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

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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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ABSTRACT Proponents of early childhood education and care programs cite evidence that high-quality center-based childcare has positive impacts on child development, particularly for disadvantaged children. However, much of this evidence stems from randomized evaluations of small-scale intensive programs based in the United States and other Anglo/English-speaking countries. Evidence is more mixed with respect to widespread or universal center-based childcare provision. In addition, most evidence is based on childcare experiences of 3- to 5-year-old children; less is known about the impact of center-based care in earlier childhood. The French context is particularly suited to such interrogation because the majority of French children who attend center-based care do so in high-quality, state-funded, state-regulated centers, known as *crèches*, and before age 3. We use data from a large, nationally representative French birth cohort, the *Étude Longitudinale Français depuis l'Enfance* (Elfe), and an instrumental variables strategy that leverages exogenous variation in both birth quarter and local crèche supply to estimate whether crèche attendance at age 1 has an impact on language, motor skills, and child behavior at age 2. Results indicate that crèche attendance has a positive impact on language skills, no impact on motor skills, and a negative impact on behavior. Moreover, the positive impact on language skills is particularly concentrated among disadvantaged children. This implies that facilitating increased crèche access among disadvantaged families may hold potential for decreasing early socioeconomic disparities in language development and, given the importance of early development for later-life outcomes, thereby have an impact on long-term population inequalities.

KEYWORDS Childcare • Crèche • Child development • Early childhood • *Étude Longitudinale Français depuis l'Enfance* (Elfe)

Introduction

Early childhood education and care programs have increasingly been advanced for fostering child development and reducing early inequalities therein. As such, both demand for and access to center-based childcare have dramatically expanded across developed countries in recent decades (Kulic et al. 2019). In a context of well-documented long-term returns to high-quality early investments, particularly for

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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 school (Bradbury et al. 2015), policies that promote high-quality formal childcare may have implications for reducing long-term population inequalities.

The most rigorous evidence to date indicates that high-quality center-based childcare has positive impacts on child development, especially for disadvantaged children. However, much of this evidence has come from randomized evaluations of small-scale intensive programs from the United States and, to a lesser extent, other Anglo/English-speaking countries (Kulic et al. 2019). Evidence is more mixed with respect to widespread or universal programs. Moreover, much of the evidence reflects center-based childcare provision for 3- to 5-year-old children; less is known about its impact 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 and heterogeneity in quality of childcare. Furthermore, heterogeneity by population subgroups or by counterfactual condition(s) is a challenge to generalizing causal impacts across different populations.

We use a data from a nationally representative French birth cohort, the *Étude Longitudinale Français depuis l'Enfance* (Elfe), and an instrumental variables (IV) strategy that harnesses exogenous variation in birth timing and local center-based childcare supply—both of which affect a child's likelihood of childcare center attendance while arguably being orthogonal to family choices, conditional on other characteristics of the locale—to estimate whether age 1 attendance in high-quality, state-regulated childcare centers, known as *crèches*, impacts child development at approximately age 2. We examine whether effects differ across developmental domains (language, motor skills, and behavior) and whether there is heterogeneity in effects by socioeconomic characteristics (mother's education, household income, and immigrant status).

The French context is particularly well-suited to interrogating these questions for several reasons. First, although access to publicly sponsored childcare is universal, the form of that care—whether in a crèche or in a provider's home—is not guaranteed. Rather, it varies by local availability, creating the opportunity to leverage a natural experiment based on when during the year a child is born and the supply of childcare center slots in the family's municipality. Second, the majority of French children attending center-based care are placed in homogenously high-quality, publicly funded, and heavily regulated centers (Fagnani 2014), providing a context for testing the effects of high-quality center-based care at a population level. Third, children whose families are unable to secure a center-based placement (or prefer an alternative arrangement) are entitled to a subsidy to receive childcare in the home of a government licensed and regulated childcare provider. Nonetheless, not all French children are placed in a formal childcare arrangement; a significant proportion are cared for by a parent (usually the mother), who can receive modest financial compensation through parental leave of up to three years. This diversity in childcare arrangements allows us to compare crèche attendance with 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 administration 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 trans-

mission 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 forming the structures and mechanisms that shape cognitive, physical, social, and emotional well-being throughout the life course (Shonkoff and Phillips 2000). An extensive literature has examined the role of early childhood education and care programs on various domains of child development. Most commonly, assessing the determinants of child development—and the role of social intervention therein—is approached from 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 (dynamic complementarity), and (2) the more one skill or domain of well-being is developed, the more other domains will also improve (skill complementarity) (Carneiro and Heckman 2003; Cunha and Heckman 2007; Heckman 2006). In other words, "skills beget skills" (Heckman 2008).

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 and explicit opportunities for skill development and socialization. They may benefit indirectly if such care has positive spillover effects into the family environment and improves family functioning by, for example, enabling parents to better balance work and family roles (Bianchi and Milkie 2010), thereby reducing parental stress and improving the quality of parent-child interactions (Hsin and Felfe 2014). Evidence that early inputs play a significant role in the long-term production of human capital has bolstered calls for social investment to begin well before formal education (Irwin et al. 2007; UNICEF 2007).

The most rigorous 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 preschool period. These programs (Abecedarian, High Scope/Perry Preschool, Infant Health and Development Program) typically included high-quality center-based care along with components directly targeting parents (e.g., home visiting); moreover, the quality of care provided was strictly enforced and monitored (Elango et al. 2016; Fryer 2017; Heckman et al. 2010; Masse and Barnett 2002). Such programs have demonstrated substantial long-term positive effects that extend into adulthood and span cognitive skills and academic achievement, physical and mental health, employment and earnings, criminal justice involvement, and welfare dependency.

There have also been large-scale experimental evaluations of the Head Start (for low-income 3- and 4-year-olds) and Early Head Start (for low-income children under

3) programs in the United States. Head Start demonstrates short-term benefits for language development for 4-year-olds and short-term benefits for language, math, behavior, and health for 3-year-olds. These benefits tend to fade over time but are larger and more likely to persist for less advantaged children (U.S. Department of Health and Human Services 2010). They also vary by counterfactual condition, with gains being larger relative to home-based care than to other forms of center-based care (Kline and Walters 2016; Morris et al. 2018). Despite evidence of fade-out found in the experimental impact evaluation, econometric (non-experimental) analyses have identified long-term positive impacts of Head Start throughout the life course (Currie and Almond 2011; Gibbs et al. 2011). The Early Head Start experimental evaluation identified positive impacts on language development and behavior, with the largest and most persistent effects found among the most disadvantaged children and children who attended center-based care subsequent to program exit (Love et al. 2013).

In contrast to these studies, non-experimental studies of large-scale center-based initiatives have produced decidedly mixed results. This may reflect differences in institutional contexts (Blossfeld et al. 2017), data quality and timing of assessments, identification strategies, and operationalization of center-based childcare receipt, counterfactual conditions, and developmental outcomes (Shager et al. 2013). Most observational studies have also been conducted in the Anglo/English-speaking countries, which may limit their generalizability to contexts with widespread or universal provision of high-quality care given that availability, type(s), and quality of childcare vary considerably across developed countries (Gambaro et al. 2014). Most notably, there is substantial heterogeneity in access to and quality of care in the Anglo/English-speaking countries, which predominantly rely on market-based childcare provision (Kamerman and Waldfogel 2005), whereas childcare services in continental Europe are more heavily regulated, homogeneous, and universal (Spiess et al. 2003).

A growing literature has harnessed 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. Such studies have produced markedly diverging estimates, although the evidence is more promising for children from disadvantaged families (Burger 2010; van Huizen and Plantenga 2018). It is also important to consider that documented effects of center-based care tend to differ by developmental domain, with more promising findings for cognitive skills and achievement (Duncan and NICHD 2003) than behavior, for which some studies find adverse short-term effects for at least some groups of children (Baker et al. 2015; Belsky et al. 2007; Data Gupta and Simonsen 2010; Gomajee et al. 2018; Pingault et al. 2015; Yamauchi and Leigh 2011).

