



Curriculum and Quality Analysis and Impact Review
of European Early Childhood Education and Care



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CARE

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Early childhood education and care: promoting quality for individual, social and economic benefits

D4.1: A review of research on the effects of Early Childhood Education and Care (ECEC) upon child development

This report considers international research on the impact of Early Childhood Education and Care (ECEC) provision upon children's development, using studies reported from a wide range of sources including journals, books, government reports and diverse organisation reports.

High-quality childcare has been associated with benefits for children's development, with the strongest effects for children from disadvantaged backgrounds. There is also evidence that negative effects can sometimes occur. The results of studies partly depend upon the context and ECEC systems in place in different countries, but there is sufficient commonality of findings to indicate that many results are not culture-specific.

Discrepant results may relate to age of starting and also differences in the quality of childcare. In addition, childcare effects are moderated by family background with negative, neutral and positive effects occurring depending on the relative balance of quality of care at home and in childcare. Recent large-scale studies find effects related to both quantity and quality of childcare. The effect sizes for childcare factors are about half those for family factors. The analysis strategy of most studies attributes variance to childcare factors only after family factors has been considered, and, where the two covary, this can produce conservative estimates of childcare effects.

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Executive Summary

This report considers international research on the impact of Early Childhood Education and Care (ECEC) provision upon children's development and, while not exhaustive, is an extremely comprehensive review, using studies reported from a wide range of sources including journals, books, government reports and diverse organisation reports.

Early research was primarily concerned with whether children attending non-parental care developed differently from those not receiving such care. Later work recognised that childcare is not unitary and that the quality or characteristics of experience matters. Further research drew attention to the importance of the interaction between home and out of home experience. High-quality childcare has been associated with benefits for children's development, with the strongest effects for children from disadvantaged backgrounds. There is also evidence that negative effects can sometimes occur. The results of studies partly depend upon the context and ECEC systems in place in different countries, but there is sufficient commonality of findings to indicate that many results are not culture-specific.

While the research on preschool education (aged three and above) is fairly consistent, the research evidence on the effects of childcare (birth to three years) has been more equivocal with some negative effects, some null effects and some positive effects. Discrepant results may relate to age of starting and also differences in the quality of childcare. In addition, childcare effects are moderated by family background with negative, neutral and positive effects occurring depending on the relative balance of quality of care at home and in childcare. Recent large-scale studies find effects related to both quantity and quality of childcare. The effect sizes for childcare factors are about half those for family factors. The analysis strategy of most studies attributes variance to childcare factors only after family factors has been considered, and, where the two covary, this can produce conservative estimates of childcare effects.

Summary of evidence for disadvantaged children

The evidence on ECEC in the first three years for disadvantaged children indicates that high-quality ECEC can produce benefits for cognitive, language and social development. Low-quality childcare produces either no benefit or negative effects. High-quality childcare with associated home visits appears to be an effective package of services.

With regard to provision for three years onwards, disadvantaged children benefit particularly from high-quality preschool provision. Also children benefit more in socially mixed groups rather than in homogeneously disadvantaged groups. A number of interventions have shown improvements in cognitive development, but in some cases such benefits have not persisted throughout children's school careers. This appears to be partly because subsequent poor school experiences for disadvantaged children overcome earlier benefits from high-quality ECEC experience. However early childhood interventions do boost children's confidence and social skills, which provides a better foundation for success at school (and subsequently in the workplace). Reviews of the research often infer that it is the social skills and improved motivation that lead to lower levels of special education and school failure and higher educational achievement in children exposed to early childhood development programs. However there is clear evidence that cognitive, language and academic skills can also be enhanced by ECEC experience and these are likely to play a role in the later educational, social and economic success that is often found for well-implemented ECEC interventions. Studies into adulthood indicate that this educational success is followed by increased success in employment, social integration and sometimes reduced criminality. There is also an indication of improved outcomes for mothers. The greatest improvements appear to occur for those problems that are endemic for the particular disadvantaged group, where there is greatest opportunity for improvement, e.g. behaviour problems, criminality and lack of educational achievement.

Summary of evidence for the general population

The evidence on ECEC in the first three years indicates that for children who are not disadvantaged in their home environment, high-quality ECEC benefits children's cognitive, language and social development in both the short- and long-term, but low-quality childcare can be a risk factor and may lead to a dual risk for children from low-income families, leading to possible deficits in language or cognitive development. There has been some evidence that high levels of childcare, particularly group care in the first two years, may elevate the risk for developing antisocial behaviour. However subsequent research indicates that this may be related to high levels of poor quality care, particularly in centres and in the first year.

The low level of much ECEC quality is of concern. Some have argued (e.g. see Haskins & Barnett, 2010) that, in the US for example, government-funded preschool programs (e.g. childcare centres, Head Start and state-funded prekindergarten) offer services that are of 'mediocre or worse' quality, that children attending the average program may gain little cognitive boost, and that greater benefits could be gained by improving the quality of these programs. Others (e.g. Pianta, Barnett, Burchinal, & Thornburg, 2009) maintain that publicly funded preschool in the US narrows the achievement gap between poor and non-poor groups by as little as five per cent because of the prevalence of low-quality programs and that preschool could be narrowing the gap by up to 50 per cent if quality were improved. Furthermore, it has been argued that, while ECEC for children at risk can contribute importantly to combating educational disadvantage, this can only occur if certain circumstances are met. The design of programs and pedagogy and curriculum are crucial (Leseman, 2009).

For provision for three years onwards the evidence is consistent that preschool provision is beneficial to educational and social development for the whole population. An example of the multi-national nature of positive ECEC effects is provided by an (OECD, 2011) report on PISA results that found that students who had attended some pre-primary school outperformed students who had not, by about a year of achievement. Studies indicate that the benefits are greater for high-quality provision. Some evidence shows that part-time provision produces equivalent effects to full-time provision for the general population but more deprived children may benefit from full-time. Also there is evidence that a starting age from two years of age onwards is most effective for preschool education.

Characteristics of Early Years provision and child development

Children's daily experiences drive child development. To optimise the child experience it is possible to act upon several characteristics and hence improve the quality of ECEC. Aggregating evidence across much research indicates that the following quality characteristics of Early Years provision are important for enhancing children's development:

1. Adult-child interaction that is responsive, affectionate and readily available
2. Well-trained staff who are committed to their work with children
3. A developmentally appropriate curriculum with educational content
4. Ratios and group sizes that allow staff to interact appropriately with children
5. Supervision that maintains consistency in the quality of care
6. Staff development that ensures continuity, stability and improving quality
7. Facilities that are safe and sanitary and accessible to parents

To promote stronger outcomes, ECEC should be characterized by both structural features of quality and ongoing supports to teachers to assure that the immediate experiences of children, those provided through activities and interactions, are rich in content and stimulation, while also being emotionally supportive, and adapted to the children's developmental level. In addition to in-classroom professional development supports, the pre-service training and education of ECEC staff is of critical concern. However, here evaluation research is still scant. There are a range of recent innovations, however, these innovations have yet to be fully evaluated for their impact on staff capacities or ECEC quality.

Complex pathways in child development

Child development is affected by the whole range of children's experiences, particularly in the Early Years, and ECEC is a substantial part of the young child's experience. Also as children enter school, experiences in that environment will influence longer-term outcomes. Not only do ECEC experiences play an important role in promoting child well-being, but some other background factors are also important. The relevant factors do not function alone, but interact with each other. Hence the potential effects of ECEC experience are partly moderated by family factors, such as deprivation and parental sensitivity as well as child factors such as gender, temperamental reactivity and self-regulation. Sometimes the moderating variable may itself be influenced by ECEC experience, e.g. self-regulation, and when this occurs the distinction between moderating and mediating variable becomes blurred. In the case of self-regulation it appears to be important in the process by which early family and ECEC experiences get transmitted into later educational, social and economic success.

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I N T R O D U C T I O N

Internationally, the number of children attending non-parental childcare and education services before primary school entry has been increasing since the 1960s, and in developed countries some preschool education or care is the norm for most groups of children.

'Today's rising generation in the countries of the OECD is the first in which a majority are spending a large part of their early childhoods not in their own families but in some form of childcare' (UNICEF Innocenti Research Centre, 2008:3).

The terms day care, child care and Early Childhood Education and Care (ECEC) have all been used to refer to various forms of non-parental childcare and early education occurring before school. This could include relatives (e.g. grandmothers), family day care, and group or centre-based childcare and early education. Sometimes, such ECEC has an explicit educational component (e.g. preschool centres) and sometimes not. However, in that all experience can potentially be educational, this distinction is not clear-cut. The vast literature on ECEC spans the disciplines of developmental psychology, education, economics, and beyond, with interest from researchers, practitioners, policy makers, and the general public.

ECEC has become a salient developmental context for most children in high-income countries, and increasingly so in low- and middle-income countries. Also, ECEC provision has implications for fertility rates and female workforce participation, and is consequently embedded in a broader context of educational and family policies. Rates of ECEC use, types of ECEC, and the content and quality of ECEC differ by child age and socio-political context. For instance, on average across OECD countries, 67 per cent of three year-olds, and 94 per cent of five year-olds were enrolled in paid ECEC of some form in 2011 (see www.oecd.org). For children under three, amongst OECD countries, the use of ECEC varies greatly, from ten per cent and lower in some countries (e.g. Czech Republic and Poland) to around 60 per cent in Scandinavian countries, with the OECD average being 33 per cent.

Countries vary considerably in ECEC and parental leave policies. Some countries, (e.g. Sweden and Norway) offer universal access to subsidized and quality regulated ECEC from infancy, following extensive parental leave. In contrast, the US has limited support for ECEC or parental leave, and public funding for ECEC is targeted at low-income preschool children in most states, although an increasing number of states now offer universal preschool from age three or four. Due to limited availability of parental leave in some countries (e.g. in the US), many children enter ECEC early during their first year. Moreover, ECEC constitutes a considerable financial burden on families; across the OECD, ECEC costs 12 per cent of an average family's income, with the UK and Switzerland being the most expensive for families with 27 per cent and 50 per cent, respectively (www.oecd.org).

A HISTORICAL PERSPECTIVE OF ECEC RESEARCH

Research on ECEC and child development goes back more than five decades. The first wave of research focused on comparisons between children in non-parental day care or at home, and grew out of attachment research and concerns about consequences of early separations from the mother. There were methodological limitations, and variation in day care settings and differences among children or families were not adequately addressed. The second wave of research included diverse populations and recognised the importance of measuring variations in the quality of ECEC for understanding influences upon the development of children. The third wave of ECEC research took a social-ecological approach (Bronfenbrenner, 1989), in which both family context (especially family disadvantage and poverty), as well as child characteristics (e.g. temperament), were considered to interact with the characteristics of ECEC in its influence on child development. Researchers started acknowledging that children from more advantaged families often receive higher quality ECEC than children from less advantaged families, unless disadvantaged children attend subsidized ECEC which is used as an intervention to improve developmental outcomes.

The earliest ECEC research was particularly interested in attachment security and parenting, with interest being maintained in socio-emotional outcomes (especially externalizing and internalizing behaviours and social skills), and increasingly in cognitive and academic outcomes (including language development and school achievement). Moreover, there has also been increasing interest in stress responses (measured via change in cortisol levels) to caregiving environments, as outcomes of day care experiences.

Even though ECEC research has evolved, many of the same research questions persist, especially concerning quantity and quality of care. Quantity issues concern whether child development is related to (a) use of non-parental day care versus parental care, or the use of different types of care; (b) the age at which children enter ECEC; and (c) the amount of time (e.g. hours per week, six hours in one setting or three plus three hours in two settings) children spend in ECEC. Quality of ECEC can be considered in terms of structural and process quality. Structural quality comprises the organisational and physical features of ECEC, and is in general considered higher when child group sizes and child-adult ratios are small, teachers are trained, and curriculum/program type, toys and learning materials, and physical space are age-appropriate and adequate. Process quality refers to the quality of the children's daily experiences, including adult-child interactions, that foster children's development, and is often measured with systematic observational rating scales. Although structural and process quality are correlated, the relationship may be strong or weak, e.g. sensitive and stimulating interactions may occasionally take place when staff training is poor or child-adult ratio is high. Nevertheless, process quality is more proximal to the child, and therefore more directly relevant to developmental outcomes.

While many questions in ECEC research, as well as the outcomes studied, have persisted, recent ECEC research has evolved along three lines. The first involves context: while much research has been conducted in the US and the UK, studies from other countries with other ideologies, policies and practices have become increasingly common, including studies from low and middle-income countries such as Chile and Bangladesh (see Engle et al., 2011; Love et al., 2003 for extended discussions). The second concerns time span: studies have now followed children into school age, and even adulthood. The third is methodological, particularly selection effects: researchers are increasingly aware that parent choices have a strong influence on the 'when and what' of children's ECEC experiences, and that apparent effects of ECEC on children's development may, in part, be a function of family characteristics that vary with selection into ECEC. Studies of the effects of ECEC on child outcomes may therefore be biased if family factors both influencing ECEC variables and child outcomes are not controlled for, poorly measured, or not measured. Hence, the better research studies will include measurements of substantial family characteristics. Although a few studies of ECEC interventions for disadvantaged children have used randomized controlled trials (RCTs), most ECEC research is based on observational studies, because having researchers control families' ECEC choices is unacceptable to most families.

This review deals with research on the possible influences of ECEC on children's development, including attachment security, socio-emotional development, and cognitive and academic development. It uses empirical studies primarily, and literature reviews when relevant. Note that when the term *effect* is used it is in a broad sense, referring to both associations and to plausibly causal relationships.

PART 1 : ECEC AS AN INTERVENTION FOR CHILDREN FROM DISADVANTAGED BACKGROUNDS

Childcare or preschool education has been used as an intervention strategy to improve the lives and development of specific groups, particularly children living in deprived circumstances. Children from disadvantaged/impoverished family backgrounds often experience particular difficulties at school. They enter school with fewer academic skills than their more advantaged peers, and they often lag behind in their cognitive development during the later school years (Stipek & Ryan, 1997). More than 40 years of research have convinced scholars and policy makers that quality preschool experiences benefit children from impoverished environments and help prepare them for school entry (see, for example, reviews by Barnett, 1995; Brooks-Gunn, 2003; Committee on Developments in the Science of Learning et al., 2000; Frede, 1995; Haskins, 1989; Heckman, 2006; Melhuish, 2004b; National Research Council, 2001; Yoshikawa, 1995).

Several studies investigate the effects of these intervention programs on the development of children from disadvantaged backgrounds. In some cases, the degree of control over the intervention and the potential recipient population has allowed an intervention based on a RCT procedure to be adopted. In a RCT, assignment to intervention or control groups is random, hence theoretically balancing groups on background factors that may influence the results. Where properly executed this is the most powerful evaluation strategy. For more widespread interventions this level of control usually has not been possible and evaluations have adopted quasi-experimental designs where group assignment is not randomized, and control for background factors is carried out by statistical adjustment. This strategy has a potential flaw in that there may be an unacknowledged background factor that may affect the results. However such designs do allow interventions to be assessed in typical or usual circumstances and hence produce results of potentially greater generalisability.

U S S T U D I E S O F E C E C A S A N I N T E R V E N T I O N F O R C H I L D R E N F R O M D I S A D V A N T A G E D B A C K G R O U N D S

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

Several US programs have used ECEC from zero to three years as an intervention for children from disadvantaged backgrounds. The evaluations of programs were all RCTs and include:

- Early Head Start
- Infant Health and Development Program
- Milwaukee Project
- Abecedarian Program (Carolina)
- Project CARE

EARLY HEAD START (EHS)

EHS is a two-generation intervention program serving parents and children from birth to age three, targeted within disadvantaged communities. It began in 1995 and by 2003 had grown to over 700 programs serving more than 62,000 children in the US. EHS aims to promote children's development and provides childcare, developmental assessments, health and parenting services. There are three models of intervention; centre-based, home visiting, and a combination of these two.

Evaluation of EHS has included a RCT involving 17 EHS sites and following 3,000 EHS children and controls (Love et al., 2002). Mixed results have been found depending on the cohort of children. For the cohort of three year-olds, there have been positive effects and for the four years old cohort null or negative effects have been found. The positive effects for children of EHS participation include:

- Better cognitive and language development;
- better immunisation records and less hospitalization;
- lower levels of aggressive behaviour;
- more sustained play;
- and greater engagement and less negativity with parents.

For parents positive effects include:

- Greater warmth and supportiveness to children and less detachment;
- more time playing with children;
- more stimulating home environments;
- more language learning and reading support for children;
- less spanking with a wider range of discipline strategies;
- a higher likeliness to be employed or in training;
- and delayed subsequent child bearing compared to controls.

Effect sizes were modest, generally in the ten to 20 per cent range, and there were notable differences in the effects for different groups of parents. Where parents were enrolled in EHS in pregnancy rather than later, there

were stronger impacts, and early implementation had stronger effects. Generally, effects were stronger for African-American than other ethnic groups, with only small impacts for white families. The effects of EHS were strongest for families with a moderate number of demographic risks (three out of five) rather than low or high risk, but there were no significant impacts upon the highest risk families who seemed impermeable to this intervention.

There were also differential effects for the different models of intervention. Centre-based programs had the strongest effects on child outcomes, whereas home-based programs had the strongest effects on parenting outcomes. The mixed model combining both centre-based provision with home visiting had the most wide-ranging and strongest positive impact.

For cognitive outcomes Barnett (2008) reported that EHS has small effects at ages two and three, (0.10 to 0.15 standard deviations - S.D.) and by age five, no significant effects remained. Aos, Lieb, Mayfield, Miller, and Pennucci (2004) reported an adjusted effect size of EHS on test scores of 0.085 S.D., and Love et al. (2005) estimated the impact of EHS at 0.10 to 0.13 S.D. for the cognitive and language development outcomes, similar findings were reported by Gormley (2007) and Karoly, Kilburn, and Cannon (2005). Findings from the EHS prekindergarten follow-up conducted by the Administration for Children and Families (2006) suggested that the effect size of the program on receptive vocabulary for Spanish speakers was 0.27 S.D, while Karoly et al. (2005) report that the effect size of the EHS program on cognitive outcomes near or in elementary school was 0.10 S.D..

Regarding non-cognitive outcomes, Barnett (2008) found EHS had small effects on parent outcomes. When children were five, small improvements (0.10 S.D.) occurred in measures of children's behavior problems, parenting, and maternal depression. Also Barnett (2011) found that at ages two and three, some social-emotional benefits occurred 0.10 to 0.15 S.D.. According to Love et al. (2005) EHS produced positive impacts on several aspects of children's social-emotional development, including less aggressive behaviour (effect size - ES= 0.11), more sustained attention (ES= 0.16), and higher engagement of their parent during play (ES= 0.20). Also findings by the Administration for Children and Families (2006) showed that the effect size on behaviour problems was -0.10 S.D. (i.e. less behaviour problems) and 0.12 S.D. on approaches to learning. Adams, Tout, and Zaslow (2007) report that at 36 months, after being assigned to participate in EHS, children showed higher scores on overall mental development. Parents rated children who have participated in EHS as showing less aggressive behavior. During observations the children seemed to be more engaged in play with a parent and showed more sustained attention to objects during play.

INFANT HEALTH AND DEVELOPMENT PROGRAM (IHDP)

The Infant Health and Development Program (IHDP) was an intervention aimed at improving the health and development of premature, low birth weight (LBW) (less than 2.5 kg) infants through a combination of education and support for parents plus enriched educational day care and health services for children. A RCT was used at eight sites to examine the impact of IHDP on children's growth and development from birth to eight years of age. The results of the study differed markedly by child's birth weight. For children in the range 2 to 2.5 kg, there were large significant benefits of the enriched educational day care intervention. For the very LBW (less than 2kg) infants results were more equivocal, but with limited evidence of benefit from the intervention (Brooks-Gunn et al., 1994; McCarton et al., 1997; Ramey et al., 1992). Also there is recent evidence that the positive effects of the IHDP intervention are moderated by child temperament in that positive effects are most pronounced for children rated highly for negativity in infancy (Blair, 2002).

For cognitive outcomes, Barnett (2008) reported that, at age three, the treatment group had a higher intelligence quotient (IQ) (10 points, ES= 0.67). The IQ gain was larger (14 points, 0.93 S.D.) for the heavier LBW program group. Although no effects persisted beyond age three for the sample as a whole, long-term gains were found for the heavier LBW IHDP participants. The analyses indicated cognitive advantages of about 0.30 to 0.45 S.D. at ages five and eight, and higher math (but not reading) achievement at age eight. Also Magnuson and Waldfogel (2005) reported that the heavier LBW children had IQ scores close to four points higher than their counterparts in the comparison group at ages five and eight.

However, Aos et al. (2004) reported that the adjusted effect size of the program on test scores was only 0.033 S.D.. While Barnett (2008), noted that, at age 18, the heavier LBW participants scored higher for a measure of cognitive ability and language (0.25 S.D.), as well as higher math achievement (0.34 S.D.), but not on overall IQ.

For non-cognitive outcomes, short-term positive effects on children's behaviour were reported by Magnuson and Waldfogel (2005), with evidence that at age three, the treatment group had fewer behaviour problems and better maternal employment (Barnett, 2008). For long-term outcomes, at age 18, the heavier LBW program participants had less self-reported risky behaviour (Barnett, 2008) however, no significant effects were found on arrest rates. However, Karoly et al. (2005) reported that the effect size of the IHDP on child behaviour checklist at age five was only -0.06 S.D..

MILWAUKEE PROJECT

The Milwaukee Project was an intervention program designed to facilitate intellectual development of very young, disadvantaged children. The project, which began in the 1960s, aimed to improve the IQs and scholastic achievement of children at risk, and to study the effects of intellectual stimulation on children from deprived environments. The intervention technique employed an intensive educational program for the very young high-risk child, beginning before six months of age. Using survey data, maternal IQ (lower than 80) was designated as the basis for selection of a group of 40 newborns from one deprived district. Although this district contained only three per cent of the city's population, 33 per cent of all children who had been labeled 'mentally retarded' lived there.

This very small-scale intervention included a full-time, child-oriented, centre-based program from infancy to age six years with increasing educational input as age increased; and vocational training, childcare and household guidance was provided for mothers. Families were randomly assigned to intervention or control groups.

Regarding the major findings, by age six all of the children from the experimental group had higher IQs than all of the children from the control group (Garber, 1988; Heber, Garber, Harrington, Hoffman, & Falender, 1972). Mean IQ was 120 in the experimental group and 87 in the control group. After leaving the program their IQs started declining. By ten years of age the mean IQ of the children from the experimental group was 105, while that of the control group was 85. At age 14, the children in the experimental group had a mean IQ ten points above that of the control group (0.67 S.D.), but the scholastic achievement scores of the experimental group were not better than those of the control group (Barnett, 2008). Surprisingly, both groups performed similarly in school and as would be expected from children with a mean IQ of 80. Yet the effect on reading achievement was an estimated 0.68 grade equivalent, or ten percentiles (Barnett, 2008).

ABECEDARIAN PROJECT

The Abecedarian Project involved a poor African-American population in North Carolina, (Campbell & Ramey, 1994; Ramey & Campbell, 1991; Ramey et al., 2000). The 111 children, whose mothers had a low IQ and low-income, were randomised into two groups. One group was placed in a program involving centre-based care and home visits from three months of age and continuing until children entered school. The control group received family support, social services, low-cost or free pediatric care, and child nutritional supplements but no additional childcare beyond what the parents and the local services provided. The high-quality ECEC program had one qualified early childhood educator for every three infants and toddlers until age three and one for every six children over age three.

By age 21, when 104 of the original 111 were measured, the RCT revealed that the program group, as compared with the control group, showed gains in cognitive functioning, academic skills, educational attainment, employment, parenthood, and social adjustment, and the earlier the start the greater the effect. The likelihood of retention in grade during primary school declined by almost 50 per cent for children from the program (Ramey et al., 2000). Also the mothers in the intervention group became better educated and were more likely

to become employed, hence both generations benefited (Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; Clarke & Campbell, 1998).

Similar effects on cognitive outcomes were reported in other analyses of the Abecedarian data. Magnuson and Waldfogel (2005) reported that Abecedarian children continued to outperform the comparison group on IQ tests at age eight by just over one-third of a standard deviation. While Karoly et al. (2005) reported that the effect size of the Abecedarian on cognitive outcomes in elementary school was 0.71 S.D..

