0.23	0.11	0.19
		After school care	0.42	0.66	0.61
		Missing (incl. home care)	0.35	0.23	0.20
	2003 Age 7½	After school care	0.54	0.71	0.73
	2004 Age 9	After school care	0.51	0.67	0.63
	2005 Age 10	After school care	0.39	0.53	0.44
	2006 Age 11	After school care	0.29	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.

Although the interpretation is not as clean, the treatment "participation in preschool relative to home care at age 3½" is partly the effect of earlier entry into preschool and partly the effect of a

larger propensity to ever enroll in preschool again combined with a slightly higher propensity to enroll in after school care. There is also a weak tendency for children in family day care and home 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.

3.3 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.

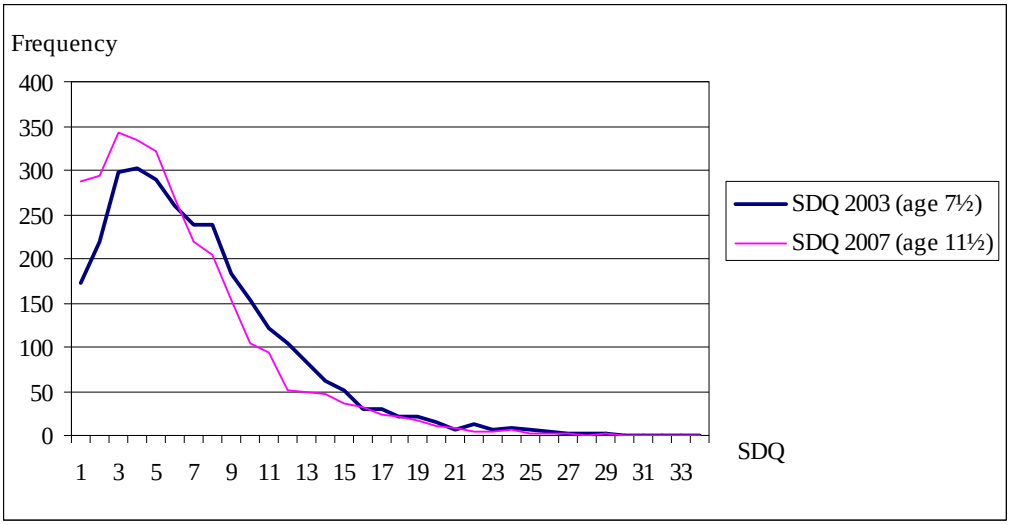
Our first outcome measure is the *Strength and Difficulties Questionnaire* (*SDQ*), a behavioral measure known from the child development literature, cf. Goodman (1997). To avoid confusion, denote *SDQ* measured in 2003 *SDQ2003* and *SDQ* measured in 2007 *SDQ2007*. The *SDQ* index is based on emotional symptoms, conduct problems, hyperactivity/inattention problems, and peer relationship problems. Parents are asked 25 questions about the child's behavior. Response categories are "not true", "somewhat true" and "certainly true". See www.sdqinfo.com for further

details including a list of the questions used to construct the *SDQ* index. The measure takes on discrete values in the interval between 0-40, where 0 indicates no behavioral problems.

Research suggests 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]

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.com.

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

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]

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 positive gains from late school enrollment in terms of 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?"

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

[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".

and "You are good at Danish. To what extent do you agree?".[15] We form four binary outcome measures based on these questions: "Fares excellently academically", "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. Children in home care, on the other hand, are less likely to state that they fare excellently in school and their self-evaluated performance in Danish is also lower. This is possibly due to deficits in self-confidence; however, there is no evidence that these children on average do worse in terms of the objective performance measures than children enrolled in family day care.

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 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

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

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).