Heterogeneity by Center-Based Care Characteristics

The impact of center-based childcare is likely to vary by age at program initiation, quality and intensity of care, whether care includes complementary supports for parents, and counterfactual conditions considered (Burger 2010; Schindler et al. 2015; Shager et al. 2013; van Huizen and Plantenga 2018). In a review of 32 studies from developed countries, for example, Burger (2010) concluded that more intensive programs are generally associated with substantial short-term and smaller long-term

improvements in cognitive skills but short-term increases in behavioral problems. Positive impacts are also larger for programs that include interventions to improve parenting and the home environment. A recent meta-analysis of 30 quasi-experimental studies from developed countries (van Huizen and Plantega 2018) further found consistent evidence that childcare quality is a key factor *vis-à-vis* child development as well as modest evidence that higher-intensity (full-time) care leads to better outcomes. However, child outcomes were not found to vary by age at program entry. A meta-analysis of U.S. studies over nearly a 50-year period 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 larger positive effects on behavior (Schindler 2015).

In short, quality and intensity matter, as do complementary components aimed at improving family functioning and the quality of children's home environments. 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).

Heterogeneity by Developmental Domain

Child development spans multiple domains across which a variety of skills (cognitive, language, socioemotional/behavioral, motor) emerge at different times (developmental stages) in a dynamic and cumulative manner (Cunha and Heckman 2008). Thus, examining the impact of early childcare on different developmental domains is warranted both to identify areas of promise and concern and to illuminate processes linking attendance to later aspects of functioning and well-being. We focus on three distinct outcomes: early language, motor skills, and behavior. First, early language development is a key indicator of school readiness that may be particularly sensitive to childcare quality. Early language development is associated with subsequent cognitive skills, educational achievement, and labor market success (Magnuson and Duncan 2016). Second, to the extent that childcare is associated with increases in (structured and/or unstructured) physical activity for young children, it may improve motor skills. Indeed, many programs include an explicit focus on motor skills (Camilli et al. 2010). Fine motor skills are associated with better later writing, reading, and math scores (Duncan et al. 2007; Grissmer et al. 2010; Pagani and Messier 2012) and may, therefore, be important for school readiness. Gross motor skills are relevant to identifying developmental delay and are associated with later physical well-being, behavior, and socioemotional skills (Cameron et al. 2016). Third, child behavior is linked to future academic and labor market outcomes (Durlak et al. 2011; National Research Council et al. 2012; OECD 2015) throughout the life course. As noted earlier, however, some evidence suggests that the short-term developmental benefits of high-quality center-based care vis-à-vis school readiness and performance tend to fade out relatively rapidly (Deming 2009; Gomajee et al. 2018; U.S. Department of Health and Human Services 2010). Nonetheless, evidence also links high-quality center-based care to a

range of long-term economic, health, and social benefits in adulthood (Currie and Almond 2011; Elango et al. 2016; Gibbs et al. 2011).

Prior research on the short-term effects of center-based care has most frequently assessed cognitive skills and achievement, and this is the domain in which the largest effects have been found. Current estimates suggest positive effect sizes in the range of 0.14 to 0.28 standard deviations (SDs) for cognitive skills (Camilli et al. 2010; Magnuson and Duncan, 2016; Shager et al. 2013; van Huizen and Plantenga 2018). Evidence on motor skills is relatively rare. However, Gormley and Gayer (2005) reported a 0.24 SD improvement in motor skill as a result of attendance in Tulsa's pre-K program. Given well-documented heterogeneity in impacts of center-based childcare on child behavior, effect sizes range widely, from −0.13 (adverse effect on behavior) to 0.50 SDs (Schindler et al. 2015).

Heterogeneity by Socioeconomic Characteristics

A considerable literature has documented that more advantaged families are disproportionately likely to select into high-quality center-based care and that less advantaged children are disproportionately likely to receive informal care or care in the provider's home (Cascio 2017; van Lancker and 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 earlier, however, evidence also indicates that less advantaged children who do attend high-quality center-based care realize greater gains therefrom than do their more advantaged counterparts (Bradbury et al. 2019; Cascio 2017, Doyle et al. 2009; Garcia 2015), although there are notable exceptions to this general pattern (Deming 2009; Gormley 2008). To the extent that center-based care disproportionately benefits disadvantaged children, attendance may reduce socioeconomic inequalities in school readiness and beyond. We approximate socioeconomic disadvantage by maternal education, household income, and maternal immigrant status.[1]

The French Context

France is an interesting case study both because crèche care is of homogeneously high quality and because there is considerable variability in the types of arrangements in which children are placed (Fagnani 2014). Fagnani (2014:83) reported that "crèches are highly valued by families, as a result of the staff's qualification requirements . . . and of the prevalent idea that crèches provide an 'ideal' preparation for the transition to nursery school and consequently to primary education." Nationally mandated ratios are one staff per five children who are not yet walking and one staff per eight older children. Staff are extensively supervised and trained on early childhood content such as early health, development, and age-relevant educational and health

[1] Immigrant families tend to be more socioeconomically disadvantaged and considerably less likely to access center-based care than their native counterparts, even though they may benefit more from such care, particularly with respect to language development (Karoly and Gonzalez 2011; Magnuson et al. 2006).

practices (Fagnani 2014). Crèche staff must include one or more pediatric nurses, early childhood educators, and assistant pediatric nurses. In addition, all personnel in contact with children must have at least subject-specific secondary or university-level qualifications, a feature often linked to high-quality childcare provision (Gambaro 2017). Each child is assigned a reference staff person who oversees their well-being.

About one-fifth of French children under age 3 attended a crèche in in 2013. However, there are large regional differences in crèche availability. Families have a 17% to 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. Although staff training and salaries, as well as subsidies to parents, are centrally funded, program management and infrastructure costs are delegated to municipalities. Given these costs, allocating sufficient crèche slots is not always prioritized by (particularly smaller) municipal authorities. Moreover, despite the French government's goal of providing crèche to disadvantaged families, more advantaged urban families are typically most successful in accessing crèche (Le Bouteillec et al. 2014). Crèche is available to children up to about 3 years of age; children age 3 and older are guaranteed a place in free preschool (*école maternelle*).

Although the majority of parents indicate that crèche is their preferred childcare arrangement (Virot 2017), it remains the second most common form of formal childcare in France, behind subsidized state-regulated caregivers (*assistantes maternelles*), who care for children in their own home. Assistantes maternelles provided care for about one-third of French children under 3 years of age in 2013 (Le Bouteillec et al. 2014). In theory, crèche and assistante maternelle care are intended to provide comparably high-quality care. Yet training and education requirements are more stringent for crèche staff than for assistantes maternelles. The latter need not hold formal qualifications; rather, they must attend 120 hours of training over their first three years of activity (including 80 hours before caring for any child). They are, however, held to strict structural requirements in terms of infrastructure, hygiene, and the like, and are licensed to care for no more than three children at a time (Public Health Act 2010). Furthermore, although there is no national curricula for early care provision, strict structural requirements are centrally determined and regulated for both crèche and assistante maternelle care. Both crèches and assistantes maternelles receive regular quality inspections, which include observations, interviews, and self-assessments, and are designed to monitor both structural and process quality (OECD 2016). Oversight, regulation, and licensing are administered at the national level.

Data and Methods

Data

We use data from the *Étude Longitudinale Française depuis l'Enfance* (Elfe), a population-based longitudinal cohort study following more than 18,000 French children from the time of their birth, in 2011, forward (Charles et al. 2020). Children were born at a random sample of 341 maternity units throughout continental France and were sampled at four intervals with initial data collection April 1–4, 2011, followed by June 27–July 4, 2011; September 27–October 4, 2011; and November 28–December 5, 2011.

Interviews were carried out in the maternity unit shortly after a child's birth, by telephone roughly two months post-birth, and again when the child was approximately 1 and 2 years of age. Data were collected on diverse topics, including socioeconomic background, parenting, child development, and living conditions.

From the initial Elfe sample of 18,329 births, we retain families with no missing interview waves between birth and age 2, leaving a potential analysis sample of 12,574.[2] We then exclude 343 families with missing data on all three outcomes (language skills, motor skills, and behavior) and an additional 244 families with missing data on their primary childcare arrangement. This results in an analysis sample of 11,987 families, of which 11,986 had nonmissing language data, 11,190 had nonmissing motor skills data, and 11,983 had nonmissing behavior data. We allow the sample to vary across outcomes.[3] Notably, disadvantaged families were disproportionately lost to follow-up and are therefore underrepresented in our analysis sample compared with the initial Elfe sample (Thierry et al. 2018). Compared with families in the initial Elfe sample, those in our analysis sample had higher levels of maternal education, maternal employment, and family income; they were also more likely to have a native French mother and less likely to be headed by a single mother.[4] Thus, our findings may not be fully generalizable to the most disadvantaged children and may potentially underestimate the effects of crèche attendance for such children.