At age 21 effect sizes were 0.23 S.D. for reading, 0.20 S.D. for math and 0.03 S.D. for high school completion (Reynolds, Magnuson, & Ou, 2006, 2010). In Gormley's study (2007) effect sizes were 0.53 S.D. for reading and 0.65 S.D. for math for Abecedarian children at the age of 15.

Karoly et al. (2005) reported the effect size of the Abecedarian on cognitive outcomes in elementary school was 0.71 S.D., and that for the 15 year-olds the effect size on grade retention was -0.48 S.D. and on special education was -0.49 S.D. (i.e. both improved), while the effect on high school completion was surprisingly low at 0.06 S.D.. In another report, Campbell et al. (2002 cited in Barnett & Masse, 2007) found that at age 21 there were continued effects on IQ and achievement, though effects on IQ appear to have declined and then stabilized at about five points compared to early assessments. Effects on school success include much lower levels of grade retention; placements in special education classes; reduced high school dropout and a higher rate of attending a four-year college at age two. The authors also report that there are differences between treatment and control groups in terms of reading achievement at age 14/15; math achievement at age 14/15; grade repetition; special education; and college attendance. Similarly Barnett (2008) estimated that initial gains in IQ have declined over time, with effect sizes of about 0.33 S.D. at ages 15 and 21. Effects on reading and math achievement averaged about 0.40 S.D. from ages eight to 21, with only a slight decrease over time. Similar effects are reported by Temple and Reynolds (2007), and Pianta et al. (2009) in that this educationally focused childcare intervention reduced grade retention and placement in special education by 23 percentage points each. Also high school graduation and attendance at college were significantly affected. In addition, according to Adams et al. (2007) children in the intervention group had higher achievement in reading, math, and cognitive assessment scores through young adulthood. As young adults, participants in the intervention had completed more years of education, and were more likely to have participated in college. So overall there is a consistent positive message on the long-term impact of Abecedarian on cognitive and educational outcomes.

In addition to cognitive effects the Abecedarian Project produced long-term effects for non-cognitive outcomes. Manning, Homel, and Smith (2010) in a meta-analysis showed effects of 0.49 S.D. (on deviance), 0.43 S.D. (social participation) and 0.21 S.D. (criminal justice). McLaughlin, Campbell, Pungello, and Skinner (2007) showed that the early intervention reduced depression, and Barnett (2008) reported that the program group mentioned fewer depressive symptoms at age 21 (0.42 S.D.). Also according to Karoly et al. (2005) the effect on adult crime and delinquency by age 21 was 0.13 S.D. whereas effects for employment were 0.28 S.D.; 0.53 S.D. for skilled jobs and 0.25 S.D. for use of social services.

Barnett (2008, 2011) reports positive effects were found for health-related behaviors and symptoms of depression. The program group was more likely to have a skilled job, less likely to have become teen parents, and less likely to smoke marijuana. Effects were not found on social development or behavior during the program or in later delinquency and crime, as was also reported by Temple and Reynolds (2007). However, control group involvement in crime and delinquency was low. Finally, the free childcare appeared to have improved mothers' long-term employment opportunities and earnings. Similarly, Pianta et al. (2009) comment on the long-term effects beyond schooling and cognitive skills in a similar way.

PROJECT CARE

The same team involved in the Abecedarian Project undertook a subsequent RCT study (Project CARE) that compared the effects of a centre-based program, home visiting and control condition with interventions starting shortly after birth, again with low-income African-American families. At 12, 18, 24, and 36 months, the day care plus home visit intervention group scored significantly higher on developmental assessments than the control and home visit only groups. At 30, 42, 48, and 54 months, the two intervention groups differed from each other

in that the home visit only group's scores were lower than the day care plus home visit group's scores. Children in treatment groups that included childcare were rated as more task-oriented in infancy and tended to show higher, more stable cognitive scores beginning during late infancy and continuing through early childhood than the children who did not receive the childcare intervention (Ramey & Campbell, 1982; Wasik, Ramey, Bryant, & Sparling, 1990). In essence, only the centre-based program had any significant effect (Burchinal, Campbell, Bryant, Wasik, & Ramey, 1997; Wasik et al., 1990).

ECEC FOR CHILDREN AGED OVER THREE YEARS

There are also a range of programs involving ECEC for children from three years upwards that have been used as an intervention for children from disadvantaged backgrounds. The evaluations of these programs include RCTs and quasi-experimental studies.

RANDOMISED CONTROL TRIALS (RCTS)

PERRY PRESCHOOL PROJECT (PPP)

The Perry Preschool Project (PPP) occurred in Ypsilanti, Michigan. This half-day, five days a week, centre-based program started at three years of age and was supplemented by 90-minute weekly home visits. It was based in an area of extreme urban deprivation and the population was African-American. Children with IQs lower than 90 were randomly assigned to the intervention or control groups, and 123 of the children have been followed into adulthood. The intervention involved a high-quality educationally oriented curriculum (High/Scope), with well-trained staff. In a RCT the program was demonstrated to have long-term effects. In school, the intervention group showed higher levels of educational achievement, but there were no long-term effects for IQ. By age 27, the long-term benefits of the intervention included: reducing school drop-out, reducing drug use, reducing teenage pregnancy, enhancing employment, reducing welfare-dependence and reducing crime. Fewer females in the intervention group showed 'educable mental impairment' or poor mental health, and the males had far fewer criminal arrests (Schweinhart, Mcnair, Barnes, Lerner, & Mary, 1993).

Barnett (2008) reports that initial effects of PPP on language and general cognitive abilities after two years were about 0.90 S.D., which is about the size of the typical black/white test score gap. The standardized effect size for achievement gains from pre-k at age four in cognitive/language development is 0.75 S.D. (Barnett, 2010). According to Barnett (2011) treatment and control groups did not differ on measured IQ at the start, but at the end of the program, the preschool group scored 0.87 S.D. higher than controls, but the IQ gain disappeared by age eight.

Long-term effect sizes were in the range of 0.30 to 0.50 S.D. and high school graduation increased from half to two-thirds (Barnett, 2008). There were positive effects on achievement tests (e.g. 0.33 S.D. on reading and math at age 14 through age 27. Barnett (2011), and Nores, Belfield, Barnett, and Schweinhart (2005) reported that participation in preschool was correlated with associate or higher degree by age 40. Finally, Karoly et al. (2005) reported that effect of the PPP on grade retention was -0.15 S.D. by age 27 and on special education was -0.29 S.D. by age 19, the effect on high school completion was 0.37 S.D. by age 40.

Belfield, Nores, Barnett, and Schweinhart (2006) maintain that program participation is linked with lower grade retention and less placement in special education classes. In terms of further and higher education program males reported fewer semester credits, but program females reported higher rates of college progression. Also authors indicate that individuals continued to accumulate education credentials after age 28. Similarly, both Temple and Reynolds (2007) and Pianta et al. (2009) report better outcomes for the participants in the PPP in terms of high-school completion, reduced special education, highest grade completed, and college attendance. For non-cognitive outcomes, Barnett (2008) reported that the preschool group had better behaviour as reported by teachers and less involvement in delinquency and crime. Long-term effect sizes are in the range from 0.30 to

0.50 S.D.. The number of arrests by age 27 fell by half, and employment at age 40 showed an increase of 14 percentage points. While Karoly et al. (2005) reported the effect size on number of arrests by age 27 was -0.54 S.D., on per cent employed was 0.25 S.D. at age 27 and 0.30 S.D. at age 40, and on monthly earnings (\$1,993) at age 27 was 0.51 S.D.. In terms of social services use the effect size was 0.44 S.D. on per cent received in the past ten years by age 27 and -0.37 on per cent of lifetime use of social services by age 40. Similarly, Manning et al. (2010) reported effect sizes on deviance of 0.64 S.D. and on criminal justice of 0.41 S.D.. While Muennig, Schweinhart, Montie, and Neidell (2009) used 37 years of follow-up data to explore the linkage with adult health. The intervention led to improvements in education, health insurance, income, and family environment, which, in turn, led to improvements in behavioural risk factors and health.

Belfield et al. (2006) reported that at age 40, the program group was more likely to be employed, have higher earnings, and rely less on economic support from family or friends. In terms of lifetime gross earnings, Belfield et al. (2006) reported that for program males, lifetime earnings ranged from \$874,608 to \$1,391,307; these totals compare favorably to control group males' earnings of \$651,296 to \$1,168,871. The program differential is considerable, with earnings 11 per cent to 34 per cent higher than the control group. Similarly, program females reported higher lifetime earnings; the absolute earnings differential may even be higher than the males, and the premium ranges from 19 per cent to 36 per cent. Moreover, Belfield et al. (2006) reported higher rates of asset possession and money amounts of wealth by the program group, which has implications for wealth and well-being on retirement. High/Scope Perry Preschool Program was also found to have affects as 48 per cent of the no-program group had never been arrested for violent crime, compared to 32 per cent for the program group; similarly 17 per cent of the no-program group were incarcerated at the time of interview, compared to six per cent of the program group. Also, there were program differences in murder rates (2% vs. 5%). Overall, there was lower lifetime criminal activity by the program group.

Turning to welfare receipt, Belfield et al. (2006) reported that in general, welfare reliance was slightly lower for program participants. This differential was large for the ages 17 to 27, but narrowed subsequently with equivalent proportions reporting any services during the ages 33 to 40. Also, welfare receipt differed fundamentally by gender, particularly when females were the primary caregivers for children. There were also health status differences across the groups, with the program group being less likely to report that they: had stopped working for health reasons (43% vs. 55%); had a health problem (20% vs. 29%); smoked (42% vs. 55%); used soft drugs (45% vs. 54%); used hard drugs (22% vs. 29%); or needed treatment for drug-use or drinking (22% vs. 34%). Also, there was a difference between the groups in terms of mortality rates. Of the initial 58 program participants, one female and one male were deceased by age 40; of the 65 participants in the no-program group, two females and three males were deceased. Finally, the authors suggest that the data showed differences in family formation and behaviors with intergenerational consequences, such as abortions (17% vs. 32%) and differences in family size and two-parent family rates and teenage parenting.

Finally, Pianta et al. (2009) suggest that through age 40, the program was associated with increased employment and earnings, decreased welfare dependency, and reduced arrests. The number of arrests by age 27 fell by half, and employment at age 40 increased by 14 per cent. Authors report the following percentages: ever arrested as juvenile 16% vs. 25%; mean number of adult arrests 2.3 vs. 4.6 (age 27); and adult smoker 42% vs. 55% (age 40).

EARLY TRAINING PROJECT (ETP)

The ETP occurred in Murfreesboro, Tennessee (1962 to 1964). Sixty-five, three to four year-old children were randomly assigned to treatment (44) and control (21) groups. Children were selected if they lived in poor or deteriorating housing or public housing, had a low family income, and had parents with less than a high school education and in an unskilled or semi-skilled occupation. The intervention program consisted of a ten-week summer preschool program for the two or three summers prior to the first grade, plus weekly home visits during the remainder of the year. Hence this intervention was comparatively of low duration. The purpose of the study was to assess the impact of a preschool educational intervention on attitudes relating to achievement, and on academic performance. Children received positive reinforcement and participated in activities focusing on motivation and persistence in classes of four to five. They also received a 90 minute home visit per week (Anderson, 2005).

ETP data comes from three sources: interviews with subjects and parents, program administered tests, and school records. Data from this study include tests of intellectual development prior to, during, and after intervention; tests of school achievement from first grade to high school; various indices of the affective domain; school records; ratings by teachers and counselors; interviews with participants in 1976 and 1979; annual interviews with the parents from 1962 to 1966 and again in 1975; and demographic and family data. No crime data were collected (Anderson, 2008).

According to Karoly et al. (2005) the effect of ETP by age 18 on grade retention was 0.12 S.D. and on special education was -0.79 S.D. and at age 18, 0.27 S.D. on high school completion, thus indicating overall beneficial effects from the ETP.

HEAD START

Head Start is different from other interventions. It is federally funded but administered by each state independently. As a consequence Head Start varies substantially between states, and also within states. Head Start is a broad-based early intervention program to improve outcomes for children in disadvantaged families. It was initiated in the 1960s as an eight-week summer preschool program but rapidly developed to be a year-round program and has included a wide range of variations. Typically a Head Start program would include centre-based early childcare and education from three years of age on at least a half-time basis. A range of other services may supplement this basic package and the diversity has made it difficult to assess. By the early 1970's Head Start had become a continuous preschool program, and by 1999 it served 800,000 children at a cost of \$5,400 per child.

Participation in Head Start has been associated with short-term improvements in cognitive development (see Barnett, 1995; Karoly et al., 1998 for reviews). However often effects appeared to fade after a few years. However, subsequent follow-up in adolescence indicated that Head Start was still having an effect, possibly ' sleeper ' effects, in that Head Start graduates showed higher educational attainment. Oden, Schweinhart, Weikart, Markus, and Xie (1996) conducted a 17-year follow-up study. Once background differences were adjusted, Head Start subjects were generally equal to or better in educational development than what they would have been without Head Start. Kresh (1997) synthesized 30 years of research on the effects of Head Start. Findings indicated that Head Start had a substantial, immediate effect on participants, but the long-term effects were less evident. There was some evidence that Head Start increased parent-child communication, parental participation in school, mothers' satisfaction with their quality of life, and confidence in their coping abilities. Head Start participation decreased maternal depression, anxiety, and somatic symptoms. Head Start was associated with some community effects including increased educational emphasis on the poor and needy, greater sensitivity in health service delivery, and increased employment.

The Head Start initiative was a source of many studies on the effects of preschool education. Some were RCTs and some were quasi-experimental evaluations. McKey et al. (1985) developed a meta-analysis of 210 studies evaluating Head Start programs. They concluded that Head Start programs have an immediate positive effect on child development, but these effects ' wash out ' after two years. However many studies were poorly controlled. In one of the more robust studies, Lee, Brooks-Gunn, and Schnur (1988) considered data on 969 children and nineteen preschools. Some children had attended a Head Start preschool, some had attended other preschools and some children had not attended preschool. They found evidence of beneficial preschool effects upon cognitive measures, with the greatest effects occurring for the most disadvantaged children.

However such summaries have not been aware of ethnic variation in Head Start effects. Currie and Thomas (1993, 1995) used the National Longitudinal Survey of Youth (NLSY, a nationally representative US cohort) data to evaluate Head Start. They compared children who attended Head Start with siblings who did not. This strategy provided a means of controlling for family and other background factors. Using this nationally representative sample they found substantial gains in literacy, numeracy and grade repetition for white and Hispanic children, but not African-American children, at eight years of age, associated with Head Start. For African-American children these gains faded out over the early school years. Head Start also appeared to positively influence the immunisation rates, growth and nutritional status for African-American children, with those children attending Head Start being taller than their siblings who did not. For white children the

educational gains persisted into adolescence. This suggests that the fade out was associated with African-American children's experiences in school. This explanation is supported by evidence from Currie and Thomas (1998) that African-American children attending Head Start go on to lower quality schools than other African-American children. This is not true for white children.

Lee and Loeb (1995) in a follow-up study of Head Start participants provide a possible explanation for fading effects i.e. that children who attend Head Start are more likely to attend elementary schools of lower educational quality, with a less favourable socio-economic composition of students, and more problems of safety, which may cancel out previously established positive effects.

Garces, Thomas, and Currie (2000) used NLSY data to consider the effects of Head Start for young adults. They found that Head Start had positive effects on educational outcomes and earnings for whites but not African-Americans. White graduates of Head Start showed an increased likelihood of graduating from high school, and to have higher earnings. For African-Americans attendance at Head Start was significantly associated with lower criminal activity. This was not so for whites. These results indicate that interventions such as Head Start have varying effects dependent upon the population and context involved. Other evidence supports the view that versions of the program involving parents improved children's outcomes (Lee, Brooks-Gunn, Schnur, & Liaw, 1990).

A United States General Accounting Office (1997) report concluded that, after the first 30 years of Head Start, very little was known about the impact of the program. Only 22 out of 200 studies utilised any comparison group. These studies indicated higher gains in self-help, academic skills and cognitive development in the short-term, but there was inconsistent support for longer-term effects. There was some evidence of health-related benefits with Head Start participants being more likely to receive preventive health services. The dearth of strong evidence led to the setting up of two systematic evaluations. The Family and Child Experiences Survey (FACES) project is following a random sample of 3,200 families from 40 representative Head Start programs. This study (Zill et al., 2001) reports significant positive effects for Head Start on vocabulary, literacy, numeracy and social skills at the start of school, with effects being greater for the most disadvantaged children (McKey, 2003). They also report that independent observers rate the quality of Head Start programs as generally high, with some indication of better child outcomes being associated with higher quality programs. Also there are some benefits for parents in terms of increased employment and decreased benefit dependence. In a review Burger (2010) presents the results of the Head Start Family and Child Experiences Survey (FACES), at age five to six years as showing significant positive effects on vocabulary, early math and writing, with effects ranging from 0.05 to 0.67 S.D..

Barnett (2010) reports effect sizes for achievement gains from pre-K: cognitive/language 0.09 S.D. at age four and 0.18 S.D. at age three; with math 0.15 S.D. at age three; and print 0.25 S.D. at age four and 0.24 S.D. at age three. The Head Start Impact Study reported by Gormley (2007) shows effect sizes for pre-reading of 0.24 S.D. for three year-olds, and 0.22 S.D. for four year-olds; and the effect size for spelling was 0.16 S.D. for three year-olds with no impact for four year-olds. According to Barnett (2011), after one year of Head Start at age three or four, 13 of 22 measures of language, literacy, and math effects were significant; averaging 0.18 S.D. In addition, Barnett (2008) reported that the estimated cognitive effects of nine months of Head Start ranged from 0.05 to 0.25 S.D..

A smaller RCT by Abbott-Shim et al. (2003 cited in Barnett, 2008) found gains of 0.32 S.D. on vocabulary (compared to Head Start Impact Study: 0.05 to 0.12 S.D.). Barnett (2008) concluded that one year of Head Start has initial effects on cognitive abilities that are in the range of 0.10 to 0.30 S.D. While Ludwig and Phillips (2008) estimate effects of between 0.04 to 0.43 S.D. on a range of cognitive, linguistic and educational outcomes at age four years.

A RCT by the US Department of Health and Human Services estimated impacts of around 0.1–0.2 S.D. one year after Head Start entry (Puma et al., 2005). The study revealed short-term test score impacts as large as 0.20 S.D.. RCTs of longer-term impacts of the program have been estimated at 0.28 S.D. for the most disadvantaged children (Deming, 2009). According to Reynolds et al. (2006, 2010) the effect of the Head Start Follow Through Program at ages 12 to 15 ranged from 0.00 to 0.17 S.D. for reading and from 0.13 to 0.26 S.D. for math.

The Head Start Impact study was a nationally representative multisite RCT study to assess the impacts of Head Start on children and families through to the third grade (age nine years). Nearly 5000 newly entering children

(age three or four) from poor families were randomly assigned to the intervention group with access to the Head Start program services, or the control group without access to Head Start but could receive other early childhood education services selected by parents rather than only receive parental care (U.S. Department of Health and Human Services & Administration for Children and Families, 2010). After attending one year of Head Start, age three cohort children benefitted in all the four domains examined (cognitive development, social/emotional development, physical development and parenting practices); for the age four cohort children, positive effects were found in language and literacy elements of the cognitive domain and access to dental services in the health domain. However, at the end of first grade, only a few significant differences in outcomes remained, including a favourable impact for the four year-old cohort on reading, but an unfavourable impact for the three year-old cohort on grade promotion. The fact that many of the control group received ECEC rather negates the point of the study and makes conclusions difficult.

It is clear, however, that the effects of Head Start programs show great variability. Bloom and Weiland (2015) used data from the Head Start Impact Study to analyse variation in Head Start effects across children, subgroups of children, and Head Start sites. They found that:

- Head Start produced a ‘compensatory’ pattern of effects that increase cognitive outcomes most for children with the weakest initial cognitive skills. This tended to equalize cognitive skills across program participants.
- Head Start increased cognitive outcomes far more for dual language learners and Spanish-speaking children than for other children.
- Much of the program’s effect represents ‘compensation’ for limited prior English.
- The ‘value added’ by any Head Start program depends on both the program itself and the quantity and quality of other local options for early child education.
- Some Head Start centers are much more effective than their alternatives, while others are much less effective, with most centers operating between these extremes.

A policy brief from the National Forum on Early Childhood Programs and Policies (2010) summarises much research on Head Start. Evidence suggests that the achievement of children who applied but were not randomly assigned to a spot in a Head Start classroom had caught up to Head Start students’ achievement levels by first grade. However the ECEC experiences of treatment and control groups were not distinctly different, in that many of the control group had enrolled in ECEC and the more similar the ECEC experiences of the control and treatment groups, the less likely it is that the two groups of children will differ in terms of their outcomes. Also dual-language learners and children with special needs benefited more from Head Start participation than other groups, and the benefits for these groups persisted beyond first grade. There is room for improvement in Head Start. Less than one in 20 children were in centres with an *excellent* quality rating and only about half were in centres with recommended pupil-staff ratios.

Overall the very mixed results of the RCT evaluations of Head Start reflect the very mixed nature of the program itself in its myriad of locations around the USA. In particular, the fact that in several studies the comparison (control) group also received unspecified ECEC makes findings of null effects questionable. The mixed results probably reflect differences in study design, lack of control of what happens to the comparison (control) group, different measurements and methods as well as differences in implementation affecting quality.

QUASI-EXPERIMENTAL EVALUATIONS OF HEAD START

COGNITIVE OUTCOMES

According to the Head Start Impact Study (U.S. Department of Health and Human Services & Administration for Children and Families, 2010), the effects for the four year-old entry cohort at end of first grade were only for vocabulary (0.09 S.D). For the three year-old entry cohort at first grade it was found that the program had an effect only on oral comprehension (0.08 S.D.). However, according to Barnett (2008) another study of Head Start's initial effects in Tulsa, Oklahoma revealed that for one year of Head Start at age four, effects were 0.33 to 0.55 S.D. on literacy and math assessments. Inconsistency in results for Head Start continues to prevail.

Domitrovich et al. (2013) examined the exposure to an enhanced Head Start model and academic functioning in disadvantaged children at kindergarten. The mean effect size across language and literacy measures comparing children with one versus two years was 0.36 S.D and for numeracy skills the effect size was significantly higher (0.33 S.D.).

Regarding studies comparing siblings who attended, or not, Head Start, Magnuson and Waldfogel (2005) reported that six year-old Head Start children scored close to seven percentile points higher on a vocabulary test than their siblings who did not attend preschool.

NON-COGNITIVE OUTCOMES

Barnett (2008) reported that after nine months of Head Start attendance, behaviour problems and hyperactivity were all significantly reduced (0.13 to 0.18 S.D.) for three year-olds. Access to dental care was improved and child health, as reported by parents, was modestly improved (0.12 S.D.) for three year-olds.

Gormley (2007) reported that Head Start reduced the incidence of problem behaviour among three year-olds, with an overall effect size of 0.18 S.D.. Turning to health care impacts, Head Start participation had positive impacts on the child's health status, especially for three year-olds. For overall health status, the effect size was 0.12 S.D. for three year-olds, with no impact for four year-olds. Head Start participation had stronger positive impacts on the child's dental care. The effect size was 0.34 S.D. for three year-olds, 0.32 S.D. for four year-olds.

QUASI-EXPERIMENTAL STUDIES OF OTHER US PROGRAMS

CHILD-PARENT CENTERS (CPC)

Child-Parent Centers (CPC) was initiated in 1967 to provide centre-based educational support and family support to disadvantaged children and their parents, including education, family, and health services and half-day preschool and school-age services up to nine years. The guiding principle was that by providing a child-centred,

individualised approach to social and cognitive development in a school-based, stable learning environment during preschool, supported by energetic parental involvement, scholastic success will follow. Reynolds and colleagues (Reynolds, Temple, Robertson, & Mann, 2000; Reynolds, Temple, Robertson, & Mann, 2001a, 2001b) run the federally-funded Chicago Longitudinal Study of the effects of this early childhood intervention. This quasi-experimental study began in 1986 with a non-randomised, matched-group cohort of 1,539 (989 intervention, 550 control) low-income, mostly black children born in 1980 and enrolled in public early childhood programs in 25 sites in Chicago. The intervention group received CPC services while the control group typically did not receive any educational services until age five (kindergarten).

