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The Impact of Center-Based Childcare Attendance on Early Child Development: Evidence from the French Elfe Cohort

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RESUME

Les modes d'accueil collectifs sont souvent mis en avant par les décideurs politiques comme un moyen de réduire les inégalités sociales dès le plus jeune âge. La littérature internationale a abondamment étudié l'effet de l'accès à la crèche sur le développement de l'enfant mais les résultats divergent notamment en raison de la diversité dans la qualité de cet accueil. Le contexte français est particulièrement bien adapté pour explorer cette question, car la majorité des enfants qui fréquentent les crèches le font dans des crèches de qualité et subventionnées. Nous utilisons une enquête de large envergure l'Étude longitudinale française depuis l'enfance (Elfe) suivant le développement d'une cohorte d'enfants nés en 2011, pour estimer si le recours au mode d'accueil de l'enfant lorsque qu'il a un an affecte son développement dans différentes dimensions : langagières, motrices et socio-émotionnelles mesurées un an plus tard, à l'aide d'une stratégie de variables instrumentales qui tire parti de la variation exogène du mois de naissance et de l'offre locale de crèches. La fréquentation des crèches améliore les compétences linguistiques, particulièrement pour les enfants issus de milieu défavorisé, et dans une moindre mesure également les capacités motrices, mais a un impact un peu négatif sur le comportement. Dès lors, une politique qui favoriserait l'accès à la crèche pour les familles défavorisées pourrait réduire les disparités socio-économiques langagières du jeune enfant.

Mots-clefs : crèche, développement de l'enfant, inégalités sociale, petite enfance, mode d'accueil, langage

ABSTRACT

Proponents of early childhood care programs cite evidence that high-quality center-based childcare has positive impacts on child development, particularly for disadvantaged children. Much of this evidence stems from randomized evaluations of small-scale intensive U.S programs, and is more mixed with respect to widespread or universal center-based childcare provision. Most existing evidence concern 3-to5-year-old children; less is known about the impact of center-based care before. The French context is particularly suited to such interrogation as the majority of children who attend center-based care before age 3 do so in high-quality, state-funded, state-regulated centers, and known as crèches. We use a large, nationally representative French birth cohort (Elfe), to estimate whether crèche attendance at age 1 has an impact on language, motor skills, and child behavior at age 2, with an instrumental variables strategy that leverages exogenous variation in birth month and local crèche supply. Crèche

attendance has a positive impact on language skills -particularly concentrated among disadvantaged children-, to a lesser extent on motor skills, but also a negative impact on behavior. Facilitating increased crèche access among disadvantaged families may hold potential for decreasing early socioeconomic disparities in child language at age 2, and possibly on the long-term population inequalities given the importance of early development for later-life outcomes.

Keywords: Childcare, collective childcare, child development, early childhood, language skills, socio-economic inequalities.

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INTRODUCTION

Early childhood education and care programs, such as center-based childcare and preschool, have been advanced by policymakers as means to boost fertility rates, support and increase parents' (especially mothers') labor force participation, help parents balance work and family responsibilities, and, increasingly, foster child development and reduce early inequalities therein. As such, both demand for and access to formal early childhood programs has dramatically expanded across developed countries in recent decades (Kulic et al., 2019). Given well-documented long-term returns to high quality early investments on wellbeing throughout the life course, particularly for disadvantaged children (Elango et al. 2016; Heckman 2006), coupled with evidence that socioeconomic gaps in school readiness do not narrow, and may further widen as children progress through elementary and secondary school (Bradbury et al., 2015), policies that promote high-quality early childhood education and care may have implications for reducing long-term population inequalities.

In a recent review, Kulic and colleagues (2019) conclude that the most rigorous evidence to date indicates that high-quality center-based childcare has positive impacts on child development, particularly for disadvantaged children, although much of this evidence has come from randomized evaluations of small-scale intensive programs and from U.S. and, to a lesser extent, other Anglo/English-speaking countries. Evidence is more mixed with respect to large-scale center-based childcare provision, particularly in the context of widespread or universal access to such care. Moreover, much of the existing evidence reflects center-based childcare provision for 3- to 5-year-old children; less is known about the impact of center-based care in earlier childhood. Of particular concern, isolating a causal impact of center-based childcare on child development in observational studies is challenged by systematic selection into childcare type, heterogeneity in childcare arrangements (and quality) in the counterfactual condition (parental care, home-based provider, in-home nanny), and heterogeneity in both quality across center-based programs and effects across population subgroups.

To begin to address these gaps, we use a data from a large, nationally representative birth cohort, the *Etude Longitudinale Français depuis l'Enfance* (Elfe), based in France, and an instrumental variables strategy that harnesses exogenous variation in both birth quarter and local center-based childcare supply—both of which affect a child's likelihood of receiving a slot in a childcare center while, arguably, being orthogonal to family choices conditional on other characteristics of their locale—to estimate whether attendance at one year of age at a universal program of high-quality, state-funded, state-regulated childcare centers, known as a "crèches," has an impact on several domains of child development at approximately age 2. We examine whether effects differ across diverse developmental domains (language, motor skills, behavior) and whether there is heterogeneity in effects by socio-economic characteristics (mother's education, household income, family structure, immigrant status, and primary language spoken in the home) and child (parity, sex).

The French context is particularly well-suited to interrogating these questions for several reasons. First, while access to publicly-sponsored childcare is universal in France, the form of that childcare—whether in a childcare center or in a small group in a provider's home—is not guaranteed and, instead, can vary by the timing of a child's birth (which may determine whether slots are still available in local childcare centers) and, more generally, the supply of childcare center slots in the family's municipality, creating the opportunity to leverage a natural experiment. Second, the quality of center-based care in France is considered to be relatively high

and homogeneous throughout the country—the majority of children attending center-based care are placed within high-quality, publicly-funded and heavily-regulated centers—providing a context for testing the effects of high-quality center-based care (rather than center-based care of heterogenous quality) at a population level. Third, children whose families are unable to secure a center-based placement (or prefer an alternative government-subsidized placement) are entitled to a subsidy to receive childcare in the home of a government licensed and regulated childcare provider, who is caring for no more than three total children. These childcare arrangements comprise a relatively high-quality counterfactual condition to center-based care. Notably, however, parents are charged with identifying and securing their own spot in such care. Finally, while access to formal childcare in France for children from 0 to 2 is among the highest in Europe and OECD countries with a 56% rate[1] in 2017, not all such children are placed in a formal arrangement, and a significant proportion are looked after by a parent (usually the mother), who can receive a small financial compensation through a parental leave of up to 3 years. This diversity in childcare arrangements allows us to compare crèche attendance to a range of counterfactual arrangements.

Assessing the impact of government-provided center-based care is also important within the French context given that the current government's anti-poverty strategy has put early formal childcare—and, in particular, increasing formal center-based childcare enrollment for disadvantaged children—at the heart of its policies to tackle intergenerational transmission of disadvantage. To date, however, there is little evidence on whether such care in France has positive impacts on child development, in general, and for children from disadvantaged families, in particular.

BACKGROUND

The impact of center-based childcare on child development

Early childhood is a critical stage for brain development and for forming the structures and mechanisms that will shape cognitive, social, emotional, and health outcomes throughout the life course (Shonkoff & Phillips, 2000). It is well documented that, especially at young ages, the family context is crucial for child development (Berger & Font, 2015; Shonkoff & Phillips, 2000). An extensive literature has also examined the role of early childhood education and care programs on various domains of child wellbeing. Most commonly, approaches to understanding determinants of child development—and the role of social intervention therein—are grounded in an 'investment' framework (Kulic et al., 2019) ("production function" in economics), in which investments by families and institutions influence children's development in cascading fashion, such that (1) earlier investments are likely to have the largest impacts throughout the life course because they provide the infrastructure for responding to later investments and experiences (i.e. dynamic complementarity), and (2) the more one skill or domain of well-being is developed, the more other domains will also improve (i.e., skill complementarity) (Carneiro & Heckman, 2003; Heckman, 2006; Heckman & Cunha, 2007). In other words, "skills-beget-skills" (Heckman, 2008).

[1] This rate is slightly below those observed in the Netherlands and Iceland (around 60%) in 2017, but above the OECD average of 35%. It is much higher than those in countries such as the United States (28%) or the United Kingdom (38%) on which much of the prior literature is based. http://www.oecd.org/els/family/database.htm

High-quality center-based care in early childhood may have both direct and indirect effects on child development. Children may benefit directly through cognitively, emotionally, and physically stimulating and supportive interactions with trained staff, explicit opportunities for skill development, and socialization through interactions with staff and other children. They may be indirectly affected if access to care has positive spillover effects into the family environment and improves family functioning by, for example, enabling parents (particularly mothers) to better balance work and family roles (Bianchi & Milkie, 2010), thereby reducing parental stress, and improving the quality of parent-child interactions and time spent together (Hsin & Felfe, 2014). Evidence that early inputs play a significant role in the production of human capital, including the ongoing development of cognitive and non-cognitive skills, throughout the life course, has bolstered calls for social investment to begin well before formal education (Irwin, Siddiqi, & Hertzman, 2007; UNICEF, 2007).

The most rigorous such studies to date have predominantly been conducted in the United States, beginning in the 1960s, and consist of small, intensive, experimentally-evaluated interventions targeting low-income families during the pre-school period. The programs (e.g., Abecedarian, High Scope/Perry Preschool, Infant Health and Development Program) have typically included high-quality center-based care (low staff-child ratios, highly trained staff, supportive and stimulating staff-child interactions), as well as components directly targeting parents (e.g., home visiting); additionally, the quality of care provided in these programs was strictly enforced and monitored (see, e.g., Elango et al., 2016; Fryer, 2017; Heckman et al., 2010; Barnett & Masse, 2002). On the whole, these programs have demonstrated substantial long-term positive effects in a variety of domains that extend into adulthood, including cognitive skills and academic achievement, health behaviors, employment and earnings, criminal justice involvement, and welfare dependency. Karoly, Kilburn, and Cannon's (2005) review of the evidence on these programs further concludes that such interventions can be effective at reducing population-level inequalities by providing enriched environments to young children from disadvantaged communities.

