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ABSTRACT

Early Education and Gender Differences

A rich strand of the economic literature has been studying the impact of different forms of early childcare on children cognitive and non-cognitive development in the short and medium run, and on a number of educational, labor market, and life outcomes in the long run. These studies agree in assessing the importance of the first years of life on future outcomes, and identify early childhood interventions as a powerful policy instrument to boost child development. Furthermore, most research agrees in identifying stronger beneficial effects among children from disadvantaged backgrounds, making a case for the role of childcare policies in reducing inequality. Instead, heterogeneity of results across gender is less clear-cut. Yet, it is important to understand how childcare arrangements differently affect boys and girls, to figure out how to boost cognitive and non-cognitive development of young children and how to reduce gender gaps later in life. Our paper offers a comprehensive review of the literature on early childcare impacts, shedding light on the heterogeneous effects across genders, considering the role of institutional background, type of the intervention, and age of the child. We also present some empirical results on the Italian case which indicates that gender differences in the outcomes is lower among children who attended an impact toddler center, while it is higher and more often statistically significant for those who received informal care. This result confirms the positive and equalizing role of early public childcare.

JEL Classification: J13, J16

Keywords: childcare, child development, cognitive skills, non-cognitive skills, gender differences

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1. Introduction

Traditionally child development has been an area of study of development psychologists and neuroscientists. However, in the last two decades, economists have started to contribute to it in a significant and original way: as early contexts affect the development of the person over the entire lifecycle, they influence individual productivity, labor market outcomes and potentially the benefits and costs for the society (Knudsen et al. 2006).

As mothers have started to participate more and more in the labor force in most developed countries, reducing time spent with children, concerns have been raised for the negative effects that such early separation may have on children's development (i.e. Belsky 1988).

The economic evidence shows that the impacts of investments in early childcare is particularly relevant for two distinct goals: first, to encourage and sustain female employment and facilitate the reconciliation of work and family responsibilities (Del Boca et al. 2009); second, to enhance children opportunities and to reduce inequality at the earliest stages of life

Both theoretical and empirical literature highlight the importance of private and public investments in the first years of life for the cognitive and non-cognitive development of the child, but while childcare programs 3-5 improve children skills (Duncan and Magnuson 2013), results on the impacts of different forms of childcare in the pre-kindergarten age are mixed. The different results concern not only the size, but also the sign of the effect of early education on child outcome, and the duration of the impact on the individual development. Other results are more consistent, such as the different effects of formal care for children from different socio-economic background, with children from low SES benefiting most.

Recent analyses also uncovered significant gender differences, but results are less clear. Yet, it is important to understand how childcare arrangements differently affect boys and girls, to figure out how to boost cognitive and non-cognitive development of young children and how to reduce several gender gaps later in life, both those in favour of girls – such as school-related outcomes – and those in favour of boys, i.e. in terms of labour market outcomes. In this paper, we will review these mixed results, with a specific focus on gender differences and the potential mechanisms behind them.

The rest of the paper is organized as follow. Section 2 summarizes the main findings of the economic literature on the impact of early childcare; Section 3 describes the heterogeneous results according to the gender of the child; Section 4 presents some recent empirical results on the case of Italy Section 5 discusses the possible underlying mechanisms in gender differences. Section 6 concludes.

2. Literature

After having assessed that the provision of formal childcare has a positive impact on maternal employment, economic studies on early childcare has turned their attention to the effects for children, The studies have investigated several aspects of the impact of non-maternal care: (i) cognitive and non-cognitive development of the child; (ii) differences according to the background and socio-economic status of the family; (iii) *ad-hoc* programs designed for children from disadvantaged families versus universal childcare; (iv) short, medium, and long-term impact; (v) very early childcare (children aged 0-3) versus preschool programs (3-5); (vi) differences according to different type of childcare, i.e. formal, grandparental, non-formal care; and (vii) intensity and timing of childcare. We summarize hereafter the main findings across these lines of reseach.

The empirical studies on the impact of early intervention programs on child outcomes have mainly shown positive results, and this is especially true when the early intervention is directed to children coming from disadvantaged backgrounds. Two channels could explain this heterogeneity according to the family background. On the one hand, the home environment available to disadvantaged children could be less stimulating, while richer families may be able to provide a more stimulating context or have access to high quality substitutes of center based childcare. On the other hand, parents from low socio-economic status may lack information about education and pedagogical methods; for them, formal childcare may thus also have an informative role about best parenting practices (Cuhna et al. 2013, Cuhna 2015).