Overall, the CPC program has shown effectiveness on a range of child and adolescent outcomes, with the largest benefits found for participation in the preschool program and fewer (but still significant) benefits found for school-age participation. The effects were evident from grade three through grade six and nine (Reynolds, 1995, 2000; Reynolds, Temple, Robertson, & Mann, 2002). More specifically:

- Children with any CPC participation (in preschool or school) outperformed children who had no CPC exposure. Children who participated in the preschool intervention for one or two years had a higher rate of high school completion, more years of completed education, and lower rates of juvenile arrest, violent arrests, and school dropout.
- Children with two years of preschool experience had higher cognitive readiness at age five, and in reading and math achievement in school than those with one year of preschool.
- Both preschool and school age participation were significantly associated with lower rates of grade retention and special education.
- Differences in special education placement between CPC and non-CPC groups emerged at third grade and were significant from grade three through grade nine.
- The effects of preschool were greater for boys, especially for reducing school dropout.

At age 21 the CPC preschool group had significantly better outcomes (Reynolds & Robertson, 2003; Reynolds et al., 2001a, 2002) in terms of:

- Less years of special education from ages six to 18.
- Lower rates of child maltreatment from ages four to 17 and criminality.
- High school completion.
- Highest grade completed.

Finally, these positive effects of early childhood intervention on educational attainment, social development and criminality persisted up to age 24 (Reynolds et al., 2007). The findings confirmed the following benefits of the program; higher school completion, grade completion, longer college attendance; lower criminality, lower depressive symptoms.

Short-term effects include moderate to high effect sizes in a number of studies. Barnett (2008) reported that estimated effects on test scores at kindergarten varied from 0.35 to 0.77 S.D.. Similarly, Magnuson and Waldfogel (2005) reported that children who attended CPC during the year before kindergarten scored 0.64 S.D. higher on academic skills in kindergarten. Karoly et al. (2005) reported the effect size of CPC on cognitive outcomes near or in elementary school was 0.35 S.D.. Pianta et al. (2009) reported that estimated effects on test scores at kindergarten entry, with effects of just one year of CPC attendance equal to between 25% and 85% of the achievement gap at school entry. Finally, Gormley (2007) maintains that effect sizes for test scores at school entry ranged from 0.46 to 0.63 S.D..

For longer-term effects upon cognitive and educational outcomes, Karoly et al. (2005) compared children in grades three, five, and eight who had attended CPC with children who attended ordinary preschool in reading and math. CPC children outscored the comparison group every year, with effect sizes from 0.17 to 0.34 S.D.. In addition, the effect on grade retention was -0.34 S.D. by age 15, on special education -0.26 S.D. by age 18, and on school completion by age 20 was 0.23 S.D.. (Similar results are reported by Barnett, 2008; Gormley, 2007; Manning et al., 2010; Pianta et al., 2009; Temple & Reynolds, 2007).

According to Barnett (2008) the CPC study found positive effects on the following outcomes: cognitive test scores through at least middle school, special education, reduction in grade retention and more high school

graduation. Effects on cognitive abilities decline over time, but as late as eighth grade they are still nearly 0.20 S.D.. The effects on schooling outcomes are substantial (effect sizes of 0.23 to 0.34 S.D.) with a 15 percentage point reduction in grade retention, a ten percentage point reduction in special education placements, and an 11 percentage point increase in high school graduation by age 20. Also, Reynolds, Temple, Ou, Arteaga, and White (2011) examining effect on age 28 found that relative to the comparison group, the preschool group had significantly higher levels of educational attainment for four of six measures, including highest grade completed and college attendance.

For longer-term non-cognitive outcomes, Manning et al. (2010) report that effects for socio-emotional development effects ranged from 0.11 to 0.12 S.D, while the effect on criminal justice was 0.20 S.D. and on family well-being was 0.11 S.D.. Temple and Reynolds (2007) report that CPC preschool participation reduced arrests by 23.8 per cent. Finally, Karoly et al. (2005) reported that effect size of CPC on the life skills measure at eighth grade was 0.28 S.D., and effects for crime by age 18 was -0.20 S.D. and for violent offenses -0.19 S.D..

Reynolds et al. (2011) summarise the CPC findings succinctly. There were consistent and enduring benefits for children who began preschool at age three or four (compared with children who began kindergarten when older), and especially for males and children of high-school dropouts. In particular, by age 28, the former preschool students had higher educational levels, incomes, socioeconomic status, and rates of health insurance coverage—and lower rates of substance abuse and legal problems—than the kindergarten students.

MIAMI SCHOOL READINESS PROGRAM

The Miami School Readiness Program is a large-scale, university–community project. It primarily serves Latino children to prepare children for school, particularly those from low-income families. Priority for school readiness program participation is given to: children whose parents are economically disadvantaged, children at risk of abuse, neglect, or exploitation, and children with special needs. Services vary based on individual need.

Ansari and Winsler (2012) report that children who attended centre-based ECEC improved more compared with children who attended individual family-based ECEC, who did not improve much in language skills. Females improved more than males. Also children’s social skills improved over time, with teachers rating children as having better social skills in family-based ECEC than children in centre-based ECEC. However teachers also rated children in family-based ECEC with more behavioural concerns than those in centre-based ECEC.

GREAT START READINESS PROGRAM

Following the success of Head Start and other projects demonstrating positive effects for preschool attendance, many states set up their own preschool programs. State pre-kindergarten programs (also called state pre-K) provide state-funded, classroom-based educational services to young children, typically four year-old children, although some states also enroll three year-old children. Some programs are for low-income children or others at risk while some are universally open to all children. Universal pre-K programs are considered later. Here we focus on programs targeted on disadvantaged children and the evaluation involves quasi-experimental studies.

Michigan started a preschool program for children at risk of school failure in 1985. An evaluation comparing program children with non-program children from similar backgrounds found evidence of positive effects. Teacher ratings indicated improved interest in school, and attainment on a wide range of subjects. Program children were also 35 per cent less likely to be retained in grade (Michigan Department of Education, 2002).

The Great Start Readiness Program, formerly the Michigan School Readiness Program (MSRP), is a state-funded preschool initiative which began as a pilot program in 1985. To qualify for the program, a child must be four years of age and have at least two of 25 risk factors, for example, living in a low-income family and/or in a single parent family (Xiang & Schweinhart, 2002). Children in the MSRP receive a child developmental preschool program that provides age-appropriate activities in order to promote their intellectual and social growth and school readiness.

Children's families receive parenting support, guidance, and referrals to community services as needed (Xiang, Schweinhart, Hohmann, Smith, & Smith, 2000).

The first year of the longitudinal evaluation uncovered some promising findings (Florian, Schweinhart, & Epstein, 1997). Intervention children exhibited behaviours more conducive to learning in kindergarten (e.g. completing assignments and retaining learning) than similar children without a preschool experience, according to teachers' ratings. Children that attended the program were more advanced in six areas of child development: initiative, social relations, creative representation, music and movement, language and literacy, and logic and mathematics, compared to the control group, and intervention children were rated as more advanced on 19 of 30 items.

Findings from the third year evaluation indicated that after controlling for site differences, participants' characteristics, and socio-economic status, intervention children remained significantly higher in overall development in kindergarten and on some aspects of school readiness, compared to non-intervention students (Xiang et al., 2000). Intervention children had significantly lower grade retention than comparison children.

For the fifth year findings Xiang and Schweinhart (2002) suggest that in grade four, students who had attended the program had a significantly higher percentage of satisfactory scores on academic performance than students who had not attended the program. Larger percentages of the intervention group demonstrated proficiency in both math (55% vs. 47%) and reading (43% vs. 35%). Again, a smaller percentage of the intervention group than comparison group had ever repeated a grade (14% vs. 22%). Parents of intervention students were significantly more involved in school activities and communication with teachers during the first three years of school than comparable parents whose children did not participate. Parent involvement, as previously, was positively correlated to children's social relations across years, and with fourth grade academic performance.

Lamy, Barnett, and Jung (2005) examined the effects at kindergarten entry. The findings provide strong evidence of the positive impact of the program on children's language, literacy and math skills development. The effect sizes of the impact of state-funded preschool programs on receptive vocabulary, print awareness and math scores were 0.21, 0.96 and 0.44 S.D. correspondingly. Following children to eighth grade, Malofeeva, Daniel-Echols, and Xiang (2007) reported evidence of a relation between program attendance and lower grade retention rates and academic performance.

Schweinhart, Xiang, Daniel-Echols, Browning, and Wakabayashi (2012) looked at the program effects on high school graduation, grade retention, multiple grade retention, and Michigan Merit Examination proficiency. Their study identified better on-time school graduation – 57 per cent versus 43 per cent; lower retention in grade – 37 per cent compared to 49 per cent. Furthermore 43.5 per cent of the cost of the Great Start Readiness Program was recouped from savings due to the reduction in grade retentions. By grade 12, fewer intervention children of color were retained for two or more grades than their non-intervention counterparts – 14 per cent versus 28 per cent. At grades 11 or 12, the intervention group had a higher performance in mathematics (27% vs. 22%) and in math and language arts combined (35% vs. 28%).

TEXAS TARGETED PRE-KINDERGARTEN PROGRAM

Texas began offering pre-K during the 1985-1986 academic year. The purpose of state-sponsored pre-K in Texas is to bolster the academic performance of at risk children. The risk factors include: free or reduced-price lunch eligibility, limited English proficiency, homelessness or unstable housing, foster care participation, or parents who are on active military duty or who have been injured or killed on duty. The Texas program ranks low in quality in terms of class size, staff to pupil ratios, and spending per capita (Barnett, Carolan, Fitzgerald, & Squires, 2011). As such, an evaluation of this program's impact on student outcomes can provide guidance on whether modest programs, perhaps all that can be hoped for in the current budgetary environment, are worth implementing.

A longitudinal study of the effects of Texas's targeted pre-K on educational outcomes (Andrews, Jargowsky, & Kuhne, 2012). For the third grade reading test there were statistically significant effects for public pre-K attendance for those students with economic disadvantage only, for those with limited English proficiency, while the largest effect size was experienced by students eligible for the program due to both economic disadvantage and limited English proficiency. Attendance in public pre-K, relative to the alternatives, significantly reduced the

probability of retention in grade. The odds of retention were 24 per cent lower for those who attended public pre-K. Similarly the likelihood of being assigned to special education in third grade was 13 per cent lower for pre-K children.

SYRACUSE FAMILY DEVELOPMENT RESEARCH PROGRAM

The Syracuse Family Development Research Program was a comprehensive childcare, education, health and family support program from pregnancy to the start of school designed to improve child and family functioning through home visitation, parent training, and individualised day care (Lally, Mangione, & Honig, 1988). The program operated in a single site in Syracuse, New York, between 1969 and 1976, and has undergone long-term assessments of effects on participants. The program targeted young, African-American, single-parent, low-income families in order to improve children's cognitive and emotional functioning, create a positive outlook among children, and decrease juvenile delinquency. Mothers were in the last trimester of first or second pregnancy, at the start of the intervention. Child Development Trainers visited each family weekly and focused on increasing family interaction, cohesiveness, and nurturing. In the Children's Center (for day care), infants were assigned to a caregiver for attention, cognitive and social games, sensorimotor activities, and language stimulation. The preschool program supported child-chosen opportunities for learning and peer interaction, and areas of the center were designated for specific types of activities. The evaluation (Lally et al., 1988) involved 190 families and found that the intervention produced better educational attainment and school attendance for girls, but not boys, as compared with a control group. In adolescence, there were improvements in social adjustment and reduced criminality for the intervention group.

DELAWARE EARLY CHILDHOOD LONGITUDINAL STUDY

In the mid-1990s, Delaware began a comprehensive early childhood program for all children aged four living in poverty. The Early Childhood Assistance Programs (ECAP) were modeled on Head Start and used the Head Start Performance Standards as their program standards. In combination with federal Head Start funding, the ECAPs made Delaware one of the first states to provide comprehensive four year-old early childhood programming for every child living in poverty (Gamel-McCormick, Amsden, & Hartranft, 2005).

The Delaware Early Childhood Longitudinal Study was designed as a retrospective, two-group, post-test only evaluation design, which is a weak evaluation design, and was very small-scale. The 26 students who received ECAP or Head Start services at four years of age were compared with 103 students not receiving ECAP or Head Start services. Students who received ECAP or Head Start services at age four were better, in the fifth grade (age 11), at reading, math, and writing than those who did not receive ECAP or Head Start services.

EUROPEAN STUDIES OF ECEC AS AN INTERVENTION FOR CHILDREN FROM DISADVANTAGED BACKGROUNDS

There are several European countries where evaluations of such intervention have occurred and these include the UK, Denmark, Germany, Switzerland, France and the Netherlands. Studies in the UK and Denmark use RCT evaluation designs and in the other countries evaluations involve quasi-experimental or observational methodologies.

RANDOMISED CONTROL TRIALS (RCTS)

UK

In the mid-1990s new Early Years Centres were established in areas with high levels of deprivation in the UK. In setting up one such centre in Hackney (a deprived borough in London), the Hackney Day Care Study proposed to assess the effects of providing day care to children aged six months to three-and-a-half years from socially disadvantaged families. Toroyan et al. (2003) attempted to implement a RCT study of ECEC and it took place in an Early Excellence Centre, targeted on disadvantaged families. In practice it was a RCT of being allocated a place at a particular Early Excellence Centre in Hackney, a socially mixed area including a high proportion of disadvantaged families. The intervention group, chosen from a waiting list from which the control group was also selected, were allocated a place at the Early Excellence Centre. Most of the control group used other forms of day care.

The results found by the study are (1) an increase in the likelihood of mothers in the intervention group being in paid employment, but with no increase in family income and (2) the intervention group children were more likely to be infected with 'glue ear' (otitis media with effusion) probably because of the increased likelihood of cross-child infections in group care. There were no child development effects and no positive cost benefits found but, as the authors say, estimates were imprecise.

There are several points to be considered. The sample size is small. Using lenient criteria the authors' own statistical power calculations indicated the need to recruit 140 mothers, whereas they actually recruited 120 with only 51 being in the intervention group. This small imbalanced sample size reduces the power to detect differences and makes the study vulnerable to chance variation. An illustration of this is the substantial differences between the two groups at pre-test, despite the supposedly random method of selection. However, these substantial differences were not studied as the authors came to this decision: 'Statistical tests were not conducted as this is not considered good practice'. These initial group differences make the likelihood of results consistent with the intervention hypothesis more likely if children with higher pre-test scores are more likely to improve and less likely if the opposite is the case. Also, to be a worthwhile RCT the control group would need to have meaningful differences in exposure to day care. The fact that the majority of the control group in this study used day care makes the study's value questionable. While it is impossible to predict with certainty whether the control group would use day care, an inspection of the base rate of day care use in Hackney would have indicated that the majority would do so. In addition, the procedures for assessing child development would not usually be chosen by researchers experienced in child development, as several more sensitive procedures are available. Overall this study provides little evidence of significance, due to its methodological limitations. However it does

demonstrate the limitations of the RCT design for behavioural interventions where inadequate control is available for control group experiences, as typically happens where people can exercise choice.

DENMARK

Using a RCT, Jensen, Holm, and Bremberg (2011) explored the effects of the Action Competences in Social Pedagogical Work with Socially Endangered Children and Youth (ASP-program), which aims at improving all children's well-being and cognitive functioning and specifically the situation for socially disadvantaged children. They found statistically significant effects in favor of the intervention group on all five Strengths and Difficulties Questionnaire (SDQ) dimensions: emotional symptoms, conduct problems, hyperactivity/inattention, peer relations and pro-social behaviour. More precisely, authors report that all indicators suggest positive effects from the intervention, but only the effects for conduct problems and hyperactivity-inattention are statistically significant and only at a ten per cent significance level, initially but later there are larger effects for both emotional symptoms and conduct problems, which become significant at the one per cent level. A similar effect for hyperactivity inattention is significant at the five per cent level. For peer relationship and pro-social behavior, there were no significant effects. In sum, the intervention seems to have had a positive and growing effect (i.e. negative parameters) on emotional symptoms, conduct problems and hyperactivity inattention, but not on peer relationship and pro-social behavior.

QUASI-EXPERIMENTAL AND LONGITUDINAL STUDIES

GERMANY

In *Germany*, the Socio-economic Panel (SOEP) survey of private households is a wide-ranging representative study with annual follow-ups (DIW Berlin). The public kindergartens analysed in the SOEP primarily targeted four and five year-olds and were designed to promote social and cognitive development, and were mostly available on a half-day basis. Only about 20 per cent of all kindergarten places were full-day care. Hence working parents usually need additional care arrangements such as neighbours, grandparents etc. By law, the German kindergarten supports parents' labour market participation and helps parents meet family life responsibilities, and it is seen as the first stage of the education system. Kindergarten is generally provided by the community or non-profit organisations. It is intended to prepare children for school but is not compulsory. Kindergartens receive high public subsidies and are supposed to be available for every child. In Germany, family day care is typically used for toddlers (Spiess, Büchel, & Wagner, 2003). The main research question concerned the effect of kindergarten attendance on the probability of later attending a school with extended academic requirements, 'Gymnasium', 'Realschule' or 'Hauptschule' (Burger, 2013; Landvoigt, Muehler, & Pfeiffer, 2007; Spiess et al., 2003).

The SOEP data was used by Felfe and Lalive (2012). They employed a marginal treatment effects framework (MTE), and found that children from advantaged families derived lower returns to childcare attendance than children from a less advantaged family background. In particular, children from an advantaged background have lower returns to childcare in terms of comprehension and independence (their ability to dress alone). One explanation might be that higher socioeconomic status (SES) families invest already early on in their children's skills and thus, any benefits their children derive from childcare might not be captured by the measures used. The results indicate that children who have the lowest returns from attending childcare are sent to childcare first. Yet, children who would benefit the most- younger children and children from disadvantaged backgrounds- are least likely to be sent to childcare.

The effects on language skills are particularly strong in regions with high migration rates. Children who are the least likely to enter childcare (in terms of unobserved features) have higher gains from attending childcare in

terms of social, language, daily and motor skills than children who face lower unobserved entry barriers. Gains are particularly high for younger children, boys, low birth weight children and children from low SES families.

NETHERLANDS

Several early education and care programs were researched in the Dutch Cohort Study of Primary Education (PRIMA) (Driessen, 2004). The common aim of these programs was to stimulate socio-emotional and cognitive development. Various institutions targeted different age groups between birth and eight years, and were mostly part-day. Day care centers provide childcare for children between birth and four years of age. They are generally open every work day and usually administered by private organisations. The cost of day care centers is subsidised by the government, based on parents' income. Preschools or preschool playgroups target children between two and four years and are available two to three half-days a week. They are financed by municipalities which usually charge a fee to parents. ECEC programs, finally, are special services typically aimed at children from disadvantaged backgrounds and usually conducted in preschools or elementary schools. The programs are intended for children up to eight years of age. Three-quarters of programs are partly financed by municipal authorities, and one-quarter by the ministry of welfare. The Dutch Public Preschool Study (DPPS) drew on public preschools, (kindergartens), which are integrated in the primary school system, forming the first two grades of primary school (van Tuijl & Leseman, 2007). Their curriculum is predominantly developmental: Most preschools work with mixed-age groups; most time is spent in free-play activities and work lessons with children in small groups. Whole group activities are regularly provided as start, break, or closing activities during the day and include book reading, play, talking, and singing. In the second year of preschool, these activities are complemented by literacy and math activities (exploring letters and words, counting, measuring etc.).

The PRIMA-cohort study starts with five year-old children attending kindergarten classrooms of primary schools. Using retrospective analysis, reconstructing attendance to targeted preschool programs from age three to six and controlling for family background characteristics based on school records, no statistically significant effects of targeted preschool education were found on language and cognitive outcomes and school achievement (Driessen, 2004). Similarly a recent retrospective analysis of targeted preschool and kindergarten programs for three to six year-olds, with more detailed measures of the preschool programs, also did not find significant effects of targeted programs (Bruggers, Driessen, & Gesthuizen, 2014). The retrospective approach in these studies, however, is vulnerable to hidden (self-) selection mechanisms and lack of control for program implementation. Other evidence (Slot, 2014) indicates that placement in targeted preschool programs is selective. That is, children with the most cognitive and language delay are most likely to enter these programs, regardless of socio-economic and ethnic-cultural background. Screening of language delays and referral to targeted preschools is an official task of the infant and child public health care system in the Netherlands. Thus the Dutch retrospective studies cannot provide reliable evidence.

van Tuijl and Leseman (2007), in a smaller scale prospective study, of Turkish-Dutch and Moroccan-Dutch four to six year-old children (N=312) in the (20 hours/week) public kindergarten program of primary schools used age-norm-referenced intelligence measures to examine growth and catch-up effects relative to age-norms that were related to attendance of kindergarten. They reported gains with standardized effect sizes of 0.58 S.D. for total IQ, and of 0.36 S.D. and 0.44 S.D. for verbal and fluid IQ respectively. Effect sizes were largest for the youngest non-Dutch speaking children, entering the program at age four. In addition, gains in verbal and fluid intelligence predicted receptive vocabulary and pre-mathematical skills at age six, with the strongest effects for the youngest non-Dutch speaking children.

de Haan, Elbers, Hoofs, and Leseman (2013) followed two cohorts of preschoolers of low-income immigrant families (N = 91), aged three and four years at the start of the study, attending preschools and kindergarten classrooms in primary schools. Children were attending classrooms with or without an educational program intended to increase language and pre-math skills, and classrooms with a socioeconomically mixed or mainly disadvantaged composition. Classroom observations determined the amount of time spent on language, literacy and math activities initiated by the teacher. Using a cohort-sequential augmented latent growth analysis, the study showed positive effects of teacher-initiated language, literacy and math activities on children's growth in these skills over time, with effect sizes (standardized regression weights) ranging from 0.35 S.D. to 0.52 S.D. for teacher initiated academic activities and from 0.30 S.D. to 0.62 S.D. for classroom composition. Interestingly,

working with or without an education program did not explain the variance in teacher initiated activities, nor affect children's growth in academic skills, pointing to weak program implementation.

Blok, Fukkink, Gebhardt, and Leseman (2005) conducted a meta-analysis comparing targeted centre and home-based programs for disadvantaged children for the age range zero to six years. Centre-based programs and combined centre-based and home-based programs were more effective by about 0.5 S.D. on cognitive and educational outcomes than home-based programs, but they found no consistent effects for socio-emotional outcomes.

FRANCE

The French kindergarten, the 'école maternelle', is available to all children from three to six years and it has an explicit educational mission although not all necessarily focus on the promotion of pre-academic skills (some primarily emphasise the promotion of social development instead). The French kindergarten is fully funded by the State as is part of the national education system and attended by almost all three to five year-olds (OECD, 2006).

While this is a universal programme its possible benefits for disadvantaged groups have been separately investigated. Caille (2001) reported a stronger effect of an earlier start in 'école maternelle', at age two compared to age three, on early school skills and grade retention in primary school, especially for low-income and immigrant ethnic minority children. Also, it has been shown (Dumas & Lefranc, 2010) that the large-scale expansion of a universal, free preschool program led to nearly universal preschool attendance in three and four year-olds and this appeared to reduce socio-economic inequalities as children from less advantaged backgrounds benefitted most.

S U M M A R Y O F E V I D E N C E F O R D I S A D V A N T A G E D C H I L D R E N

Many of the interventions for disadvantaged groups have involved high quality ECEC. The evidence on childcare in the first three years for disadvantaged children indicates that high-quality ECEC can produce benefits for cognitive, language and social development. There are indications that low-quality childcare may not produce such benefits. High-quality childcare with associated home visits may produce the greatest benefit for children less than three years old.

With regard to provision for three years onwards disadvantaged children benefit particularly from high-quality preschool provision. Also children benefit more in socially mixed groups rather than in homogeneously disadvantaged groups (Melhuish et al., 2008). Some interventions have shown improvements in cognitive development, and in some cases these persist throughout children's school careers. However, early childhood interventions do boost children's confidence and social skills, which provides a better foundation for success at school (and subsequently in the workplace). Reviews of the research often infer that it is the social skills and improved motivation that lead to lower levels of special education and school failure and higher educational achievement in children exposed to early childhood development programs. However there is clear evidence that cognitive, language and academic skills can also be enhanced by ECEC experience and these are likely to play a role also in the later educational, social and economic success that is often found in well-implemented ECEC interventions. Studies into adulthood indicate that the educational success is followed by increased

success in employment, social integration and sometimes reduced criminality. There is also an indication of improved outcomes for mothers. The improvements appear to occur for those problems that are endemic for the particular disadvantaged group, and hence show the greatest room for improvement.