In contrast to these studies, non-experimental studies of larger center-based care initiatives have produced mixed results. This may, in part, reflect differences in data (including quality and timing thereof), analytic methods (identification strategies), and/or how center-based child care receipt, counterfactual conditions, and developmental outcomes are defined and measured (Shager et al., 2013). Differences in institutional contexts are also likely to play a role (Blossfeld et al., 2017). The majority of such studies have been conducted in the Anglo/English-speaking countries, which may limit the generalizability of their findings to contexts with more universal provision of care and/or greater emphasis on provision of high quality care; indeed, availability, type(s), and quality of childcare vary considerably across developed countries (Gambaro & Stewart, 2014). Most notably, there is widespread heterogeneity in access to and quality of early childhood education and care services in the Anglo/English-speaking countries, which predominantly rely on market-based childcare provision (Kamerman & Waldfogel 2005), whereas child care services in continental Europe are more heavily government regulated, more homogeneous, and, often, universal (Spiess et al. 2003).

A growing body of literature has used natural experiments to examine the impact of widespread or universal provision of care, frequently leveraging variation in the timing of program initiation and expansion to identify effects. On the whole, these studies have produced markedly diverging estimates, on average, though the evidence is more promising for children from lower-socioeconomic status families (Burger, 2010; van Huizen & Plantenga, 2018). It is

also important to consider that documented 'effects' of center-based care on child development tend to differ by developmental domain. Findings tend to be more promising with respect to cognitive skills and achievement (Duncan & NICHD, 2003) than early-childhood behavior, for which some studies have found adverse short-term (Belsky et al. 2007, Yamauchi C, Leigh 2011; Baker et al., 2015; Pingault et al., 2015), though not necessarily long-term, effects (Gomajee et al., 2018) and not necessarily for all children (Data Gupta & Simonsen 2010). We further consider these issues below.

Heterogeneity by center-based childcare characteristics

The impact of center-based childcare is likely to vary by age at program initiation, quality and intensity of care, whether such care includes complementary supports (as noted above, many of the small-scale interventions evaluated in the United States included complementary services intended to improve parenting behaviors), and the counterfactual conditions considered (Burger 2010; Schindler et al., 2015; Shager et al., 2013; van Huizen & Plantenga, 2018). Several recent reviews and meta-analyses speak to these issues. In a recent review of 32 studies from developed countries, for example, Burger (2010) concludes that more intensive interventions are generally associated with substantial short-term, and smaller long-term, improvements in cognitive skills. Impacts are also larger for childcare programs that include elements designed to improve parenting and the home environment. At the same time, some evidence suggests that that extensive time spent in center-based childcare is associated with short-term increases in behavioral problems.

A recent meta-analysis of 30 quasi-experimental studies (van Huizen & Plantega, 2018) in developed countries spanning 2005-2017 further confirms that there is likely considerable heterogeneity in effects based on characteristics of care. In particular, it finds consistent evidence that quality of care provided is a key factor vis-à-vis its impact on child development, and modest evidence that higher-intensity (full-time) care leads to better outcomes (as do public programs relative to private and mixed-public/private programs). Age of program initiation, however, was not found to impact child outcomes. Other meta-analyses, focusing on U.S. studies over nearly a 50-year period, have documented that smaller group sizes and child-teacher ratios are associated with larger positive impacts on cognitive development (Bowne et al., 2017) and that higher-quality programs with an explicit focus on social and emotional development have large effects on decreasing behavioral problems (while programs without such a focus are associated with increased behavior problems) (Schindler, 2015).

In short, current evidence suggests that quality and intensity matter, as do complementary components aimed at improving family functioning and the quality of children's home environments. As discussed in further detail below, the French context offers the opportunity to evaluate the impact of homogenously high-quality center-based care, which does not include complementary components aimed at improving family functioning, thereby allowing for assessment of the effect of center-based care alone on child development. Moreover, children who attend crèche tend to do so at relatively high levels of intensity (on average 36 hours per week in our sample). In addition, because crèche slots are, in effect, rationed by availability at a given time, we are able to leverage random variation in attendance to identify effects. Because our data also include information on children's primary care arrangements (including parental care), we are further able to compare crèche attendance to a range of counterfactual conditions.

Heterogeneity by developmental domain

Child development spans multiple domains across which a variety of skills (cognitive, language, socio-emotional/behavioral, motor) emerge at different times (developmental stages) in a dynamic and cumulative manner, with complementarities realized among different types of skills, as well as between skills, family, and institutional investments, over time (Cunha and Heckman, 2008). Thus, examining the potential impact of early childcare on multiple developmental domains is warranted in order both to identify areas of promise and concern, and to illuminate processes linking childcare attendance to later aspects of functioning and wellbeing.

We focus our analyses on three distinct outcomes: early language, motor skills, and behavior. Early language development is a key indicator of school readiness that varies considerably by socioeconomic status and the quality of the home environment and may be particularly sensitive to child care quality. Early language development is associated with subsequent cognitive skills, educational achievement, and labor market success (Magnuson & Duncan, 2016). The timing and attainment of gross and fine motor skills milestones are considered important markers of neurological integrity (First & Palfrey 1994) and are reciprocally related to physical activity among young children (Figueroa & An, 2017). To the extent that high-quality childcare is associated with increases in (structured and/or unstructured) physical activity for young children, it may have the potential to improve motor skills. Indeed, many high-quality programs include an explicit focus on motor skills, which can be fostered through play activities (Camilli et al., 2010). Nonetheless, motor skills have received limited attention in the early childhood education and care literature. Child behavior is linked to future academic and labor market outcomes (OECD, 2015; Durlak et al, 2011; National Research Council, 2012) throughout the life course. Research has documented steep socioeconomic gradients child behavior beginning in early childhood (Doyle et al, 2009; Bradbury et al, 2019; Garcia, 2015). As such, to the extent that high-quality childcare delivered to disadvantaged children can reduce disparities in behavioral (socioemotional) development, it may hold promise for decreasing long-term social and economic inequalities.

Prior research on the short-term effects of center-based childcare has most frequently assessed cognitive skills and achievement, and this is the domain in which the largest effects have been found. Current estimates suggest effect sizes for improved cognitive skills as a result of high-quality center-based childcare in the range of .14 to .28 standard deviations (Camilli et al., 2010; Magnuson & Duncan, 2016; Shager, 2013; Shindler, 2015; van Huizen & Plantega, 2018). Evidence on motor skills is relatively rare. However, Gormley & Gayer (2005) report an effect size of .24 for improvements in motor skills as a result of attending the high-quality Tulsa Pre-K Program. Given well-documented heterogeneity in impacts of center-based childcare attendance on child behavior by program quality (including explicit focus on socioemotional development) and population group, effect sizes in this domain range widely, from -.13 (indicating an adverse effect on behavior) to .50 (Schindler et al., 2015).

Heterogeneity by family and child characteristics

A considerable literature has documented that, across developed countries, more advantaged families are disproportionately likely to select into high-quality center-based care and less advantaged children are disproportionately likely to receive informal care or care in the provider's home (Cascio, 2017; van Lancker & Ghysels, 2016). These patterns underscore the

importance of accounting for such selection in attempting to isolate the causal effect of childcare arrangement on child development. As noted above, however, evidence also indicates that less advantaged children who do attend high-quality centre-based care realize greater gains therefrom than do their more advantaged counterparts (Cascio, 2017), though there are notable exceptions to this general pattern (Deming, 2009; Gormley, 2008).

In our analyses, we approximate socioeconomic disadvantage by maternal education, household income, and family structure. In addition, we compare differences in effects of crèche attendance for children of (first or second generation) immigrant mothers and children of native French mothers, as well as between children for whom French is the primary language spoken in their home and those for whom it is not. Evidence indicates that immigrant families tend to be more socioeconomically disadvantaged and are considerably less likely to access center-based care than their native counterparts, despite that they may benefit more from such care, particularly with respect to language development (Karoly & Gonzalez, 2011; Magnuson, Lahaie, & Waldfogel, 2006).

We also examine potential heterogeneity in effects by child sex and birth order (first born versus higher order children). Prior research has produced mixed evidence with respect to child sex. For example, results from several small-scale randomized evaluations from the United States (Perry Preschool, Abecedarian) suggest larger gains for girls, particularly with respect to cognitive skills, whereas some analyses of larger scale interventions (Head Start, Tulsa Pre-K) have reported larger gains for boys; perhaps unsurprisingly, then, a recent meta-analysis found similar effects for boys and girls in terms of child cognitive and behavioral outcomes (although boys benefitted more on outcomes such as grade retention and special education classification) (Magnuson et al., 2016). We are unaware of prior studies to assess heterogeneity by birth order but, given that crèche provides an important environment for children to develop language and motor skills, in part by interacting with and learning from other children around them, it is reasonable to examine whether it may have differential effects for children who do and do not have siblings with whom to interact at home.

The French context

Despite the expansion of EU childcare systems in accordance with the 2002 Barcelona European Council goals of "providing childcare to at least 33% of children under 3 years of age and to at least 90% of children between 3 years old and the mandatory school age in each EU member state by 2010" (European Union, 2002), considerable differences exist in the availability and quality of care provided across EU countries (Uhlendorff, Rupp, & Euteneur, 2011). Such differences may have implications not only for parents' choices and constraints regarding the type(s) of childcare (including parental care) that their children receive, but also regarding the influence of such care on subsequent child development. Such heterogeneity may help to explain some of the mixed results in the literature.

France is an interesting case study both because government subsidized childcare services are considered to be of homogeneously high quality and because there is considerable variability in the types of arrangements in which children are placed. About a fifth of French

children under age 3 attended a childcare center in which they were regularly enrolled (crèche)[2] in 2013, and the supply of center-based childcare has been steadily increasing over time, as in other EU countries. However, while the majority of parents indicate that crèche is their preferred childcare arrangement (Le Bouteillec, Kandil, & Solaz, 2014, Virot 2017), it remains the second most common form of formal paid childcare in France, behind state-regulated and subsidized caregivers (*assistantes maternelles*), who are licensed to care for up to three children in their own home (Virot, 2017). Assistantes maternelles provided care for about a third of French children under 3 years of age in 2013 (Le Bouteillec, Kandil, & Solaz, 2014). In theory, crèche and assistante maternelle care are explicitly intended to provide comparably high-quality care.