The first empirical results come from the evaluation of randomized social experiments targeted to disadvantaged children, introduced in US states in the 1960s-1980s: the Perry Preschool Program (PPP); the Carolina Abecedarian Project (ABC); Head Start; the Early Training Project (ETP); Infant Health and Development Program. Researchers find significant positive effects on early measures of IQ and achievement test-scores, school-related oucomes (such as school completion rates), and adult outcomes (e.g. employment, crime, and health) (e.g. Cuhna et al. 2006; Anderson 2008; Elango et al. 2016; García et al. 2018).

Additional evidence comes from universal programs, both in the US and in Europe. For the US, Bernal and Keane (2011) find that, as a substitute of maternal time with the child, center based care has no negative effects on children cognitive outcomes (measured by

standardized vocabulary, reading, and math tests), while informal care does. Loeb et al. (2007) find positive impact of center based care on reading and math scores, in particular for children who start center care between ages two and three. Gormley (2008), evaluating the impact of universal pre-kindergarten in Oklahoma, finds increases in cognitive, language, and motor skills, especially for black children and children of immigrant parents.

Using UK data, Del Boca, Piazzalunga and Pronzato (2018) study the effect of formal childcare on several cognitive outcomes, assessed through standardized tests, namely Bracken School Readiness assessment at age 3; Naming Vocabulary, at ages 3 and 5; Picture Similarity at age 5, which measures children's non-verbal reasoning; Pattern Construction, at ages 5 and 7, which assesses the spatial problem-solving ability of the child; Word Reading Score and the Number Skills test at age 7; Verbal Score, at age 11; and Spatial Working Memory Time, Strategy and Errors, also at age 11.[1] They find that formal care at 18 months has a positive effect on school readiness at age 3, on the picture similarity test at age 5 and on number skills at age 7; most results are only significant for children from disadvantaged background when considering heterogeneous effects. On average, early formal care attendance at 18 months is positively correlated with several cognitive outcomes, from age 3 up to age 11; however, it has a negative and significant effect on Naming Vocabulary at age 3. Also, formal care between the ages of 3 and 5 has a negative effect on Naming Vocabulary at age 5, confirming the fact that children benefit most from a one-on-one relationship with adults in terms of vocabulary.

Drange and Havnes (2019), for Norway, show that children from low-educated or low-income families who went to early childcare centers perform better in language and mathematics test at seven (about 25% of a standard deviation), while modest and no significant impact emerges among children from high income families. Felfe and Lalive (2018) use rich German data to study the impact of early center-based care on both cognitive and non-cognitive outcomes (language, motor, and socio-emotional skills): they find that it is beneficial for children with less educated mothers or foreign parents.

Studies have investigated not only the impact of formal care on cognitive development, but also on non-cognitive skills, which have been shown to be at least as important as cognitive ones for future school-related outcomes and labour market outcomes (Cuhna and Heckman 2008). Moreover, non-cognitive skills also influence cognitive skills (Almlund et al. 2011). Economists cluster under “non-cognitive outcomes” different characteristics valued

[1] More details about the outcomes can be found in Del Boca, Flinn et al. (2018).

at school and in the labor market, but which are not measured by achievement tests and by IQ, such as behaviour, personality traits,[2] locus of control, self-control, self-confidence, goals, motivation, and preferences. However, most studies up to now have focused only on behaviour, due to data limitations. Compared to cognitive skills, non-cognitive skills are considered to be more malleable for longer periods of time, even though also in this case investments at early ages have larger effects and higher return (Kautz et al. 2014).

Few studies find an increase of behavioural problems for children attending early formal care (Magnuson et al. 2007; Baker et al. 2008), while others do not find any difference with parental care. According to a study for Denmark by Datta Gupta and Simonsen (2010), being enrolled in formal care at age 3 is as good as parental care on non-cognitive outcomes; on the other hand, family day care negatively affects children's behaviour. Hansen and Hawkes (2009) find similar results for the UK: they report no effect of formal care at 9 months on the behaviour of the child at age 3, while children cared for by grandparents have more peer problems. Other researches find not only no negative effect, but even a reduction in behavioural problems thanks to formal care (Figlio and Roth 2009; Chor et al. 2016; Felfe and Lalive 2018 for disadvantaged children).

As mentioned above, another important aspect for policy purposes is the duration of the effects of early formal care, and on which outcomes. Findings are mixed: while some researches show that the positive effects of attending formal care on cognitive abilities of the children fade or dissipate within few years, others find a long lasting effect.