Measures

Childcare Arrangement at Age 1

Our key variable of interest is the focal child's primary childcare setting at the time of the age 1 interview, including parental care, crèche, assistante maternelle, private nanny (in 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 French short version of the MacArthur-Bates inventory to assess

[2] From the initial Elfe sample, 55 parents asked to be withdrawn from the study and have their data removed. Others in the sample did not participate in interviews in all waves of data collection: 128 did not participate in the birth interview; 1,680, in the two-month interview; 2,257, in the one-year interview; and 1,635, in the two-year interview.

[3] Four of the control variables had small amounts of missing data: income (1.8%), female unemployment rate (1.0%), mother's satisfaction with the timing of the pregnancy (0.6%), and local unemployment rate (0.3%). Given such low rates of missing data, we replace missing values with either the sample mean (for income) or 0 (for the satisfaction with pregnancy timing and employment and unemployment rate categories), and include indicators that these values were initially missing in all our models. Our results are not sensitive to exclusion of cases with initially missing values on the controls.

[4] Table A1 in the online appendix presents descriptive statistics for child and family characteristics measured at the birth or two-month interviews for the remaining sample after cases were dropped based on each sample exclusion criterion.

vocabulary size when children were about 2 years old. The MacArthur-Bates is used extensively and has strong psychometric properties (Kern et al. 2010). It measures children's vocabularies by asking mothers to report whether the child can spontaneously produce words used in daily life from a proposed list of 100 words (the father was administered the scale in 3% of cases). A higher score indicates a larger vocabulary.

We assess motor skills using the sum of seven father-reported items, indicating the child's ability to walk up stairs, kick a ball, run, use a tricycle, put on slippers or socks, eat alone, and drink alone. These items were asked mainly of the father (for 89% of sample children) and of the mother only if the father was not interviewed or did not respond. A higher score indicates more advanced motor development.

We assess behavior using the sum of three mother-reported items indicating how often, on a 5-point scale (from never to always), the child (1) resists what the caregiver suggests, (2) challenges or defies the caregiver when reprimanded, and (3) hits the caregiver or destroys things when angry. Items were reverse coded such that a higher score indicates fewer behavior problems (better behavior).

Because focal children's age at the two-year interview ranged from 23 months to 28 months, we age-standardize (by months of age at the time of the interview) each outcome to have a mean of 0 and an 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 sex, low birth weight, twin, first child, and the presence of a younger sibling. We do not control for child age because our outcomes are age-standardized. Household characteristics include the mother's age at the two-month interview and, measured at age 1, her education (less than a baccalaureate [upper secondary degree in France], a baccalaureate, or more than a baccalaureate), immigrant status (first-generation immigrant, second-generation immigrant, or French native), work status (not working, working part-time, or working full-time), and work sector (private sector, public sector, or self-employed/other), 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 (ever a single-mother family from the birth to age 2 interview), whether a foreign language is primarily spoken in the home, and the mother's reaction to the timing of her pregnancy (happy with timing, wanted the pregnancy sooner, wanted the pregnancy later, did not want the pregnancy, and an indicator for missing). In addition, to reduce the risk of omitted variable bias, we control for whether the mother expressed a preference for crèche care at the two-month interview (when most mothers were still on maternity leave and children were not yet in nonparental care). We also control for whether the family moved between learning of the pregnancy and the one-year interview because such moves may have been crèche-seeking in nature. These latter controls are particularly important for adjusting for systematic selection into crèche attendance. 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 categorical measures of the local[5] female employment rate (41% to 59%, >59% to 62%, and >62% to 71%) and the local unemployment rate (4.5% to 8.5%, >8.5% to 10.0%, >10.0% to 16.5%), as well as indicators for missing data on each of these measures.[6] To account for additional heterogeneity at the local level, we also add to some models a birth hospital fixed effect under the assumption that children born in the same hospital are exposed to similar local environments.

Instruments

Quarter of birth is represented by an indicator that the child was born in spring versus other quarters of the year (summer, fall, winter). We focus on spring births because children born in spring have a higher probability of receiving crèche than children born at other times of the year. This reflects that crèche slots tend to become available when older children move to preschool in September (Le Bouteillec et al. 2014), which also corresponds with when mothers of children born in spring typically return to work from maternity leave. In addition, municipal committees typically assign crèche slots each May or June, and a child must already be born to be considered for the coming year.[7]

By the time of the Elfe cohort births, in 2011, there was little seasonal variation in birth timing, and the limited fluctuations therein suggests a summer (July–August) peak and winter (January–March) low point.[8] There are also few differences in birth timing by socioeconomic status, and those differences do not suggest systematic variation in spring births. In 2007, the only observed differences by maternal occupational class were that births to agricultural workers peaked in winter and those to primary school teachers peaked in spring (Régnier-Lolier 2010a). In addition, data from the Gender and Generation Survey for France indicate that only 14% of mothers reported attempting to time their births. Among those who reported trying to do so, the most common reasons were to align the birth with the summer holidays, to allow increased time for the father to provide childcare, and for reasons related to the health of the mother or baby (Régnier-Lolier 2010b). As such, it does not appear that there is systematic selection into birth timing to increase the probability of receiving a crèche slot.

Local crèche supply is measured by the number of crèche slots per 100 children age 3 and younger in the municipality. Childcare supply has been used to instrument center-based care participation in prior work (Datta Gupta and Simonsen 2010, 2016;

[5] 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 5,000 workers.

[6] The Elfe study protocol required that we use categorical rather than continuous versions of these measures.

[7] Municipalities vary in how they select children to receive a crèche slot, but most seek to ensure social and economic diversity in placements, and single-mother families are typically given priority.

[8] Tabulated by the authors using data from the French National Institute of Statistics and Economic Studies (Insee), available at https://www.insee.fr/fr/statistiques/serie/000436391?idbank=000436391.

Felfe and Lalive 2018).[9] There are 35,000 French municipalities that substantially vary in size and population density, and the local crèche supply distribution is quite skewed: 31% of children in our sample live in a municipality that offers no crèche slots, 51% live in a municipality with fewer than 12 slots, 20% live in a municipality with more than 20 slots, and 10% live in a municipality with more than 25 slots per 100 children ages 0–3. Given the skewness of the distribution, we top code crèche supply at the 99th percentile (42 slots per 100 children age 3 or younger) and model its natural logarithm (ln).[10]

Empirical Strategy

We first estimate ordinary least squares (OLS) regressions in which we regress each outcome on crèche attendance and the covariates. The models take the following form:

$$DEV_{im} = \beta_0 + \beta_1 crèche_{im} + \beta_2 \mathbf{CHILD}_{im} + \beta_3 \mathbf{HH}_{im} + \beta_4 \mathbf{CNTXT}_m + \varepsilon_{im}, \quad (1)$$

where DEV_{im} is an age 2 developmental outcome for child i in municipality m; *crèche* is an indicator of crèche attendance at age 1; **CHILD**, **HH**, and **CNTXT** are vectors of child, household, and contextual characteristics; and ε is an error term.

The OLS results provide descriptive evidence of the association between crèche attendance and child development, net of the covariates. However, systematic selection into crèche attendance is likely based on unobserved factors that are also associated with children's developmental progress. Thus, to identify a causal impact of crèche care on child development, we employ an IV approach that leverages exogenous variation in crèche participation—by birth quarter and local crèche supply—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 spring birth and local crèche supply, net of child, household, and contextual characteristics. The predicted probability of crèche participation is then forwarded to a second-stage regression to predict the unbiased LATE of crèche attendance on the outcome, leveraging only exogenous variation in crèche attendance. The first-stage equation takes the following form:

$$\begin{aligned} crèche_{im} = {} & \beta_0 + \beta_1 springbirth_{im} + \beta_2 crèchesupply_m + \beta_3 \mathbf{CHILD}_{im} + \beta_4 \mathbf{HH}_{im} \\ & + \beta_5 \mathbf{CNTXT}_m + \varepsilon_{im}, \end{aligned} \quad (2)$$

where *crèche* is an indicator of crèche attendance at age 1, *springbirth* is an indicator that the child was born in spring, and *crèchesupply* is the ln of crèche slots

[9] Datta Gupta and Simonsen (2010, 2016) estimated the effects of public center-based childcare receipt in Denmark using whether a child lives in a municipality that guarantees access to center-based care as an instrument. Felfe and Lalive (2018) estimated the impact of having attended childcare before age 2 in West Germany using within-state differences in childcare supply as an instrument.