There are large regional differences in crèche availability: families have a 17-20% chance of obtaining a place in crèche in, for example, Pays de Loire, an almost 30% chance in the Paris region, and a nearly 50% chance in Provence-Alpes-Côte d'Azur and in Corsica. These disparities reflect differences in crèche supply. Although the cost of training and salaries for crèche staff are centrally funded, the management of the programs and cost of infrastructures is delegated to the municipalities. Thus, given the high cost of center-based childcare, allocating sufficient crèche slots is not always prioritized by municipal authorities, particularly in smaller municipalities. Moreover, despite governmentally stated aims of providing crèche to disadvantaged families, in a context where demand exceeds supply, more advantaged, urban families are typically most successful in accessing these services (Le Bouteillec, Kandil, Solaz, 2014).

The crèche system is predominately financed and operated by municipalities, though with centralized oversight, regulation, and licensing, and some subsidization. Subsidies to parents are financed and administered centrally by the state. Crèche is available to children up to about 3 years of age, as children age 3 and above are guaranteed a place in free pre-school ("*école maternelle*"). Unlike many other settings, and in the US and UK in particular, in which childcare policies largely constitute providing financial subsidies for parents to spend on (largely) private-sector arrangements (Noden & West, 2016), the French system is largely delivered by local authorities and financed through a mix of local and central funding.

A second particularity of the French system is that crèche based staff are relatively highly educated, a feature often linked to high quality childcare provision (Gambaro, 2017). All crèche personnel in contact with children must have at least a subject-specific secondary (*CAP Petite Enfance* or a *Diplôme d'auxiliaire de puériculture*) or university-level (*Diplôme d'éducateur de jeunes enfants*) qualification. In contrast, assistantes maternelle do not have to hold formal qualifications, but they have to attend a 120-hours training over the first 3 years of activity (including 80 hours before caring for any child). They are also held to strict structural requirements in terms of quality of infrastructure, hygiene, child-staff ratios, and the like.

Third, while there is no national curricula for child care provision, strict structural requirements are centrally determined and regulated for both crèche and assistante maternelle care, including strict staff-child ratios[3]. Both crèches and assistantes maternelles receive regular quality checks from the state.

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[2] In addition, some children attend *halte-garderie* at least once a week. Halte-garderie's cannot be used for full-time care, but rather limit the number of days or hours a child can use their services, typically at no more than three days per week.

[3] At least one professional per five younger children (before walking age), and at least one professional per eight older children; moreover, at least two supervisors must be consistently present. As noted above, assistantes maternelles are licensed to care for no more than 3 children at a time (Public Health Act, 2010).

France has a long tradition of relatively early access to quality education and care. While initially seen as a tool to boost fertility, increase parental employment, and decrease infant mortality (with therefore a strong focus on hygiene and environmental safety) and, more recently, foster child development (and decreasing socioeconomic inequalities therein). For example, pre-school is free and guaranteed for all children ages 3-6. Since 2019, the age of compulsory instruction has been lowered from 6 to 3[4]. Since 2017, a national "anti-poverty" strategy has focused on early childhood development, in particular by expanding opportunities for more disadvantaged children to access formal childcare to reduce the intergenerational transmission of disadvantage. The policy also includes a new training protocol for early childhood professionals, as well as new "best practice" guidelines to promote early child development (HCFEA, 2019).

DATA AND METHODS

Data

We use newly available data from the *Etude Longitudinale Française depuis l'Enfance* (Elfe), a population-based longitudinal birth cohort study that follows over 18,000 French children from the time of their birth, in 2011, forward (see Charles et al., in press, for a description of the Elfe study). The sample constitutes approximately 2% of all births in France during that year. Children were born at a randomly selected sample of 341 maternity units throughout continental France and were sampled at four intervals: April 1-4, June 27-July4, September 27-October 4, and November 28-December 5, 2011. Interviews were carried out in the hospital shortly after a child's birth, by telephone roughly 2 months post-birth, and again when the child was approximately both 1 and 2 years of age. The study is ongoing and collects data on a diverse number of topics including socio-economic background, parenting, child development, and living conditions.

From the initial Elfe sample of 18,329 births, we kept families with no missing interviews between the birth and the age-2 waves, leaving a potential analysis sample of 12,574[5]. From this sample, we excluded 343 families that had missing data on all three of our outcome measures (language skills, mother skills, and behavior) and an additional 244 families that had missing data on their primary childcare arrangement. This resulted in an analysis sample of 11,987 families, of which 11,986 had non-missing language development data, 11,190 had non-missing motor skills development data, and 11,983 had non-missing behavioral development data. We allow the analysis sample size to vary across outcomes.[6]

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[4] However, parents can ask for a 'derogation' to home school their child.

[5] From the initial Elfe sample, 55 parents asked to be withdrawn from the study and to have their data removed, 128 did not the birth interview, 1,680 did not participate in the 2-month interview, 2,257 in the 1-year interview, and 1,635 in the 2-year interview.

[6] Three of the control variables had small amounts of missing data: income (1.8%), female unemployment rate (1.0%), and overall unemployment rate (0.3%). Given such a small amount of missing data on these variables, we replace missing values with either the sample mean (for income and) or zero (for the employment and unemployment rate categories), and include indicators that these values were initially missing in all of our models. Our results are not sensitive to exclusion from the analytic sample of cases with initially missing values on the controls.

Measures

Childcare arrangement at age 1. Our key variable of interest is the focal child's primary child care setting at the time of the age-1 interview (when children were 12-18 months of age), including: parental care, crèche (center-based care), assistante maternelle (care of up to three children at the home of the care provider), private in-home nanny (individual care at the child's home), or informal care provided by grandparents, friends, or neighbors.

Developmental outcomes. We focus on three developmental outcomes: language skills, motor skills, and child behavior. We use the short French version MacArthur–Bates inventory to assess early language development when children were about 2 years of age. The MacArthur-Bates is an extensively used and validated scale (Kern et al., 2010). The Inventory measures the size and variety of children's vocabularies; the information is collected from the mother (in 3% of cases, when the mother could not be interviewed, the father was administered the scale), who reports whether the child can spontaneously produce words used in daily life, from a proposed list of one hundred words. A higher score indicates a larger vocabulary.

We assess motor-skills using eight father-reported items indicating the child's ability to walk stairs, kick a ball, run, use a tricycle, to put on slippers or socks, eat alone and drink alone, as well as an additional indicator that the child could walk independently by 18 months of age, the upper age limit considered developmentally "normal" by the WHO (WHO, 2006). These items were asked of children's father; they were asked of the mother only if the father was not interviewed or did not respond to them. Father reports were collected for 89% of sample children. To construct an overall score, we use each individual's coordinates on the first axis of a principle component analysis. The first axis explains 79% of the inertia of the point cloud, indicating a good correlation between the variables. A higher score indicates a more advanced motor development.

We assess child behavior using the sum of three mother-reported items indicating how often, on a five-point scale (from never to always), the child (1) resists what the caregiver suggests, (2) challenges or defies the caregiver when they are reprimanded, and (3) hits the caregiver or destroys things when they are angry. Items were reverse coded such that a higher score indicates fewer behavior problems (better behavior).

Focal child age at the time of the two-year interview ranged from 23 months to 28 months. Thus, we age-standardized (by months of age at the time of the interview) the three outcomes to have a mean of 0 and standard deviation (SD) of 1. This also facilitates comparison of effect sizes across outcomes.

Covariates. Our models control for child, household, and contextual characteristics. Child characteristics include indicators for sex, child was born low birthweight, child is a twin, child is a first child, and child has younger siblings (born between the child's birth and the age-2 interview). We do not control for child age as all of our indicators are age-standardized using child age in months. Household characteristics include the mother's age at the 2-month interview and, measured at age 1, her education (less than a baccalaureate [upper secondary degree in France], a baccalaureate, and more than a baccalaureate), immigrant status (first generation immigrant, second generation immigrant, French native), work status (not working, working part-time, working full-time), and work sector (private sector, public sector, self-

employed/other)[7], as well as total household equivalized income (euros per person per month, using the OECD modified equivalization scale) and an indicator for income missing, family structure (married, Pacs [civil partnership agreement], cohabiting [without Pacs], and single-mother[8]), and whether a foreign language was the primary language spoken in the home. In addition, in order to reduce the risk of omitted variable bias, we control for initial childcare preference: whether the mother expressed a preference for crèche care at the 2-month interview (when most mothers were still on maternity leave and children were not yet in non-parental care), to capture parental attitudes and values toward formal group care. We also control for whether the family moved between learning of the pregnancy and the 1-year interview, as such moves may have been crèche-seeking in nature. These latter controls are particularly important in adjusting for systematic selection into crèche. For models in which motor skills is the outcome, we further control for whether the mother, rather than the father, provided the motor skills data.

Contextual variables include the local[9] female employment rate (in three categories: 41-59%, >59-62%, and >62-71%) and the local unemployment rate (in three categories: 4.5-8.5%, >8.5-10.0%, 10.0-16.5%), as well as indicators for missing data on each of these measures.[10] Finally, to account for additional heterogeneity at the local level, we add a birth hospital fixed effect under the assumption that children born in the same hospital are exposed to similar local environments.