Elango et al. (2016) in their review highlight the general pattern that IQ and achievement test scores fade after the beginning of primary school and, in some cases, completely vanish by teenage years. On the contrary, a few papers find significant effects on cognitive outcomes in the long run. Elango et al. (2016) report two studies that find persistent, though weakening, effects on IQ long after school entry, and they both concern pre-kindergarten interventions. Evaluating a Spanish reform, Felfe et al. (2015) find that high quality childcare for 3-year-olds improves children reading skills at age 15 and reduces grade retention in primary school. In Denmark, Datta Gupta and Simonsen (2016) show that early formal care at age 2 has a positive effect on grades in language at age 16. García et al. (2018) report that a high quality program starting at age 0 and targeting disadvantaged children have a long lasting effect on IQ. Even when the effect on cognitive outcomes vanishes, there are persistent impacts on adults' life outcomes. According to Heckman and coauthors, later outcomes on health, crime,

[2] The "Big Five": Conscientiousness, openness, agreeability, emotional stability, extraversion.

and employment are mediated by the positive impact of early childhood education on non-cognitive skills, even if the impact on cognitive skills dissipate early (Heckman et al. 2013; Elango et al. 2016). Recently, different authors have shown that changes in early non-cognitive skills have an impact on later outcomes, proving that they often have the same predictive power[3] of cognitive measures (Heckman et al. 2006, Almlund et al. 2011, Becker et al. 2015).

3. Differences by gender

Although studies on early childhood education have usually considered heterogeneous effects according to the socio-economic status of the family, taking into account income, parental education, ethnic background or immigrant status, less attention has been devoted to whether childcare impact changes accorging to the gender of the child. Only sometimes, gender differences have been investigated together with other heterogenous effects. Considering existing articles, we will try to assess whether gender differences exist, if they are not only statistically significant, but also relevant, and which are the causes of such differences in terms of child development and type of program investigated.

Overall, the literature on the effects of early childhood interventions presents mixed evidence regarding which gender benefits the most. Differential gender impacts seem to vary by early childhood care features, such as context, type and quality of provision, counterfactual care, starting age, and by outcomes characteristics, such as timing and the specific developmental domain under study.

The impact of early childcare could differ by gender because of developmental differences of boys and girls in early childhood, due both to biological and social processes. The psychological literature, summarized by Magnuson and co-authors (2016), points out that at the same age boys tend to be less "developmentally advantaged" than girls in several domains, both in cognitive and non-cognitive development. Girls outperform boys in vocabulary, language outcomes, and pre-reading skills, but not in pre-math skills, even though these differences are rather small. Moreover, girls have some advantages in temperament and socio-emotional development: for instance, they perform better in terms of effortful control, self-regulation, and prosocial behaviour, while boys tend to be more competitive and aggressive. Overall, thus, the literature indicates small gender differences in favour of girls concerning cognitive development, and somehow larger differences in

[3] Among personality traits, conscientiousness is considered to have the largest predictive power (Almlund et al. 2011).

language, social development, and behaviour. As Magnuson et al. (2016) indicate, these differences could allow girls to reap greater benefits in learning both academic and behavioural skills from early formal care. However, at the same time girls may have larger benefits also from other childcare settings (i.e. parental or informal care), while early formal care may act for boys as more compensatory with respect to other types of care, as it provides more learning activities and enriching interactions with respect to the counterfactual. There is also an additional aspect to consider: as boys tend to perform worst in school, the same impact by gender in the short-run could have larger effects for boys in the long one. Taken these considerations together, theoretical predictions are not as clear as when socio-economic characteristics are considered, and it may be that the two effects are at place at the same time, leading to small gender differences or to gender differences that change according to the contextual characteristics mentioned earlier (counterfactual care, age at entry, quality of the intervention, etc…).

3.1 Positive effects for girls

One of the first research investigating gender differences is the work by Anderson (2008), who reevaluates the effects of three influential randomized early childhood interventions: the Perry Preschool Program (PPP), the Abecedarian Project (ABC), and the Early Training Project (ETP). While they differ in terms of age at entrance, eligibility, quality, duration, treatment intensity, and other characteristics, they share some important features: they are targeted programs, expressely designed to boost early lives of disadvantaged children; they are thus mean tested, high-quality center-based program. While previous studies on PPP, ABC, and ETP found different effects by gender depending on the outcome, Anderson (2008) replicates the analysis correcting for multiple testing, and find that overall girls benefit more, both in the short and in the long run. For ABC, this result confirms findings by Cuhna et al. (2006) and is subsequentely supported by García et al. (2018); on the contrary, subsequent studies find that PPP benefit more boys (see next paragraph). Despite being both targeted interventions, ABC and PPP differers both in terms of starting age and intensity: treated children entered the Abecedarian Project as young as 4 months and attended a preschool center for 8 hours per day, 5 days per week, 50 weeks per year, until reaching schooling age; instead, treated children entered PPP at age 3 or 4 and attended the program for 5 mornings per week from October through May, resulting in lower intensity. Moreover, while Anderson (2008) interpret the findings in light of the "general perception that schooling helps girls more than it does boys", García et al (2018) report that girls benefitted more than boys did

because girls came from more deprived households in which the learning environment was worse and with less parental support. If this is the case, the channel would not be gender per se, but the home environment, and thus the results are less relevant in terms of gender differences, at least for the ABC program.[4]