[10] We conducted supplemental analyses using the nontransformed (linear) crèche supply measure, as well as inverse hyperbolic sine and cube root transformations, and found a consistent pattern of results across all specifications. See Table A2, online appendix.

per 100 children ages 3 or younger in the municipality. The second-stage equation takes the following form:

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

where $\widehat{crèche}$ is the predicted probability of crèche attendance. We estimate White-Huber heteroscedasticity robust standard errors for all models.

The IV strategy requires that two assumptions be met. First, the instruments must be highly predictive of crèche attendance. Second, they must be uncorrelated with the error term in the explanatory (second-stage) equation, such that they affect child development only 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 our models. The second may be violated if, for example, parents time their child's birth or move between municipalities to maximize the probability of a crèche placement. It may also be violated if municipalities with greater crèche supply provide better environments for supporting child development in other ways.

Although we cannot fully rule out these possibilities, we attempt to minimize them by adjusting for an extensive array of covariates. First, we control for both maternal preference for crèche when the child was approximately 2 months old and whether the family moved during the pregnancy or in the first year of the child's life. These factors should be highly correlated with crèche-seeking behaviors, such as timing a child's birth or moving to municipality with greater crèche supply. Adjusting for them should reduce the risk of bias from such. Second, we control 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, we include in our models birth hospital fixed effects to capture additional unobserved environmental homogeneity among families who gave birth in the same hospitals.

To empirically examine the likely exogeneity of the instruments, we compare the predicted probability of crèche attendance across the distributions of the instruments when estimated as a function of only the observed covariates and when estimated as a function of both the instruments and covariates. These results are presented in Figures 1 and 2.[11] Figure 1 shows that the predicted probability of crèche attendance is

[11] Descriptive statistics by levels of the instruments are shown in Tables A3 (birth quarter) and A4 (crèche supply) of the online appendix. Notably, parents experiencing a spring birth are slightly more likely to report a preference for crèche care than those experiencing a summer, fall, or winter birth, potentially because they are more likely to have secured a crèche slot (which is disproportionately likely for parents with a spring birth). Although these differences are generally modest in magnitude, we cannot completely rule out that some parents may attempt to time their births in order to maximize their chances of receiving crèche care. The relevant question is whether the children from families most engaged in crèche-seeking behaviors are affected differently from crèche attendance, such that the estimated impacts of crèche attendance is biased by this subgroup. As described in the text, we engage in a range of strategies and robustness tests (sensitivity to alternative instruments and model stratification by preference for crèche and moves during the pre- or postnatal period) to check for evidence of such. We also estimate our primary models using local crèche supply as the sole instrument. Results (not shown) indicate that this approach generates qualitatively consistent findings to those when both local crèche supply and spring birth are included as instruments.

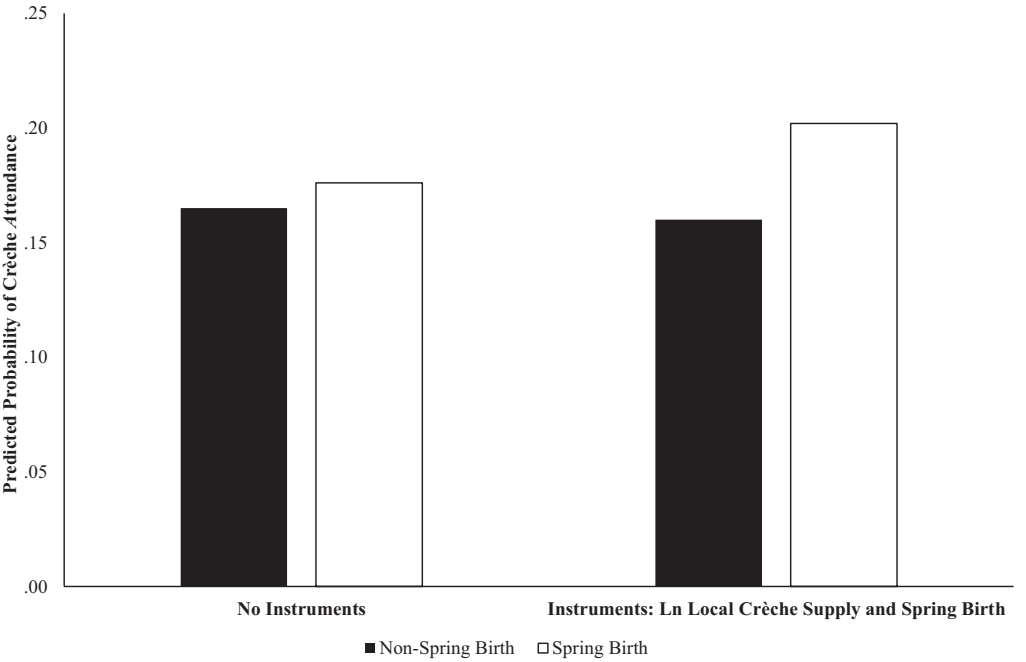

Fig. 1 Predicted probability of crèche attendance with and without instruments, by spring birth status. Models control for the full set of child, mother, and contextual covariates listed in Table 2, as well as birth hospital fixed effects. Instruments are ln local crèche supply and spring birth.

considerably higher for children born in spring when estimated using the instruments than when estimated using only the covariates, but that it is similar for children born at other times of the year when estimated with and without the instruments, suggesting that the instruments provide exogenous variation in crèche attendance. Figure 2 shows the predicted probabilities of crèche attendance plotted by local crèche supply. We see a clear pattern such that the predicted probabilities of crèche attendance using the instruments exhibit a much steeper slope across the local crèche supply distribution than do the predicted probabilities of crèche attendance using only the covariates. This again suggests that the instruments provide exogenous variation in crèche attendance.

We also engaged in a series of analyses to further validate our IV approach. First, we tested as a secondary instrument the interaction between ln local crèche supply and spring birth. Because families are highly unlikely to have *both* timed their birth to occur in spring *and* moved to a high crèche supply municipality, this instrument should be particularly likely to meet the exclusion restriction. We do not prioritize the interaction term as our primary instrument, however, because only 10% of children were both born in spring and lived in a municipality with any crèche slots—and only 5% of children were both born in spring and lived in a municipality with a crèche supply at or above the median among this group (16 slots per 100 children under age 3), thereby limiting the statistical power of this instrument. Second, we estimated the OLS and IV models without covariates to examine how differences in the