Instruments. As noted above (and described below), our instrumental variables models leverage plausibly exogenous variation in quarter of birth and local crèche supply to predict the probability that a child receives crèche care at age 1 and to subsequently estimate the causal effect of crèche care on the developmental outcomes. Quarter of birth is represented by an indicator that the child was born in April (with child born in June/July, September/October, and November/December as the reference category). We selected April because children born in Spring have a higher probability of receiving a crèche slot than children born later in the year because crèche slots tend to become available when children in crèche care move to pre-school in September (Le Bouteillec, Kandil, & Solaz, 2014), which also corresponds with the timing at which many mothers to children born in Spring return to work after maternity leave. In addition, municipal committees[11] meet to assign children to crèche slots in May or June of each year and a child must already have been born to be considered for a crèche placement in the coming year. It is important to note that, while in decades past France exhibited a very distinct pattern of birth seasonality, with relatively more births occurring in the Spring, and particularly so for more advantaged couples, this pattern has been declining since the 1980s and has not been observed

[7] We adjust for mother characteristics, and not father characteristics, in order to retain single mothers in our sample.
[8] There were not enough single fathers in the sample to consider them in our analyses (n=7 at the age 2-month interview, n=11 at the 1-year interview, and n=22 at the 2-year interview).
[9] Local represents the "*zone d'emploi*" of residence, which is defined by the national statistics office as "a geographical area within which most of the working population resides and works, and within which establishments can find most of the labour force needed to fill the jobs offered". There were 322 *zones d'emploi* in France in 2010, and each had a minimum of 5000 workers.
[10] The Elfe study protocol required that we use categorical rather than continuous versions of these measures.
[11] Municipalities vary in their means for determining which children will receive a crèche slot, but most seek to ensure social and economic diversity in placements and some family types (single-mother families) are typically given priority.

since the turn of the Millennium (Regnier-Loilier, 2010). As such, it does not appear that couples, both in general or particular subgroups thereof, disproportionately time births for spring (potentially for the purpose of increasing the probability of receiving a crèche slot).

Local crèche supply is measured by the number of crèche slots available per 100 children age 0 to 3 in the municipality, which we expect to affect a child's probability of crèche placement. Local childcare supply has been used to instrument center-based care participation in prior work estimating plausibly causal effects of center-based care (see, Datta Gupta & Simonsen, 2010, 2016; Felfe & Lalive, 2018).[12] There are 35,000 French municipalities that substantially vary in size and population density. For anonymization reason, we were not able to use the exact value of the local crèche supply in all municipalities. Rather, municipalities with crèche supplies ranging from greater than 78 to 100 slots per 100 children age 0 to 3 were bracketed in 5 categories. Nonetheless, this provides 79 unique local crèche supply rates, which offers adequate variation for our analyses. Of additional note, 31% of children in our sample live in a municipality that offers no crèche slots, while 20% live in a municipality that offers more than 20 slots per 100 children under age 3.

Empirical Strategy

We first estimate ordinary least squares regressions in which we regress each of the outcomes on crèche attendance, as well as the child, mother, and contextual covariates. The models take the form:

$$DEV_{im} = \beta_0 + \beta_1 \text{crèche}_{im} + \beta_2 \mathbf{CHILD}_{im} + \beta_3 \mathbf{HH}_{im} + \beta_4 \mathbf{CNTXT}_{m} + \varepsilon_{im} \quad (1)$$

Where DEV_{im} is a developmental outcome for child i in municipality m; crèche is an indicator that the child attended crèche at age 1; **CHILD**, **HH,** and **CNTXT** are vectors of child, household and contextual characteristics, respectively; and ε is an error term.

The OLS models provide descriptive evidence of the association between crèche attendance and child development, net of the child, mother, and contextual characteristics we observe. However, it is likely that there is systematic selection into crèche care based on unobserved factors that are also associated with children's developmental progress such that they may explain differences in language skills, motor skills, or behavior between children receiving crèche care and those receiving other types of care. Thus, to identify the causal impact of crèche on child development, we employ an instrumental variables approach that leverages exogenously determined variation in crèche participation—caused by the child's quarter of birth and the supply of crèche slots in the municipality of residence when the child is approximately one year old—to estimate the unbiased local average treatment effect (LATE) of crèche attendance on child development. Specifically, we use a two-stage least squares (2SLS) regression approach to first estimate the probability of crèche attendance as a function of the child having an April birth and local crèche supply, net of child, household (including parental preference for crèche and residential moves from the beginning of the pregnancy through the age-1 interview), and

[12] Datta Gupta and Simonsen's (2010, 2016) analyses of the effects of participation in public center-based childcare in Denmark use as their instrument an indicator of whether a child lives in a municipality that guarantees access to center-based care. Felfe and Lalive (2018) estimate the impact of having attended childcare before age 2 in West Germany using within-state differences in childcare supply as an instrument for childcare attendance.

contextual characteristics. The predicted probability of crèche participation is then forwarded to a second stage regression to predict the unbiased LATE of crèche on the developmental outcome, leveraging only exogenous variation in crèche attendance. The first-stage equation takes the form:

$$\text{crèche}_{im} = \beta_0 + \beta_1 \text{Aprilbirth}_{im} + \beta_2 \text{Crèchesupply}_m + \beta_3 \mathbf{CHILD}_{im} + \beta_4 \mathbf{HH}_{im} + \beta_5 \mathbf{CNTXT}_m + \varepsilon_{im} \quad (2)$$

where crèche is an indicator that the child attended crèche at age 1; Aprilbirth is an indicator that the child was born in April (versus June/July, September/October, and November/December); and, crèchesupp is the number of crèche slots per 100 children under age 3 in the child's municipality. The second stage equation takes the form:

$$\text{DEV}_{im} = \beta_0 + \beta_1 \widehat{\text{crèche}}_{im} + \beta_2 \mathbf{CHILD}_{im} + \beta_3 \mathbf{HH}_{im} + \beta_4 \mathbf{CNTXT}_m + \varepsilon_{im} \quad (3)$$

where DEV is a developmental outcome and $\widehat{\text{crèche}}$ is the predicted probability of crèche attendance. We estimate White-Huber heteroskedasticity robust standard errors for all models.

The IV strategy requires that two assumptions be met. First, the instruments—having been born in April and the local crèche supply—must be highly predictive of crèche attendance. Second, the instruments must be uncorrelated with the error term in the explanatory (second stage) equation, such that they must only affect child development through their effect on crèche participation (thereby satisfying the exclusion restriction). The first assumption is easily tested and, as shown in the results section, holds true in all of our models. The second may be violated if, for example, parents time their child's birth to maximize the probability of getting a crèche placement[13] or move in response to pregnancy or birth to a municipality with greater crèche availability. It may also be violated if municipalities that offer a more generous supply of crèche slots also offer better environments for supporting child development in other ways. While we cannot rule out these possibilities, we attempt to minimize them. First, we control for both preference for crèche when the child was approximately 2 years old and whether the family moved during the pregnancy or in the first year of the child's life. These controls should be highly correlated with crèche-seeking behaviors, such as attempting to time a child's birth or moving to municipality with greater crèche supply, and should thus reduce the risk of bias from such. Second, we control in all models for the local female employment rate and the local unemployment rate, which should be correlated with both demand for childcare and municipal socioeconomic status. Third, the inclusion of hospital of birth fixed effects captures additional unobserved environmental heterogeneity, including local context and shared characteristics of families who give birth in the same hospitals. Finally, we estimate supplemental analyses in which we examine whether there are differences in results by (1) initial preference for crèche and (2) residential moves during the pregnancy or first year of the child's life.

Our primary focus is estimating the effect of crèche care versus all other childcare arrangements. To this end, we first present OLS and IV estimates (with and without the inclusion of the birth hospital fixed effect) for both the full sample and the subsample of mothers who were working at the time of the age-1 interview. We then present OLS estimates comparing

[13] As noted above, no disproportional seasonal pattern of births has been observed in France since the turn of the century, either for the population as a whole or by socioeconomic status (Regnier-Loilier, 2010), indicating that this is unlikely to be a major concern.

children attending crèche to those in each of the other childcare arrangements: parental care, assistante maternelle, in-home (private) nanny, and informal care. We present only OLS estimates for these analyses because IV analyses would require a separate instrument for each childcare type and we have been unable to identify such instruments. Third, we present OLS estimates of associations of crèche dosage (hours and days in crèche care) with the developmental outcomes. Here, we present only OLS (and not IV) estimates because, whereas our instruments should predict whether a family is offered crèche care, there is no reason to believe they should be related to hours in crèche care, conditional on receipt. Finally, we examine potential heterogeneity in any effects of crèche care on child development by demographic characteristics of children and mothers using our primary specification (crèche care vs. any other arrangement). We test for such heterogeneity by household socioeconomic status (maternal education, family income, and family structure), maternal immigrant status, whether French is the primary language spoken in the home, and by child sex and parity.

RESULTS

Descriptive statistics

Table 1 presents descriptive statistics for childcare intensity (days and hours) at age 1 and language, motor, and behavior development at age 2 for the full sample and by age-1 childcare arrangement. Both raw and z-scores (standardized by month of age such that the full sample has a mean of zero and standard deviation [SD] of 1) are presented for each developmental outcome. At one year of age, 34.2% of the children in our sample were primarily cared for by a parent, 16.7% were cared for in a crèche, 41.9% by an assistante maternelle, 1.9% by a nanny in the child's home, and 5.4% by an informal caregiver, most commonly a grandparent.[14] Children attending crèche did so for an average of 4.2 days (36.0 hours) per week compared to 4.1 days (35.6 hours) for children cared for by an assistante maternelle, 4.4 days (39.6 hours) for children cared for by a private nanny, and 4.2 days (33.1 hours) for those receiving informal care.

The raw data indicate that children attending crèche score highest (best), on average, on the language assessment, followed by those cared for by a nanny in their own home, those cared for by an assistante maternelle, and those in informal care; children cared for by their parents exhibit the poorest language skills. Children attending crèche are able to say an average of 80 words, which constitutes 6 words (.23 SDs) more than the sample mean. They are able to say 12 (.47 SDs) more words than those being cared for by their parents, 3 words (.12 SDs) more than those in assistante maternelle care, 2 words (.10 SDs) more than those cared for by a private nanny, and 8 words (.32 SDs) more than those in an informal care arrangement. Differences in motor skills are considerably smaller in magnitude than those for language development. However, children attending crèche are reported to have greater motor skills than those in all other forms of care (the advantage ranges from .07 to .16 SDs), and those being cared for by their parents exhibit greater motor than those in all other forms of care except crèche. The pattern for behavior is different. On average, children cared for by their parents are reported to have

[14] Approximately 18% of children changed their primary care arrangement between ages 1 and 2, with parental care becoming less prevalent (27.1% vs. 34.2%), crèche (16.7% vs. 22.2%) and assistante maternelle (41.9% vs. 44.9%) care becoming more prevalent, and both nanny care in the child's home (1.9% vs. 1.8%) and informal care (5.4% vs. 5.7%) staying relatively stable.

better behavior than children in all other care arrangements, with the difference attaining statistical significance compared to both crèche and assistante maternelle care. Children in crèche are also reported to have significantly poorer behavior than those being cared for by an assistante maternelle.