Findings for the ABC program should thus be interpreted with caution, as the underlying mechanism is the counterfactual home environment, rather than gender. Instead, only a minority of studies find that girls benefit more than boys from formal childcare. It is worth mentioning Nores and coauthors (2018), who analyze the AeioTU childcare experience in Colombia (childcare inspired by the Reggio Emilia approach, with a design similar to the Abecederian program) on the development of disadvantaged infants and toddlers (below age three). They find significant gender differences in the (positive) impacts on language and cognitive development in favor of girls 8 months after enrollment. They do not observe systematic baseline differences between boys and girls in socioeconomic characteristics. One should also keep in mind the specific context, i.e. a developing and low-income country, whose results could differ compared to developed countries, especially if different gender norms are in place.

Two other papers, both focusing on high quality universal childcare, find stronger positive results for girls: Felfe et al. (2015) in Spain for children aged 3 and Havnes and Mogstad (2011), in Norway, for children aged 3-6 (gender differences are limited to earnings as adult, while no differences emerge on other educational achievement outcomes). Finally, in their meta-analysis of how the effects of early education programs for children aged 3-5 differ by gender, Magnuson et al. (2016) report that girls have slightly larger benefits in terms of cognitive and achievement outcomes, but the difference is small and not substantially meaningful. Instead, they find that there are large and significant differential positive effect for boys on other school-related outcomes, which seem to be a more widespread result, as it will become clear later on.

3.2 Negative effects for girls

Only few recent papers find that attendance of early childcare could have a negative impact on girls' development. Herbst and Tekin (2016) find larger negative effects for boys or girls depending on the outcome. They investigate the effect of receiving subsidized care at age 3 to

[4] Interesting, Conti et al. (2016) evaluate the impact of ABC and PPP programs on health outcomes, and find that in terms of health and health behaviour they had a stronger effect for boys. However, health is a different outcomes compared to those we have analysed in the rest of the paper, and mechanisms may be different.

4 score on achievement tests and behaviour at age 5: while boys have larger negative effects in mathematics test scores and behavioural outcomes, girls have larger negative effects in reading score (no effect on math or behavioural outcomes). These negative effects begin to fade by the end of first grade and are completely attenuated by the end of fifth grade. The authors comment that the subsidy may have directed parents to low-quality early care environments. Other papers focusing on Italy find negative effects for gilrs, and are discussed in the following section.

3.3 Positive effect for boys

Elango et al. (2016) consider the evidence on 4 means-tested programs: PPP, ABC, IHDP and ETP, focusing on a variety of outcomes. They replicated the studies, running their own analysis. When differences by gender are analysed, they find that PPP tends to benefit more boys on many dimensions: girls have positive effects only on IQ at age 5, while boys have positive effects also on test scores and on socio-emotional skills. The explanation provided by the authors is that as girls develop earlier, uniform curricula appear to benefit boys more. Moreover, the program targets children between three and four, when aggressive behaviour begins to manifest, especially among boys: providing a stimulating environment compared to the home environment may have a larger beneficial effect on boys.

Studies on other well-known American programs find also greater advantages for boys. Deming (2009) reassessed the impact of the Head Start program in the US (children aged 4) and find beneficial effects on boys on all the outcomes considered: educational achievement (including math and reading test scores form age 5 to age 14, grade retention and learning disabilities diagnosis), and an index of adult outcomes (including high school graduation, college, crime, teen parenthood, health status, and idleness), while the positive effect for girls was found only on this latter index. Ou and Reynolds (2010) evaluate the Chicago Child-Parent Centre program targeted to disadvantaged children aged 3 and 4. They find that it had stronger long-term effects on the educational outcomes of boys compared to girls. Hill et al. (2015) study the effect of the Tulsa, Oklahoma prekindergarten program, targeting 4 years old, and find that program effects on math scores persisted through third grade for boys but not for girls.