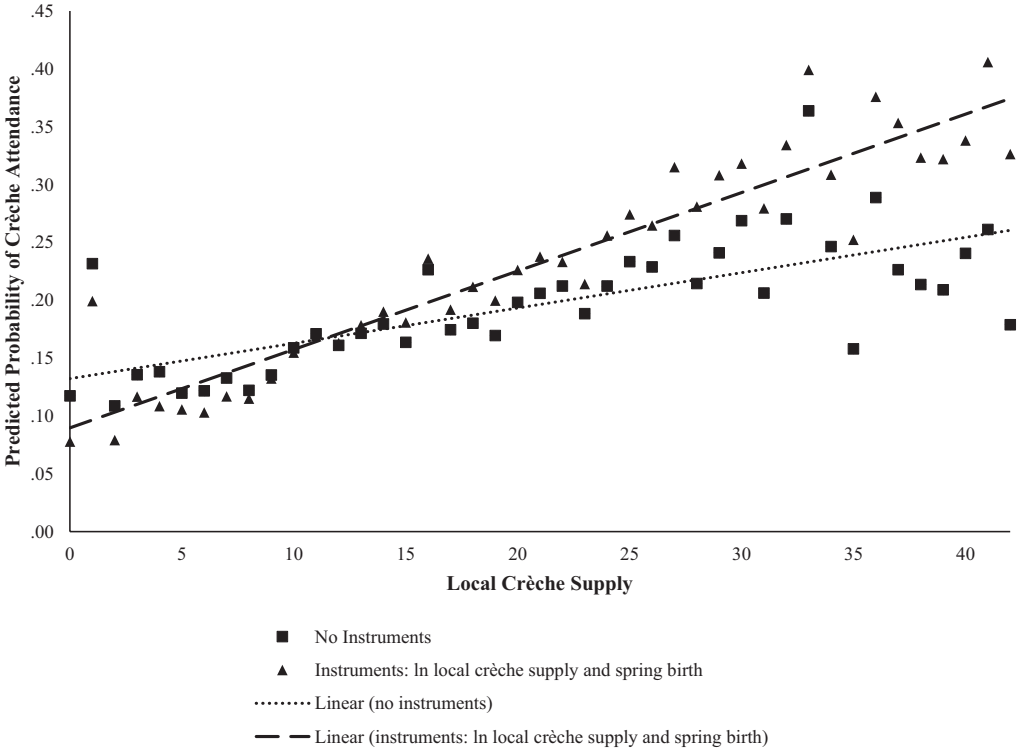

Fig. 2 Predicted probability of crèche attendance with and without instruments, by crèche supply. Models control for the full set of child, mother, and contextual covariates listed in Table 2, as well as birth hospital fixed effects. Instruments are ln local crèche supply and spring birth.

characteristics of families by crèche attendance status may bias the results of each. Third, we conducted supplemental analyses in which we examined whether there are differences in results both by initial preference for crèche and by residential moves during the pregnancy or first year of the child's life to rule out that these factors are driving the IV results. Fourth, we engaged in a series of falsification tests in which we estimated models using outcomes that should not be affected by crèche participation, including birth weight and one-minute and five-minute APGAR scores. Ruling out a relation between crèche attendance and these outcomes using our IV approach may provide further indication that the IV results are not driven by selection into birth timing or locality.

Because our primary focus is estimating the effect of crèche care versus all other childcare arrangements, we first present OLS and IV estimates of this difference. However, we also present OLS estimates comparing outcomes for children attending crèche with 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. We then present OLS estimates of associations of crèche dosage (hours and days in crèche care)

with the developmental outcomes. Here, we again present only OLS estimates because, whereas our instruments should predict whether a family is offered crèche care, there is no reason to believe the instruments 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 maternal education, family income, and maternal immigrant status using our primary specification (crèche care vs. any other arrangement).

Results

Descriptive Statistics

Table 1 presents descriptive statistics for childcare intensity at age 1 and language, motor skills, and behavior at age 2. At age 1, 34.2% of sample children were cared for by a parent; 16.7%, in a crèche; 41.9%, by an assistante maternelle; 1.9%, by a private nanny; and 5.4%, by an informal caregiver.[12] Children attending crèche did so for an average of 4.2 days (36.0 hours) per week, compared with 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.

Children attending crèche scored highest, on average, on the language assessment, followed by those cared for by a private nanny, those cared for by an assistante maternelle, and those in informal care; children in parental care exhibited 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 (0.47 SDs) more words than those in parental care, 3 words (0.12 SDs) more than those in assistante maternelle care, 2 words (0.10 SDs) more than those cared for by a private nanny, and 8 words (0.32 SDs) more than those in informal care. Differences in motor skills are considerably smaller in magnitude than those for language. However, children attending crèche are reported to have greater motor skills than those in all other forms of care (the advantage ranges from 0.07 to 0.16 SDs). The pattern for behavior is different. On average, children cared for by their parents are reported to have better behavior than children in all other care arrangements, with the difference attaining statistical significance compared with both crèche and assistante maternelle care. Children in crèche are reported to have significantly poorer behavior than those in assistante maternelle care.

Descriptive statistics for the covariates and instruments, shown in Table 2, reinforce that there is likely systematic selection into childcare arrangements. Children born low birth weight are disproportionately likely to be in parental or informal care, and twins are more likely to be in parental or private nanny care. Firstborn children disproportionately experience nonparental care, particularly crèche, assistante maternelle, or informal care. Differences are also evident by both maternal and con-

[12] 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.

Table 1 Descriptive statistics for childcare intensity at child age 1 and developmental outcomes at child age 2 by type of childcare at age 1: Means, with standard deviations shown in parentheses

	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[c,d]
	(0.826)	—	(0.828)	(0.778)	(0.940)	(1.074)
Hours per week	35.627	—	36.010	35.621	39.644[b,c]	33.055[b,c,d]
	(9.856)	—	(9.766)	(9.261)	(12.061)	(12.772)
Developmental Outcomes (age 2)						
Language (raw score)	74.449	68.598	80.365[a]	76.967[a,b]	77.978[a]	72.503[a,b,c]
	(24.999)	(27.022)	(20.934)	(23.628)	(22.665)	(26.697)
Language (*z* score)	0.000	–0.239	0.229[a]	0.109[a,b]	0.132[a]	–0.089[a,b,c]
	(1.000)	(1.080)	(0.843)	(0.941)	(0.907)	(1.078)
Motor skills (raw score)	5.579	5.594	5.669[a]	5.538[a,b]	5.523[b]	5.557[b]
	(0.950)	(0.980)	(0.922)	(0.935)	(0.923)	(0.960)
Motor skills (*z* score)	0.000	0.016	0.086[a]	–0.039[a,b]	–0.078[b]	–0.032[b]
	(1.000)	(1.028)	(0.976)	(0.984)	(0.974)	(1.014)
Behavior (raw score)	5.934	6.036	5.774[a]	5.909[a,b]	5.996	5.952
	(2.159)	(2.309)	(2.091)	(2.055)	(1.999)	(2.202)
Behavior (*z* score)	0.000	0.046	–0.072[a]	–0.011[a,b]	0.025	0.004
	(1.000)	(1.068)	(0.972)	(0.951)	(0.929)	(1.017)
Percentage of Sample		34.2	16.7	41.9	1.9	5.4
Number of Observations	11,987	4,101	1,997	5,021	226	642

Notes: The sample contains 11,986 observations for language, 11,190 for motor skills, and 11,983 for behavior.

[a] Differs from parental care at $p < .05$.

[b] Differs from crèche care at $p < .05$.

[c] Differs from assistante maternelle at $p < .05$.

[d] Differs from nanny in child's home at $p < .05$.

textual characteristics. For example, children of less educated, lower-income, and single-mother families 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, crèche use is more common among single-mother and lowest income–quintile families that use nonparental care (31% in both cases, not shown in Table 2) than among the full sample (25%). Children of French-native mothers are more likely to receive care from an assistante maternelle or a private nanny, and they are less likely to receive parental or informal care than children of immigrant mothers (crèche care is relatively proportionate among these groups). About three-quarters of children with working mothers attend nonparental childcare, compared with about one-half of those with nonworking mothers. Crèche is particularly common when mothers work in the public sector, whereas private nannies are more common when mothers work in the private sector or are self-employed. Notably, whereas maternal preference for crèche care is positively associated with crèche attendance, many children whose mothers prefer crèche care receive other

Table 2 Descriptive statistics for covariates and instruments by type of childcare at age 1: Proportions or means with standard deviations shown in parentheses