TABLE 3[a]

OUTCOME MEASURES

	Home care		Family Day Care		Preschool	
	Mean	# obs	Mean	# obs	Mean	# obs
Behavioral measure:						
SDQ2003	6.41	399	6.79	806	6.49	3,237
	(5.25)		(5.19)		(5.04)	
SDQ2007	5.46	314	5.35	533	5.18	2,038
	(4.40)		(4.45)		(4.53)	
Objective performance measures:						
Language test	20.56	494	20.34	740	**21.22**	3,000
	(5.59)		(5.38)		(4.97)	
Cognitive skills test	28.87	501	28.84	750	*29.25*	3,031
	(5.67)		(5.52)		(5.26)	
Delayed school entry (or progress) (0/1)	0.27	510	0.26	760	**0.22**	3,083
Self-evaluated school performance:						
Fares excellently academically (0/1)	*0.31*	491	0.36	727	0.37	2,930
Likes school very much (0/1)	0.25	491	0.25	727	0.24	2,931
Strongly agree:						
Good at math (0/1)	0.35	491	0.37	727	**0.43**	2,929
Good at Danish (0/1)	**0.41**	491	0.50	727	0.50	2,930
Risky behavior measures:						
Ever smoked (0/1)	0.05	491	0.05	727	0.04	2,930
Ever drunk alcohol (0/1)	0.08	490	0.08	727	0.08	2,929
Petty theft and vandalism (0/1)	0.14	491	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.

4. Empirical Framework

This section first discusses potential parameters of interest and then considers identification of these parameters. We consider the effects on child outcomes at age eleven of participating at age three in some form of publicly provided child care compared to a given alternative type of 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. Furthermore, it is only possible for

politicians to affect the supply and quality of these types of care. We also only include children whose *mother* filled in the questionnaire.[16]

Effects of type of child care

Consider first participation in a municipality provided child care program, *MP*, relative to home care. Let *MP = 1* indicate participation in such a program, whereas *MP = 0* indicates home care. Let O_0 be potential outcome in home care and O_1 the potential outcome in municipality provided care. We first consider the average effect of municipality provided care for the group of participants:

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

Of course, (1) will be some weighted average of the effects of being enrolled in preschool and family day care. We therefore continue to investigate whether participation in different types of municipality provided child programs results in different outcomes compared to home care. In order to do this, we need to extend our framework slightly. Let O_j be the potential outcome, $j = 0,1,2$:

$$j = \begin{cases} 0 & \textit{if home care} \\ 1 & \textit{if family day care} \\ 2 & \textit{if preschool} \end{cases}$$

We consider the following parameters:

(2) $$E[O_1 - O_0 \mid FC = 1],$$

where *FC* indicates family day care participation. Thus, (2) is the average effect of participating in family day care compared to home care for the group of children enrolled in family day care. Furthermore, we consider

(3) $$E[O_2 - O_0 \mid PS = 1],$$

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

where *PS* indicates preschool participation. (3) is then the effect of participating in preschool compared to home care for the group of children enrolled in preschool.

Finally, we consider the effects of participating in preschool compared to family day care for the group of children enrolled in preschool:

(4) $$E\left[O_2 - O_1 \mid PS = 1\right].$$

All three parameters, (1) – (4), discussed above should be interpreted as the effects of a given type of care compared to the alternative, *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 in (4), we are, however, not too worried about such indirect effects here. Still, all 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 skill formation differently compared to family day care enrollment, this will be captured by (4).

Consider now a random coefficient model a la Björklund and Moffit (1987). For the sake of illustration, suppose that we are interested in estimating (1). Let O^i indicate observed outcome and X^i observable characteristics for child *i*.

(5) $$O^i = X^i \beta + \alpha^i MP^i + \varepsilon^i$$

or alternatively

(6) $$O^i = X^i \beta + \overline{\alpha} MP^i + \left[MP^i (\alpha^i - \overline{\alpha}) + \varepsilon^i\right]$$

where the term in the squared brackets is the error term. Clearly, *MP* 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, *MP* may be correlated with α if parents enroll children

in day care based on expected gains. For this reason, we pursue two identification strategies: One where we rely on a conditional independence assumption (henceforth CIA) and estimate regression type models and one where we exploit plausible exogenous variation in the take-up of preschool relative to family day care. This latter strategy is only possible when evaluating the effects of different types of municipality provided care conditional on enrollment in non-parental 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 effect (*LATE*) (Angrist, Imbens, and Rubin (1996)) associated with the instrument is

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

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. 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 (4) above, we need to assume monotonicity: any child enrolled in preschool in the absence of *GAPS* must be enrolled in preschool if *GAPS* is effective. Also, any child enrolled in family day care under a *GAPS* regime must be enrolled in family day care in the absence of *GAPS*.[17]

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 OLS and 2SLS where relevant. 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

[17] Actually, we need a stricter version of monotonicity because we exclude children in home care. It needs to be the case that the take-up of home care is unaffected by the policy. See Datta Gupta and Simonsen (2010) who argue that it is likely to hold in our setting and under all circumstances only causes a minor bias.