PART 2 : ECEC FOR THE GENERAL POPULATION

ATTENDANCE PATTERNS OF CARE

Children's attendance patterns at early education and care settings, and the age at which they first attend, can vary greatly. Understanding the individual and combined effects of variations in these factors is important for both researchers and policy makers; yet in reality they are hard to disentangle. Timing, duration, and intensity of ECEC attendance can be highly correlated. For example, in the US, the majority of children receive care in their first year, and once care is initiated, the amounts of time spent in an ECEC setting stay high and stable throughout early childhood (Bradley & Vandell, 2007; Phillips & Lowenstein, 2011). Thus, findings on the effect of ECEC attendance patterns on developmental outcomes generally reflect combined effects of timing and amount. However complex patterns involving amount, type and timing of care do occur in some countries as, for example, reported in the UK by the 'Families Children and Child care' (FCCC) study (Eryigit-Madzwamuse & Barnes, 2014). Such differences between countries are but one reason why conclusions about ECEC effects may vary from country to country.

ATTENDANCE AND QUANTITY OF CHILDCARE

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

Findings on the relationships between attendance or amount of early childcare and children's development are mixed: negative effects, no effects and positive effects (particularly for children at risk) have been identified (see for example, Anders, 2013; Bradley & Vandell, 2007; Melhuish, 2004b; Ruzek, Burchinal, Farkas, & Duncan, 2014; Vandell, 2004; Zaslow et al., 2010).

SOCIO-EMOTIONAL DEVELOPMENT

The consequences of day care for socio-emotional development, and especially attachment and behaviour problems, are extremely contentious, because of the strong emotional reactions aroused.

ATTACHMENT

The issue of whether day care is bad for children was partly derived from the theoretical work of Bowlby (1951, 1969) on the development of an attachment by the infant towards the principal caregiver, usually the mother. Attachment has come to be seen as a fundamental step in development and that disruption to attachment may have longer-term developmental consequences (Ainsworth, Blehar, Waters, & Wall, 1978). A child's attachment to the mother may be classified as secure or insecure, with secure attachment leading to positive development but insecure attachment being associated with an increased risk of negative developmental outcomes. Examples of developmental sequelae are; children with secure relationships to their mothers when infants have been reported to be more sociable (Pastor, 1981), and more socially competent in preschool (LaFreniere & Sroufe, 1985; Waters, Wippman, & Sroufe, 1979). The perspective that daily separations may reduce secure attachment influenced much early research on infant childcare.

Two 1980's meta-analyses summarised many US studies and concluded that non-maternal care in the first years of life could increase the likelihood of insecure attachment with the mother (see Friedman & Boyle, 2008, for a comprehensive review of day care and attachment in the US). Concerns possible effects of non-parental care upon infant attachment, as well as concerns over sample sizes and the quality of previous studies were instrumental in the setting up of the hallmark study known originally as the National Institute of Child Health and Human Development Early Child Care Research Network (NICHD ECCRN) and now known as the NICHD Study of Early Child Care and Youth Development (NICHD SECCYD), comprising approximately 1300 children sampled from ten sites across the US.

The NICHD Study of Early Child Care and Youth Development (NICHD SECCYD) is a landmark study and deserves detailed consideration. It is paid more attention and given greater credibility for its results than other studies. Certainly it has spent more money per child, had more researchers per child and more measurements per child than any other study in this field. However it has limitations. The sample size is only 1300 and substantial amounts of data are missing across the study period. Hence reports of the study are largely reliant upon results from analyses of imputed data. Typically imputation methods assume data are missing at random (MAR), meaning that the nature of missingness is related to other measured variables and these can be used in the imputation model to make reasonable estimates of missing values. However there is reason to believe that the missing data on quality of childcare in the NICHD-SECCYD study is missing not at random (MNAR), i.e. it is likely that refusal to participate in quality measurement is more likely for the lowest quality settings, and hence the value of the quality variable is linked to missingness and other measured variables do not account for missingness. All methods for incomplete data imputation under MNAR make unverifiable assumptions, because it is very rare to know the appropriate model for the missingness mechanism. Hence imputation under these circumstances is inherently open to question. In these circumstances (i.e., lower quality care more likely to be missing) it is likely that estimates based on data imputed under MAR assumptions will underestimate or miss any effect related to the quality of childcare.

Regarding US studies it should be noted that the nature of employment rights, parental leave and childcare availability in the US mean that parents who wish to return to employment after the birth of a child and use childcare have typically done so from the time when the child is a few months old. They will then usually continue to be employed and use childcare. This results in a situation where those children who receive childcare in the first year are likely to be largely the same as those receiving childcare in the second and third years so that amounts of time in ECEC remain stable throughout early childhood (Bradley & Vandell, 2007; Phillips & Lowenstein, 2011). The consequence is that there are limits to the investigation of age of starting and timing effects for childcare. Hence analyses of quantity of childcare become similar to analyses of the intensity of

childcare (hours per week) as the variation due to age of starting has less influence on the quantity of childcare measure.

With regard to measuring the quality of childcare, the study used several measures of process and structural quality. However a substantial number of childcare settings used by children in the study did not cooperate with the quality assessment visits. It is possible, even likely, that the settings that did not cooperate were settings where the quality is lower than in other settings. To the extent that this occurs, the analyses will underestimate possible effects due to variation in quality. Additionally, if the characteristics of the missing quality measurements are not reflected in settings for which quality measurements are available then imputation will only replicate the range of variation in the complete data and hence even analyses of imputed data will underestimate the potential effects of quality of childcare variation.

Contrary to expectations, this study showed no main associations between either quantity (including type of care and age of entry) or quality of care, and attachment security with the mother at ages 15 and 36 months, measured with the Strange Situation (Friedman & Boyle, 2008). However, if quantity was high in the first 15 months (something that now rarely happens in countries with extensive parental leave such as Norway or the UK) and also either day care was of low-quality or unstable, or parental sensitivity was low, only then was the likelihood of insecure attachment somewhat increased. Other studies also find that higher rates of insecure attachment are associated with poor quality daycare (Harrison & Ungerer, 2002; extended analyses in Love et al., 2003). In summary, daycare may compromise attachment security, but only in instances of poor quality infant care either at home and/or in daycare. This explanation gets support from findings showing that more hours of non-maternal childcare in the first three years can relate to more negative and less positive parenting (Belsky, 1999) or less maternal sensitivity (NICHD Early Child Care Research Network, 1999a). On the other hand, higher quality non-maternal care predicts greater maternal sensitivity (NICHD Early Child Care Research Network, 1999a).

The timing of childcare in terms of child's age can be important. Varin, Crugnola, Molina, and Ripamonti (1996) looked at the effects of age of entry into childcare on the development of attachment amongst 129 children. Their analysis was based on care-givers evaluating the behavior of the children using the Day Care Adaptation Scale at three years of age. They also observed the reunion between 54 of the children and their parents. They found that children who started childcare between six to 12 months and 18 to 23 months were more prone to frustration and had difficulty reuniting with their mothers. In contrast, children who started between 12 to 17 months displayed lower levels of relational distress.

Furthermore, infants and toddlers, securely attached to their primary caregivers, may find experiencing and settling into day care less stressful. This hypothesis gets support from a German study (Ahnert, Gunnar, Lamb, & Barthel, 2004), which showed that, during their adaptation to day care, infants classified as less securely attached had higher cortisol levels, and showed more negative affect. Importantly, attachment security to the parent was related to the time spent adapting their children to day care - if more time was spent, attachment remained secure or became secure.

Children may also form attachment relationships with caregivers in ECEC. Secure attachment with caregivers is less frequent than with parents (40% vs. 60%), and caregivers showing high levels of sensitive responsiveness were more likely to have children securely attached to them (Ahnert, Pinquart, & Lamb, 2006).

OTHER ASPECTS OF SOCIAL AND EMOTIONAL DEVELOPMENT

Other reports have focused on subsequent aspects of social and emotional development, such as behavior problems and social skills. Quantity of group care, in particular where there is early age of entry and high hourly amounts have been associated with somewhat elevated levels of externalizing behaviour problems in the SECCYD NICHD ECCRN study, as in other US studies (e.g. Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007) and other countries (Belsky, 2001; Yamauchi & Leigh, 2011). Sometimes associations remain when outcomes are measured in later childhood and adolescence (see Zachrisson, Dearing, Lekhal, & Toppelberg, 2013, for review). However, while earlier reports from the NICHD SECCYD found that negative effects on externalizing behaviours were independent of ECEC quality, emphasising quantity and type of care (Belsky et al., 2007), later analyses from the

NICHD *SECCYD* have found that quality does moderate the effects of quantity and type of care on behavioural outcomes (McCartney et al., 2010). This study found that high-quality childcare could partially compensate negative behavioural effects of high quantity childcare. A recent paper that aimed to get a better understanding of the links between quantity of childcare and children's behaviour problems and poor social skills, reviewed results from the largest and most representative childcare studies in the US as well as many other smaller studies. It concluded that there is a real effect of childcare hours on children's behaviour and good quality care does not completely eliminate these effects. However, effects are context specific (occurring primarily for teacher/caregiver reports), specific to particular aspects of social behaviour (particularly externalizing behaviour problems), specific to populations not facing disadvantage, and a function of cumulative hours rather over time rather than any particular developmental period (Huston, Bobbitt, & Bentley, 2015).

A longitudinal study in Quebec (Pingault et al., 2015) found that children who received non-parental child-care in the pre-school years were rated by teachers as less shy, less socially withdrawn, more oppositional, and more aggressive at school entry (age 6 years). However, these differences were related to greater amounts of group care experience and disappeared during elementary school as children who had received exclusive parental care caught up with those who received preschool group care. For oppositional and aggressive behaviours these differences had disappeared by 8 years of age. Similar results relating to antisocial behaviour to group care in the first two years of life had previously been reported for an English longitudinal study by Melhuish (2010) where initially more antisocial behaviour was associated with more group care in the first two years of life but this effect gradually reduced and then disappeared during the elementary school years. Similar results occurred in a parallel study in Northern Ireland (Melhuish, Taggart, Siraj-Blatchford, & Sammons, 2006). In another British study of childcare use at three, ten, 18 and 36 months, Barnes et al. (2010) failed to find an association between amount or type of childcare and mother-reported levels of disruptive behaviour at 36 months of age. It would appear that any link between group care and later externalizing or antisocial is not as persistent or long-term in non-US research.

Studies in socio-political contexts with more stringent quality regulations and greater parental leave than in the US also question whether these negative associations are universal (Love et al., 2003). For instance, in two studies in Norway, Solheim, Wichstrøm, Belsky, and Berg-Nielsen (2013) and Zachrisson et al. (2013) failed to find associations between quantity of care and externalizing behavior, the latter using statistical methods that mimic the effects of randomisation. Furthermore, Lekhal (2012) using data from the Norwegian Mother and Child Cohort Study (MoBa; data also used in Zachrisson et al., 2013), found no associations between the use of childcare in the first three years of life and externalizing and internalizing problems. Moreover, using data from the Behaviour Outlook Norwegian Development Study (BONDS), Dearing, Zachrisson, and Naerde (submitted) examined the links between age of entry into continuous ECEC, both extensive and not, and the development of aggression across ages two, three and four years. Based on teacher reported aggression, they found that early entry into ECEC was associated with modest increases in physical aggression at age two, however, by age four the effect of age of entry disappeared, while statistical techniques mimicking randomisation failed to confirm even this early association.

While Zachrisson et al. (2013), did not find any association between quantity of childcare and externalizing behavior, they did find some evidence that larger group size in childcare may be associated with increased externalizing behavior, and less social competence.

Nonetheless, two Norwegian studies have found associations between age of entry and behavioural problems. Schjølberg, Lekhal, Vartun, Saugestad Helland, and Schjelderup Mathiesen (2011) found that childcare before 18 months of age was slightly correlated with both language difficulties and behavioural problems at age five. However, this study did rely on less stringent methodology, with poor control of selection effects, than the other Norwegian studies cited. Hence their results may reflect methodological limitations. A study that collected data around 30 years earlier in Norway (Borge & Melhuish, 1995) did find a link between anti-social behaviour and amount of early childcare. The differences in results between this very early study in Norway and recent studies may well be a consequence of the extensive development of the childcare system in Norway over the past 30 years. In particular, when the earlier study data were collected parental leave was more limited so childcare in the first year was common and the structural quality in terms of staff characteristics etc. was less well developed, so that the quality of childcare was probably not as good as for the later studies.

Also, in the Netherlands, Broekhuizen, van Aken, Dubas, and Leseman (2014), it was found that high quantities of childcare was linked to more teacher-rated externalizing behaviour both concurrently at age two, and one year later at age three. However, for parent-rated externalizing behaviours, more days in high-quality childcare were related to less externalizing behaviour. Follow-up analyses showed that the difference in externalizing behaviour for children in relatively low or high-quality childcare became significant when children spent three days or more in this high-quality childcare setting.

When comparing studies across countries, it appears that most consistent negative behavioural effects are found for teacher reports (e.g. Broekhuizen, van Aken, Dubas, & Leseman, 2014; Loeb et al., 2007; NICHD Early Child Care Research Network, 2006), and for families from relatively high SES families (Broekhuizen, van Aken, Dubas, & Leseman, 2014; Loeb et al., 2007; Yamauchi & Leigh, 2011). Thus, mixed findings for effects of childcare quantity appear to be partially due to variations in study designs, such as differences in informants and sample characteristics. Moderation of ECEC effects by sample characteristics is discussed later in this review.

Like the study of McCartney et al. (2010) and Broekhuizen, van Aken, Dubas, and Leseman (2014), several other studies have examined interactions between early childcare quantity and quality in relation to children's socio-emotional behaviours. For indicators of childcare structural quality, it was found that negative behavioural associations with extensive time in childcare could be partially compensated by a low child-staff ratio (Yamauchi & Leigh, 2011), and a low proportion of time spent in a large group of peers (McCartney et al., 2010). For indicators of childcare process quality, it was also found that high process quality care could mitigate the association between extensive time in childcare and child externalizing behaviour (McCartney et al., 2010). Moreover, like the study of Broekhuizen, van Aken, Dubas, and Leseman (2014), Votruba-Drzal, Coley, and Chase-Lansdale (2004) found that children who spent extensive time in high process quality childcare showed the least mother-rated externalizing behaviour (Votruba-Drzal et al., 2004). So while some studies found that negative behavioural effects of high quantity care could partially be compensated by high-quality childcare (McCartney et al., 2010; Yamauchi & Leigh, 2011), other studies found that positive behavioural effects of high-quality childcare were even strengthened by spending many hours in this high-quality setting (Broekhuizen, van Aken, Dubas, & Leseman, 2014; Votruba-Drzal et al., 2004).

COGNITIVE, LANGUAGE AND EDUCATIONAL DEVELOPMENT

Overall, however, the studies in this review suggest positive effects of ECEC attendance under the age of three with regard to children's cognitive and language development, and their academic achievement – some effects lasting into later childhood and adolescence. This seems particularly true for attendance in centre-based care, and for children starting to attend ECEC settings between the ages of two to three years (see also recent reviews by Leseman, 2009; Mathers, Eisenstadt, Sylva, Soukakou, & Ereky-Stevens, 2014). Furthermore, centre-based care at an early age seems to be particularly beneficial for children from educationally disadvantaged families. However, there is strong evidence that not only the disadvantaged, but also the general population, benefit from preschool education (Melhuish, 2011).

US Studies

An early example of a community-based approach to ECEC was the Brookline Early Education Project (BEEP). This project began in 1972 providing a range of health and centre-based care and education services from birth to school to families in the intervention group. The intervention was open to any family in Brookline, Boston. At both kindergarten and third grade BEEP children scored higher and demonstrated fewer difficulties in social development and learning skills than comparison children from the same classrooms and similar family backgrounds. Participation in the highest level of program services, for instance, tended to close the performance gap between children of more educated and less educated mothers (Theroux, 2006). As young adults the intervention group reported higher incomes, less depression, better employment, better health and less risk-taking behaviour than the comparison group (Hauser-Cram, Pierson, Walker, & Tivnan, 1991; Tremblay, Pagani-Kurtz, Mâsse, Vitaro, & Pihl, 1995). Long-term follow-up revealed that for disadvantaged students, differences between those enrolled and not enrolled were evident as late as age 25 (Herrod, 2007; Palfrey et al., 2005).

The US NICHD Early Child Care Research Network study of early childcare on developmental effects of day care in ten US communities brought strong evidence that more experience of centre-based ECEC predicted better cognitive and language outcomes at 24, 36, and 54 months (NICHD Early Child Care Research Network, 2000b, 2002b, 2003a, 2004, 2005b). By third grade, however, centre-care exposure predicted only enhanced memory, but no longer superior academic achievement (Belsky et al., 2007; NICHD Early Child Care Research Network, 2005b). Advantages of more centre-based experience in early childhood were not found to persist into adolescence (NICHD Early Child Care Research Network, 2002b; Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010). Additionally, the report on this study by Vandell et al. (2010) shows the moderating effect of quality on age 15 cognitive effects, with standard effect sizes of $d = 0.14$ to 0.19 on cognitive academic achievement for the highest quality, but effects were very small to very small negative for low to moderate quality.

Data from the US birth cohort Early Childhood Longitudinal Study showed that – overall – centre-based care raises reading and math scores, and that the intensity of centre-based care matters: more hours per day leads to greater benefits (Loeb et al., 2007). Using data from 9,185 children (five years and older) who participated in another US cohort study (Children of the National Longitudinal Survey of Youth), it was reported that those children starting non-maternal care in the first two years had higher achievement scores in childhood and adolescence compared to those children not attending ECEC under the age of three (Jaffee, Van Hulle, & Rodgers, 2011). Data from 317 US children enrolled in kindergarten found that months in ECEC during the infant, toddler and preschool period predicted letter recognition skills (Christian, Morrison, & Bryant, 1998). And a study of 229 US children enrolled in childcare at the age of two-and-a-half showed positive effects of centre attendance on children's cognitive skills at age seven-and-a-half (Bassok, French, Fuller, & Kagan, 2008).

Alongside a body of strong evidence of beneficial effects of early ECEC attendance, there are some research findings that point to no effects, or negative effects (Bornstein, Hahn, Gist, & Haynes, 2006; Driessen, 2004; Lefebvre & Merrigan, 2002). Jaffee et al. (2011), for example, reported for their US cohort sample (Children of the National Longitudinal Survey of Youth) positive effects for between-family comparisons, however when comparing siblings within the same family, different experience of early care had neither positive or negative effects on children's outcomes.

Early results from the NICHD study showed that children without early non-maternal care experience showed no differences to those children with early non-maternal care experience (NICHD Early Child Care Research Network, 2002b, 2002c), and that the quantity, or average amount of time children spend in ECEC each week, was not related to children's cognitive skills, language skills, or to their school readiness prior to school entry. Children did not gain any greater benefit from spending more time in childcare, even in childcare rated as being of high-quality (NICHD Early Child Care Research Network, 2003a). Yet time, in certain types of care (mainly centre-based) was shown to be effective for children's language and cognitive development (NICHD Early Child Care Research Network, 2000b, 2002b, 2003a, 2004, 2005b).

Results from the Early Childhood Mental Health Program showed that hours of non-maternal care across infant, toddler, and preschool age were not predictive of children's language and cognition at 54 months (Bornstein et al., 2006).

Australasian studies

The New Zealand study 'Competent Children, Competent Learners' Study (Wylie & Thompson, 1998) demonstrated that attending centre-based care before the age of three was related to benefits for children's cognitive-linguistic development. While some effects on children's academic skills lasted into adolescence (Wylie, Hodgen, Ferral, & Thompson, 2006), an analysis at age 16 showed that effects were no longer visible (Hogden, 2007; Wylie, Hodgen, Hipkins, & Vaughan, 2009). The Longitudinal Study of Australian Children reported better learning outcomes at age six years for children attending up to 24 hours of ECEC per week. Again there are studies indicating possible negative effects. The Sydney Family Development Project reported generally positive effects of early ECEC attendance; however, they also found negative effects for children's learning at age six in combination with many hours within the first three years (Love et al., 2003).

European and international studies

In the UK, the Effective Pre-School, Primary and Secondary Education Project (EPPSE) study found that children who attended centre-based care before the age of three years (and in some cases before the age of two) had better cognitive and language skills at age three and just prior to school entry (Sammons et al., 2002; Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2010). The English FCCC study found that more hours of group care up to 18 months related to higher cognitive scores at 18 months, with a marginal effect on language development (Sylva, Stein, Leach, Barnes, & Malmberg, 2011).

In Sweden, researchers found that longer duration of ECEC attendance before the age of four was related to enhanced cognitive and language development. Advantages persisted into later childhood (Broberg, Hwang, Lamb, & Bookstein, 1990; Broberg, Wessels, Lamb, & Hwang, 1997), but could not be found any more in adolescence or adulthood (Hwang, 2006). In Norway, Dearing, Zachrisson, Mykletun, and Toppelberg (submitted) found that ECEC at age one-and-a-half had positive effects on early language, in particular for children from lower and middle-income families, providing causal estimates of the effects of ECEC.

In Germany, a national ECEC study did not show differences between those children with and without ECEC experience in terms of their linguistic and cognitive skills. However, at two time points (age two-and-a-half and age four) the study found evidence that an earlier starting age related to better language skills (Tietze et al., 2013). Also it was reported that attendance in ECEC before the age of three increased the likelihood of attending a more academically focussed secondary school system, offering final pre-university exams, from 36 per cent to 50 per cent (Fritschi & Oesch, 2008). Again in Germany, Lalive (2010) found that ECEC attendance in the first years increased language skills among two to three year-old children, and school grades in middle childhood. In Italy, the availability of additional childcare slots for the zero to two age group was shown to be effective in raising children's language scores, but not for their maths skills (Brilli, 2012; Brilli, Del Boca, & Pronzato, 2014).

In the Netherlands, Luijk et al. (2015:1) recently looked at the association between children's language development, between the ages of one and six, and the amount of hours they spent in non-parental care. They found that in general 'more hours in non-parental childcare were associated with better language abilities. However, more hours in care in the first year of life were associated with less language proficiency at ages 1 to 1.5' Additionally, they also found that children who attended more hours of centre base care, compared to home-based care, scored better in language assessments.

Finally, a meta-analysis on the effectiveness of early childhood educational programs reported that programs with a duration of more than three years had larger effects on cognitive development than those programs lasting only one or two years (thus starting at a later age) (Gorey, 2001).

The inconsistencies in evidence from different contexts and countries indicate that that paths of influence to longer-term child outcomes are likely to be complex and involve the intertwined issues of starting age, program duration and intensity, as well as several parts of ecological systems (child, family, school), each of which is vulnerable to external influences (Leak et al., 2010; Leseman, 2009).

ECEC FOR CHILDREN AGED OVER THREE YEARS

SOCIO-EMOTIONAL DEVELOPMENT

Much research has considered the effects of specific preschool programs for disadvantaged groups. A meta-analysis of US studies found, on average, a small but positive effect on socio-emotional outcomes of attending such programs, compared to not attending (Camilli, Vargas, Ryan, & Barnett, 2010). This resonates with findings

from the broader ECEC literature, where some evidence suggests that behaviour of children from socially disadvantaged or low-income families may benefit from ECEC, especially when quality is high. Although not all studies find ECEC to be beneficial for disadvantaged children, this was recently found in Norway (see Zachrisson & Dearing, 2015), but the children were only 18 to 36 months old and maybe the greater benefit for disadvantaged children occurs at older ages. Also a meta-analysis by Blok et al. (2005) of centre-based, home-based and combined centre-home-based programs, has indicated a very small overall effect on socio-emotional outcomes of 0.05 S.D. versus an effect size of 0.32 S.D. in the cognitive domain.

COGNITIVE, LANGUAGE AND EDUCATIONAL DEVELOPMENT

Findings on the relationships between attendance or amount of ECEC and children's cognitive, language and academic outcomes are more conclusive when it comes to over-threes in ECEC. Reviews point to a consistent large body of international evidence that showed that ECEC participation boosts cognitive development and school readiness skills, as well as school achievement, some of them lasting into later childhood, and adolescence. While effect sizes from studies reporting everyday ECEC experience for the general population are considerably lower than for intervention programs targeting children from low-income families, findings overall suggest that investing in universally available good quality ECEC can bring benefits to governments, and to children, families, and communities (see also reviews by Mitchell, Wylie, & Carr, 2008; Pianta et al., 2009).