	Full Sample	Parental Care	Crèche	Assistante Maternelle	Nanny in Child's Home	Informal Care
Child Characteristics						
Boy	.508	.512	.507	.506	.518	.495
Low birth weight	.038	.050	.035[a]	.029[a]	.031	.055[b,c]
Twin birth	.017	.027	.018[a]	.008[a,b]	.031[c]	.008[a,c,d]
First child	.434	.304	.485[a]	.500[a]	.438[a]	.597[a,b,c,d]
Younger sibling	.079	.096	.082	.063[a,b]	.093	.081
Household Characteristics						
Mother's age (at 2-month interview)	31.379	31.164	32.153[a]	31.284[b]	33.235[a,b,c]	30.436[a,b,c,d]
	(4.690)	(5.169)	(4.371)	(4.286)	(4.377)	(5.095)
Less than baccalaureate	.165	.320	.075[a]	.077[a]	.035[a]	.187[a,b,c,d]
Baccalaureate	.411	.424	.347[a]	.427[b]	.168[a,b,c]	.481[a,b,c,d]
Greater than baccalaureate	.424	.256	.578[a]	.496[a,b]	.796[a,b,c]	.332[a,b,c,d]
Equivalized income (euros/month)	1,821.883	1,340.128	2,081.399[a]	2,053.941[a]	3,153.564[a,b,c]	1,808.331[a,b,c,d]
	(1,259.193)	(987.703)	(1,320.686)	(1,147.688)	(1,473.642)	(2,038.976)
Income missing	.018	.029	.018[a]	.010[a,b]	.031[c]	.014[a]
Ever single mother	.038	.059	.033[a]	.021[a,b]	.009[a]	.069[b,c,d]
Immigrant mother	.081	.135	.088[a]	.036[a,b]	.066[a]	.072[a,c]
Second-generation mother	.100	.123	.113	.070[a,b]	.093	.159[a,b,c,d]
French native mother	.819	.742	.800[a]	.894[a,b]	.841[a,c]	.769[c,d]
Foreign language at home	.043	.073	.046[a]	.018[a,b]	.049[c]	.036[a,c]
Nonworking	.214	.491	.102[a]	.055[a,b]	.097[a]	.073[a]
Working full-time	.476	.263	.568[a]	.590[a]	.668[a,b,c]	.597[a]
Working part-time	.310	.246	.330[a]	.355[a,b]	.235[b,c]	.330[a,d]
Working private sector	.451	.316	.465[a]	.541[a,b]	.553[a,b]	.545[a,b]
Working public sector	.278	.157	.363[a]	.343[a]	.186[b,c]	.318[a,b,d]
Self-employed/other	.056	.036	.071[a]	.061[a]	.164[a,b,c]	.064[a,d]
Happy with pregnancy timing	.762	.734	.773[a]	.781[a]	.765	.754
Wanted pregnancy sooner	.129	.120	.130	.137[a]	.106	.131
Wanted pregnancy later	.085	.108	.075[a]	.067[a]	.088	.097[c]

Table 2 (continued)

	Full Sample	Parental Care	Crèche	Assistante Maternelle	Nanny in Child's Home	Informal Care
Did not want pregnancy	.018	.033	.011[a]	.009[a]	.013[a]	.014[a]
Pregnancy reaction missing	.007	.004	.011	.006	.027	.005
Preference for crèche	.153	.077	.448[a]	.105[a,b]	.155[a,b,c]	.087[b,d]
Moved in first year	.164	.197	.151[a]	.143[a]	.115[a]	.184[b,c,d]
Mother reported motor skills	.110	.161	.092[a]	.075[a,b]	.065[a]	.146[b,c,d]
Contextual Characteristics						
Female employment rate						
41% to 59%	.310	.356	.314[a]	.277[a,b]	.084[a,b,c]	.341[c,d]
>59% to 62%	.326	.320	.291[a]	.354[a,b]	.173[a,b,c]	.302[c,d]
>62% to 71%	.354	.312	.383[a]	.361[a]	.739[b,c]	.343[d]
Missing	.010	.012	.012	.008	.004	.014
Unemployment rate						
4.5% to 8.5%	.333	.309	.257[a]	.392[a,b]	.204[a,c]	.315[b,c,d]
>8.5% to 10%	.355	.327	.433[a]	.336[b]	.677[a,b,c]	.330[b,d]
>10% to 16.5%	.308	.360	.309[a]	.269[a,b]	.119[a,b,c]	.349[c,d]
Missing	.003	.003	.001	.003	.000	.006[b]
Instruments						
Local crèche supply	11.719	10.929	16.949[a]	9.893[a,b]	22.354[a,b,c]	11.036[b,c,d]
(per 100 <age 3)	(10.649)	(10.028)	(10.782)	(10.202)	(11.285)	(9.999)
Born in spring	.147	.141	.179[a]	.142[b]	.133	.129[b]
Percentage of Sample		34.2	16.7	41.9	1.9	5.4
Number of Observations	11,987	4,101	1,997	5,021	226	642

Notes: The sample contains 11,987 observations for families with no missing data on at least one outcome variable (language, motor skills, and behavior).

[a] Differs from parental care at $p < .05$.

[b] Differs from crèche care at $p < .05$.

[c] Differs from assistante maternelle at $p < .05$.

[d] Differs from nanny in child's home at $p < .05$.

forms of care; whereas 49% of children whose mothers reported a preference for crèche care at the two-month interview attended crèche at age 1 (not shown in Table 2), only 45% of mothers whose children attended crèche at age 1 reported a preference for crèche care at the two-month interview. Turning to the contextual factors, children in locales with a high female employment rate are disproportionately likely to receive crèche, assistante maternelle, and private nanny care. With respect to the instruments, children in municipalities with greater relative crèche supply and those born in spring are disproportionately likely to receive crèche care.

Regression Results

Primary Estimates

Our primary results are presented in Table 3. We show these estimates for the full sample of children as well as the subsample whose mothers were employed at the age 1 interview. The full-sample OLS results (panel A) indicate that net of the covariates, attending crèche at approximately age 1 is associated with greater language and motor skills but also greater behavior problems at age 2. These findings are robust to the inclusion of birth hospital fixed effects. On average, compared with children in other arrangements, children attending crèche have age 2 language scores that are 0.18 to 0.19 SDs better and motor skills that are 0.11 to 0.13 SDs better, but also behavior scores that are roughly 0.07 SDs worse.

Turning to the IV results, the instruments perform quite well. The first-stage F statistics are large (107–116), and the underidentification (Kleibergen-Papp) test is satisfied in each model. The weak instrument (Anderson-Rubin) robustness test of the joint significance of the instruments in the reduced-form model is satisfied for language and behavior but not for motor skills.[13] The first-stage estimates (see Table A6, online appendix) suggest that a 10% greater local crèche supply is associated with roughly a 4 percentage point (~24% given a crèche attendance rate of 16.7% in our sample) greater probability of crèche attendance and that being born in spring is associated with roughly a 3 percentage point (~18%) greater probability of crèche attendance.

The second-stage IV results for language and behavior are larger in magnitude than the OLS estimates and retain statistical significance in the non-fixed-effects models (the language estimate is also marginally significant at $p < .10$ in the fixed-effects model). The IV estimates for motor skills are nonsignificant and smaller in magnitude than the OLS estimates in all models. The IV results indicate a LATE of crèche of 0.33 to 0.34 SDs for language skills and −0.25 to −0.36 for

[13] Reduced-form estimates are presented in Table A5 (online appendix) for the full sample, for employed mothers, and for a "placebo" sample of nonworking mothers who should, in theory, not require external childcare. Our instruments are either significant and in the expected direction, or nonsignificant but in the expected direction in the full sample and in models limited to employed-mother families (suggesting that, if they impact child outcomes, they do so indirectly through crèche attendance). However, they are never significant on the placebo sample (as expected). This suggests that our IV models are not likely identifying spurious relations.

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

	Language		Motor Skills		Behavior	
	Without Birth Hospital FE	With Birth Hospital FE	Without Birth Hospital FE	With Birth Hospital FE	Without Birth Hospital FE	With Birth Hospital FE
A. Full Sample						
OLS						
Crèche	0.188***	0.180***	0.130***	0.111***	–0.072**	–0.065*
	(0.025)	(0.023)	(0.026)	(0.027)	(0.024)	(0.026)
IV: Instruments are ln crèche supply and spring birth						
Crèche	0.333*	0.344†	0.099	0.050	–0.358*	–0.248
	(0.165)	(0.199)	(0.167)	(0.208)	(0.166)	(0.206)
First-stage *F*	108.30	116.02	108.39	106.98	107.99	115.82
K-P LM[a]	.000	.000	.000	.000	.000	.000
A-R Wald[b]	.002	.009	.840	.972	.018	.085
IV: Instrument is ln crèche supply × spring birth						
Crèche	1.074**	1.026*	0.246	0.210	–0.565	–0.509
	(0.341)	(0.417)	(0.384)	(0.416)	(0.406)	(0.421)
First-stage *F*	46.27	34.10	44.04	32.90	46.35	34.19
K-P LM[a]	.000	.000	.000	.000	.000	.000
A-R Wald[b]	.000	.009	.526	.620	.158	.228
B. Employed-Mother Subsample						
OLS						
Crèche	0.179***	0.176***	0.122***	0.103***	–0.062*	–0.056*
	(0.027)	(0.025)	(0.028)	(0.029)	(0.025)	(0.028)
IV: Instruments are ln crèche supply and spring birth						
Crèche	0.274†	0.307	0.078	0.011	–0.407*	–0.273
	(0.159)	(0.192)	(0.164)	(0.201)	(0.158)	(0.198)
First-stage *F*	106.88	106.98	108.60	102.65	106.56	106.80
K-P LM[a]	.000	.000	.000	.000	.000	.000
A-R Wald[b]	.002	.004	.780	.808	.003	.052
IV: Instrument is ln crèche supply × spring birth						
Crèche	1.125**	1.117**	0.386	0.401	–0.587	–0.492
	(0.349)	(0.389)	(0.349)	(0.390)	(0.359)	(0.379)
First-stage *F*	46.96	35.33	43.99	34.13	47.02	35.49
K-P LM[a]	.000	.000	.000	.000	.000	.000
A-R Wald[b]	.000	.001	.270	.308	.094	.199