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). We therefore choose to implement a bivariate probit model though we show 2SLS results in the sensitivity analyses, see Section 6.

Choice of conditioning set

The simple model outlined in Section 2 guides our choice of conditioning set. We need information about initial conditions, determinants of earlier ability outcomes, and parental investments. In other words, we condition on a rich set of variables that explain both outcomes as well as the choice of child care. 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.

5. Estimation results

This section presents our estimation results. Table 4 shows the results from simple regression type analyses. In Specification I we pool preschool and family day care and estimate (1) whereas Specification II allows for separate effects of the two and supplies estimates of (2) and (3).[19] The

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

[19] Table B2 shows the full set of coefficient estimates for *SDQ2007*.

main conclusion is that only few outcomes are affected by child care enrollment and where significant, effects are small. Whether children are enrolled in municipality provided care or are being taken care of at home at age three does not matter much for outcomes at age 11. More importantly, there are no signs that enrollment in municipality provided care is harmful. For example, we see that the behavioral measure, *SDQ2007*, is unaffected (in a statistical sense) by type of child care. This is interesting given the findings from Datta Gupta and Simonsen (2010), where short term behavior was significantly negatively affected by family day care enrollment relative to home care.[20]

Table 5 shows the results from conditioning on enrollment in non-parental care and estimating the effects of participating in preschool vis-à-vis family day care, (4). We present regression type analyses based on CIA and IV analysis exploiting *GAPS*. 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 percentage points relative to 42 %). Overall, the sizes of the effects are small relative to mean outcomes. Note that if our conditioning set does a

[20] Quantile regressions (25^{th}, 50^{th} and 75^{th} quantiles) using SDQ2007, the language test and the cognitive test as outcomes reveal that these results are not driven by differences in effects across the distribution. The only exception is SDQ2007 where we find significant negative effects (thus behavior improvements) of participating in preschool relative to home care (and for preschool relative to family day care conditional on participation in nonparental care) for the 25^{th} quantile.

poor job explaining the selection out of home care, we will expect the effects of preschool relative to family day care (at least for the linear regressions SDQ2007, language and cognitive skills tests) to differ substantially in Tables 4 and 5, which is not the case. Thus so far, there does not seem to be evidence that CIA is violated.

TABLE 4[a]

SELECTED MARGINAL EFFECTS, REGRESSION TYPE ANALYSES

NONPARENTAL CARE VERSUS PARENTAL CARE

Outcomes	Means	Specification I		Specification II			
		Nonparental care		Preschool		Family day care	
		Marg. Eff.	Std. Error	Marg. Eff.	Std. Error	Marg. Eff.	Std. Error
Behavioral measure:							
SDQ2007	5.23	-0.020	0.252	-0.077	0.261	0.116	0.308
Objective performance measures:							
Language test	20.98	-0.063	0.273	0.051	0.280	-0.352	0.327
Cognitive skills test	29.13	0.056	0.271	0.109	0.277	-0.078	0.331
Delayed school entry (or progress)	0.23	-0.023	0.023	-0.033	0.024	0.000	0.025
Self-evaluated school performance:							
Fares excellently academically (0/1)	0.36	0.029	0.025	0.028	0.026	0.033	0.031
Likes school very much (0/1)	0.25	-0.016	0.023	-0.009	0.024	-0.031	0.026
Strongly agree:							
Good at most things at school (0/1)	0.48	0.024	0.027	0.035	0.028	-0.002	0.032
Good at math (0/1)	0.41	**0.057**	0.026	**0.077**	0.027	0.004	0.032
Good at Danish (0/1)	0.49	*0.045*	0.027	*0.047*	0.028	0.041	0.032
Risky behavior measures:							
Ever smoked (0/1)	0.05	-0.011	0.010	-0.011	0.010	-0.007	0.009
Ever drunk alcohol (0/1)	0.08	0.000	0.013	-0.003	0.014	0.010	0.016
Petty theft and vandalism (0/1)	0.14	-0.017	0.019	-0.016	0.019	-0.017	0.021