Muschkin et al. (2018) consider two programs implemented in Carolina. The two interventions were quite different in terms of target group: the Smart Start provided fundings for all children between 0 and 5 years (started in 1993); while More at Four provided

fundings for preschool slots for disadvantaged 4-year-olds (started in 2001). While significant and beneficial effects for both boys and girls are found in each of the elementary grades, boys receive the most pronounced benefits. The gain for boys was found across all SES groups, but was larger in the less advantaged families group. [5]

The study by Felfe and Lalive (2018) mentioned above assesses that access to early childcare (0-2) had brought larger gains for boys in motor and socio-emotional skills.

3.4 Negative effects for boys

Despite the several works reporting larger beneficial effects of formal childcare for boys, there are also studies reporting instead negative effects. In some cases they are limited to the short run, such as in Herbst and Tekin (2016), already commented in Section 3.2, with boys having large negative effects in mathematics test scores and behavioural outcomes. As suggested above, the subsidy may have directed parents to low-quality early care environments. Moreover, the adverse effects of subsidy receipt on behavioural outcomes are concentrated among children of high-skilled mothers.

Similar findings are reported by Kottelenberg and Lehrer (2018), who study the effect of the introduction of a low cost universal childcare program for children aged 0–4 in Quebec in 1997. The program leads to statistically significant declines in the motor-social development score and increases in the hyperactivity and inattention score for boys, measured when they are still in kindergarden. The authors comment that the overall childcare quality was reported to be minimal in Quebec, and that the policy, on average, increased time spent in childcare disproportionately for boys relative to girls, who were instead placed in home care, leading to worst outcomes for boys. Evaluating the same policy, but considering also outcomes when the exposed children are older, Baker et al. (2015) find negative effects stronger for boys on non-cognitive outcomes (when children are 5-9 years old) and crime rates (when they are teenagers), but once again they underline the low-cost and low-quality childcare, which was hurriedly created.

Baydar and Brooks-Gunn (1991) study the effect of not receving maternal care, due to mother's employment. Their findings suggest that boys are more sensitive than girls to the

[5] This result is in line with the fact that family disadvantage has a larger negative effect on boys (Autor et al., 2019).

type of childcare: grandmother and relative care are beneficial for boys' cognitive development; but center-based and father care are detrimental.[6]

A number of studies find larger negative impacts of nonmaternal care for boys, but not specifically of formal care. Either they do not differentiate between the types of nonmaternal care, or they find negative effects of informal care. Belsky (1988) finds that being exposed to nonmaternal care as early as the first year of life induces mother avoidance and insecure attachment to father, measured when children are between 12 and 18 months. Boys may be affected more adversely by early nonmaternal care as they are more vulnerable to stress. Datta Gupta and Simonsen (2010) find similar results exploring Danish data, investigating the effect of universal high quality childcare when children are 3 years old on behavioural outcomes, measured when they are 7 years old. They compare two type of care (preschools – considered high quality care – and family care – considered of lower quality) with respect to parental care. No effect of high quality formal care (*preschools*) with respect to parental care is found, but they find that *family day care* has a negative impact compared to parental care for boys of lower educated mothers (high school or below, or vocational degrees). At the same time, when comparing directly preschool to family care, the author find the same results: boys of vocational educated mother benefit from high quality care compared to low quality care. Similar are also the results by Gathmann and Sass (2018), who evaluate the effect of a policy reform, introduced in one East German state, that provides subsidies to families who do *not* send their 2-year-old child to public day care, equivalent to an increase in the price of childcare. The authors find that in the short run, boys benefit from the policy in their cognitive and non-cognitive skills, whereas girls do not; the main mechanism is that parents of boys switched from *informal care*, which is on average of lower quality, to home care as a consequence of the reform, while this didn't happened for parents of girls. Results by Gathmann and Sass (2018) should thus be interpreted as a selection issue – possibly due to different gender preferences – than as a gender differential effect of the same type of care.

Overall, the findings for boys seem to be consistent with the fact that young boys are more susceptible than girls to the environment the live in, with low quality care being more detrimental for boys than it is for girls. This theory has been widley discussed in the psychological literature, and summarized recently by Schore (2017). The author provide evidence on the differences between the two genders already in utero, and discussing the

[6] The authors comment that the negative effect of father care could be due to selction issues: fathers that take care of children are probably unemployed, and thus negatively selected.

effect of early care on boys' outcomes, states that "males appear to be more vulnerable to a unique long period of early maternal separation than females".

Using UK data from the Millennium Cohort Study, Del Boca, Flinn et al. (2018) analyse the link between early childcare attendance (at the age of 18 months) and child cognitive outcomes in the United Kingdom, with a focus on gender differences.