Notes: The full sample contains 11,986 observations for language, 11,190 for motor skills, and 11,983 for behavior; the employed-mother sample contains 9,423, 8,891, and 9,420 observations, respectively. White-Huber heteroscedasticity robust standard errors are shown in parentheses. Standard errors are adjusted for intracluster correlation among children born in the same hospital in models that do not include birth hospital fixed effects (FE). 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 spring (relative to summer, fall, and winter or local crèche supply × spring birth).

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

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

†$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

behavior. These are relatively large effects. The overall pattern of results—that the LATEs from the IV models for language and behavior are larger than the ATEs from the OLS models—is consistent when our secondary instrument, the crèche supply×spring birth interaction, is used in place of the two separate instruments; however, the language and behavior coefficients are much larger in magnitude (perhaps implausibly so) in this specification, potentially reflecting the small number of families (~10%) with nonzero values on the instrument. In addition, results when these analyses are replicated for the subsample of children whose mothers were working at the age 1 interview (panel B of Table 3) 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 their mothers were not working.

The difference between the OLS and IV results may reflect that children who are exogenously induced into crèche participation based on being born in spring and/or in a municipality with a greater local crèche supply (compliers with the instrument) are more heavily impacted by crèche attendance than children whose parents select them into crèche participation regardless of their birth timing and municipal crèche availability. More generally, the overall pattern of results suggests that any bias induced by the endogeneity of crèche attendance and language or behavioral development likely results in underestimation of the positive effect of crèche participation on language development and negative effect of crèche participation on child behavior, conditional on the covariates. As such, the IV estimation can be viewed as confirming the direction and significance of the OLS results.

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 (see Table A6, online appendix). Specifically, we compared the results from IV models using our primary instruments, ln local crèche supply and spring birth (panel A) and the interaction of both instruments (panel C), with those from models in which we used as instruments ln local crèche supply, spring birth, and the interaction (panel B); median local crèche supply and spring birth (panel D); median local crèche supply, spring birth, and the interaction of both instruments (panel E); median local crèche supply×spring birth (panel F); >0 local crèche supply and spring birth (panel G); >0 local crèche supply, spring birth, and the interaction of the two (panel H); and >0 local crèche supply×spring birth (panel I). Although the estimated magnitude of the LATEs differs somewhat across specifications, the pattern of results is quite consistent: regardless of the particular instruments used and whether birth hospital fixed effects are included in the model, the IV estimates for language and behavior suggest that the OLS estimates are downwardly biased.

Second, we estimated the OLS and IV models without covariates (Table A7, online appendix) to examine how adjusting for differences in the characteristics of families, by crèche attendance status, may alter our results. Again, the overall pattern of estimates is quite consistent with those from our primary specifications. In addition, the

unadjusted OLS and IV (without birth hospital fixed effects) estimates for language are larger in magnitude, suggesting that they are upwardly biased if not adjusted for differences in the covariates by crèche attendance status; however, the estimates for motor skills and behavior are relatively similar in magnitude regardless of whether the covariates are controlled.

Third, to further account for potential unobserved characteristics associated with parental preference for crèche and child development, we estimated separate models for families in which the mother did and those in which the mother did not report an initial preference for crèche. Here, the concern is that parents who prefer crèche may take actions, such as timing their births or moving to a municipality with a more generous crèche supply, that may bias our IV results. On the contrary, however, these results (online appendix, Table A8, panel A) indicate that, if anything, the beneficial effect of crèche care for language is larger and, to a lesser extent, the negative effect for behavior is smaller for children whose mothers did not prefer crèche care than for those whose mothers preferred crèche care. We would not expect the former to engage in crèche-seeking behaviors.

To account for the possibility that families may have moved municipalities to increase their probability of getting crèche, we estimated separate models for families that did and families that did not move between learning of the pregnancy and the age 1 interview (see Table A8, panel B). The crèche benefit for language skills is slightly larger for children whose families moved than for those whose families did not move in the OLS models. However, this pattern is reversed in the IV estimation: language benefits for children of nonmovers are greater than those for movers. This suggests that our primary results for language are not driven by children whose families moved to obtain a greater likelihood of crèche receipt. We find a less clear and consistent pattern for motor skills and behavior.

Finally, we estimated several falsification tests (Table A9, online appendix) to confirm that our IV estimation did not predict child outcomes at the time of birth, which could not be affected by crèche attendance at age 1. Specifically, we estimated the effect of crèche attendance on birth weight and the child's APGAR score one minute and five minutes after birth. In each case, we found no relation between crèche attendance and the outcome.

Counterfactual Childcare Arrangements

Table 4 presents results from OLS regression (with birth hospital fixed effects) for 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. 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 the coefficients are reversed because, here, we model non-crèche care rather than crèche care. The second column presents results from a regression in which crèche care is the reference category with which the other forms of care are compared. Children in all other types of care exhibit poorer lan-

Table 4 OLS results, comparison of crèche care to multiple counterfactual childcare arrangements

	Language		Motor Skills		Behavior	
Non-Crèche Care	–0.180***		–0.111***		0.065*	
	(0.023)		(0.027)		(0.026)	
Parental Care		–0.305***		–0.128***		0.125***
		(0.030)		(0.032)		(0.032)
Assitante Maternelle		–0.102***		–0.099***		0.029
		(0.025)		(0.028)		(0.028)
In-Home Nanny		–0.138*		–0.090		0.147*
		(0.067)		(0.074)		(0.070)
Informal Care		–0.268***		–0.149**		0.049
		(0.046)		(0.048)		(0.048)
Number of Observations	11,986	11,986	11,190	11,190	11,983	11,983

Notes: White-Huber heteroscedasticity robust standard errors are shown in parentheses. All models control for the full set of child, mother, and contextual covariates listed in Table 2, as well as birth hospital fixed effects.

*$p < .05$; **$p < .01$; ***$p < .001$

guage development than those in crèche care, but the differences are particularly large with respect to parental care (0.31 SDs) and informal care (0.27 SDs), and are somewhat smaller with regard to assistante maternelle (0.10 SDs) and in-home nanny care (0.14 SDs). For motor skills, we see significant differences of similar magnitude between crèche care and parental, assistante maternelle, and informal care: crèche care is associated with 0.09 to 0.15 SDs better motor skills. Finally, crèche care is associated with poorer behavior compared with both parental care (0.13 SDs) and in-home nanny care (0.15 SDs) but not compared with 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. These results suggest a clear dose-response relation such that additional hours or days per week in crèche are associated with greater language skills. For example, relative to children in all other types of care, children who spend three, four, or five days per week in crèche exhibit 0.10, 0.19, and 0.20 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 five days per week in crèche exhibit 0.15 SDs greater skills than children who use other types of care. For behavior, children spending three and five days in crèche exhibit 0.12 and 0.10 SDs poorer behavior than those experiencing other types of care (the estimate for four days per week is close to 0 in magnitude and is nonsignificant).