As discussed above, there is likely systematic selection into childcare arrangements by child and family characteristics. The descriptive statistics for our covariates and instruments, presented in Table 2, reinforce that this is likely the case. On the whole, low-birthweight children are disproportionately likely to be in parental or informal care and twins in parental or private nanny care. First-born children are disproportionately likely to experience nonparental care, particularly crèche, assistante maternelle, or informal care. This reflects that most French mothers do not withdraw from the labor market following the birth of their first child. There are also differences by both maternal and contextual characteristics. For example, children of less-educated and lower-income families, and those experiencing a single-mother family are more likely to receive informal or parental care and less likely to receive crèche or assistante maternelle care; they are particularly unlikely to have a private nanny. However, among single mothers and those in the lowest income-quintile who use a non-parental care, crèche is more common (31% in both cases, not shown in Table 2) than in general population (25%), indicating that we have reasonable cell sizes for analyses of such families. Compared to children of immigrant and second-generation mothers, those with French-native mothers are more likely to receive care from an assistante maternelle or private nanny, and less likely to receive parental or informal care (rates of crèche care were relatively proportionate among these groups). As expected, most mothers who use nonparental childcare are employed, while this is true for about half of mothers with children receiving parental care. Crèche is particularly common among mothers working in the public sector, while having a nanny in the child's home is more frequent among mothers working in the private sector and those who are self-employed. Finally, it is important to note that, while the mother having a preference for crèche is positively associated with her child attending crèche, many children whose mother prefers crèche are in other forms of care, likely as a result of limited crèche availability. Moreover, only 45% of mothers whose children were attending crèche at the age-1 interview reported a preference for crèche at the 2-month interview, whereas 49% of children whose mothers who reported a preference for crèche at the 2-month interview were attending crèche at the age-1 interview (not shown in Table 2).

Turning to the contextual factors, children in locales with a high female employment rate are more likely to receive crèche, assistante maternelle, and private nanny care. Finally, with respect to the instruments, children in municipalities with greater relative crèche supply are highly likely to receive crèche or private nanny care. Those born in April (relative to June/July, September/October, and November/December) are considerably more likely to receive crèche care.

Regression results

Primary estimates. Our primary results are presented in Table 3. For each of the three outcomes—language (Panel A), motor skills (Panel B), and behavior problems (Panel C)—we present estimates of the effect of crèche participation from OLS and IV regressions both without and with birth hospital fixed effects. We show these estimates for the full sample of children as well as the subsample of children whose mothers were employed at the 1-year interview.

Consistent with the descriptive statistics, the OLS results indicate that, net of the full set

of covariates, attending crèche at approximately 1 year of age is associated with greater language skills (Panel A) at about age 2. Children attending crèche have age-2 language scores that are 0.19 SDs higher, on average, than those of children in all other arrangements. This finding is robust to the addition of the birth hospital fixed effect. Turning to the IV results, the instruments perform extremely well. The first stage F-statistics is very large (98) and the underidentification (Kleibergen-Papp) and weak instrument (Anderson-Rubin) robustness tests are satisfied in each model. The first stage estimate (see Appendix Table A1, Panel A) suggest that a 10% increase in the local crèche supply is associated with a 5 percentage point increase in the probability that a child receives crèche care and that being born in April is associated with a 3 percentage point increase in the probability of crèche care receipt. The second stage IV results are positive, statistically significant, and larger in magnitude than the OLS estimates. The IV results indicate a LATE of crèche on language skills of .36 to .42 SDs—a relatively large effect. The difference between the OLS and IV results may reflect that children who are exogenously induced to crèche participation based on being born in Spring and in a municipality with a greater local crèche supply benefit more from crèche attendance than children whose parents 'select' them into crèche participation regardless of their birth date and municipal crèche availability. More generally, the overall pattern of these results suggests that any bias induced by the endogeneity of crèche attendance and language development likely results in underestimation of the positive effect of crèche participation on language development, conditional on the observed covariates. As such, the OLS results can potentially be interpreted as conservative approximations of the causal impact of crèche on language development.

The OLS and IV results for motor skills (Panel B) and behavior (Panel C) are also consistent with the descriptive results for these outcomes and show a similar pattern of OLS and IV estimates as was found for language development. Specifically, the IV estimates are in the same direction as the OLS estimates but are larger in magnitude. The OLS and IV estimates for motor skills indicate that crèche attendance is associated with increased motor skills development on the order of .11 to .13 SDs (OLS) and .33 to .36 SDs (IV), whereas crèche attendance is associated with poorer behavioral development on the order of .07 SDs (OLS) and .25 to .36 SDs (IV). As with language development, these IV results indicate that the OLS estimates are likely conservative approximations of the causal effect of crèche participation on child development. Results when these analyses are replicated for the subsample of children whose mothers were working at the age-1 interview are substantively consistent with those for the full sample, indicating that the findings do not primarily reflect poor outcomes for children who were not attending formal childcare because of maternal inactivity or unemployment.

Robustness Checks. We conducted a range of robustness checks to test the sensitivity of our analyses to various model specifications. First, we tested several alternative instruments. These results are presented in Appendix Table A1. Specifically, we compared the results from IV models (with and without the inclusion of birth hospital fixed effects) using our primary instruments (local crèche supply and April birth, Panel A), to those from IV models in which we used as instruments (1) only crèche supply (Panel B), (2) only April birth (Panel C), (3) a dichotomous indicator for above national median local crèche supply and the indicator for local birth (Panel D), and (4) the interaction between the above national median local crèche supply and April birth indicators (Panel E). The first stage F-statistics are larger than the Staiger and Stock (1997) rule-of-thumb cutoff of 10 in almost all models. However, they were smallest, by several orders of magnitude, when April birth alone was used as the instrument. Moreover, this

specification produced implausibly large second stage estimates for language and behavior. The other specifications all produced second stage results that were generally consistent with those from our primary specification, whether or not birth hospital fixed effects were included in the model, with large F-statistics. However, the second stage estimates were less precisely estimated, and the instruments performed somewhat less well, with the inclusion of birth hospital fixed effects. This is not surprising given that there is limited variation in local crèche supply among children with the same birth hospital. These findings reinforce our preference for our primary IV strategy.

Second, to further attempt to account for potential unobserved characteristics associated with both parental preference for crèche and child development, we estimated separate models for families in which the mother did and did not report an initial preference for crèche. Here, we are concerned that parents who prefer crèche may take actions, such as attempting to time their births or move to a municipality with a more generous crèche supply, and that this may be driving our IV results, and thereby ruling out causal interpretation. On the contrary, however, results (Appendix Table A2, Panel A) from these analyses suggest that, if anything, the beneficial effect of crèche for language and motor skills is larger (and the negative effect for behavior is smaller) for children whose mothers did not express a preference for crèche than for those whose mothers preferred crèche. We would not expect the former to engage in crèche-seeking behaviors.

Third, to further account for the possibility that families may have moved municipalities to increase their probability of getting a crèche slot, we estimated separate models for families that did and did not move between learning of the pregnancy and the age-1 interview (results shown in Appendix Table A2, Panel B). As would be expected, the benefit of crèche for children whose families move is slightly larger than those for those whose families do not move in the OLS models. However, this is probably due to selection and the results are reversed in the IV estimation, in which benefits for children of non-movers are greater than those for movers. This suggests that our primary results are not driven by children whose families moved to obtain a greater likelihood of crèche receipt.

Counterfactual childcare arrangements. Table 4 present results of OLS regressions with birth hospital fixed effects estimating associations of crèche attendance with child development relative to each of the alternative childcare arrangements: parental care, *assistante maternelle*, in-home (private) nanny, and informal care. As noted above, we present only OLS estimates for these analyses because we do not have separate instruments for each childcare type. The first column for each outcome presents the association of non-crèche (vs. crèche) care with the outcome. These estimates are the same as those presented in Table 3 for the OLS with birth hospital fixed effects regressions, except that the signs (direction of coefficients) are reversed given that, here, we model non-crèche care rather than crèche care. The second column for each outcome presents results from a regression in which crèche care is the reference category to which the other forms of care are compared. The language results indicate that children in all other types of care exhibit poorer language development than those in crèche care, but that the differences are particularly large with respect to parental care (.31 SDs) and informal care (.27 SDs), and somewhat smaller with regard to *assistante maternelle* (.10 SDs) and in-home nanny care (.14 SDs). For motor skills, the difference between crèche care and parental, *assistante maternelle*, and informal care is significant, whereas the difference between crèche care and in-home nanny care is not. However, the estimates are similar in magnitude for each form of care,

suggesting that crèche care is associated with .09 to .14 SDs better motor skills. Finally, crèche care is associated with poorer behavior compared to both parental care (.13 SDs) and in-home nanny care (.14 SDs), but not compared to *assistante maternelle* or informal care.

Dosage. Table 5 presents OLS estimates of associations of crèche dosage (hours and days in crèche care) with the developmental outcomes, relative to all other forms of care. We present only OLS (and not IV) estimates because, whereas our instruments should predict whether a family is offered crèche care, there is no reason to believe they should be related to hours in crèche care, conditional of receipt. For language development, these results suggest a clear dose-response relation such that additional hours or days per week in crèche care are associated with greater language skills. For example, relative to children in all other types of care, children who spend 3, 4, or 5 days per week in crèche care exhibit .10, .19, and .20 SDs greater language skills, respectively. We also find evidence of a dose-response relation for motor skills and behavior. For motor skills, children who spend 5 days per week in crèche care exhibit .15 SDs greater skills than children who who use other types of care. For behavior, children spending 3 and 5 days in crèche care exhibit .12 and .10 poorer behavior than those experiencing other types of care (the estimate for 4 days per week is close to zero in magnitude and nonsignificant).