Findings show that girls and boys benefit from early formal care on different outcomes, while the negative effect on Naming Vocabulary arises only for girls. More in detail, both the positive effect of formal care on School Readiness at age 3 and the negative effect on Naming Vocabulary at the same age arise only for girls, with the size being much larger than at the average. Moreover, among girls attending formal care also significantly improves Word Reading (age 7) and Spatial Working Memory Time (age 11). On the other hand, the positive effect of formal care on Picture Similarity and SWM Errors is similar for boys and girls, while the positive effect on Number Skills arise only among boys. These results may indicate that formal care influences the outcomes on which girls – or boys – outperform the other sex, namely vocabulary and school performance for girls and "math" skills for boys.

4. A focus on Italy

Italy is an interesting case for the analysis of the importance of childcare. Exploring the role of public childcare is particularly important in Italy, since labor market participation of mothers is much lower than in other European countries and children do less well in school than their European counterparts. In Italy, only 54 percent of mothers are employed, while this value is over 70 percent in the UK, France and Germany. Furthermore, according to 2006 data from PISA (the Programme for International Student Assessment), 15-year-old Italian students rank fourth from the bottom in average educational performance among advanced countries (OECD, 2007 and Del Boca, Flinn et al., 2018). Given the large number of children from single-child families, their main opportunities for early socialization may be those provided by childcare services and investments in childcare policies may also help alleviate inter-generational persistence, especially for children from low-income families. Instead, recent data (OECD, 2010) show that public investment in pre-school education in Italy is among the lowest in Europe.

Brilli et al. (2016) explore the relation between early childcare for children aged 0-2 and children's performance in primary school, exploiting the fact that early childcare supply is highly rationed and heterogeneously distributed across Italian provinces. They use data on

children's cognitive outcomes taken from the Italian Institute for the Evaluation of the Education System (INVALSI) for 2009-2010. Since the school year 2008-09, INVALSI and its National Evaluation Service (SNV) provide the only ongoing national survey of students' educational achievements at primary school. These assessments measure the abilities of students in second, fifth and sixth grades (ISCED levels 1 and 2). In addition to test scores, INVALSI provides information on the children's and parents' characteristics reported by the schools. Thus, the data include individual-level covariates indicating gender, citizenship, parents' working status and education. They find that childcare availability has a positive effect on children's scores, and they show that child's gender affects the impact, as boys experience a positive impact on Math test scores, and a negative one on Language.

Another study using Italian data is by Carta and Rizzica (2018), who analyze the effects of a recent reform that introduced early access to subsidized childcare for 2-year-old children in Italy. They explore the effects on several measures of maternal labor supply and on children's cognitive outcomes. Their analysis, exploiting discontinuities in the eligibility rules and the staggered implementation of the reform, shows that the policy increased mothers' participation in the labor market but did not affect children's cognitive development. When they explore heterogeneities in gender, they find that, while the point estimates are not statistically significant, they systematically observe that girls report a negative coefficient both for language and for math test scores, whereas boys report a positive effect.

Other papers analyse data from different municipalities. Fort et al. (forthcoming) analyse data on the city of Bologna using a quasi experimental approach exploiting discontinuities in the admission thresholds in a regression discontinuity design. They explore the impact of childcare 0-2 attendance on later child outcomes and show that one additional daycare month at age 0–2 has a negative impact on children's IQ at age 8–14 for more affluent families, and the magnitude of this negative effect increases with family income; when considering gender differences, the negative effect is significant only for girls. They explain their findings using arguments from psychology: children in center-based childcare experience fewer one-to-one interactions with adults, with negative effects in families where parental inputs are of higher quality. This is especially relevant for girls, who are more "mature" than boys at this age and are likely to benefit more from this type of interactions. This may at the same time explain why, on the contrary, high-quality childcare benefit girls more than boys when they come from disadvantaged background or and especially in the case of low teacher-to-child ratio.

Biroli et al. (2018) analyze childcare and later child outcomes using data on three cities in Northern Italy - Reggio Emilia, Padua and Parma - to evaluate the impact of Reggio Emilia's

early education program. Using different empirical strategies, they find that the differences among Reggio childcare and other types of childcare are not sufficiently large to result in substantial positive differences in outcomes across these groups. Comparisons with individuals exposed to alternative forms of childcare do not yield strong patterns of positive and significant effects. Their results are supported by a survey, which documents increasing similarities in the administrative and pedagogical practices of childcare systems in the three cities over time: over time, the different preschools' programs in Northern Italy improved their quality and adopted administrative and pedagogical features that are the key features of the public childcare system.