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

	Language			Motor Skills			Behavior		
	Hours per Week	Days per Week (linear)	Days per Week (dummy variables)	Hours per Week	Days per Week (linear)	Days per Week (dummy variables)	Hours per Week	Days per Week (linear)	Days per Week (dummy variables)
Hours in Crèche	0.005***			0.003***			–0.002*		
	(0.001)			(0.001)			(0.001)		
Days in Crèche		0.042***			0.026***			–0.014*	
		(0.005)			(0.006)			(0.006)	
Three Days in Crèche			0.100*			0.079			–0.123*
			(0.051)			(0.053)			(0.056)
Four Days in Crèche			0.193***			0.083*			–0.001
			(0.034)			(0.040)			(0.038)
Five Days in Crèche			0.201***			0.147***			–0.094**
			(0.031)			(0.037)			(0.036)
Number of Observations	11,977	11,986	11,986	11,184	11,190	11,190	11,974	11,983	11,983

Notes: White-Huber heteroscedasticity robust standard errors are shown in parentheses. All models control for the full set of child, mother, and contextual covariates listed in Table 2, as well as birth hospital fixed effects.

*$p < .05$; **$p < .01$; ***$p < .001$

Table 6 OLS results by family characteristics

	Language	Motor Skills	Behavior
A. Maternal Education			
Less than baccalaureate education			
Crèche	0.230*	0.187†	–0.096
	(0.089)	(0.095)	(0.110)
Number of observations	1,978	1,742	1,978
Baccalaureate education			
Crèche	0.184***	0.095*	–0.141**
	(0.042)	(0.048)	(0.046)
Number of observations	4,921	4,572	4,918
More than baccalaureate education			
Crèche	0.154***	0.111**	–0.036
	(0.031)	(0.037)	(0.035)
Number of observations	5,087	4,876	5,087
B. Family Income			
Bottom two quintiles			
Crèche	0.216***	0.128*	–0.076
	(0.053)	(0.057)	(0.060)
Number of observations	4,272	3,865	4,271
Middle quintile			
Crèche	0.207***	0.156*	–0.096
	(0.058)	(0.064)	(0.060)
Number of observations	2,426	2,278	2,426
Top two quintiles			
Crèche	0.165***	0.099**	–0.079*
	(0.031)	(0.038)	(0.036)
Number of observations	5,068	4,849	5,067
C. Nativity			
Mother is French native			
Crèche	0.167***	0.080**	–0.054†
	(0.026)	(0.030)	(0.029)
Number of observations	9,813	9,266	9,811
Mother is first- or second-generation immigrant			
Crèche	0.232***	0.191**	–0.074
	(0.056)	(0.066)	(0.064)
Number of observations	2,173	1,924	2,172

Notes: The sample contains 11,986 observations for language, 11,190 for motor skills, and 11,983 for behavior. White-Huber heteroscedasticity robust standard errors are shown in parentheses. All models control for the full set of child, mother, and contextual covariates listed in Table 2, as well as birth hospital fixed effects.

†$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Subgroup Analyses

We conduct a series of subgroup analyses based on family socioeconomic characteristics; the results are shown in Table 6. We present only OLS results for these analyses given that the instruments do not always perform well in the context of smaller sub-

group sample sizes.[14] With respect to family characteristics, the results suggest that the positive associations of crèche attendance with language development are particularly concentrated among disadvantaged children: those with less educated mothers (panel A shows a clear decreasing gradient by education), those living in lower-income households (panel B shows a clear decreasing gradient by income), and those born to (first- or second-generation) immigrant mothers (panel C). There is also some indication that crèche attendance is more strongly associated with greater motor skills among less advantaged children. Finally, the association of crèche attendance with increased behavior problems appears to be most concentrated among more advantaged children. On the whole, these findings suggest that regardless of dimension considered, crèche attendance appears to be somewhat more beneficial for disadvantaged children than for their more advantaged counterparts.[15]

Discussion

On the whole, we find that relative to all other types of early childcare arrangements, attending crèche at age 1 is associated with relatively large gains in language skills but also increased behavior problems at age 2. 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 for language and behavioral development (although not for motor skills) and that the more naïve OLS estimates likely underestimate the causal effect of crèche attendance on language and behavior. We also find descriptive evidence that the associations of crèche attendance with child development are especially pronounced when crèche attendance is compared with parental and informal care and are less pronounced but still present when it is compared with assistante maternelle and private nanny care. These differences are particularly large for language development. In addition, we find descriptive evidence that greater intensity of crèche participation (time spent in care) 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 finding is consistent with prior research on the impact of high-quality center-based care on child development (Kuehnle and Oberfichtner 2017) and suggests that in the French setting (and potentially similar settings characterized by high-quality publicly provided care), facilitating disadvantaged families in accessing crèche may hold potential for

[14] We also performed IV estimations on subgroups and found the results to be generally consistent with OLS estimations when the instrument satisfied weak instrument tests, which was not the case for all subgroups. For subgroups with particularly small sample sizes and thus less statistical power, the instruments tended to be weaker, and the IV estimates were less stable and precise.

[15] We also performed subgroup analyses by birth parity and child sex and found no clear pattern of differences in results in either case (see Table A10, online appendix).

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).

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, Table 3) for language skills are 0.18 to 0.19, whereas cognitive skills effect sizes in the prior literature range from 0.14 to 0.28 (Camilli et al. 2010; Magnuson and Duncan 2016; Shager et al. 2013; van Huizen and Plantenga 2018). Our OLS estimated effect sizes for motor skills are 0.11 to 0.13. By comparison, Gormley and Gayer (2005) reported an effect size of 0.24 for motor skills in their evaluation of the Tulsa pre-K program. Although our estimate is smaller in magnitude, it is not drastically so. Finally, as discussed earlier, estimates for behavior vary widely across settings, ranging from –0.13 SDs (indicating an adverse effect on behavior) to 0.50 SDs (Schindler et al. 2015). Our OLS estimate suggests an effect size of approximately –0.07. However, our subgroup analyses suggest that this result does not hold for all groups of children. Our IV regressions tend to produce considerably larger effect-size estimates; however, these estimates 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, a first avenue toward understanding how to contextualize these results may be to consider (1) that the French crèche system is almost entirely based on public provision; (2) that structural quality of provision is strictly enforced nationally; and (3) that crèche workers tend to be relatively highly educated in child development–specific fields and are subject to the extensive crèche monitoring and inspection processes. These factors point toward high levels of process quality as well, although we are not aware of studies empirically assessing process quality of crèche care (Fagnani 2014; OECD 2016). Our results therefore support hypotheses that a positive impact of center-based childcare is possible 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 that actively attempt to recruit a socioeconomically diverse population. Research from the United States 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, high-quality, state-subsidized, and state-monitored nature 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, although this would be 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. For example, evidence suggests that short-term negative impacts of center-based childcare attendance on child behavior do not hold in the longer term (Gomajee et al. 2018). Fifth, as is the case with all longitudinal studies, the Elfe sample experienced attrition over time. Attrition appears to occur disproportionately among more disadvantaged and residentially mobile families (Thierry et al. 2018). This, too, may limit the generalizability of our results, particularly for disadvantaged families. It may also imply that we are underestimating the effects of crèche attendance for disadvantaged children's language skills given that the effect of crèche attendance on language skills is particularly large for such children. It is further possible that the (disadvantaged) children lost to follow-up may have benefitted even more than those included in our sample (e.g., if they are even more disadvantaged). Conversely, the negative effect of crèche attendance on behavior is smaller for disadvantaged children than their more advantaged counterparts. Thus, we might be overestimating the adverse effect of crèche attendance on behavior for such children. Sixth, the counterfactual condition to crèche care in our IV analyses is heterogenous and may differ by birth timing and local crèche supply. Heterogeneity in the counterfactual condition is a common limitation of studies of childcare. Moreover, rigorous econometric studies indicate that the benefits of high-quality center-based care are more pronounced when compared with parental care than with other types of formal childcare (Kline and Walters 2016; Morris et al. 2018), which is consistent with our OLS findings. Nonetheless, our IV models produce only a LATE of crèche relative to all other arrangements. Finally, our IV analyses rely on the assumption that families do not move to particular municipalities and do not time their births to increase their chances of obtaining crèche care for their infants. If this assumption is incorrect, 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 but also have a negative influence on behavior. Moreover, positive effects on language skills appear to be particularly concentrated among disadvantaged children, for whom there also appear to be no negative effects on behavior. These findings suggests that an expansion of access to crèche may have potential to contribute to decreasing early gaps in child well-being if quality is maintained and less advantaged parents are willing to use crèche care. ■

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