Subgroups analyses. As noted above, prior literature has identified considerable heterogeneity in associations of childcare type with child development. Thus, we conducted a series of subgroup analyses based on family and child characteristics. We present only OLS results for these analyses given that the instruments did not always perform well in the context of smaller subgroup sample sizes.[15] With respect to family characteristics, the results (Table 6) suggest that the positive associations of crèche attendance with language development are particularly concentrated among disadvantaged children: those with less educated mothers (Panel A), those living in lower-income households (Panel B), those ever experiencing a single-mother family between birth and age 2 (Panel C), those born to (first or second generation) immigrant mothers (Panel D), and those for whom French is not the primary language spoken in the home (Panel E). The pattern of results for motor skills are less pronounced and less consistent across groups. With respect behavior, while the patterns are less clear than for language, we note that the most disadvantaged group, regardless of dimension considered, is never penalized, whereas more advantaged groups sometimes are.

Turning to child characteristics (Table 7) the OLS results suggest relatively similar associations of crèche attendance with language development for first-born and higher-order birth children, but also imply a larger association for boys than girls. The association of crèche attendance with motor skills appears to be stronger for first-born children than higher-order children, and relatively similar for boys and girls. Finally, these results suggests that the association of crèche attendance with greater behavior problems may be more pronounced for first-born than higher order children, but is relatively similar for boys and girls.

DISCUSSION

[15] We also performed IV estimations on subgroups and results are generally consistent with OLS estimations when the instrument satisfies weak instrument tests, which is not the case for all subgroups. Specifically, the instruments tend to be weak and the IV estimates less stable and precise for subgroups with particularly small sample sizes, which results in models with less statistical power.

This study uses extensive, high quality data from a recent French birth cohort and both OLS and IV regressions to estimate the effect of attending center-based childcare (crèche) at age one on children's language, motor skills, and behavior at approximately age 2. The French context offers an ideal setting for this interrogation. First, French families exhibit considerable use of diverse childcare arrangements for young children allowing examination of heterogeneity in childcare arrangements. Second, while French policy purports to offer universal childcare, it does not guarantee a crèche slot. Rather, ability to access crèche for families that desire to do so depends on the availability of a slot in their locale at a given time. Third, the quality of center-based care in France, which is provided through a system of publicly funded and managed crèches, is relatively high and homogeneous, allowing us to assess LATEs of crèche attendance on child development at the population level.

On the whole, we find that, relative to all other types of early childcare arrangements (including parental care), attending crèche at 1 year of age is associated with relatively large gains in language skills and modest gains in motor skills, but also with an increase in behavior problems. These findings are robust to a range of sensitivity tests. Moreover, our IV results suggest both that relations between crèche attendance and child development are likely causal in nature and that the more naïve OLS estimates likely underestimate the causal effects of crèche attendance on child outcomes. We also find descriptive evidence that the associations of crèche attendance with child development are especially pronounced when crèche attendance is compared to parental and informal care, and less pronounced when it is compared to *assistante maternelle* and private nanny care. These differences are particularly large for language development. In addition, we find descriptive evidence that greater intensity (time spend in care) crèche participation is associated with larger developmental effects—both positive (for language and motor skills) and negative (for behavior).

Results from our subgroup analyses further suggest that there is heterogeneity in the magnitude and domains of impacts across population subgroups. Most notably, less-advantaged children—particularly those with low-educated and immigrant mothers and those in lower-income households—appear to benefit most from crèche attendance, especially with respect to language development. This is consistent with prior research on the impact of high-quality center-based care on child development (e.g., Kuehnle & Oberfichtner, 2017), and suggests that, within the French setting (and, potentially similar settings characterized by high-quality publicly-provided care), facilitating disadvantaged families in accessing crèche may hold potential for decreasing early socioeconomic disparities in child development. This may be particularly important given that disadvantaged children are less likely than their more advantaged counterparts to attend center-based childcare in the majority of European countries (Collombet, 2018). We find less consistent patterns of results with respect to child characteristics (parity and sex). Thus, consistent with findings from larger-scale U.S. evaluations (see, Magnuson et al., 2016), we cannot conclude that there are sex differences in effects (we are not aware of prior studies to examine differences by birth order).

How do our results fit within a very mixed literature? First, it is notable that our estimated effect sizes are not out-of-line with the range of prior estimates from other settings for language and motor skills, although they tend to be larger when estimated using IV. For example, our full sample OLS estimated effect sizes (Model 1 in Table 3) for language skills are .18 to .19, whereas cognitive skills effect sizes in the prior literature range from .14 to .28 (Carmilli et al. Magnuson & Duncan, 2016; Shager, 2013; Shindler, 2015; van Huizen &

Plantega, 2018). Our OLS estimated effect sizes for motor skills are .11 to .13. By comparison, Gormley & Gayer (2005) report an effect size of .24 for motor skills in their evaluation of the Tulsa Pre-K Program. While our estimate is smaller in magnitude, it is not drastically so. Finally, as discussed above, estimates for behavior vary widely across settings, ranging from -.13 SDs (indicating an adverse effect on behavior) to .50 SDs (Schindler et al., 2015). Our OLS-estimate suggests an effect size of approximately -.07, which is on the lower end of prior estimates (and our subgroup analyses suggest this result does not hold for all groups of children). Our IV regressions tend to produce considerably larger effect size estimates, however, these represent LATEs rather than average treatment effects. As such, they are less readily comparable to effect size estimates from prior work.

With respect to the relative magnitude of our findings for language and motor skills, a first avenue toward understanding how to contextualize these results may be to consider that the French crèche system is almost entirely based on public provision; structural quality of provision is strictly enforced nationally; and, while we are not aware of studies assessing processes quality, the relatively educated profiles of crèche workers point towards high quality in this dimension as well. Our results therefore support hypotheses that a positive impact of center-based childcare can be had when quality of provision is high. Moreover, children attending crèche in France do so mostly in State-run, subsidized programs that are open to all children, and which actively attempt to recruit a socio-economically diverse population. Research from the US suggests that more disadvantaged children benefit more from socially mixed preschool settings than from socioeconomically homogenous programs (Cascio, 2017), which might explain why we find a particular benefit of crèche attendance for more disadvantaged children.

Our results should be interpreted in the context of a number of limitations. First, they are French-specific, and may not apply to other settings with different childcare frameworks. Key elements of the French context, which may not be found in other settings, include the relatively homogeneous and high-quality nature of the care provided, and high levels of State-subsidies and control over structural aspects of the care provided. Second, all of the individual-level data used in this study were reported by parents. To the extent that parents selecting different childcare types may systematically report differently on their children's development, our estimates could be biased. However, while this is problematic for our OLS regressions, the IV strategy should reduce such bias. Third, the developmental measures of focus—particularly those for motor skills and behavior—may lack the sensitivity to fully and meaningfully assess differences in development for the young children in our sample. Indeed, there is relatively limited variation across children on these measures, most notably for motor skills. Fourth, we measure relatively short-term outcomes, only a year after crèche attendance is observed. We therefore cannot comment on whether these effects will persist, exacerbate, or fade out over time. There is for example evidence that short-term negative impacts of center-based child care attendance on child behavior do not hold in the longer term (Gomajee et al., 2018). Fifth, as is the case with all longitudinal studies, there has been attrition over time in Elfe. Attrition appears to be disproportionately among more disadvantaged and residentially mobile families (Thierry, Pilorin, Lanöe, 2018). This, too, may limit the generalizability of our results. Finally, our IV analyses rely on the assumption that families do not move to particular municipalities, nor time their births, to increase their chances of obtaining crèche care for their infants. If this is the case, our IV estimates will be biased. Although our sensitivity analyses help to allay such concerns, we cannot be certain of the absence of such behaviors.

Keeping these limitations in mind, our results suggest that, within the universal,

subsidized, high-quality French childcare system, experiences of early collective care appear to benefit children's language development and, to a lesser extent, motor skills, but also to have a negative influence on behavior. Moreover, positive effects language skills appear to be particularly concentrated among disadvantaged children for whom their also appear to be no negative effects on behavior, suggesting that an expansion of access to crèche may have potential (if quality is maintained and less-advantaged parents are willing to use crèche care) to contribute to decreasing early gaps in child wellbeing.

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Table 1. Descriptive statistics, childcare intensity at child age 1 and developmental outcomes at child age 2.

	Full Sample	Parental Care	Crèche	Assistante Maternelle	Nanny in Child's Home	Informal Care
Childcare intensity (age 1):						
Days per week	4.173	--	4.247	4.134[b]	4.369[b]	4.178[cd]
	(0.826)	--	(0.828)	(0.778)	(0.940)	(1.074)
Hours per week	35.627	--	36.010	35.621	39.644[bc]	33.055[bcd]
	(9.856)	--	(9.766)	(9.261)	(12.061)	(12.772)
Developmental outcomes (age 2):						
Language	74.449	68.598	80.365[a]	76.967[ab]	77.978[a]	72.503[abc]
	(24.999)	(27.022)	(20.934)	(23.628)	(22.665)	(26.697)
Language	-0.000	-0.239	0.229[a]	0.109[ab]	0.132[a]	-0.089[abc]
(z-score)	(1.000)	(1.080)	(0.843)	(0.941)	(0.907)	(1.078)
Motor skills	6.535	6.549	6.625[a]	6.494[ab]	6.472[b]	6.520[b]
	(0.993)	(1.027)	(0.967)	(0.977)	(0.943)	(0.991)
Motor skills	0.000	0.014	0.083[a]	-0.037[ab]	-0.082[b]	-0.023[b]
(z-score)	(1.000)	(1.029)	(0.979)	(0.984)	(0.954)	(1.003)
Behavior	5.934	6.036	5.774[a]	5.909[ab]	5.996	5.952
	(2.159)	(2.309)	(2.091)	(2.055)	(1.999)	(2.202)
Behavior	0.000	0.046	-0.072[a]	-0.011[ab]	0.025	0.004
(z-score)	(1.000)	(1.068)	(0.972)	(0.951)	(0.929)	(1.017)
Percent of sample		34.2	16.7	41.9	1.9	5.4
Observations	11,987	4,101	1,997	5,021	226	642

Note: 11,986 observations for language, 11,190 for motor skills, and 11,983 for behavior. Means (and standard deviations presented).
[a]Differs from "Parental Care" at p<.05.
[b]Differs from "Crèche" at p<.05.
[c]Differs from "Assistante Maternelle" at p<.05.
[d]Differs from "Nanny in Child's Home" at p<.05.