Thus, despite the large number of possible combinations which define individual preschool experience, enrolment to routine preschool for the over-threes provides developmental benefits to children. This is an impressive finding, considering the relative consistency in results even though there is huge variability and fragmentation in ECEC across countries, systems and settings, making the evidence complicated.

Recent meta-analytic papers and longitudinal studies has provided clear evidence for beneficial effects of preschool programs – with substantial effects for both cognitive and socio-emotional outcomes, and possibly through to adulthood (Camilli et al., 2010; Nores & Barnett, 2010).

US STUDIES

In the US, state-funded preschool programs are a relatively new phenomenon. Following the success of Head Start and other projects demonstrating positive effects for preschool attendance, many states have set up their own preschool programs. State pre-K programs provide state-funded, classroom-based educational services to young children, typically four year-old children, although some states also enroll three year-old children. Some programs are targeted on low-income children or others at risk of entering school unprepared (considered in section on disadvantaged children), while other pre-K programs are open to all children.

Some rigorous evaluations of state-funded pre-K programs were completed recently. Most of these studies use regression discontinuity designs based on birthday cut-offs. Assessments are given to children who just started the one-year program (control group) and those who just completed it (treatment group), but are similar in age. Results point to positive effects of program attendance on children's language, cognition and academic achievement (including literacy and maths skills, and print awareness), both for full-time and part-time attendance, and for children from diverse ethnic backgrounds and family incomes (Barnett, Jung, Wong, Cook, & Lamy, 2007; Gormley, 2008; Gormley & Gayer, 2005; Gormley, Gayer, Phillips, & Dawson, 2005; Gormley, Phillips, & Gayer, 2008; Huang, Invernizzi, & Drake, 2012; Hustedt, Barnett, Jung, & Figueras, 2008; Winsler et al., 2008; Wong, Cook, Barnett, & Jung, 2008). Using this approach, the short-term effects of one year state pre-K on children's learning has been evaluated in a number of US states, with results remarkably conclusive. While short-term effects of pre-K attendance vary across states and types of tests, effects are generally medium to large – with effect sizes on general cognitive and language abilities being compared to those in the Perry and IDS studies (Barnett, 2008). The pre-K state programs are not necessarily representative, and some are clearly very high-quality programs (e.g. Oklahoma's pre-K program Tulsa). However, they provide evidence of what pre-K can do on a large public scale. For example, it has been estimated that the benefits of universal pre-K programs are equivalent to about a third-of-a-year of additional learning, above and beyond what would have occurred

without access to preschool. Two recent evaluations of at-scale urban programs, in Tulsa and Boston, showed large effects (between a half-of-a-year to a full year of additional learning) on language, literacy and math (Gormley et al., 2005).

At the moment this approach has not yet yielded evidence that can be used to estimate long-term effect, and strong policy conclusions about their effectiveness cannot yet be drawn because of the possibility of fade out effects over time (Duncan & Magnuson, 2013). Bassok et al. (2008) found that for low-income children from one-parent families, that pre-K attendance benefited them in terms of their cognitive development, with effects lasting up to the age of seven-and-a-half. A longer follow-up study of pre-K programs however found only limited evidence for long-term impacts (Hill, Gormley, & Adelstein, 2012), with positive effects on maths performance in third grade, but no other achievement impacts at that time.

Some studies have used other designs, for example, comparing children with pre-K experience to similar children from the same locality with no pre-K experience. They have found persisting evidence through kindergarten and second grade (Frede, Jung, Barnett, Lamy, & Figueras, 2007; Hustedt, Barnett, Jung, & Thomas, 2007) – with effects on cognitive gains being comparable to those from the Perry Preschool Project.

Magnuson and colleagues, using observational data on a nationally representative US sample of children who entered kindergarten (Early Childhood Longitudinal Study, ECLS), also found that attending prekindergarten and other types of centre-based care in the year before kindergarten led to increases in reading and math scores in kindergarten, and with some effects lasting into third grade (Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Magnuson, Ruhm, & Waldfogel, 2007a, 2007b). They found that children of all income levels gained from pre-K but the impact was greatest among disadvantaged children. For example, the gain in math and reading skills was larger among disadvantaged children than in the overall national sample in ECLS-K, and impacts persisted through the spring of first grade, in contrast to the fade out observed for the overall population. Isaacs (2008) reported that in this study the effect sizes on pre-reading and pre-math scores were 0.24 S.D. and 0.20 S.D., respectively, for disadvantaged children, compared to 0.10-0.12 S.D. for all children.

Huang et al. (2012) also used the ECLS data to investigate the effects of a state-funded pre-K program, the Virginia Preschool Initiative (VPI), and found that program attendance related to a lower likelihood of repeating kindergarten and improved probabilities of meeting or exceeding minimum literacy competencies.

Other studies using the Early Childhood Longitudinal Study assessed whether receipt of a subsidy in the year before kindergarten was associated with cognitive outcomes in kindergarten (Griffen, Hawkinson, Dong, & Maynard, 2010; Herbst & Tekin, 2010, 2011). All three studies found unexpected negative links between subsidy receipt and child outcomes, and it has been argued that this may be due to the low-quality of care received by those families receiving subsidy. The three studies have been criticized for their limitations (Johnson & Brooks-Gunn, 2012). In another study, Johnson, Martin, and Brooks-Gunn (2013) found that among subsidy eligible families, there was no association between subsidy use and reading outcomes, but again – negative links to maths scores. The results of these ECLS-based studies on the effects of subsidies may also be influenced by selection tendencies brought about by the nature of the subsidy: most subsidies going to centres that serve the most disadvantaged, concealing possible positive effects.

A study on impacts of pre-K in 11 US states tracked changes over the pre-K years in children's language, and academic skills, and found that children showed moderate sized gains during their preschool year that were larger than would have been expected by age alone (Howes et al., 2008). Studies using data from the National Assessment of Educational Progress found small positive impacts of state pre-K on test scores and grade repetition (Fitzpatrick, 2008; Grissmer, Flanagan, Kawata, Williamson, & LaTourrette, 2000).

A US study of a representative sample of twins found that preschool attendance at age four substantially reduced family-level influences on early reading and math skills at age five, and was prospectively associated with enhanced reading and math skills (Tucker-Drob, 2012). Additionally, a study of 3,969 participants representative of a kindergarten cohort in a large urban school district found that formal, centre-based experiences were related significantly to higher levels of language arts, mathematics, social knowledge, motor skills, and work

habits performance assessments and attendance in kindergarten. Initial advantages associated with centre-based early care and education were sustained across the kindergarten year (Fantuzzo et al., 2005).

A recent well-researched state-funded pre-K program is New Jersey's Abbott Preschool Program. It is of broad national and international interest because the program provides a model for building a high-quality system of universal pre-K through public-private partnerships that transform the existing system. It consists of a six-hour, 180-day preschool program as well as before- and after-school care and summer programs for young children in 31 of New Jersey's poorest urban school districts, which include about a quarter of the state's children. The Abbott Preschool Program adheres to quality standards set by the state Supreme Court and codified in regulations adopted by the New Jersey Department of Education. To facilitate children's transitions to school, the Abbott Preschool Program's curriculum is aligned with New Jersey's Core Curriculum Content Standards (CCCS). In 2005-2006, the seventh year of implementation, the program served more than 40,500 three and four year-old children in a mix of settings including public schools, private childcare centers, and Head Start agencies (Frede et al., 2007).

A longitudinal study of the program, in low-income districts, following children to the end of kindergarten used a regression-discontinuity design to examine outcomes in language, literacy, and math (Frede et al., 2007). There were substantial gains in learning and development in language, literacy, and mathematics. The standardised effects (i.e. standard deviation units) of one year at age four were 0.28 S.D. for the language, 0.56 S.D. for print awareness, and 0.36 S.D. for math. The longitudinal study finds that these gains are sustained during the kindergarten year. Even children who did not attend preschool made some gains in the kindergarten year. For example, they gained nearly 0.25 S.D. and closed 18 per cent of the gap between their scores and the national average in vocabulary, the broadest measure. However, the children who attended Abbott pre-K also continued to close the gap and those who attended for two years had closed over half the gap with the national average vocabulary score by the end of kindergarten. Similarly, in mathematics children who had one or two years of Abbott Preschool education maintained nearly all of their initial advantage through to the end of kindergarten despite strong kindergarten gains for all children. Only in print awareness do the children who did not attend Abbott Preschool Programs catch-up by the end of kindergarten, and this raises concerns about the extent to which they fell behind on more advanced skills while working to acquire the basics.

Another study investigated the persistence of effects for the New Jersey Abbott pre-K Program for children through second grade (Frede, Jung, Barnett, & Figueras, 2009). For receptive vocabulary, at the end of second grade the effects of Abbott participation were 0.22 S.D. for one year of attendance and 0.40 S.D. for two years, favouring Abbott Preschool Program attendees. Similar results occurred for grade retention, with two years having an effect of 0.80 S.D. and one year an effect of 0.40. Follow-up in fourth and fifth grade using statewide assessment and school placement data provided evidence that the Abbott Preschool Program produced persistent gains in achievement for children in disadvantaged communities (Barnett, Jung, Youn, & Frede, 2013). Achievement gains were particularly large for children who attended the program for two years. Substantial reductions in grade retention and special education placements were produced as well. As might be expected, the effects at grades four and five for one year of pre-K are smaller than the initial effects at second grade. The effects of both one and two years of pre-K also tend to be somewhat smaller at grades four and five than found earlier. However, the effects on achievement remain substantial at fourth and fifth grade. As grade retention and special education are cumulative, reductions are somewhat larger in absolute terms at fifth grade than at second grade.

EUROPEAN AND INTERNATIONAL STUDIES

In the UK, the Effective Preschool, Primary and Secondary Education (EPPSE) project has studied the effects of ECEC in a sample of over 3000 preschool aged children (Sylva, Melhuish, Sammons, & Siraj-Blatchford, 2007; Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004a). Using a value-added approach, and controlling for the effects of the quality of the home learning environment and the quality of the ECEC settings, the EPPSE study found effects of ECEC versus none, with significant benefits of ECEC in children's language, cognitive and mathematical skills which persisted for at least several years into school (Melhuish et al., 2008; Sylva et al., 2004a). The EPPSE study reported reducing effect sizes between school entry age and age seven, possibly due to the accumulating and powerful effects of the primary school (Sylva et al., 2004a). At the end of the primary

school period (age 11) effects of any ECEC attendance were not found to be significant, but only high-quality or effective preschool settings were found to relate to benefits in children's academic achievement (Anders et al., 2011; Sammons, Anders, et al., 2008; Sammons, Sylva, et al., 2007; Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, & Hunt, 2008). This study also found similar benefits at age 11 in terms of special educational needs (Anders et al., 2011). Yet, in adolescence (age 14) the EPPSE study found that ECEC attendance effects reappeared for children's skills and knowledge in maths and sciences (Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, Toth, et al., 2011). And the most recent report (Sylva et al., 2014) showed that attending preschool had long-term benefits, shaping academic outcomes up to the end of statutory education: preschool attendance and more hours of preschool predicted GCSE scores as well as English and maths grades at age 16.

The Effective Preschool Provision In Northern Ireland (EPPNI) study of 683 children in different types of preschool, and 151 children without preschool experience showed that preschool experience was related to children's performance and progress up to the age of 11, with the most beneficial effects for those children attending nursery school/classes or playgroups (but little evidence for other types of preschool) (Melhuish et al., 2004; Melhuish, Quinn, et al., 2010; Melhuish et al., 2013; Melhuish, Taggart, et al., 2006; Quinn et al., 2006). In Ireland, participation in an intervention scheme offered in preschools in disadvantaged areas (Early Start Program) was shown to relate to long-term benefits, for example improved academic attainment in mathematics and science at age 15 (Martin, 2010; Melhuish, Taggart, et al., 2006).

Analysis of the development of a cohort of British children born in 1958, examining long-term effects of ECEC attendance, and controlled for a rich set of child, parental, family and neighbourhood variables, found that attendance of ECEC had a positive, but short lived impact on mathematic test scores (Goodman & Sianesi, 2005). Cognitive benefits from participation in ECEC programs a year before school entry have also been illustrated using data from the Australian child cohort study 'Growing up in Australia' (Harrison, Ungerer, Smith, Zubrick, & Wise, 2010).

In France, universal, free, education preschool access from age three (*école maternelle*) was expanded during the 1960s and 1970s. This led to increases in preschool attendance from 35 per cent to 90 per cent for the three year-olds, and from 60 per cent to 100 per cent for the four year-olds. Based on state-collected data of representative samples, including a national panel study, attendance at pre-primary education was reported to increase levels of literacy and maths knowledge at the start of primary school (Jeantheau & Murat, 1998) reduce class retention of low-income and immigrant children in primary school (Caille, 2001) and show persistent effects indicating that preschool helps children succeed in school and obtain higher wages in the labour market (Dumas & Lefranc, 2010).

Similarly, evidence comes from the expansion of preschool education for three to six year-olds during the 1970s in Norway, where it was found that preschool participation was causally related to small benefits for later income, educational and job outcomes (Havnes & Mogstad, 2011).

As recounted earlier, in the Netherlands, van Tuijl and Leseman (2007), using a prospective design, studied the effects of pre-primary education on about 300 Turkish-Dutch and Moroccan-Dutch four-six year-old children's verbal and cognitive abilities and found that two years of ECEC participation halved the gap found between the sample children's scores at kindergarten entry and the age mean. Another Dutch study, however, (Driessen, 2004) found no significant effect of ECEC participation on children's cognitive competences at age ten years. While a Danish study (Datta Gupta & Simonsen, 2012) reported some positive effects of preschool relative to family day care in terms of children's language outcomes at age 11.

A number of German studies examined relations between ECEC attendance and duration and educational outcomes (Becker & Biedinger, 2006; Becker & Lauterbach, 2004; Bos et al., 2007; Büchner & Spieß, 2007; Spiess et al., 2003). Findings conclusively point to beneficial effects of ECEC attendance, but also show intertwined issues of the duration of ECEC.

Findings from a number of studies that included international data on preschool experience and educational outcomes support the view that ECEC attendance after the age of three benefits children's development. For example, the Organisation for Economic Cooperation and Development (OECD) examined educational attainment data for 65 countries, finding that better literacy at age 15 was strongly associated with countries where a large

proportion of the population were in preschool for more months, and in countries where there were measures to maintain the quality of preschool. They concluded that widening access to preschool can improve performance and equity by reducing socio-economic disparities, if extending coverage does not compromise quality (OECD, 2011).

Results for age 15 mathematics performance in the international PISA study showed students who had attended ECEC for at least a year before school scored eight points higher on average than those who had not, after taking socio-economic background into account (OECD, 2004). More evidence on the positive effects of ECEC stems from a number of international comparisons which found that more preschool education is associated with higher achievement test scores, and high participation rates are associated with less within-country inequality in test scores (Fuchs & Wößmann, 2004; Rindermann & Ceci, 2009; Schütz, Ursprung, & Wößmann, 2008; Waldfogel & Zhai, 2008). The replication of major findings across countries that differ a great deal in their economic, social, and political circumstances suggests that they are very broadly generalisable.

DEVELOPING COUNTRIES

Some research has focused on the potential for ECEC to improve general population outcomes for developing countries. For example, preschool was found to boost primary school achievement in Bangladesh (Aboud, 2006) with similar results reported in a review of studies from ten countries (Montie, Xiang, & Schweinhart, 2006). With the expansion of preschool provision in Uruguay comparisons were possible of (a) siblings with and without preschool and (b) regions varying in preschool expansion. The study revealed clear benefits in terms of academic achievement from preschool up to secondary school, including increased educational attainment and decreased drop-out rates (Berlinski & Galiani, 2007; Berlinski, Galiani, & Manacorda, 2008). Similar analyses in Argentina found that the expansion of preschool education increased school participation and achievement on third grade tests, and that one year of preschool was associated with primary school attainment increases by a moderate but important degree (Berlinski & Galiani, 2007; Berlinski, Galiani, & Gertler, 2006, 2009; Berlinski et al., 2008).

A recent study in Cambodia (Rao, Sun, Pearson, et al., 2012) showed that ECEC had positive effects on developmental outcomes, with centre-based care being most effective. Similarly a Chinese study reported positive effects of ECEC attendance on children's language and cognitive outcomes at the start of primary school (Rao, Sun, Zhou, & Zhang, 2012). Attendance of an age-appropriate preschool program was more effective than an earlier start to school. Also, research in a poor district of China by Luo et al. (2012) found that children with preschool attendance achieved higher educational readiness scores than those without preschool, after controlling for child and family factors.

A review of the available evidence (Engle et al., 2007) concluded that increasing preschool enrolment was amongst the most effective ways of improving child outcomes and would have substantial benefits with a very favourable benefit-to-cost ratio.

In sum, there is a general pattern of strong evidence across different countries and context that – for over-threes – participation in preschool education as a routine provision is beneficial for the general population. However, a number of additional aspects relating to ECEC attendance need to be considered, including the duration, starting age or intensity of program attendance.

THE SEARCH FOR THE IDEAL STARTING AGE,
DURATION AND INTENSITY OF ATTENDANCE

The 'skill begets skill' human capital production models (Cunha & Heckman, 2007) provide a justification for early intervention, a logic which might apply to ECEC provision for the general population. If boosting skills can improve the productivity of later programs, this leads to the expectation that ECEC provision at an early age would have larger impacts than those provided later in children's lives (Leak et al., 2010). The overall positive findings on positive effects of quantity and duration of ECEC on children's cognitive and language skills are in line with this argument.

A recent meta-analysis of ECEC programs has shown that starting age is a more powerful predictor of outcomes than duration; but differences in ECEC effects for programs starting before the age of three as compared to those starting later were only modest and lower than expected (Leak et al., 2010).

Regarding socio-emotional development, there have been concerns that an early starting age (especially under the age of one), particularly in combination with many hours of ECEC attendance might be 'too much too early'. This is supported by reports of negative effects of quantity of care in the first year and children's negative social-behavioural adjustment, as discussed in many reviews (see for example, Bradley & Vandell, 2007; Jacob, 2009; Melhuish, 2004b; Phillips & Lowenstein, 2011; Vandell, 2004). In a recent study in Quebec, Kottelenberg and Lehrer (2014:15) found that entering subsidized childcare before the age of three had negative effects on several aspects of children's motor, health and socio-emotional outcomes. Also the younger the child entered childcare the larger these negative effects. Despite, these negative effects for childcare before age three, Kottelenberg and Lehrer (2014) found that access to subsidized childcare at age three onwards had positive effects on children's motor and social development, particularly for the most disadvantaged children. In a UK study based on data from the Families, Children and Child Care (FCCC) study, Barnes and Eryigit-Madzwamuse (2012), found that entering childcare for a short period before age two did not affect behavioural outcomes in children, but prolonged exposure to centre-based care before two years of age was linked to greater likelihood of behavioural problems at later ages. In Italy it was found that day care entry before the age of 18 months related positively to social and behavioural outcomes (Cassibba & D'Odorico, 2003). And in Sweden, entry to day care before the age of one related positively to later cognitive and social development (Andersson, 1989, 1994).

However, a number of studies that have previously assessed effects of maternal employment in the first year on child outcomes have showed negative effect on infant development. Also an analysis of the NICHD Early Child Care Research Network data showed that maternal employment at nine months was related to lower school readiness scores and lower receptive language at 36 months, with the effects more pronounced when mothers were working 30 hours or more per week (Brooks Gunn, Han, & Waldfogel, 2002). However, more recent and complex analysis brought contradicting findings. In an analysis of the National Longitudinal Survey of Youth, Bernal and Keane (2010) found that maternal employment and childcare use reduced the child's cognitive ability, however, it appears that the maternal time input was more important for older children than for infants and toddlers. Using US data from the Panel Study of Income Dynamics (PSID) and the Child Development Supplement (CDS) Brilli (2013) found that the reduction in maternal time through maternal employment can be compensated for by alternative forms of non-maternal childcare. Using Italian data from the INVALSI dataset, the psychology department of Turin University, and the ISFOL-PLUS dataset, Del Boca and Pasqua (2010) and Del Boca, Pasqua, and Suardi (2013 ISFOL-PLUS dataset only) mirrored this finding. They too found that childcare can offset the negative effects of maternal employment. Finally, a fairly recent meta-analysis of 69 studies (1483 effect sizes), which used random effects models (Lucas-Thompson, Goldberg, & Prause, 2010) found little evidence that early employment was associated to later child achievement and behaviour problems. Timing of employment however was found as an important moderator; Year 1 employment was negatively associated with children's achievement, whereas later employment (Years 2 and 3) was positively associated with achievement.

Thus, ECEC attendance in children's first year can, but does not necessarily have negative effects on children's cognitive and language development (Andersson, 1992; Brooks Gunn et al., 2002; Gregg, Washbrook, Propper, & Burgess, 2005; Harrison et al., 2010; Waldfogel, Han, & Brooks-Gunn, 2002; Wylie & Thompson, 1998). However, there is evidence that a starting age at preschool of two to three years is the most beneficial for children. The NICHD SECCYD study for example, reported that more hours in care in the first year were associated with lower

scores on cognition and language at age four-and-a-half, while more hours after the age of two related to better language development (NICHD Early Child Care Research Network, 2004). And children who had more experience of centre-based care in their first years had higher language and cognitive scores between the ages two and four-and-a-half (NICHD Early Child Care Research Network, 2000b, 2002b), but changes in cognitive functioning were only higher for those children who attended centre care after 27 months of age, and not earlier (NICHD Early Child Care Research Network, 2003a).

Similarly, data from the Early Childhood Longitudinal Study showed that an ECEC starting age between two and three years, but not earlier could be related to higher reading and maths scores at age five (Loeb et al., 2007; Votruba-Drzal, Li-Grining, & Maldonado-Carreño, 2008). For the children of the New Zealand 'Competent Children, Competent Learners' study the finding was that starting ECEC between the ages of one and two was more beneficial to their development, than starting after the age of three (Wylie et al., 2006). An Australian study using a nationally representative study of a cohort of approximately 5,100 children found that experience of ECEC during the toddler years, but not at infant or preschool ages, was associated with better cognitive functioning at age seven, including maths and literacy skills, reasoning scores, and vocabulary skills (Coley, Lombardi, Sims, & Votruba-Drzal, 2013).

The English EPPSE study found a small effect for longer duration of ECEC on academic outcomes, however no additional effect of time in ECEC before two years of age was found (Sammons, Siraj-Blatchford, Taggart, Barreau, & Grabbe, 2007; Sammons, Sylva, et al., 2007; Siraj-Blatchford, Sammons, Taggart, Sylva, & Melhuish, 2006; Sylva et al., 2004a). Similarly, using sibling comparisons with children in the US Children of the National Longitudinal Survey of Youth study, Jaffee et al. (2011) concluded that entry to non-maternal care in the first three years had neither positive nor negative effects in children's outcomes.

In contrast, using data from the Norwegian Mother and Child Cohort Study, Lekhal, Zachrisson, Wang, Schjølberg, and von Soest (2011) found that positive associations between attending universal (high-quality) childcare on children's language development started after the age of one – with positive associations with childcare attendance observed at age one-and-a-half and age three years, but not before the age of one. In addition, the study found a positive effect of full-time versus part-time attendance at age three, but full-time attendance was not more effective earlier on.

In another Norwegian study, Drange and Havnes (2014) used childcare assignment lotteries to estimate the effect of childcare starting age on early cognitive achievement at age seven. They compared children who were and were not randomly allocated a public childcare place. In general the children who were allocated a public childcare place, started to attend childcare four months before those who were not allocated a place (15 months and 19 months respectively), although there was some overlap. By comparing the children's test performance at age seven they found that the children who received a public childcare place performed better on both the language test (0.12 S.D.) and the mathematics test (0.12 S.D.). However, these effects were stronger for children from low educated and low-income families, and in fact starting age was found to have no impact on the test scores of children from high-income families. It is important to mention however, that these results may have been affected by quality factors. Despite reporting that there were no significant differences between the structural characteristics of the public childcare that the children attended, it is still possible that process quality characteristics differed and therefore had an effect.

Much of the research addressing those questions has focused explicitly on centre-based ECEC programs for three and four year-olds in the year or two prior to entering primary school. Also note that while current research provides some answers with regards to starting age and duration, virtually nothing is known about program intensity (hours per day).