Following these results and using the same data set, Del Boca, Martino and Pronzato (2018) focus on the impact of formal childcare (without distinguishing different types of care) on child socioemotional outcomes at the end of the first year of primary school. The strong interactions between public and private childcare existing in the Italian system, including the spillover effects reported by the results by Biroli et al. (2018), motivate their choice of focusing on the impact of formal childcare attendance without distinguishing between different types of care. They compare socioemotional skills of children who attended any formal childcare at age 0-2 with children who received informal childcare (children who stayed home, taken care of by either a parent, grandparents or a nanny) and analyse gender differences. They find that attendance of early childcare (0-2) improves attitude towards schooling and socio-emotional behaviour at age 7, results being driven by households with lower educated mothers or fathers employed in low-skilled occupations. When focusing on gender differences, they find that the results are driven by the positive impact on boys, while no effect is found on girls.

We hereby analyse results from the same dataset focusing primarily on gender differences in the impact of early formal childcare. Table 1 reports results of the impact of attending formal childcare in age 0-2 on a number of outcomes, namely attitudes towards schooling at the end of first grade and the scores in the five areas of the Strengths and Difficulties Questionnaire. The first column reports results from a simple regression only controlling for city of residence: the correlation is positive and significant for boys in most domains, while it is never significant for girls (a weak negative correlation emerges on the Conduct score). The

same evidence holds in the second regression, where we control for several socio-demographic variables of the child and household.[7]

For boys, attending an infant toddler center as opposed to being taken care of at home is positively correlated with higher probability of liking school, reading and doing math, experiencing no difficulties in first grade (either difficulties in sitting still, obeying the teacher, eating at the canteen and being interested during class); it is also correlated with better scores in hyperactivity and prosocial behaviour indicators.

Since girls usually outperform boys in most of these outcomes, the differential impact of formal childcare may reduce the gap at the beginning of primary school: Table 2 shows that the gender difference in the outcomes is lower among children who attended an impact toddler center, while it is higher and more often statistically significant for those who received informal care.

Table 1: Impact of attending formal childcare for boys and girls

Outcome	**(1)**		**(2)**	
	Boys	**Girls**	**Boys**	**Girls**
Like school	0.095**	-0.006	0.097**	-0.014
Like reading	0.178***	0.062	0.160***	0.048
Like math	0.104***	0.041	0.086**	0.013
No difficulties at beginning of primary school	0.099**	0.048	0.087**	0.040
Emotional score	-0.035	-0.037	-0.039	-0.050
Conduct score	0.038	-0.108*	0.029	-0.129***
Hyperactivity score	0.125***	0.015	0.102**	-0.003
Peer problems score	0.015	0.010	0.001	-0.019
Prosocial score	0.116***	0.056	0.107**	0.056

**** p-value<0.01, ** p-value<0.05, * p-value<0.1*

The Table reports results from OLS regression of the outcome on the interaction between gender and attendance of an infant toddler center 0-2. Results in Column (1) only include city dummies. Column (2) include the full set of control variables (see footnote 7).

[7] More specifically, we include a quadratic in age, dummies for low birthweight and presence of siblings, controls for maternal education and employment, paternal occupational level, whether the family lives in a house of property and it is low income, migrant status, religiosity of the main caregiver and having grandparents living closeby. For more details on data and variables, see Del Boca, Martino and Pronzato (2018).

Table 2: Mean outcomes for boys and girls

Outcome	Informal care 0-2			Formal childcare 0-2		
	Boys	**Girls**	***Diff.***	**Boys**	**Girls**	***Diff.***
Like school	0.51	0.76	*.25***	0.62	0.78	*.16****
Like reading	0.39	0.58	*.19****	0.57	0.65	*.08***
Like math	0.57	0.59	*.01*	0.68	0.62	*-.05*
No difficulties at beginning of primary school	0.61	0.69	*.08**	0.70	0.74	*.03*
Emotional score	0.60	0.58	*-.02*	0.57	0.55	*-.03*
Conduct score	0.53	0.66	*.13****	0.57	0.56	*-.01*
Hyperactivity score	0.31	0.46	*.15****	0.45	0.50	*.05*
Peer problems score	0.37	0.43	*.06*	0.39	0.44	*.06*
Prosocial score	0.47	0.64	*.17****	0.58	0.69	*.11****

**** p-value<0.01, ** p-value<0.05, * p-value<0.1*

5. Discussion and interpretation

We find heterogeneous results by gender in different directions: which are the possible mechanisms that drive such results?