Table 2. Descriptive statistics, covariates and instruments.

	Full Sample	Parental Care	Crèche	Assistante Maternelle	Nanny in Child's Home	Informal Care
Child characteristics:						
Boy	0.508	0.512	0.507	0.506	0.518	0.495
Low birthweight	0.038	0.050	0.035[a]	0.029[a]	0.031	0.055[bc]
Twin birth	0.017	0.027	0.018[a]	0.008[ab]	0.031[c]	0.008[acd]
First child	0.434	0.304	0.485[a]	0.500[a]	0.438[a]	0.597[abcd]
Younger sibling	0.079	0.096	0.082	0.063[ab]	0.093	0.081
Household characteristics:						
Mother's age (at 2-month interview)	31.379 (4.690)	31.164 (5.169)	32.153[a] (4.371)	31.284[b] (4.286)	33.235[abc] (4.377)	30.436[abcd] (5.095)
Less than baccalaureate	0.165	0.320	0.075[a]	0.077[a]	0.035[a]	0.187[abcd]
Baccalaureate	0.411	0.424	0.347[a]	0.427[b]	0.168[abc]	0.481[abcd]
Greater than baccal.	0.424	0.256	0.578[a]	0.496[ab]	0.796[abc]	0.332[abcd]
Equivalized income (Euros/month)	1821.883 (1259.193)	1340.128 (987.703)	2081.399[a] (1320.686)	2053.941[a] (1147.688)	3153.564[abc] (1473.642)	1808.331[abcd] (2038.976)
Income missing	0.018	0.029	0.018[a]	0.010[ab]	0.031[c]	0.014[a]
Ever single-mother	0.038	0.059	0.033[a]	0.021[ab]	0.009[a]	0.069[bcd]
Immigrant mother	0.081	0.135	0.088[a]	0.036[ab]	0.066[a]	0.072[ac]
Second-gen. mother	0.100	0.123	0.113	0.070[ab]	0.093	0.159[abcd]
French native mother	0.819	0.742	0.800[a]	0.894[ab]	0.841[ac]	0.769[cd]
Foreign lang. at home	0.043	0.073	0.046[a]	0.018[ab]	0.049[c]	0.036[ac]
Non-working	0.214	0.491	0.102[a]	0.055[ab]	0.097[a]	0.073[a]
Working full-time	0.476	0.263	0.568[a]	0.590[a]	0.668[abc]	0.597[a]
Working part-time	0.310	0.246	0.330[a]	0.355[ab]	0.235[bc]	0.330[ad]
Working private sector	0.451	0.316	0.465[a]	0.541[ab]	0.553[ab]	0.545[ab]
Working public sector	0.278	0.157	0.363[a]	0.343[a]	0.186[bc]	0.318[abd]
Self-employed/other	0.056	0.036	0.071[a]	0.061[a]	0.164[abc]	0.064[ad]
Preference for crèche	0.153	0.077	0.448[a]	0.105[ab]	0.155[abc]	0.087[bd]
Moved in first year	0.164	0.197	0.151[a]	0.143[a]	0.115[a]	0.184[bcd]
Mom reptd motor skills	0.110	0.161	0.092[a]	0.075[ab]	0.065[a]	0.146[bcd]
Contextual characteristics:						
Fem. employ. 41-59%	0.310	0.356	0.314[a]	0.277[ab]	0.084[abc]	0.341[cd]
Fem. employ. >59-62%	0.326	0.320	0.291[a]	0.354[ab]	0.173[abc]	0.302[cd]
Fem. employ. >62-71%	0.354	0.312	0.383[a]	0.361[a]	0.739[bc]	0.343[d]
Fem. employ. missing	0.010	0.012	0.012	0.008	0.004	0.014
Unemploy. 4.5-8.5%	0.333	0.309	0.257[a]	0.392[ab]	0.204[ac]	0.315[bcd]
Unemploy. >8.5-10%	0.355	0.327	0.433[a]	0.336[b]	0.677[abc]	0.330[bd]
Unemploy. >10-16.5%	0.308	0.360	0.309[a]	0.269[ab]	0.119[abc]	0.349[cd]
Unemploy. rate missing	0.003	0.003	0.001	0.003	0.000	0.006[b]
Instruments:						
Local crèche supply (per 100 < age 3)	11.896 (11.407)	11.100 (10.833)	17.215[a] (11.764)	10.058[ab] (10.969)	22.465[abc] (11.525)	11.086[bcd] (10.199)
Born in April	0.147	0.141	0.179[a]	0.142[b]	0.133	0.129[b]
Percent of sample		34.2	16.7	41.9	1.9	5.4
Observations	11,987	4,101	1,997	5,021	226	642

Note: 11,987 observations for families with no missing data on at least one outcome variable (language, motor skills, or behavior). Proportion or means (and standard deviation) presented.

[a]Differs from "Parental Care" at p<.05.

[b]Differs from "Crèche" at p<.05.

[c]Differs from "Assistante Maternelle" at p<.05.

[d]Differs from "Nanny in Child's Home" at p<.05.

Table 3. OLS and IV results, full sample and employed-mother subsample

	Full Sample				Employed-Mother Subsample			
	OLS	OLS w/ birth hospital fixed effect	IV	IV w/ birth hospital fixed effect	OLS	OLS w/ birth hospital fixed effect	IV	IV w/ birth hospital fixed effect
Panel A: Language								
Crèche	0.189***	0.180***	0.360*	0.416*	0.180***	0.176***	0.300+	0.408*
	(0.025)	(0.023)	(0.162)	(0.205)	(0.027)	(0.025)	(0.161)	(0.204)
First-stage F			97.611	77.746			86.589	70.164
K-P LM[a]			0.000	0.000			0.000	0.000
A-R Wald[b]			0.001	0.006			0.002	0.002
Observations		11,986				9,423		
Panel B: Motor Skills								
Crèche	0.125***	0.106***	0.364*	0.329	0.119***	0.099***	0.325+	0.281
	(0.027)	(0.027)	(0.173)	(0.222)	(0.029)	(0.029)	(0.169)	(0.220)
First-stage F			91.536	70.876			81.524	65.455
K-P LM[a]			0.000	0.000			0.000	0.000
A-R Wald[b]			0.072	0.244			0.147	0.432
Observations		11,190				8,891		
Panel C: Behavior								
Crèche	-0.073**	-0.066*	-0.361*	-0.245	-0.063*	-0.055*	-0.502**	-0.402+
	(0.024)	(0.026)	(0.171)	(0.214)	(0.025)	(0.028)	(0.165)	(0.209)
First-stage F			97.507	77.674			86.499	70.114
K-P LM[a]			0.000	0.000			0.000	0.000
A-R Wald[b]			0.021	0.087			0.001	0.029
Observations		11,983				9,420		

Note: Coefficient (and White-Huber heteroskedasticity robust standard error) presented. Standard errors are adjusted for intra-cluster correlation among children born in the same hospital in models that do not include birth hospital fixed effects. All models control for the full set of child, mother, and contextual covariates listed in Table 2. First stage instruments are local crèche supply and child born in April (relative to June/July, September/October, and November/December).

+ p<.10, * p<.05, ** p<.01, *** p<.001.

[a]Kleibergen-Papp underidetification test, rank LM statistic (p-value).

[b]Anderson-Rubin weak instrument robustness test, Wald statistic (p-value).

Table 4. OLS results, multiple comparison childcare arrangements

	Language		Motor Skills		Behavior	
	OLS w/ hospital f.e.	OLS w/ hospital f.e.	OLS w/ hospital f.e.	OLS w/ hospital f.e.	OLS w/ hospital f.e.	OLS w/ hospital f.e.
Non-Crèche Care	-0.180***		-0.106***		0.066*	
	(0.023)		(0.027)		(0.026)	
Parental Care		-0.306***		-0.120***		0.125***
		(0.030)		(0.032)		(0.032)
Assit. Maternelle		-0.103***		-0.093**		0.030
		(0.025)		(0.029)		(0.028)
In-home Nanny		-0.138*		-0.109		0.141*
		(0.067)		(0.072)		(0.070)
Informal Care		-0.270***		-0.139**		0.047
		(0.046)		(0.048)		(0.048)
Observations	11,986	11,986	11,190	11,190	11,983	11,983

Note: Coefficient (and White-Huber heteroskedasticity robust standard error) presented. All models control for the full set of child, mother, and contextual covariates listed in Table 2, as well as birth hospital fixed effects.
+ p<.10, * p<.05, ** p<.01, *** p<.001.