DURATION

Positive associations with length of ECEC experience have been reported in a number of studies – both across the US and in Europe. Generally, children who have attended ECEC for longer show higher cognitive performance levels and educational attainment (provided that the ECEC is good quality) (Büchner & Spieß, 2007; Caille, 2001;

Driessen, 2004; Sylva et al., 2004a; Votruba-Drzal et al., 2004). Inconsistencies exist on the question of how many years of preschool education are most beneficial. While some studies demonstrated that more than one or two years of ECEC participation is associated with developmental benefits (Barnett & Lamy, 2006; Biedinger & Becker, 2006; Bos et al., 2003; Landvoigt et al., 2007; Owen, Klausli, Mata-Otero, & Caughy, 2008) others found evidence that more than three years were most beneficial (Sammons et al., 2002; Wylie et al., 2006; Wylie & Thompson, 2003). Length of attendance is of course related to ECEC starting age, and depends on each country's school starting age, with much variation between countries. As reported above, some studies have found that (in particular with reference to centre-based care), a starting age between two and three years is most beneficial (Loeb et al., 2007; Votruba-Drzal et al., 2008).

In China, Li, Lv, and Huntsinger (2015) conducted research at six public kindergartens in Beijing. They found that entering preschool at a younger age and staying there for a longer time benefited children's academic development. However, longer attendance was also linked to slightly more behaviour problems. They concluded that earlier entry age and higher intensity of attendance in preschools specifically benefitted the numeracy skills of children from families with lower middle-income or lower education levels in Beijing. In another Chinese study Zhang and Xin (2012) examined the relationship between preschool enrolment age and four year-old children's cognitive and behaviour development for 1,391 preschool children from 74 kindergartens. This study revealed the curvilinear effects of preschool starting age on children's cognitive and behaviour development. Entering preschool between two and two-and-a-half years old resulted in the most beneficial effect (0.26 S.D.) and starting before or later, while beneficial, did not produce such strong effects.

Further research isolating the effects of timing is needed. However, studies which followed children beyond kindergarten and school entry showed that advantages of higher duration in ECEC often diminish over time (Anders et al., 2011; Hogden, 2007; Sammons, Anders, et al., 2008; Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, & Hunt, 2008; Wylie et al., 2006), possibly reflecting the accumulating effects of school and other experiences that counter-act earlier ECEC effects.

INTENSITY

A number of recent studies have examined the effects of the number of hours per week that children spend in ECEC settings. While they have not been associated consistently with benefits for early cognitive development, there is mixed evidence of any advantage for children attending full-day ECEC.

The English EPPSE study (Sylva et al., 2004a) of everyday ECEC serving children from a range of family backgrounds found no evidence that full-time provision resulted in better outcomes than part-time. Similarly, an analysis of data from two US studies - the National Centre for Early Development and Learning (NCELD) Multi-State Study of Pre-Kindergarten and the State-Wide Early Education Programs Study (SWEET), found no evidence that being in full- versus half-day pre-K programs was associated with advantages in cognitive development (Howes et al., 2008). An analysis of the ECLS-K data showed negative associations between full-day kindergarten attendance and maths achievement in fifth grade (Le, Kirby, Barney, Setodji, & Gershwin, 2006). An analysis of the German Socio-economic Panel Data (SOEP, 1984-2005) also indicated that kindergarten full-day attendance relates negatively to educational outcomes, with those children attending full-day versus half-day having lower probability of attending the highest secondary school track. Thus, in this study intensity seemed to matter more than attendance (Landvoigt et al., 2007). Based on the Norwegian MoBa study, Schjøberg et al. (2011), in a Norwegian report, found a small correlation between being in childcare for more than 40 hours a week at 18 months and behaviour problems at age five. They found that children who attend childcare for more than 40 hours per week at 18 months show more symptoms of behavioural problem at age five, compared to children who spend less than 40 hours per week in childcare at 18 months. However, the Norwegian study has poor control of selection effects and the result may reflect this methodological limitation. Finally, a Danish study found that spending longer than 30 hours in non-parental care lead to poorer non-cognitive child outcomes, 'such as measures of emotional symptoms, conduct problems, hyperactivity/inattention problems, peer relationship problems, and pro-social behavior' (Datta Gupta & Simonsen, 2010:30).

On the other hand, a number of studies, mainly from the US, report advantages for children with full-day ECEC experience, versus those with half-day attendance (Loeb et al., 2007; Robin, Frede, & Barnett, 2006; Walston & West, 2004). However, often these effects are short lived (Bingham & Hall-Kenyon, 2013; Cooper, Allen, Patall, & Dent, 2010; DeCicca, 2007; Votruba-Drzal et al., 2008; Wolgemuth, Cobb, Winokur, Leech, & Ellerby, 2006), and there is some evidence that they depend on family background (e.g. income, race, language) (Chang, 2012; Loeb et al., 2007).

These findings have to be interpreted cautiously. Due to the non-experimental design of the studies cited above, there is uncertainty if the samples (children in half-day versus full-day) were equivalent in important ways at the beginning of the study. Furthermore, most US studies reported above do not include measures of quality of care, with the possibility that quantity and quality may be confounded.

CENTRE - BASED VERSUS HOME - BASED ATTENDANCE OF CARE

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

Concerns about early non-maternal care have been raised in particular with regards to group settings for the youngest children. It has been argued that home-based care with small numbers of children could be considered as the favourable choice for infants and young toddlers (Dowsett, Huston, Imes, & Gennetian, 2008; Mathers et al., 2014). Most of the research on the effects of varying dimensions of quality on children's development has been carried out in centre care, and very little is actually known about other non-maternal care settings. In a Dutch study, children's well-being was found to be higher in home-based care compared to centre-based care (Groeneveld, Vermeer, van IJendoorn, & Linting, 2010). However, in terms of children's cognitive and language development, and their academic achievement a number of studies found more benefits for centre-based care than home-based non-maternal care settings within the first three years – with some of these benefits lasting into school age (Bernal & Keane, 2011; Gregg et al., 2005; Hansen & Hawkes, 2009; Houg, Jeon, & Kalb, 2011; Loeb, Fuller, Kagan, & Carrol, 2004; Love et al., 2003; Sylva, Stein, et al., 2011).

Results from ECEC for disadvantaged groups covered earlier are partly relevant here. Loeb et al. (2004), for example, found for 451 children from low-income families in three US sites that compared to children experiencing non-maternal care by relatives or in home-based care, those attending centre-based care had higher cognitive and school readiness scores, controlling for family background and previous child performance. Also Blok et al. (2005) a meta-analysis of targeted programs for disadvantaged children concluded that centre-based programs and combined centre-based and home-based programs were more effective by about 0.5 S.D. than home-based programs, overall for ECEC for the age range zero to six years and they found no consistent pattern of effects for socio-emotional outcomes.

With the general population, in an analysis of the US National Longitudinal Survey of Youth data, Bernal and Keane (2010) found that use of informal care, but not use of formal centre-based care has negative effects on children's cognitive ability. In another US study, Peng and Robins (2010) analysed data from the Fragile Families and Child Wellbeing Study (FFCWS), which included mainly children from low-income single parent families. They found that relative care in the first year of life is more beneficial for disadvantaged children than maternal care, in terms of their language development at age three. They also found that centre-based care in the first year of

life, is more beneficial for disadvantaged children than maternal care in terms of their social and behavioural development at age three.

In the UK, Hansen and Hawkes (2009) analysed data from the Millennium Cohort Study (MCS) and tested the effectiveness of different types of childcare attended in the first year. They found that attendance of centre-based care was most effective for increases in school readiness scores; however it had detrimental effects on children's vocabulary scores at age three. The English FCCC study found that children who had been in centre care had better cognitive development, based on the Bayley Mental Developmental Index (MDI), at 18 months compared to children in several types of home-based care (Sylva, Stein, et al., 2011). On the other hand, in the FCCC study it was also found that more hours in group care, particularly centre-based care, related to behavioural problems, in particular hyperactivity at 51 months (Stein et al., 2013).

Using data from the Norwegian Mother and Child Cohort Study, Lekhal et al. (2011) found that attendance in family day care and centre-based care at age one-and-a-half and three reduced the risk of late talking (at age three), but other informal childcare arrangements were not effective. However, in a later study, Lekhal, von Soest, Wang, Aukrust, and Schjølberg (2012) found that centre care did not buffer the negative effects of biomedical risk factors on children's late talking. Furthermore, in another Norwegian study, Zachrisson, Backer-Grøndahl, Nærde, and Ogden (2011) found no differences in parent-rated empathy, cooperation, physical aggression, disobedience, communication skills, or motor skills, between children attending and not attending centre care at age two.

Using data from the Early Childhood Longitudinal Study, Votruba-Drzal, Coley, Koury, and Miller (2013) found beneficial effects of centre-based care settings for children's math and reading skills development at age five for the group as a whole, but for children from lower income, less educated, and less enriching family contexts, both centre- and home-based care for two year-olds as well as four year-olds were beneficial.

Reviews on the effects of childcare have concluded that differences in effects of centre-based and home-based care settings may be due to differences in quality (Anders, 2013; Melhuish, 2004b). This has recently been confirmed by an analysis of a nationally representative sample of US children (Early Childhood Longitudinal Study-Birth Cohort) (Ruzek et al., 2014). Also an analysis of 353 centres and home settings that serve poor families in five US cities found wide disparities in centre- and home-based care quality. Positive caregiver interaction was not consistently higher in centre-based care (Fuller, Kagan, Loeb, & Chang, 2004). And the NICHD study (NICHD Early Child Care Research Network, 2000a) found that at six months, in-home caregivers offered the highest levels of positive caregiving, while caregivers in centres offered the lowest. Between 15 and 36 months, positive caregiving in centre-based care increased, while it decreased for home-based care, and by 36 months, no differences in positive caregiving were found between the two types of care. Across the infant, toddler, and preschool age group, children in centre-based care experienced more cognitive stimulation, but also less frequent language interaction with adults than children in other types of care (Dowsett et al., 2008). In the UK, the FCCC study (Leach et al., 2008) found that at ten and 18 months, observed quality of care, based predominantly on the nature of interactions, was lowest in nurseries (except that at 18 months nurseries offered more learning activities than childminders). The sensitivity of interactions was similar across different types of home-based care (childminders, relatives and nannies). And in Germany, the quality of home-based care was not found to be lower than the quality of centre-based care for under-threes (Tietze et al., 2013). Moreover, caregivers in Dutch home-based care were found to be more sensitive compared to caregivers working in centre-based care (Groeneveld et al., 2010).

The NICHD SECCYD study reported that when children were in childcare home-care (similar to childminders) more often through to two years of age, they scored higher on the Bayley development index at 24 months; and when they were in such arrangements more often through to 36 months, they had greater verbal comprehension (NICHD Early Child Care Research Network, 2000b). Thereafter, however, significant effects of exposure to childcare homes were no longer evident (NICHD Early Child Care Research Network, 2004).

In the NICHD SECCYD study, findings regarding exposure to relative care (i.e. father, grandparent, or other adult relative) were mixed. Relative care was not found to be predictive at any time point (NICHD Early Child Care Research Network, 2004). However in a subsequent analysis, Tran and Weinraub (2006) found that childcare arrangements using family caregivers (fathers, grandmothers) in infancy were related to significantly higher language scores.

Similarly, an analysis of US data from the Early Childhood Longitudinal Study Birth Cohort showed that toddlers experiencing informal non-maternal care had better expressive language skills than their peers in parent care, while during preschool age (but not earlier) centre-based care benefited children (Coley et al., 2013). In the UK, the EPPSE study reported that being cared for by a relative such as a grandmother before age three showed moderate effects on cognitive outcomes (Sammons, Siraj-Blatchford, et al., 2007; Sammons, Sylva, et al., 2007; Siraj-Blatchford et al., 2006; Sylva et al., 2004a). One study using the ALSPAC data found a negative impact of informal care (unpaid care by a friend, relative – including grandparents - or neighbour) as compared with formal (paid) care in the first three years of a child's life on children's performance in literacy and numeracy tests between the ages of four and eight (Gregg et al., 2005). The negative effects were, however, restricted to children from a subsample of more advantaged households who used such informal care for long periods, and who did not also use formal childcare such as a nursery or playgroup.

In the UK, analysis of MCS data showed that children who had been looked after by grandparents at the age of nine months while their mothers worked had, on average, similar vocabulary scores at age three to those who had attended formal group care (nurseries, crèches, nursery schools and playgroups) and were ahead of those who had been involved in other informal care arrangements, but they were behind on assessments of their school readiness (understanding of colours, letters, numbers etc.). The researchers suggest this may be due to grandparents having less access to settings where children can interact with their peers, such as toddler groups and children's centres (Hansen & Hawkes, 2009). The FCCC study in the UK also showed that greater hours of individual care, such as that provided by grandparents and nannies, were related to lower scores on a measure of orientation and engagement (e.g. being task-focused, cooperative and curious), after controlling for demographics and the quality of maternal caregiving while more group care was associated with higher cognitive scores (Sylva, Stein, et al., 2011).

The potential advantage of grandparent care as a supplement to other forms of care is highlighted by Australian research, which found a tendency for children using either 'long day care' (day nurseries) or family day care (childminders) in combination with grandparent care to have better early communication skills than children who used long day care only (Wise et al., 2005).

To conclude, home-based care for under-threes may have some benefits for children's language development although evidence is mixed for socio-emotional development. Although evidence here is limited, there is some support for the argument that younger children may develop optimally within smaller and more intimate non-parental care settings (such as home-based care by relatives or non-relatives), where there are fewer peers and greater adult-child ratios than centre-based programs (Dowsett et al., 2008). However the FCCC study in the UK and the US NICHD SECCYD study both found that socio-emotional problems at 36 months were unrelated to which type of childcare had been experienced (Barnes et al., 2010; NICHD Early Child Care Research Network, 2005a). Some findings have shown that home-based care can be of good quality. Yet, carers in home-based setting do not receive the same amount of peer support, opportunities for critical reflection, or ongoing professional training as practitioners in centre-based care, and are missing out on support provided by management leadership. They are fairly isolated, and with low pay, which can leave them feeling undervalued (Mooney, Boddy, Statham, & Warwick, 2008). Undeniably, we do not know enough how home-care settings relate to children's development, and how to support carers in home-based care.

ECEC FOR CHILDREN AGED OVER THREE YEARS

Some have argued that as children grow from infancy through early childhood the influence of ECEC settings on children's development may change. Centre-based care during the later toddler and preschool years (e.g. after age two or three) may be more beneficial for children's academic skills development than centre-based care for the youngest children. This may be due to the fact, that preschool aged children with their growing language, communication, and social skills, and better emotion regulation may benefit from enhanced variation and stimulation offered in centre-based care, and from more opportunities to engage with groups of peers (Votruba-Drzal et al., 2013).

There is strong evidence that for over-threes attendance of centre-based care enhances children's cognitive skills development. However, only few studies have assessed whether associations between type of care and children's outcomes change depending on their age. Support for this proposition comes from some analyses of the NICHD study, which found that time in centre-based childcare in the third and fourth years of life, but not earlier had consistent significant associations with both cognitive and achievement outcomes (NICHD Early Child Care Research Network & Duncan, 2003) and that children who experience home-based care during the infant-toddler period and centre-based care during the preschool period display the improved cognitive outcomes, but not the increased behavioural problems, generally associated with sustained centre-based care attendance (Morrissey, 2010). An analysis of data from the Early Childhood Longitudinal study Birth Cohort (Votruba-Drzal et al., 2013) showed that neither centre- nor home-based care in infancy or toddlerhood was significantly related to children's reading and math skills at age five. However, centre-based preschool attendance was related to improved academic skills.

Importantly, type and quantity of care arrangements are intertwined, making it difficult to disentangle the effects of attending long hours in certain types of care. Moreover, many children will experience more than one type of care, and care of differing quality, further complicating the issue. Furthermore, type of care is correlated with family background. In Germany for example, it was found that children from disadvantaged families are less likely to attend centre-based care (Geier & Riedel, 2009), and that low educational background may have more barriers to centre care access than those with immigrant background (Sachverstaendigenr deutscher Stiftungen fuer Integration und Migration, 2013).

V A R I A T I O N I N T H E Q U A L I T Y O F E C E C

Such differences and inconsistencies across findings demonstrate the extent to which issues of starting age, duration, and intensity, as well as type of care are intertwined, but perhaps most importantly, issues of quantity of care are also intertwined with issues of quality. While negative effects of hours in early non-maternal care may be larger if children are experiencing low-quality care, the experience of high-quality care has been shown to facilitate development, particularly for children at risk (Bradley & Vandell, 2007; Melhuish, 2004b; Phillips & Lowenstein, 2011). Also Broekhuizen, van Aken, Dubas, and Leseman (2014) studied two to three year-olds in Dutch day care, and found positive effects on behaviour (less externalizing behaviour) of long hours (four or more days) when combined with high emotional quality as observed with the CLASS Toddler observation scale.

Generally research on the effects of early childcare quality has indicated that high process quality childcare (e.g. child-teacher relationships and interactions) is prospectively related to more social competence and less behaviour problems in children (Burchinal et al., 2008; Mashburn et al., 2008; NICHD Early Child Care Research Network, 2006; Peisner-Feinberg et al., 2001), with effects sometimes even lasting into adolescence (Vandell et al., 2010). Recent experimental studies demonstrate that comprehensive socio-emotional curricula and professional development that focuses on teachers' responsive interactions can enhance children's social skills, behaviour regulation, and emotion understanding (Bierman et al., 2014; Landry et al., 2014). Comparable advantages of high process quality ECEC (e.g. teacher-child interactions) for child social and behavioural skills are found in observational studies (e.g. NICHD Early Child Care Research Network, 2006; Peisner-Feinberg et al., 2001), with positive behavioural effects extending to adolescence (Vandell et al., 2010).

However, several studies find no effects for some socio-emotional outcomes (NICHD Early Child Care Research Network, 2006; Peisner-Feinberg et al., 2001; Vandell et al., 2010), and a recent meta-analytic study by Keys et al. (2013) of four large-scale studies in the US showed that ECEC process quality was not reliably associated with children's social skills and problem behaviours one year later. One possible explanation for these mixed findings is

that individual characteristics might moderate these effects (Crockenberg, 2003; Phillips, Fox, & Gunnar, 2011), and such possible moderation effects of child characteristics are discussed later in this review.

On the basis of their thorough review covering the birth to five age range, Zaslow et al. (2010:18) concluded:

‘Perhaps the most striking pattern of findings that we have identified in this review of the research on dosage of young children’s exposure to early care and education is the increase in positive outcomes (and in some studies, decrease in negative outcomes) when children attend high quality early care and education program for more time. The pattern of findings is identified in studies focusing on concurrent participation as well as cumulative participation, in both large national studies and in studies with smaller local samples, and is noted for both cognitive and social emotional outcomes. In recent research, more sustained exposure to high quality care has been found to narrow the gap on measures of achievement between low income and higher income children.’

Despite this strong conclusion there is little research that directly investigated how quality and quantity of early non-maternal care interact in affecting children’s development. Earlier NICHD SECCYD analysis did not show any evidence that more time spent in high-quality care carried greater developmental benefit than less time spent in high-quality care, or vice versa (NICHD Early Child Care Research Network, 2003b). Similarly, a recent analysis of a nationally representative data source on children’s early development, the Early Childhood Longitudinal Study-Birth Cohort of US children born in 2001 did not identify significant quality-by-quantity interactions, thus the effect of quality did not vary depending on the amount of time children spent in ECEC (Ruzek et al., 2014), and quality of childcare did not account for associations between attendance of centre care and children’s cognitive outcomes (Abner, Gordon, Kaestner, & Korenman, 2013). Furthermore, quantity did not predict cognitive outcomes above quality measures. Yet, another analysis of the NICHD data (NICHD Early Child Care Research Network, 2005b) pointed out that the quantity of non-maternal care was a significant predictor of some child outcomes over and above quality and these effects of quantity of childcare are mediated by the age of the child, and the quality of care. Their findings suggest that it is not simply a question of how much is enough, but how good is the quality of education and care, in determining outcomes for under two year-olds.

The authors Zaslow et al. (2010) point to the need to further investigate amount of care in conjunction with quality (and type), and in particular the need to better understand the specific quality features that young children most benefit from. Only some of the studies cited above took account of the quality of care children receive. Yet, quality is critical in determining the direction, strength and persistence of effects of ECEC attendance patterns on children’s development. It has been argued that especially for the zero to three age group, the quality and stability of care are particularly crucial (Anders, 2013; Burchinal et al., 2009).

The importance of high-quality ECEC is widely recognised within the field of childhood development. The positive impact of childcare quality on various aspects of children’s development is one of the most consistent findings in developmental science. In good to excellent childcare, children score higher than their peers in mediocre or poor childcare for cognitive and language development (e.g. Loeb et al., 2004). More recently, it has also been argued that the persistence of those effects depends on the quality of care provided (Anders, 2013).

International research has shown that high-quality childcare provides children with warm and positive relationships with their childcare providers, a safe and healthy environment, and opportunities for children to learn (Shonkoff & Phillips, 2000). While the ECEC field contains varying views for defining what makes up program quality, two broad dimensions have been identified consistently to describe the most critical facilitators of children’s development and learning. As mentioned at the beginning of this review, they include: (a) process quality, which includes the quality of the curriculum and pedagogical practices, and supporting positive relationships and children’s emotional development; and (b) the quality of structural aspects of childcare (e.g. adult-child ratios, caregiver qualifications, group size and characteristics of the physical space) (Early et al., 2007). Measures of the global quality of settings include a wide spectrum of quality dimensions, including process as well as structural aspects of the environment (e.g. ITERS-R, FDCRS).

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

For the zero to three group, evidence that ECEC quality viewed as such a global construct relates to children's learning is limited. In Germany, the NUBBEK-study found little evidence that the quality of care for under-threes was related to child outcomes (Beckh, Mayer, Berkic, & Becker-Stoll, 2015; Leyendecker, Agache, & Madsen, 2014; Tietze et al., 2013). In Portugal, it was recently found that centre-based childcare quality for preschoolers (ECERS-R) and the quality of the home environment, but not centre-based childcare quality for infants (ITERS) related to children's language and literacy outcomes at preschool age (Pinto, Pessanha, & Aguiar, 2013).

However, a US study of 89 African-American children however found that quality of early non-maternal care as measured by the ITERS was related to measures of cognitive development, language development, and communication skills at age three. Also in another US study, an analysis of the Early Childhood Longitudinal Study-Birth cohort (Ruzek et al., 2014) found that quality measured by the ITERS and FDCRS did predict two year-olds cognitive skills over and above quantity and type. Similarly the UK FCCC study found that the quality of care in infancy was related to cognitive development, assessed with the Bayley at 18 months (Sylva, Stein, et al., 2011). Additionally in the Netherlands, Slot et al. (Slot, 2014; Slot, Mulder, Verhagen, Boom, & Leseman, In Press) studied two to three year-olds in day care and preschools, and found small but significant positive effects of the CLASS observation measure of quality of emotional support on vocabulary growth, and of quality of instructional support on attention skill growth over one year.

ECEC FOR CHILDREN AGED OVER THREE YEARS

For children above the age of three in ECEC settings a large body of research has shown that the quality of children's ECEC as measured by observational tools, is related to children's academic, cognitive and educational outcomes. Much of the research in the field however is cross-sectional or follows children only for a short time, and longitudinal studies face challenges relating to the choice of comparable measures on ECEC quality or child assessment across children's ages.

Yet, a number of important longitudinal studies have been carried out. While significant positive and long-lasting effects have been found, but fade out effects are observed regularly. Nevertheless, the general conclusion is that when children experience good quality ECEC, they benefit, and these benefits can be long-lasting, and found for all children (Ahnert & Lamb, 2011; Anders, 2013; Andersson, 1992; Belsky, 2009; Brill, Del Boca, & Pronzato, 2011; Broberg et al., 1997; Del Boca & Pasqua, 2010; Felfe & Lalive, 2010; Melhuish, Taggart, et al., 2006; Sylva et al., 2014).

For example, the Cost, Quality and Child Outcomes in Child care Centres study (CQO) in the US showed that measures of global quality at age four (ECERS) related to maths outcomes at age eight, but was not related longitudinally to language and reading outcomes (Peisner-Feinberg et al., 2001). Following a similar design, the European Child Care and Education Study (ECCE Study Group, 1997; ECCE Study Group, 1999) found positive associations between the global quality of care (ECERS) at age four and cognitive development, however associations faded out over time - at age eight they were not significant any more.