[a]Italic indicates significance at the 10% level and bold at the 5% level. Robust standard errors, clustering at municipality level. The model for SDQ is OLS. Binary outcomes modeled using Probits. Marginal effects evaluated at the mean. Conditioning set described in Table B1.

TABLE 5[a]

SELECTED MARGINAL EFFECTS

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcomes	Means	Regression type analyses		IV analyses	
		Preschool		Preschool	
		Marg. Eff.	Std. Error	Marg. Eff.	Std. Error
Behavioral measure:					
SDQ2007	5.21	-0.200	0.252	-0.314	1.468
Objective performance measures:					
Language test	21.96	*0.414*	0.245	-1.853	1.439
Cognitive skills test	29.17	0.243	0.255	-0.729	1.551
Delayed school entry (or progress)	0.23	*-0.041*	0.023	-0.060	0.227
Self-evaluated school performance:					
Fares excellently academically (0/1)	0.36	0.001	0.024	-0.053	0.062
Likes school very much (0/1)	0.25	0.028	0.020	**0.107**	0.039
Strongly agree:					
Good at most things at school (0/1)	0.48	*0.046*	0.025	-0.013	0.061
Good at math (0/1)	0.42	**0.077**	0.024	-0.029	0.060
Good at Danish (0/1)	0.50	0.018	0.025	-0.026	0.060
Risky behavior measures:					
Ever smoked (0/1)	0.04	-0.003	0.007	-0.118	0.075
Ever drunk alcohol (0/1)	0.08	-0.010	0.013	0.001	0.027
Petty theft and vandalism (0/1)	0.14	0.007	0.017	-0.004	0.035
First stage: GAPS				**0.149**	0.012

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

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. Here, only the indicator for whether or not the child likes school is statistically significant and most point estimates are small. As is usual, standard errors are much larger than those of the simple regression analysis. Note also that we are identifying off of a different population, namely the group of compliers.

6. 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 6 and 7 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. Unfortunately, the samples are too small to make strong conclusions across gender. 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 than 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 8, all results are robust to this exclusion.

The second set of estimations in Table 8 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.

TABLE 6[a]

SELECTED MARGINAL EFFECTS FOR BOYS

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

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

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

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

Finally, Table 9 investigates whether our IV results are robust to choosing a bivariate probit over a 2SLS procedure for binary outcomes. As argued above, the former is more appropriate. Table 9 demonstrates that 2SLS estimates are generally more negative than those from the bivariate probits but the standard errors are also larger. In fact, none of the estimates in Table 9 are significantly different across model type.

9. Conclusion

This paper contributes with rare evidence on the effects of universal child care. Specifically, we follow up on the analyses by Datta Gupta and Simonsen (2010) and consider the effects on a wide range of age 11 child outcomes of being enrolled in universal, publicly provided care compared to home care. In contrast to the few existing studies, we evaluate the effects of universal care within a regime where universal care has been in place for a long time. Outcomes 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 large administrative registers and exploit plausible exogenous variation in the take-up of preschool for identification purposes.

We find that eleven year old children who have been in non-parental care at age three perform just as well as children who have been in parental care. Furthermore, there is no evidence that one type of non-parental care outperforms the other. The findings from Datta Gupta and Simonsen (2010) that short term behavior was significantly negatively affected by family day care enrollment relative to preschool enrollment may be a result of earlier socialization of preschool children which is reflected in their greater emotional and social competence at school-entering age, but it appears that this gap closes by age eleven. One explanation that has been suggested for this is that universal

child care, by exposing children to peers from different family backgrounds, tends to reduce the variance of skills in the long run (Esping-Andersen, 2006). While our data setup did not allow an investigation into this question, future research could explore the peer effects of universal child care.