Table 5. OLS results, hours per week and days per week in crèche

	Language			Motor Skills			Behavior		
	Hours per week	Days per week (linear)	Days per week (dummies)	Hours per week	Days per week (linear)	Days per week (dummies)	Hours per week	Days per week (linear)	Days per week (dummies)
Hours in crèche	0.005***			0.003***			-0.002*		
	(0.001)			(0.001)			(0.001)		
Days in crèche		0.042***			0.025***			-0.014*	
		(0.005)			(0.006)			(0.006)	
3 days in crèche			0.102*			0.081			-0.124*
			(0.051)			(0.053)			(0.056)
4 days in crèche			0.194***			0.067+			0.001
			(0.034)			(0.040)			(0.038)
5 days in crèche			0.201***			0.148***			-0.096**
			(0.031)			(0.037)			(0.037)
Observations	11,977	11,986	11,986	11,184	11,190	11,190	11,974	11,983	11,983

Table 6. OLS results by family characteristics

	Language	Motor Skills	Behavior
Panel A: Maternal education			
Less than baccalaureate education			
Crèche	0.252**	0.163+	-0.049
	(0.082)	(0.084)	(0.096)
Observations	1,978	1,742	1,978
Baccalaureate education			
Crèche	0.191***	0.148***	-0.126**
	(0.040)	(0.045)	(0.044)
Observations	4,921	4,572	4,918
More than baccalaureate education			
Crèche	0.166***	0.107**	-0.044
	(0.030)	(0.035)	(0.034)
Observations	5,087	4,876	5,087
Panel B: Family income			
Bottom two quintiles			
Crèche	0.231***	0.142**	-0.085
	(0.050)	(0.052)	(0.056)
Observations	4,272	3,865	4,271
Middle quintile			
Crèche	0.175***	0.186**	-0.055
	(0.052)	(0.057)	(0.055)
Observations	2,426	2,278	2,426
Top two quintiles			
Crèche	0.173***	0.113**	-0.055
	(0.030)	(0.036)	(0.055)
Observations	5,068	4,849	5,067
Panel C: Family structure			
Parents always co-resident			
Crèche	0.188***	0.128***	-0.075**
	(0.023)	(0.026)	(0.026)
Observations	11,531	10,770	11,528
Ever single-mother family by age 2			
Crèche	0.252+	0.156	-0.082
	(0.131)	(0.153)	(0.171)
Observations	455	420	455
Panel D: Nativity			
French native			
Crèche	0.177***	0.106***	-0.068*
	(0.025)		
	(0.026)	(0.029)	(0.029)
Observations	9,813	9,265	9,811
First- or second-generation immigrant			
Crèche	0.227***	0.211***	-0.085
	(0.052)	(0.059)	(0.060)
Observations	2,173	1,925	2,172
Panel E: Language spoken at home			
French			
Crèche	0.188***	0.123***	-0.071**
	(0.023)	(0.027)	(0.026)
Observations	11,472	10,742	11,469
Foreign language			
Crèche	0.229*	0.200+	-0.095
	(0.116)	(0.119)	(0.128)

Observations	514	448	514

Note: 11,986 observations for language, 11,190 for motor skills, and 11,983 for behavior. Coefficient (and White-Huber heteroskedasticity robust standard error) presented. All models control for the full set of child, mother, and contextual covariates listed in Table 2.
+ p<.10, * p<.05, ** p<.01, *** p<.001.

Table 7. OLS results by child characteristics

	Language	Motor Skills	Behavior
Panel A: Parity			
Higher-order child			
Crèche	0.206***	0.104**	-0.104**
	(0.034)	(0.039)	(0.038)
Observations	6,429	6,003	6,427
First child			
Crèche	0.181***	0.150***	-0.041
	(0.031)	(0.035)	(0.036)
Observations	5,447	5,084	5,446
Panel B: Child sex			
Girl			
Crèche	0.161***	0.137***	-0.073+
	(0.029)	(0.036)	(0.037)
Observations	5,901	5,502	5,899
Boy			
Crèche	0.216***	0.112**	-0.069+
	(0.035)	(0.037)	(0.036)
Observations	6,085	5,688	6,084

Note: 11,986 observations for language, 11,190 for motor skills, and 11,983 for behavior. Coefficient (and White-Huber heteroskedasticity robust standard error) presented. All models control for the full set of child, mother, and contextual covariates listed in Table 2.
+ p<.10, * p<.05, ** p<.01, *** p<.001.

Appendix Table A1. Comparison of alternative instruments

	Language		Motor Skills		Behavior	
	without hospital f.e.	with hospital f.e.	without hospital f.e.	with hospital f.e.	without hospital f.e.	with hospital f.e.
Panel A: Instruments are crèche supply and April birth (primary instruments)						
Second stage						
Crèche	0.360*	0.416*	0.364*	0.329	-0.361*	-0.245
	(0.162)	(0.205)	(0.173)	(0.222)	(0.171)	(0.214)
First stage						
Crèche supply	0.005***	0.004***	0.005***	0.004***	0.005***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
April birth	0.030**	0.031***	0.028**	0.031**	0.030**	0.031***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)
First-stage F	97.611	77.746	91.536	70.876	97.507	77.674
K-P LM[a]	0.000	0.000	0.000	0.000	0.000	0.000
A-R Wald[b]	0.001	0.006	0.072	0.244	0.021	0.087
Panel B: Instrument is crèche supply						
Second stage						
Crèche	0.271	0.284	0.385*	0.376	-0.298+	-0.138
	(0.167)	(0.212)	(0.173)	(0.230)	(0.175)	(0.221)
First stage						
Crèche supply	0.005***	0.004***	0.005***	0.004***	0.005***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
First-stage F	190.743	144.936	178.189	132.022	190.494	144.751
K-P LM[a]	0.000	0.000	0.000	0.000	0.000	0.000
A-R Wald[b]	0.106	0.184	0.025	0.103	0.091	0.532
Panel C: Instrument is April birth						
Second stage						
Crèche	2.527*	2.243*	-0.197	-0.321	-1.890+	-1.705+
	(1.076)	(0.986)	(0.852)	(0.834)	(1.044)	(0.931)
First stage						
April birth	0.031***	0.032***	0.030**	0.031**	0.031***	0.032***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)
First-stage F	11.366	11.375	9.853	10.373	11.412	11.423
K-P LM[a]	0.001	0.001	0.002	0.001	0.001	0.001
A-R Wald[b]	0.001	0.004	0.814	0.697	0.032	0.033
Panel D: Instruments are above median crèche supply (indicator) and April birth						
Second stage						
Crèche	0.593**	0.689*	0.456*	0.406	-0.395*	-0.267
	(0.190)	(0.269)	(0.197)	(0.278)	(0.199)	(0.275)
First stage						
> median supply	0.097***	0.078***	0.098***	0.079***	0.097***	0.078***
	(0.010)	(0.008)	(0.011)	(0.009)	(0.010)	(0.008)
April birth	0.031***	0.032***	0.029**	0.031**	0.031***	0.032***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)
First-stage F	51.294	50.767	48.734	47.454	51.344	50.795
K-P LM[a]	0.000	0.000	0.000	0.000	0.000	0.000
A-R Wald[b]	0.001	0.006	0.041	0.230	0.031	0.100
*Panel E: Instrument is above median supply*April birth interaction*						
Second stage						
Crèche	0.979**	1.044*	0.695	0.717	-0.517	-0.517
	(0.343)	(0.512)	(0.439)	(0.522)	(0.434)	(0.523)
First stage						
> median supply*	0.097***	0.080***	0.094***	0.079***	0.097***	0.080***
April birth	(0.015)	(0.017)	(0.016)	(0.018)	(0.015)	(0.017)
First-stage F	39.889	21.199	34.516	19.627	39.912	21.210

K-P LM[a]	0.000	0.000	0.000	0.000	0.000	0.000
A-R Wald[b]	0.002	0.027	0.108	0.153	0.223	0.316

Note: 11,986 observations for language, 11,190 for motor skills, and 11,983 for behavior. Coefficient (and White-Huber heteroskedasticity robust standard error) presented. Standard errors are adjusted for intra-cluster correlation among children born in the same hospital in models that do not include birth hospital fixed effects. All models control for the full set of child, mother, and contextual covariates listed in Table 2).

+ p<.10, * p<.05, ** p<.01, *** p<.001.

[a]Kleibergen-Papp underidetification test, rank LM statistic (p-value).

[b]Anderson-Rubin weak instrument robustness test, Wald statistic (p-value).

Appendix Table A2. OLS and IV results, robustness checks

	Language		Motor Skills		Behavior	
	OLS w/ hospital f.e.	IV	OLS w/ hospital f.e.	IV	OLS w/ hospital f.e.	IV
Panel A: Parental preference for crèche at 2-month interview						
Preference for crèche						
Crèche	0.085+	0.043	0.075	0.442	-0.097+	-0.489*
	(0.047)	(0.225)	(0.059)	(0.278)	(0.054)	(0.209)
First-stage F		32.875		29.244		32.875
K-P LM[a]		0.000		0.000		0.000
A-R Wald[b]		0.727		0.280		0.058
Observations	1,828	1,828	1,726	1,726	1,828	1,828
No preference for crèche						
Crèche	0.217***	0.468*	0.113***	0.345	-0.065*	-0.315
	(0.028)	(0.208)	(0.032)	(0.212)	(0.032)	(0.217)
First-stage F		71.669		67.002		0.000
K-P LM[a]		0.000		0.000		0.000
A-R Wald[b]		0.001		0.169		0.036
Observations	10,158	10,158	9,464	9,464	10,155	10,155
Panel B: Moved by age 1						
Moved						
Crèche	0.238***	-0.129	0.123+	0.309	0.014	-0.198
	(0.063)	(0.413)	(0.070)	(0.399)	(0.069)	(0.372)
First-stage F		22.090		20.040		22.090
K-P LM[a]		0.000		0.000		0.000
A-R Wald[b]		0.915		0.737		0.719
Observations	1,967	1,967	1,792	1,792	1,967	1,967
Did not move						
Crèche	0.173***	0.455*	0.102***	0.387*	-0.076**	-0.413*
	(0.026)	(0.189)	(0.029)	(0.192)	(0.029)	(0.192)
First-stage F		77.894		71.740		77.763
K-P LM[a]		0.000		0.000		0.000
A-R Wald[b]		0.000		0.086		0.017
Observations	10,019	10,019	9,398	9,398	10,016	10,016

Note: 11,986 observations for language, 11,190 for motor skills, and 11,983 for behavior. Coefficient (and White-Huber heteroskedasticity robust standard error) presented. Standard errors in the IV models, which do not include birth hospital fixed effects, are adjusted for intra-cluster correlation among children born in the same hospital. All models control for the full set of child, mother, and contextual covariates listed in Table 2, as well as birth hospital fixed effects. First stage instruments are local crèche supply and child born in April (relative to June/July, September/October, and November/December).

+ p<.10, * p<.05, ** p<.01, *** p<.001.

[a]Kleibergen-Papp underidentification test, rank LM statistic (p-value).

[b]Anderson-Rubin weak instrument robustness test, Wald statistic (p-value).