On the other hand the English EPPSE study showed that preschool quality and effectiveness predicted child outcomes consistently over time, with continuing effects on academic attainment lasting up to the age of 16 (Anders et al., 2011; Melhuish et al., 2008; Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, Hunt, et al., 2008; Sammons, Sylva, et al., 2014a, 2014b, 2014c; Sammons, Sylva, Melhuish, Siraj, Taggart, Toth, et al., 2014; Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, Draghici, et al., 2011; Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2011). Similar results also emerged in a parallel study of over 800 children in Northern Ireland; those who had attended high-quality preschool were 2.4 times more likely to attain the highest grade in national assessments at age 11 in English, and 3.4 times more likely in mathematics, than children without

preschool (Melhuish, Quinn, et al., 2006; Melhuish, Quinn, Sylva, Sammons, Siraj-Blatchford, Taggart, & Currie, 2002; Melhuish, Quinn, Sylva, Sammons, Siraj-Blatchford, Taggart, & Shields, 2002; Melhuish et al., 2001). Similarly the New Zealand 'Competent Children, Competent Learners' study reported long lasting effects of preschool quality and cognitive outcomes up to the age of 16 (Hogden, 2007; Wylie & Hodgen, 2007).

The IEA Pre-primary Project, a longitudinal, cross-national study of pre-primary care and education in ten countries (including the European countries Finland, Greece, Ireland, Italy, Poland and Spain) found some links between aspects of ECEC quality and cognitive and language development at age seven (Montie et al., 2006). In Germany, the BiKS 3-10 study (Bildungsprozesse, Kompetenzentwicklung und die Formation von Selektionsentscheidungen) found that measures of process quality in preschool related to children's mathematics achievements throughout the preschool years, and at school age (age seven) (Anders, Grosse, Rossbach, Ebert, & Weinert, 2013; Anders et al., 2012). Also in rural China, a recent study found that children's experiences of observed quality in ECEC centres was predictive of child outcomes at the start of school (Qi, 2015).

Recent meta-analyses of a number of large-scale ECEC studies (Burchinal, Kainz, & Cay, 2011; Camilli et al., 2010) and recent literature reviews (Zaslow et al., 2010) have concluded that while - in terms of cognitive and language development - associations between quality and child outcomes are often significant, associations may not be consistent, and rather modest in size. It has been argued that the wide variation in program designs, curriculum, staffing, and level of educational aims plays a major role in such disappointing impact findings of preschool quality (Pianta et al., 2009), and that, in the light of these differences, even small effects are important.

It has also been argued however, that quality in universal childcare for the general population in some countries may not be high enough to reveal any significant effect of quality. Research has shown that most settings in the US score somewhere in the low or mid-range of quality measures (Phillips & Lowenstein, 2011; Yoshikawa et al., 2013). There is evidence that, with quality in good to high ranges, benefits are larger and persistent until at least age 15 (Burchinal et al., 2011; Burchinal et al., 2009; Vandell et al., 2010).

In England, the evaluation of the Sure Start local program (SSLP) (Melhuish, Belsky, MacPherson, & Cullis, 2010) found that while the quality of provision of group childcare settings used in SSLP areas was generally good (as measured by the ECERS-R), ratings of educational opportunities offered in settings (as measured by the ECERS-E) were mostly scored only as adequate. While in SSLP areas, higher childcare quality was associated with improved language development for children from three to five years of age, no other child outcome showed significant effects to preschool childcare quality. Also, children in SSLP areas were not showing greater language development by age five than children in comparable areas elsewhere. It was concluded that 'if SSLP are to produce greater long-term effects upon child outcomes for children in deprived areas, particularly for literacy and academic outcomes, an important step would be to improve childcare quality across all settings' (Melhuish, Belsky, et al., 2010:v). These findings fit with those from another major study in England (EPPSE; Sylva et al., 2014) where it was found that attending any preschool has benefits that last up and beyond age 16, shaping academic outcomes up to the end of statutory education in predicting GCSE scores as well as English and maths grades. Nevertheless, going to a preschool of high-quality showed the most positive effects. In Northern Ireland, the EPPNI study first brought somewhat limited evidence for the effects of preschool quality on educational outcomes and progress during primary school (Melhuish et al., 2004; Quinn et al., 2006), however, at age 11, children in preschools rated higher on the ECERS-R had better performance in English and maths, and more progress in maths over primary school (Melhuish, Quinn, et al., 2010; Melhuish et al., 2013). In Portugal, it was found that even though global preschool classroom quality as measured by the ECERS-R was relatively low, it predicted children's literacy skills and their social/behaviour skills (Abreu-Lima, Leal, Cadima, & Gamelas, 2013).

An alternative explanation increasingly offered by ECEC experts is that existing measures of quality of ECEC might not adequately capture the essentials of quality; in particular they might not capture those dimensions of interaction and the environment which are most relevant for children's development and learning. For example, it is argued that – in terms of children's learning in mathematics or literacy – measures of specific quality of instruction may be needed, rather than general structural, emotional, and instructional quality measures (Burchinal et al., 2011; Burchinal et al., 2009; Farran & Hofer, 2012; Keys et al., 2013; Weiland, Ulvestad, Sachs, & Yoshikawa, 2013; Zaslow et al., 2006). In line with this suggestion, the EPPNI study found that after two years of primary school, quality of preschool provision mattered for children's outcomes and progress in English and mathematics. However, effects were differential; children whose preschool settings were rated by the ECERS-R as

higher in terms of their program structure, science provision and range of activities achieved higher and made more progress; those who experienced preschool rated higher in their routine care activities or their provision for parent and staff needs achieved lower and made less progress (Melhuish et al., 2004).

Importantly, associations between quality and outcomes are not consistent across different measures of quality. For example, a secondary analysis of data from four large studies of ECEC recently showed that the strength of associations between quality and child outcomes are higher if dimensions of quality were more closely aligned to the outcome examined, and if quality indicators focused on interaction and instructions (Burchinal et al., 2009).

Such findings demonstrate the need to operationalise the basic characteristics of quality, and to assess key characteristics that differentiate between various dimensions of quality, in particular process quality. In order to identify the specific ECEC quality features that facilitate young children's development and learning, this chapter will be organised across six dimensions of quality:

1. Positive relationships and interactions between practitioners and children
2. Pedagogical practices: Quality of instruction and quality within specific content areas
3. Stability and continuity of care
4. The physical environment
5. Adult-child ratio and group size
6. Practitioner qualifications and training

POSITIVE RELATIONSHIPS AND INTERACTIONS BETWEEN PRACTITIONERS AND CHILDREN

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

One of the earliest studies of the effects of ECEC process quality investigated the effects caregiver-child interaction upon child outcomes. It was found that higher levels of communication and responsiveness by caregivers was linked to higher language development at both 18 months (Melhuish, Lloyd, Martin, & Mooney, 1990) and three years of age (Melhuish, Martin, & Mooney, 1991) and that these effects persisted until at least six years of age (Melhuish, 2001), after allowing for family demographic differences.

Today, pedagogy for infants and toddlers focuses strongly on relationships, attunement, sensitive responsiveness, interactional synchrony, and the role of the teacher as an attachment figure, and also a partner, observer, investigator or mediator (Dalli, White, Rockel, & Duhn, 2011). The emphasis is on the notion that the youngest children in ECEC need warm reliable adult support, and sensitive and responsive interaction attuned to their subtle cues, preferences, temperamental and age characteristics (Dalli & Rockel, 2012; Stephen, Dunlop, Trevarthen, & Marwick, 2003; Trevarthen et al., 2003).

In line with these concepts, observational measurements of quality of non-maternal care in the Early Years focus strongly on the interactional quality, aiming to determine the extent to which caregivers provide children with the kinds of experience thought to enhance development. They share a strong focus on the sensitive responsiveness of the caregiver. While some describe the childcare setting and classroom experience in general as it applies to all children in that setting (e.g. ITERS, FDCRS, CIS, CLASS) others assess the specific experience of individual children (e.g. ORCE). The focus of instruments varies with the conceptual framework, and some include separate assessments of quality of instruction, or assessments of quality in specific content areas (Burchinal, 2010).

One critique raised about measures of interactional quality in ECEC settings is that they do not capture the facilitation of group experiences. Within group settings there is only limited time for one-to-one interactions, and teachers have to consider the group of children even while engaged in one-to-one interaction. A recent study brought some evidence that the degree to which teachers supported group processes related to the level of cognitive engagement in children's play (van Schaik, Leseman, & Huijbregts, 2014). However, this study is an exception and generally research has focused on individualistic approaches to working with children, which attempt to model the mother-child relationship, and may undervalue the dynamics of groups, and the ways in which groups of peers can be supportive of young children's development (Ahnert et al., 2006; van Schaik et al., 2014). This critique may apply to all of the findings that we report below on associations found between quality measurements which emphasise dimensions of responsiveness or sensitivity, and young children's cognitive and language outcomes.

NICHD SECCYD quality findings are often based on the ORCE, an instrument designed to measure the extent to which caregivers create a secure base for the child by showing positive affect, responsiveness and sensitivity towards the child, and also includes a focus on the amount of language stimulation the child experiences (Burchinal, 2010). In the US study, scores on the ORCE measure were found to be a consistent modest to moderate predictor of children's language and cognitive development (McCartney, Dearing, Taylor, & Bub, 2007; NICHD Early Child Care Research Network, 2000b, 2002b, 2003b, 2005b, 2005c, 2006). Differences in child outcomes between children in the high and low-quality groups ranged in effect sizes from 0.18 to 0.48 S.D., with the largest effects occurring on measures of expressive language at 24 months and comprehension at 36 months (NICHD Early Child Care Research Network, 2000b).

Results from the NICHD SECCYD study demonstrated that almost all children, not only those from less stimulating home environments can benefit cognitively from early ECEC, if they enjoy positive relationships with their caregivers, and those effects can persist into adolescence. This was also found for the group of children in home-based care settings (Clarke-Stewart, Vandell, Burchinal, O'Brien, & McCartney, 2002). Consistent with a cognitive advantage hypothesis, higher quality care in infancy and early childhood appeared to promote achievement indirectly via early school readiness skills (Dearing, McCartney, & Taylor, 2009). At age 15, the effects of quality on cognitive-linguistic achievement were estimated around 0.1 to 0.2 S.D. (Vandell et al., 2010). While previously, it had been concluded that for the US NICHD sample, the relationship between early ECEC quality and child outcomes was linear (NICHD Early Child Care Research Network, 2003b, 2006), Vandell et al. (2010) found some evidence, that for a non-linear relationship, with higher associations between early quality and later achievement in the higher quality range.

Vandell et al. (2010:750) have argued that the evidence of the long-term effect of early childcare quality is one of the most important findings of the 15 year report because 'it occurred in a large economically and geographically diverse group of children who participated in routine non-relative childcare in their communities' rather than in high-quality interventions, and this suggests that 'the quality of early childcare experiences can have long-lasting (albeit small) effects on middle class and affluent children as well as those who are economically disadvantaged' (Dalli et al., 2011).

In the English FCCC study, quality of non-maternal care was assessed with a number of instruments, and a latent construct of quality included dimensions from the ORCE, HOME and CIS, all focusing on responsive, warm, attentive and supportive caregiver interaction. Findings demonstrated that this aspect of quality measured in the first 18 months was related to better cognitive development at one-and-a-half years (Sylva, Stein, et al., 2011).

In the Netherlands, pre-COOL study, quality was assessed with the CLASS Toddler observation scale when children were two years of age. The first findings revealed positive effects of emotionally supportive teacher-child interactions on children's vocabulary one year later (Slot, 2014) and on children's social skills one year later (Broekhuizen, van Aken, Dubas, & Leseman, 2014). Furthermore, slightly stronger, positive effects were found for teacher's educational support on children's attention skills at age three years. Also another Dutch study (Albers, Riksen-Walraven, & de Weerth, 2010), found that higher levels of developmental stimulation predicted higher levels of infant cognitive development at nine months, taking into account infant cognitive development at three months. Sensitivity did not predict cognitive advance, but it mattered in that the effects of cognitive stimulation were more predictive of infant cognitive development if provided by sensitive caregivers. Finally, another Dutch day care study revealed concurrent relations between teacher's positive interaction skills, including aspects of

sensitivity as well as developmental stimulation, and children's social competence (Helmerhorst, Riksen-Walraven, Vermeer, Fukkink, & Tavecchio, 2014).

Likewise, a recent Canadian study involving two to four year-old children revealed positive effects of a comprehensive quality construct, including both emotional supportive interactions and specific language stimulation, on children's language outcomes at age four years (Côté, Doyle, Petitclerc, & Timmins, 2013).

In contrast, some European studies have found little to no effect of the relationship quality in Early Years settings. In Germany, the cross-sectional NUBBEK found little to no evidence that the quality of care for under-threes, measured by the German version of the ITERS-R and the CIS, was related to child outcomes (Tietze et al., 2013). However, while the CIS focuses clearly on the interactional quality between caregiver and children, the ITERS-R assesses quality more globally, and includes structural aspects as well as process dimensions. Similarly, in a Swiss study (Pierrehumbert, Ramstein, Karmaniola, Miljkovitch, & Halfon, 2002) no associations between measures of the quality of caregiver relationships at age two and children's cognitive outcomes at age three were found.

While a longitudinal study in Sweden (Broberg et al., 1990) found no associations between process quality at age two and language development at age four, it did find positive associations later at age eight (Broberg et al., 1997). A small Australian study of 48 toddlers and 37 preschoolers found that it was highly beneficial for young children's cognitive development for positive attitudes to be displayed towards children by the teachers (Dalli et al., 2011; Kowalski, Wyver, Masselos, & de Lacey, 2005).

ECEC FOR CHILDREN AGED OVER THREE YEARS

Process quality dimensions on relationships and interaction include more 'emotional aspects' such as general sensitivity, attention, warmth and responsiveness to the individual child, as well as aspects which capture the quality of stimulation and instructions. There is consensus that all of these aspects matter for children's learning. However, to date little evidence exists about how to combine different process elements in order to best support learning across all areas and ages. The most widely used ECEC quality assessment instruments mainly focus on those dimensions that relate to the general sensitivity, responsiveness and stimulation of caregivers. And while those quality aspects have been shown to be linked to children's cognitive and language outcomes (see review above), it is increasingly argued that – at least for the older preschoolers – effects might be stronger if measures also captured the quality of instructional strategies. Recent research findings have clearly shown that cognitive stimulation and instructional quality matter.

In the New Zealand 'Competent Children, Competent Learners' study (Wylie et al., 2006; Wylie & Thompson, 2003), the quality of children's ECEC - particularly those dimension related to teacher-child interaction - showed the continuing contribution of ECEC to children's cognitive competencies, lasting into later childhood and adolescence. Quality indicators included the responsiveness of staff to children, the staff guiding children in activities and joining in with their play, asking open-ended questions, and giving children choice to select their own activities from a variety of learning areas.

In England, findings from the qualitative analysis of settings found to differ in their effectiveness for improving child outcomes from the REPEY (Researching Effective Pedagogy in the Early Years) study analysed pedagogic models and practices (Siraj-Blatchford, 2004; Siraj-Blatchford & Sylva, 2004). In effective settings, adult-child interactions were observed that are responsive, cognitively challenging, and encourage joint attention and negotiation. Adults offered opportunities for dialogue and use of complex language, children were encouraged to problem solve, and adult-child interactions involved sustained shared thinking and open-ended questions to extend thinking.

In Greece, Mantziou (2001 cited in Petrogiannis, 2010) found that better teaching behaviour and higher quality of care led to children asking more substantial questions, whereas children in lower quality care were more likely to ask simpler identification questions.

A number of large-scale US studies on pre-K across multiple states that investigated the separate contribution of differing quality dimension found that the CLASS pre-K measurement capturing ‘instructional support’ was found to be more predictive for children’s cognitive and academic outcomes than ECERS or ORCE quality scores, or the CLASS pre-K measurement on ‘emotional or organizational support’ (Burchinal et al., 2011; Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Howes et al., 2008; Keys et al., 2013; Mashburn et al., 2008). The measurement of the instructional classroom climate assesses whether teachers ask questions that require problem-solving and higher-order thinking, provide opportunities to apply previously learned knowledge to new situations, embed learning within real-world contexts, initiate frequent feedback loops that prolong learning moments, and model the use of language for multiple purposes (e.g. social/pragmatic, vocabulary, narrative). However, a Finnish study of 49 kindergarten classrooms reported that both, classroom organisation and instructional quality matter: high classroom organisation related to higher learning motivation in children, which in turn predicted phonological awareness (Pakarinen et al., 2010). In classrooms with more instructional support children showed more empathy, and were less disruptive (Siekkinen et al., 2013), and were rated as showing less task-avoidant behaviour. Task-avoidant behavior then predicted children’s low levels of math skills (Pakarinen et al., 2011). And a Portuguese study that also used the CLASS pre-K observation scale of quality found effects of both emotional support and instructional support on children’s language development (Cadima, Leal, & Burchinal, 2010). Likewise, a Chilean study revealed effects of emotional and instructional support as well as classroom organization, with the strongest effects of the latter (Leyva et al., 2015). In a US study on children’s maths development in preschool (Choi & Dobbs-Oates, 2014) it was found that the emotional aspect of teacher-child closeness was associated with gains in maths, while only few associations between the frequencies of maths related activities and maths outcomes were found. However, in comparison to the studies reported above, this study did not take account of the quality of instructional support, but only captured the frequency of certain maths related activities.

A recent study investigated links between general and domain-specific elements of teacher-child interactions and children’s developmental outcomes (Hamre, Hatfield, Pianta, & Jamil, 2014). Among a diverse group of four year-old preschoolers, responsive teaching was related to development in cognitive domains, and cognitive facilitation was associated with gains in early language and literacy skills. However, strong emotional aspects of the relationship between children and teachers may also predict school related outcomes. For example a study of 152 four and five year-old children in Italy found that children with secure attachment had better language and psychomotor abilities, and performed better at most of the battery tasks which measure school readiness (Commodari, 2013).

Experimental evaluations of successful curricula suggest that a combination of warmth and responsiveness as well as a focus on depth of instruction within content areas is needed to positively affect children’s school readiness skills (Keys et al., 2013). Further support comes from a number of research findings showing that both the warm and responsive interaction style and learning-focused interactions predict the persistence of developmental gains into preschool years (Burchinal et al., 2008; Dickinson & Porche, 2011; Vandell et al., 2010).

P E D A G O G I C A L P R A C T I C E S A N D C U R R I C U L U M

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

The curriculum can play an important role in terms of providing children with the opportunity to develop school readiness skills in preschool. Curricula vary widely. Some have a wide scope (‘global curricula’), with activities to promote language, literacy, and mathematics skills and socio-emotional development, as well as knowledge

about science, arts, and social studies. Other curricula ('developmentally focused') provide specific content area (e.g. language and literacy) so that specific skills are better fostered.

There is general consensus that children in the first three years of life who participate in ECEC need predictable activities and routine care, provided within a balanced curriculum (Dalli et al., 2011; Melhuish, 2004a), involving play-based activities and routines, use of narrative and story-book reading, and informal conversations – both within child-caregiver interactions and peer relationships and interactions. However, research provides little evidence on specific pedagogical practices that can be used to support children's language, or their development of those skills supporting areas of academic learning such as early literacy or mathematical understanding in ECEC environments. Also, little systematic evidence concerns how specific pedagogical strategies can be best combined with sensitive, responsive and warm interactions and relationships in order to ensure healthy all-round development of infants and toddlers (Downer, Sabol, & Hamre, 2010).

For the zero to three age group, most of our knowledge about children's development and learning, and the ways in which learning takes place and is best supported, stems from research within developmental psychology, or observations within the home environment – in particular between mothers and their infants and toddlers (Evangelou, Sylva, Kyriacou, Wild, & Glenny, 2009). While little is known about the specifics of Early Years pedagogy within ECEC environments, there is some indicative evidence. The NICHD SECCYD Study found that the observed language stimulation provided by a practitioner was positively associated with children's performance on measures of cognitive and language skills at ages 15, 24 and 36 months (Huntsman, 2008). Furthermore, Girolametto, Weitzman, and Greenberg (2003) have shown that teacher's increased responsiveness in the use of interactive language stimulation techniques was positively related children's language use. Additionally, McArthur (1995) has shown how using familiar songs, rhymes and rhythms with movements, fosters children's early language skills. Storytelling using familiar story-books and repeating the same story-book offers infants a sense of security and familiarity, and promotes vocabulary development (Evans, Leija, & Falkner, 2001). Whitehead (2007) has suggested that looking at books and other texts together, even if only talking about the pictures and pointing to objects that are familiar, promotes emergent literacy skills. However, the Dutch pre-COOL study revealed null effects of the provision of academic activities, including language, literacy and math activities, on two year-old children's vocabulary or attention skills development one year later (Slot, 2014). Likewise, an intervention study in toddler childcare focusing on a responsive teaching style in combination with a developmentally appropriate academic curriculum also failed to reveal effects on children's cognitive and language outcomes (Landry et al., 2014).

ECEC FOR CHILDREN AGED OVER THREE YEARS

Effective pedagogy includes interactions explicitly aimed at supporting learning in higher-order thinking in general, and learning content in specific areas (Sylva et al., 2004a; Yoshikawa et al., 2013).

A number of large-scale US studies on pre-K across multiple states found that gains during children's preschool year in language and academic skills were related to the quality of instruction, as well as the time spent in specific types of instructional activities (Howes et al., 2008; Mashburn et al., 2008). These gains relating to the quality of the pre-K experiences were maintained through kindergarten (Burchinal et al., 2008). Similarly, there is evidence for the effectiveness of early interventions at the preschool level. For example, using a sample of disadvantaged pre-K children in collaborative Head Start classrooms, a recent study in the US (Hilbert & Eis, 2014) revealed the effectiveness of an early literacy intervention for children's vocabulary, phonological awareness, and print knowledge. Findings from the large-scale US Early Childhood Longitudinal Study, Kindergarten Class (ECLS-K) reported that time spent on reading instruction was related to reading gains. Time for maths instruction on the other hand was not related to maths gains (Walston & West, 2004). In Portugal, it was recently found that the quality of language and literacy environment was not consistently predicting most of the measured child developmental outcomes (Abreu-Lima et al., 2013).

Another US study (Choi & Dobbs-Oates, 2014) reported only limited evidence for links between the frequency of maths related activities in preschool, and children's maths gains – only the frequency of activities related to patterns and shapes was identified as a significant predictor. However, in another study involving preschoolers the amount of math-related talk during circle-time was found to predict children's math gains over the course of a year (Klibanoff, Levine, Huttenlocher, Vasilyeva, & Hedges, 2006). Likewise, the teacher's language input was related to vocabulary growth (Bowers & Vasilyeva, 2011). Also Dickinson (2011) and Dickinson and Porche (2011) cite a meta-analysis and their own work on pre-K language curricula and fostering complex (academic) language. There were no effects overall on later language and literacy when there was low implementation fidelity by teachers with difficulties in instruction practices. However more focused interventions (e.g. vocabulary instruction, shared book reading) are more successful. Some of the inconsistencies in findings may be explained by differences in the quality of instruction, often not captured by studies focusing on the amount of specific educational activities.

The large-scale longitudinal research project 'Growing up in Scotland' (GUS) included administrative data provided by the CARE Inspectorate and Education Scotland and found that children who attended a preschool setting with a higher care and support grade had better vocabulary ability at age five, irrespective of their skills at age three and their social characteristics (Bradshaw, Lewis, & Hughes, 2014). The English EPPSE study included the ECERS-R – a measurement of the global quality of the setting, as well as the ECERS-E – an instrument developed to assess quality measured in four of the developmental domains in the Foundation Stage Curriculum (Literacy, Maths, Science and Diversity). Results showed that those centres with emphasis on the development of literacy and maths and catering for children's individual needs promoted better outcomes for children in the subsequent development of reading and mathematics. Preschool quality and effectiveness continued to predict academic attainment up to age 16 (Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, Toth, et al., 2011; Sammons, Sylva, Melhuish, Siraj, Taggart, Toth, et al., 2014; Sylva et al., 2004a; Sylva et al., 2012). Similarly, Clements and Sarama (2011) found the best practices for mathematics instruction incorporate foundational math conceptual learning within everyday activities that support progression of mathematical learning.

In the EPPSE study, case studies were carried out in the most effective ECEC centres. In effective centres, adult-child verbal interaction was of higher quality (see above); staff had a better knowledge and understanding of the curriculum (most effective centres provided children with more experience of curriculum-related activities – especially language and maths). They had more knowledge of how young children learn (most effective centres use play environments to provide the basis for instructive learning). Staff were better at helping children resolve conflicts and also better at helping parents to extend children's learning at home. There was a balance between initiated activities by children and adults and it was found that spending time in small groups, and during freely chosen activities provide the best opportunities to extend children's thinking (Siraj-Blatchford et al., 2003; Sylva et al., 2004a).