TABLE 7[a]

SELECTED MARGINAL EFFECTS

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

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

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

TABLE 8[a]

SELECTED MARGINAL EFFECTS, SENSITIVITY ANALYSES

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcomes	Exclude Copenhagen (# obs 2,425)				Exclude weak children (# obs 1,080)				Exclude children with siblings aged 4-6 (# obs 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:												
Fares excellently academically (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

[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 9[a]

SELECTED MARGINAL EFFECTS

MUNICIPALITY PROVIDED PRESCHOOL VERSUS FAMILY DAY CARE

Outcomes	Means	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	-0.058	0.138	-0.060	0.227
Self-evaluated school performance:					
Fares excellently academically (0/1)	0.36	-0.146	0.142	-0.053	0.062
Likes school very much (0/1)	0.25	0.008	0.123	**0.107**	0.039
Strongly agree:					
Good at most things at school (0/1)	0.48	-0.072	0.156	-0.013	0.061
Good at math (0/1)	0.42	**-0.277**	0.144	-0.029	0.060
Good at Danish (0/1)	0.50	-0.098	0.173	-0.026	0.060
Risky behavior measures:					
Ever smoked (0/1)	0.04	-0.084	0.055	-0.118	0.075
Ever drunk alcohol (0/1)	0.08	-0.059	0.078	0.001	0.027
Petty theft and vandalism (0/1)	0.14	-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.

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Appendix A

As in almost all surveys, there is significant attrition in the data.[21] 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 notably lower for children in home care but similar in family day care and preschool.

TABLE A1[a]

DATA ATTRITION

			# obs			#obs 2007/
	SDQ2003	SDQ2007	Only SDQ2003	Only SDQ2007	Both	#obs 2003
Home care	399	314	175	90	224	0.79
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

[21] 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.

high-*SDQ* children who leave the sample.[22] Also note that samples of children in home care experience the largest decline in *SDQ2003* though the changes are not statistically different across types of care. Thus we should be cautious with regards to the sample in home care. Table A2 next presents mean *SDQ2003* and *SDQ2007* for the 2007 sample. In general, children become better behaved over time. This was also demonstrated in Figure 2 above. Still, there are important differences in the change across types of care: children in home care only experience a smaller decline in *SDQ*, whereas children in family day care and preschool experience large and similar changes in behavior. As discussed, however, since attrition is lower among children in home care, this is expected.

TABLE A2[a]

DATA ATTRITION AND SDQ

	SDQ2003			2007 sample		
	2003 sample	2007 sample	Difference	SDQ2003	SDQ2007	Difference
Home care	6.41	5.51	**-0.90**	5.51	5.25	-0.26
	(5.25)	(4.27)		(4.27)	(4.21)	
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 results with SDQ2003 as outcome using the full and the reduced sample. Neither of the estimates is significantly different from zero nor different from each other.

[22] 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 increase attrition. Similarly, children with low birth weight born to single mothers who smoke are more likely attrit.

TABLE A3[a]

SELECTED OLS 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	-0.450	0.213	-0.164	0.240

[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 and presents a more complete set of estimation results for the analysis in Table 4.

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)
Arranged for care at age six months	Having 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:**	
Child Characteristics:		*High school or below*	Has a high school degree or less education (0/1)
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)	*Single parent children*	Share of single parent children 0-17 years old in municpality, 1999
Region 2	Residing in counties of Frederiksborg and Roskilde, 1999 (0/1)	*Asylum seekers*	# of asylum seekers per 10,000 inhabitants in municipality, 1999
Region 3	Residing in counties of Western Sealand and Storstrøm, 1999 (0/1)	*Third world immigrants*	# of third world immigrants per 10,000 inhabitants in municipality, 1999
Region 4	Residing in county of Fuen, 1999 (0/1)	*Social Democrats*	Largest party in 1997 municipality election social democrats (0/1)
Region 5	Residing in counties of Southern Jutland and Ribe, 1999 (0/1)	*Conservatives*	Largest party in 1997 municipality election conservatives (0/1)
Region 6	Residing in counties of Vejle and Ringkøbing, 1999 (0/1)	*Liberals*	Largest party in 1997 municipality election liberals (0/1)
Region 7	Residing in counties of Aarhus and Viborg, 1999 (0/1)	*Child families*	Share of families with children among all households within municipality
Region 8	Residing in county of Northern Jutland, 1999 (0/1)		