Boys seem to benefit more from formal childcare "in general", with more positive impacts in favour of boys emerging when formal care is introduced after age 3, and especially for boys coming from disadvantaged families (see Datta Gupta and Simonsen 2010; Muschkin et al. 2018), even though this second aspect is even less investigated. Studies that take into account simultaneously gender and SES differences are indeed a minority. Also, the positive impact for boys decline less over time than for girls (Magnuson et al. 2016). Girls instead tend to benefit more than boys from very high-quality formal care (Felfe et al., 2015 and Havnes and Mogstad, 2011), as already pointed out by Magnuson et al. (2016), and possibly thanks to a low child-teacher-to-child ratio (Fort et al., forthcoming).

On the other hand, we noticed also some negative effects of formal care for both genders. In general, when negative effects of formal care emerge, it happens if it is introduced below age 3.[8] The negative effects are larger for boys when they start formal care very early, probably below 12 months, and when it is of low-quality: Belsky (1988; 2001) and Schore

[8] This does not mean that formal care below age 3 is detrimental, because several papers find the opposite, but that *when* it is detrimental, it has usually been introduced very early.

(2017) suggest that young boys are more vulnerable to stress than girls over a longer period, because "stress-regulating circuits of the male brain mature more slowly than those of the female in the prenatal, perinatal, and postnatal critical periods" (Schore 2017), and in particular they are more vulnerable to early maternal separation (see also García et al. 2018). Girls, instead, experience negative impact of formal care when it starts before age 3 and they come from more affluent and more educated families, where girls may take advantage of the one-to-one relationship with adults that are able to offer them enriching interactions.

Overall, while the heterogeneity of results across gender is less clear-cut than, i.e., across socio-economic status, it seems that two main features are important to explain gender differences in the impact of childcare: age at entry and the alternative type of care. Girls develop earlier and benefit more from interaction with adults who are able to provide a stimulating environment – such as high educated mothers or high quality childcare. Boys, on the other hand, are more vulnerable to early maternal separation if the alternative is low-quality care because they "develop" later, but as they grow older they may benefit more than girls from formal care, especially with uniform/standardized curriculum and when the declared objective is to improve behaviour. In addition, beneficial effects for boys are more consequential, because on average they have lower levels of academic skills at school entry (Magnuson et al., 2016). Given the developmental differences, the optimal age of entry in formal care may differ for boys and girls, but to the best of our knowledge there is currently no study which investigates this issue.

There are three main limitations of our exercise. First, we considered only studies that reported gender differences, while a large part of them do not report gender differences, and we do not know if they didn't find any significant difference between boys and girls or they didn't investigate them. Therefore, it is possible that some form of publication bias affects our findings. Second, gender differences in formal childcare effectiveness were rarely the primary focus of the analysis, and not always the studies use corrections for multiple tests. Third, generally the studies consider gender as one of the possible sources of heterogeneity, without taking into account if and how more heterogeneities interacted. For instance, an alternative interpretation proposed by García et al. (2018) – who analysed the impact of the ABC program – about why young boys experience negative effect of early childhood education is that male home environments are generally better, consistent with the results reported by Dahl and Moretti (2008) that US families tend to prefer boys. Across our review, however, García et al. (2018) are the only ones who consider simultaneously gender and

home environment, and for the state of art it is difficult – if not impossible – to assess how much such conclusions can be extrapolated to other programs and countries.

6. Conclusions

In this paper, we reviewed the literature on the impact of different types of childcare on child cognitive and non cognitive development, with a focus on gender differences and we present some recent results for Italy.

Despite heterogeneity in the institutional setting, empirical methodology, outcomes investigated and populations of interest, most studies find a beneficial effect of high quality formal childcare on both cognitive and non cognitive skills. These positive effects are stronger for children from more disadvantaged background. As for gender differences, when investigated, results are quite diverse: because of heterogeneity in the developmental process of boys and girls in the first years of life, age of entry and alternative type of childcare appear to be of strong importance when interpreting gender differences in the results. More specifically, while the impact of formal childcare is more often positive and longlasting for boy, girls seem to benefit more from high quality adult-child interactions before the age of 3, and boys seem to suffer more from early maternal separation. More studies investigating the optimal age of entry for boys and girls and the interaction of gender with other dimensions could help understanding better the gains that boys and girls can have from high quality childcare services.

The empirical results for the Italian case shows that there is a the differential impact of formal childcare which is likely to reduce the gender gap at the beginning of primary school: In fact the gender difference in the outcomes is lower among children who attended an impact toddler center, while it is higher and more often statistically significant for those who received informal care.

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