TABLE B2[a]

SELECTED MARGINAL EFFECTS, REGRESSION TYPE ANALYSES

OUTCOME: SDQ2007. NONPARENTAL CARE VERSUS PARENTAL CARE

	Model I		Model II	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
Child care at age 3				
Municipality provided program	-0.020	0.236	•	•
Family Day Care	•	•	-0.077	0.250
Preschool	•	•	0.116	0.285
# prior non-parental care facilities	0.087	0.098	0.117	0.108
Preschool teachers	-0.031	0.061	-0.035	0.061
Nursery 1997	0.035	0.372	0.044	0.371
Nursery 1998	-0.040	0.276	-0.036	0.277
Family Day Care 1997	-0.053	0.344	-0.039	0.346
Family Day Care 1998	0.289	0.298	0.267	0.299
Had a child care arrangement at age six months	0.201	0.186	0.207	0.186
Waiting list in municipality at age six months	0.027	0.217	0.032	0.218
Child characteristics				
Girl	**-0.832**	0.165	**-0.833**	0.165
Birth month September	-0.019	0.165	-0.014	0.164
Siblings	0.050	0.133	0.054	0.133
Birth weight (in 1000 grams)	*-0.264*	0.141	*-0.266*	0.141

TABLE B2 CONTINUED[a]

SELECTED MARGINAL EFFECTS, REGRESSION TYPE ANALYSES

OUTCOME: SDQ2007. NONPARENTAL CARE VERSUS PARENTAL CARE

	Model I		Model II	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
# hospitalizations	-0.431	0.281	-0.437	0.281
Physically disabled	0.281	0.413	0.279	0.414
Full term birth	-0.187	0.177	-0.189	0.177
Mother's characteristics				
Age	**-0.066**	0.032	**-0.067**	0.032
Vocational degree	**-0.436**	0.201	**-0.437**	0.201
Short tertiary	**-0.506**	0.237	**-0.508**	0.237
Medium or long tertiary	-0.593	0.415	-0.598	0.415
Labor market experience	-0.006	0.018	-0.005	0.018
Degree of year employed in 1996	0.191	0.353	0.195	0.352
Degree of year employed in 1997	0.121	0.433	0.122	0.433
Degree of year employed in 1998	0.056	0.365	0.053	0.366
Hourly wage 1995	0.001	0.001	0.001	0.001
Senior management level 1995	-0.250	1.007	-0.235	1.007
Higher management level 1995	-0.554	0.383	-0.553	0.382
Medium level employee 1995	-0.390	0.287	-0.391	0.287
Lower level employee 1995	-0.043	0.265	-0.043	0.266
Smoker	**0.717**	0.201	**0.721**	0.202
Single	**1.919**	0.978	**1.926**	0.980
Non-native speaker	0.576	0.730	0.571	0.728
Breast fed child in question	-0.647	0.589	-0.641	0.591
Postpartum depression	0.987	0.767	1.006	0.768
Father's Characteristics:				
Vocational degree	**-0.506**	0.204	**-0.507**	0.205
Short tertiary	**-0.617**	0.262	**-0.620**	0.261
Medium or long tertiary	**-0.963**	0.292	**-0.962**	0.291
Labor market experience	0.004	0.016	0.004	0.016
Leave	*0.338*	0.199	*0.341*	0.199
Hourly wage 1995	0.000	0.001	0.000	0.001
Senior management level 1995	-0.134	0.484	-0.121	0.483
Higher management level 1995	-0.591	0.365	-0.582	0.362
Medium level employee 1995	-0.257	0.287	-0.247	0.284
Lower level employee 1995	0.197	0.231	0.200	0.230
# observations	3,013		3,013	
R^2	0.097		0.097	

[a]Italic indicates significance at the 10% level and bold at the 5% level. Robust standard errors, clustering at municipality level. The model for SDQ is OLS. Binary outcomes modeled using Probits. Marginal effects evaluated at the mean. Conditioning set described in Table B1.

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