In the meta-analysis by Camilli et al. (2010) of the results from 123 US studies in which at least one year of ECCE was provided prior to age five and related to long-term effects on development, intentional teaching and individualisation were associated with larger gains. Thus, preschool programs with a greater emphasis on educational experiences appeared to have larger effect sizes.

The international IEA Pre-primary Project (Montie et al., 2006) found that children were likely to have higher language scores at age seven if they attended centres where less time was spent in whole group activities, and where teachers allowed children to choose their own activities, compared to children who had attended centres where personal care and group activities predominated. They also scored higher than children who had been in settings where pre-academic activities predominated (a non-significant trend). The authors suggested free choice activities may be more interesting and engaging to the child, and the difficulty level more suitable than those that are proposed by teachers. In addition, these activities allow opportunities for children to interact verbally with other children, and for teachers to engage in relevant conversation and introduce new vocabulary.

It has been argued that the type of instruction is linked to children's early learning (Reynolds et al., 2010). A distinction is often drawn between child-centred instruction (activities are child initiated, children engage in

problem-solving and inquiry-oriented learning) and didactic instruction (teacher directed, planned tasks focusing on acquiring and practicing academic skills). Both approaches may boost academic skills, but there is some evidence that child-centred instruction may be more effective (Huffman & Speer, 2000). In a Finnish study, Lerkkanen et al. (2012) looked at kindergarten classroom teaching practices and children's interest in reading and mathematics. They found that children were more interested in mathematics and reading in classrooms where child-centred instruction was prioritised. Similarly instruction that blended child-initiated and teacher-directed instruction within a comprehensive program model led to higher levels of school readiness and early school achievement (Graue, Clements, Reynolds, & Niles, 2004).

The curriculum can play a crucial role in ensuring that children receive care and education that facilitates their development of cognitive and academic skills, and thus helps them to acquire school readiness skills during the preschool years (Yoshikawa et al., 2013). Curricula vary widely in their design and focus, and in their recent review, Yoshikawa et al. (2013) distinguished between global curricula which tend to have a wide scope, and refer to activities which are thought to promote development in all areas of learning, and developmentally focused curricula which are designed to promote learning in specific content areas. Developmentally focused curricula are generally added to a global curriculum that is already in place.

While the research evidence on the effectiveness of global curricula is slim, Yoshikawa et al. (2013) argue, that existing evidence indicates no or only small gains associated with their use (Bierman et al., 2008; Clements & Sarama, 2007; Preschool Curriculum Evaluation Research Consortium, 2008). On the other hand, for developmentally focused curricula, there is strong evidence that they can be effective in the targeted domain of children's development. For math's curricula (Clements & Sarama, 2008; Jörns, Schuchardt, Mähler, & Grube, 2015; Starkey, Klein, & Wakeley, 2004) as well as language and literacy curricula (Bierman et al., 2008; Fantuzzo, Gadsden, & McDermott, 2011; Farver, Lonigan, & Eppe, 2009; Lonigan, Farver, Phillips, & Clancy-Menchetti, 2011; Preschool Curriculum Evaluation Research Consortium, 2008; Wasik, Bond, & Hindman, 2006; Whitehurst et al., 1999). Although other research has shown only moderate effects of relatively large doses of a curriculum with high-quality language instruction (Justice, Mashburn, Pence, & Wiggins, 2008). And a recent meta-analysis of German language training programs (Fischer & Pfof, 2015) found lower effects on phonological awareness, compared to studies from English speaking countries.

Yoshikawa et al. (2013) argue that most successful curricula are characterised by intensive integrated professional development and monitoring of child progress, they target small samples, and often involve the extensive support from the developer. This leads to the question of whether these intensive curricula can be implemented on a wide scale for universal childcare settings (Justice, Mashburn, Hamre, & Pianta, 2008). While the authors point to difficulties in taking interventions to scale, they also list some important recent research results in real-world conditions, which promise that substantial effects can be achieved (Clements et al., 2011; Weiland & Yoshikawa, 2013).

A recent report systematically reviewed research on the outcomes of ECEC preschool programs (mainly in the US). On the basis of 38 studies and 27 programs the authors reported that in terms of academic outcomes at the end of preschool and/or kindergarten, some programs (six) showed strong evidence of effectiveness, and some programs (five) moderate evidence of effectiveness. Where effects were found, programs targeting specific learning areas generally improved development in those areas. The authors conclude that aspect of both cognitive developmental and academic approaches have benefits, and call for research to determine long-term impacts (Chambers, Cheung, Slavin, Smith, & Laurenzano, 2010).

In Germany, the KIDZ curriculum is a broad curriculum targeting learning in language, literacy, maths and science domains and was shown to be effective for children's language and maths development up to age eight (Roßbach, Sechtig, & Freund, 2010; Sechtig, Freund, Roßbach, & Anders, 2012).

Auger, Jenkins, and Burchinal (2014) attempted to compare across different types of curricula based on their target domain into 'whole child'/global curricula or by specific academic domain (literacy, maths). The study

investigated whether the type of curricula children experience during preschool (age four) is differentially related to their school readiness in terms of their math, language, literacy, and socio-emotional skills. Findings indicate that both – the literacy and maths curriculum –served to improve skills in the targeted content domains. However, the domain specific literacy curriculum showed also some negative effects on social skills and problem behaviours, leading to the conclusion that this may imply a trade-off between cognitive and socio-emotional outcomes. Because most Head Start classrooms across the US use a global curriculum, the authors plan to use data from the Head Start Impact Study in order to examine more closely whether different types of global curricula are more effective at improving children’s skills. However, a recent German study did show positive effects of an academically oriented curriculum on children’s social-emotional competence (Kluczniok, Anders, Sechtig, & Rossbach, 2014).

DEVELOPMENTALLY APPROPRIATE PRACTICE (DAP) VERSUS DIDACTIC INSTRUCTION

Some approaches to ECEC curriculum and pedagogy have stressed the importance of teacher-directed transmission of skills that directly relate to the primary school curriculum, resulting in a didactic approach with even very young children – using direct instruction and rewards to reinforce the learning processes within a highly structured and planned academic curriculum preparing children directly to meet the standards set for primary school. Preschool education programs for low-income and ethnic minority children working with direct academic instruction have been reported to be rather effective in obtaining desired cognitive and academic goals (e.g. Dickinson, 2011; Gersten, Walker, & Darch, 1988; Justice, Mashburn, Hamre, et al., 2008; Schweinhart & Weikart, 1997) Nonetheless, the approach has been criticized for having negative effects in the social-emotional domain (see for example Burts et al., 1992; Haskins, 1985; Stipek, Feiler, Daniels, & Milburn, 1995).

Currently, the consensus view can be characterized as social-constructivist, stressing the importance of children’s intrinsically motivated activity and initiative as the motor of development (McMullen et al., 2005; Pramling-Samuelsson & Fleeer, 2009), but acknowledging that development does not take place in a cultural void. The role of the teacher, therefore, is not confined to creating conditions for optimal, self-propelled development. The teacher should also deliberately introduce children to cultural domains such as academic language, literacy, numeracy, maths and science. Yet, the way in which this is carried out should respect developmental and motivational principles, allowing children to take initiatives and partly to determine their own routes through the curriculum, using construction and symbolic pretend play, and collaborative work in small groups as the main vehicles to stimulate development. This consensus is reflected in the concept of ‘developmentally appropriate practice’ (DAP) coined by Bredekamp (1987:1). Yet, despite this consensus, early childhood care and education programs still differ in emphasis. In many countries, pressure by policy makers to produce immediate results in easy measurable domains as literacy and maths, and the increasing emphasis on accountability are reported to undermine the developmental approach and to lead to a more didactic approach (Dickinson, 2002; Marcon, 2002). Sometimes this pressure is especially felt in programs that serve disadvantaged low-income and minority children at risk of educational failure.

Critical to the issue of developmental versus didactic approaches to the early childhood curriculum, is whether program effects are assessed short- or long-term. Although didactic and academic programs may be as effective, or even superior to, developmental approaches in achieving cognitive and language goals in the short-term, several studies reveal that long-term benefits, including school achievement, are greater for developmental programs, presumably because of more positive effects on children’s social-emotional competence, self-regulation and intrinsic motivation. Schweinhart and Weikart (1997) compared the High/Scope curriculum with a didactic basic skills oriented program and a traditional approach, characterized as ‘laissez faire’. In the short-term, the didactic program and the developmental-constructivist High/Scope curriculum were equally effective in the cognitive domain, but additional advantages of the High/Scope curriculum became manifest in the longer-term: better self-regulation, work attitude, motivation, and social and behavioural adjustment, resulting in superior social outcomes (for instance, less crime, more economic independence) in adulthood compared to the other approaches. These later social outcomes are similar to the outcomes reported for the Perry Preschool Project, the predecessor of the High/Scope curriculum.

Marcon (1999) compared three different preschool approaches for their effect on children's development and mastery of language, literacy and maths skills at the end of preschool. The majority of the children involved in this study came from low-income and minority families. The results revealed that children who attended a child-centred, developmental preschool (DAP approach) demonstrated greater mastery of basic skills at the end of preschool than did children in programs with a didactic approach where academics were emphasized and skills were directly taught. However, the advantage of child-centred over academic preschools was small, and both programs had far better results than a mixed model approach, that combined in an eclectic way elements of both approaches. In a follow-up study an even more complex picture was found (Marcon, 2002). Children who attended academic preschools had better results in initial learning in grades one and two, were less often retained (especially boys) or referred to special education than children who were in the child-centred or mixed models. This advantage was maintained until grade three (age nine). In grade three the advantage in retention and referral rates disappeared and in grade four (age ten) children with child-centred and mixed-model preschool experience outperformed children from academic preschools in a broad range of school subjects and in Grade Point Average (GPA), although differences were small. The results indicated a relative decline for the children from academic preschools upon transition to grade four, which in the USA system (as probably elsewhere) is characterized by increasing demands on self-regulated learning and by a shift in focus from the basics of reading, writing and maths to comprehension, composition and insight. Marcon (2002) concludes that both children from child-centred and mixed preschools apparently were better prepared to face the new challenges in grade four.

There may be also a timing effect, meaning that education programs working with very young children, under age four or five, should work predominantly in a child-centred (DAP) way, whereas programs for older children can introduce academic subjects in a more planned, teacher-directed curriculum without having negative social-emotional consequences. A late emphasis on academic skills, after a predominantly developmental approach that focused on fostering of social-emotional competence, may even provide better support for the transition to primary school. Evidence for such a timing effect is reported by Stipek et al. (1998), who compared four groups of mainly low-income and ethnic minority children who attended either a DAP (referred to as 'social-emotional') or a basic skills oriented preschool from age three to five, and after preschool either a developmental or a basic skills oriented kindergarten from age five to six, before starting in primary school. The results of the study indicated that a DAP curriculum in preschool up to age five was essential for positive developmental effects in both academic and social-emotional domains, regardless the type of kindergarten that was attended in the third year. However, a greater academic focus in kindergarten (age five to six), after two years in a DAP-focused preschool, had slightly better learning outcomes in several subjects in primary school and no detectable negative social-emotional outcomes compared to programs with a continued DAP focus. The latter programs were slightly better with respect to problem solving and language comprehension, as in Marcon's (2002).

As a well-known example of the DAP approach, the Montessori curriculum emphasizes children's self-initiated and self-planned work, both individually and in small groups, combined with instruction of academic and social skills, while providing a pre-structured learning environment with special materials that guide children to spontaneously acquire culturally valued knowledge and skills, particularly in the domains of literacy and mathematics. The findings of the Milwaukee Montessori kindergartens evaluation study with three to five year-olds, using a randomized controlled design, clearly support the effectiveness of the Montessori curriculum compared to eclectic conventional approaches not only for developmental and educational outcomes, but also social competence, executive functions, self-regulation, moral reasoning and creativity (Lillard & Else-Quest, 2006). Although other studies of the Montessori curriculum failed to find such effects. Lillard (2012) shows that high fidelity implementations of the Montessori curriculum, preserving original concepts, are more effective than adaptations and eclectic approaches.

'Tools of the Mind' (Bodrova & Leong, 2007) is a curriculum based on Vygotskian theory. The curriculum was developed to promote the development of academic skills of preschoolers from disadvantaged backgrounds, but it uses instruction and interaction formats that support executive functions and self-regulation development. The main components are (1) teacher-guided learning and problem-solving in small groups in which children are stimulated to verbalize their plans and evaluate the problem solving, (2) peer collaboration in play and problem-solving, with children alternating the role of tutor, (3) the use of memory aids symbolizing metacognitive and social rules, such as attentive listening and waiting for one's turn; and (4) socio-dramatic play to promote emotional self-regulation. In a study with random assignment of three and four year-olds to either Tools or an

academically focused program, Tools was found superior both in academic outcomes and in executive functions at age five (Diamond, Barnett, Thomas, & Munro, 2007).

In summary, recent evidence indicates that ECEC curricula designed according to the principles of DAP, involving play and collaborative work, may be particularly important for the development of cognitive control, self-regulation, and creativity, seen as important learning-related skills (Diamond & Lee, 2011; McClelland, Acock, & Morrison, 2006). Development of cognitive control and emotional self-regulation in early childhood has been found to be promoted by peer interaction in pretend play (Berk, Mann, & Ogan, 2006; Bodrova, 2008). Development of emotional self-regulation has been related to socio-dramatic play with children taking up symbolized roles and requiring them to imagine others' state of mind (Elias & Berk, 2002).

Recent research also focuses on the role of talk to communicate with each other and to build meaning and understanding in education and care settings (Dickinson, 2011). Language is a powerful tool for exploring ideas and creating common knowledge together in different content domains (Mercer & Littleton, 2007; Rasku-Puttonen, Lerkkanen, Poikkeus, & Siekkinen, 2012). In the British EPPE project an in-depth analysis was conducted of teacher-child talk in those ECEC centers that were found most effective in fostering both academic skills and social-emotional competences in children. The results revealed that adult-child talk in these centers was characterized by frequent episodes of sustained shared thinking (Siraj-Blatchford et al., 2003), that is, by relatively long coherent dialogues about interesting topics with balanced roles of adults and children.

The distinction DAP versus didactic is an oversimplified way of characterizing the challenges of devising an ECEC curriculum. The evidence indicates that a developmental approach is the best option for the youngest children, whereas older preschooler should be gradually prepared for the type of learning tasks they encounter in primary school, smoothing the transition to first grade. An academic orientation on basic skills (for instance, concerning phonological awareness and letter knowledge) can be embedded in a curriculum of playful activities in small groups, including also episodes of shared dialogical reading and talking with the teacher, to foster children's deep vocabulary, discourse comprehension skills and world knowledge in addition (Bus, Leseman, & Neuman, 2012; Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003), which can also be considered to be 'developmentally appropriate practice'.

S T A B I L I T Y A N D C O N T I N U I T Y O F C A R E

Reviews on the quality of ECEC for young children name continuity and stability of care arrangements as core factors contributing to good quality care (Huntsman, 2008; Melhuish, 2004a; National Scientific Council on the Developing Child, 2009; Phillips & Lowenstein, 2011; Whitebook, Gombay, Bellm, Sakai, & Kipnis, 2009). The importance of stability of caregiving arrangements and the continuity of caregivers for infants and toddlers is partly based on the view that young children need to form bonds of attachment and trust, and also that interactions with children need to involve clear caregiver understanding of the individual child and its idiosyncrasies (Melhuish, 2004a; Trevarthen et al., 2003), and that caregiver experience and teamwork are important for the quality of care (Whitebook & Bellm, 1999).

Unfortunately, high stability in ECEC settings is often not available (Dalli et al., 2011; Whitebook et al., 2009). Staff retention and staff turnover, changes in childcare arrangements, staff working hours and infants' and toddlers' weekly ECEC attendance patterns all affect the continuity of relationships. While there is clear evidence that stability and continuity affect quality of care, direct or indirect impacts on children's behaviour and development are not well researched. High staff turnover in ECEC poses challenges to teamwork and quality. The EPPE case studies showed that particularly effective centres had long serving staff (Siraj-Blatchford, Sylva, Muttock, Gilden, & Bell, 2002). The International IEA-Pre-Primary Project (Montie et al., 2006) reported that staff years of experience in ECEC related to children's cognitive and language development at age seven. Lower staff turnover

rates have been associated with higher process quality, especially in day care (Goelman et al., 2006; Melhuish et al., 1990; Phillips, Mekos, Scarr, McCartney, & Abbott-Shim, 2001).

Children's attendance patterns, multiple care arrangements, and changes in childcare also impact on the continuity. Tran and Weinraub (2006) used data from the NICHD SECCYD study to explore the effects of quality, stability and multiplicity of childcare on children's development and found that certain forms of unstable childcare (non-familial change, familial to non-familial change, and within home to out of home change) predicted poorer language development. Multiple care arrangements involving family members positively predicted language comprehension, with quality making a difference. If the primary arrangement was of low to moderate quality then fewer multiple arrangements were associated with higher language scores. If the primary caregiving arrangement was of high-quality, having more multiple arrangements was associated with higher language scores. Also Cryer et al. (2005) provide evidence for the negative effect on social-emotional well-being of frequent transitions in multiple care arrangements.

Likewise, a prospective Dutch day care study revealed that children showed higher well-being when they were in fewer parallel childcare arrangements one-and-a-half year earlier, when they were between six and 30 months of age. Furthermore, children also showed more well-being when there was higher stability in staffing and grouping patterns (De Schipper, Tavecchio, Van IJzendoorn, & Linting, 2003).

An Australian longitudinal study on school readiness and transition to school (Bowes & Wales, 2009) found some evidence that children who spent more time in centre-based care and had more childcare changes in the first years in care, were more likely to have lower scores in early literacy at age five; at age six however, these associations were no longer significant. An Australian small-scale study on the effects of long-day childcare on children's complexity of pretend play found an advantage for those children with more regular attendance – four or more days were found to be more favourable than fewer days per week (Kowalski et al., 2005). While the current body of research provides some answers with regards to amount of care, virtually nothing is known about the issue of program regularity (number of attendance days per week).

T H E P H Y S I C A L E N V I R O N M E N T

The physical environment of ECEC settings is considered to be one of the structural factors that enable good quality care and education. Indoor and outdoor spaces, and equipment and learning materials, which are appropriate and stimulating, safe and protective, impact on children's learning opportunities, their physical activity, and their health and safety (Dalli & Rockel, 2012; Dalli et al., 2011; Expert Advisory Panel on Quality Early Childhood Education and Care, 2009).

Reviews on ECEC for infants and toddlers (Dalli & Rockel, 2012; Dalli et al., 2011; Trevarthen et al., 2003) emphasise that environments need to be calm, quiet, and not over-stimulated and allow for uninterrupted sleep, for comfort and feeding. Furthermore, they need to offer an environment rich in things to explore, and facilitate a range of activities including physical movement, dance, storytelling and drawing and painting.

For all age groups in ECEC settings opportunities offered by the environment and learning resources available are seen to determine the quality of children's learning experiences, and are associated with greater gains for cognitive outcomes and learning dispositions (Mitchell et al., 2008). It is argued that appropriate environments for children have to match each stage of development. For example, for infants and toddlers, space must be designed so that it offers many opportunities for physically exploring materials. For preschoolers, who begin to use objects in more complex situations, materials which offer opportunities for role play and the use of more complex language become increasingly important. Children should have spaces big enough for their needs, materials should be stored accessibly and the organisation in learning areas is seen to be an effective way to stimulate engagement with materials in play. The importance of natural materials and outdoor areas has also

been highlighted as promoting quality learning and development (Expert Advisory Panel on Quality Early Childhood Education and Care, 2009; Learning and Teaching Scotland, 2010).

The facilitating function of the physical early childhood environment may be of particular relevance for young children from disadvantaged backgrounds, because ECEC settings can offer children access to learning materials and experiences not provided in their homes (Dearing et al., 2009). This proposal seems important in the light of the view that multiple risk exposure to suboptimal physical (and social) environments may be a particular critical aspect of the adverse developmental effects of childhood poverty (Evans, 2006).

Findings on associations between children's cognitive and language development and the global quality of settings provide some support for this framework, because measurements like the ITERS or ECERS take account of aspects of the physical environment. Room layout, accessibility of resources, display, provision for sleeping, provision of exciting learning environment, resources to support specific types of play are items coded on these instrument, in addition to those items capturing the process quality of a setting. In an NICHD Early Child Care Research Network (2003b) analysis of domain specific associations between child outcomes and quality of care, it was found that young children in settings with more stimulating, varied and well organised materials (including materials to stimulate math, movement, music, language, art and play) received higher scores on tests of language comprehension and short-time memory at the age of four-and-a-half. Yet, no associations to other language and cognitive measures (letter-word identification, problem solving) were found, thus offering somewhat limited support for the proposition that the quality of the physical environment directly supports children's cognitive and language development.

van Liempd, Fukkink, and Leseman (in press) have undertaken a meta-analysis of 16 studies, published since 1987, to look at the relation between the indoor physical environment of center-based childcare and children's social and cognitive behaviour and development. A total of 1374 children, aging from zero to six years, were involved in the studies. The meta-analysis showed a positive, statistically significant correlation between the physical environment and children's behaviour ($r = .18$). The effect size was larger for studies with a focus on a deliberate spatial arrangement of the classroom ($r = .29$). The effect size was larger for social behaviour ($r = .25$) than for cognitive behaviour.

An Australian small-scale study on the effects of long day childcare on children's complexity of pretend play found that unsatisfactory provision of play materials had negative effects on toddlers' complexity of pretend play (Kowalski et al., 2005). While the European IEA-Pre-Primary Project (Montie et al., 2006) reported that the richness of the environment in early childhood settings related to children's cognitive and language development at age seven.

A recent Norwegian study illustrates the potential importance of grouping and spatial organisation in preschool settings. Skalicka, Belsky, Stenseng, and Wichstrøm (2015) tested whether the new open-group Norwegian day-care centers would affect child social behaviour differently to traditionally organized centers. They found that children from open-group centers (a) experienced less teacher-child closeness in preschool and (b) more teacher-child conflict in first grade of school, and (c) that high levels of preschool problem behavior forecast especially high levels of future teacher-child conflict, but only for children from open-group centers.

Otherwise, there is limited evidence on links between the quality of the physical environment and young children's development. It has been argued, that for the very young age group, the quality of personal attention, not the provision of educational tools is most significant (Trevarthen et al., 2003), but more research on the physical environment is needed as the spatial and physical environment may well moderate the patterns of interactions that children receive, as indicated in the studies above, and this may well have developmental implications.

A D U L T - C H I L D R A T I O S A N D G R O U P S I Z E S

There is considerable evidence that more favourable adult-child ratios (fewer children per practitioner in a group) provide conditions which promote higher quality adult-child interaction (see recent reviews by Bradley & Vandell, 2007; Dalli et al., 2011; Huntsman, 2008; Phillips & Lowenstein, 2011). Evidence for direct links between group size (number of children in a group) and process quality is less clear, but still evident (Munton et al., 2002). Most research focuses primarily on centre-based care. However, the NICHD SECCYD study found that across all non-maternal settings, more favourable child-adult ratios and group sizes were the best predictors of positive infant caregiving (NICHD Early Child Care Research Network, 2000a). However evidence is not consistent reflecting differing patterns of provision across countries and the frequent confounding of ratio, group size and other quality-related variables.

While many of the studies encompassed in existing reviews focus on preschool-age children, it is consistently argued across a number of reviews that the impact of adult-child ratios and group sizes is greater for younger children (infants and toddlers) (Expert Advisory Panel on Quality Early Childhood Education and Care, 2009; Huntsman, 2008).

The optimum recommended ratios for under two year-olds in ECEC settings is relatively consistently stated as 1:3 (Dalli & Rockel, 2012; Dalli et al., 2011; Expert Advisory Panel on Quality Early Childhood Education and Care, 2009); for two to three year-olds, recommendations on ratios are 1:4 or 1:5, and for three to five year-olds, recommendations from American professional associations are between 1:10 and 1:17 (American Public Health Association; American Academy of Pediatrics; National Association for the Education of Young Children) (Munton et al., 2002). Ideal group sizes for under two year-olds in ECEC settings are recommended to be six to eight children, and for two to three year-olds, ten to 12; three year-olds, 14 to 18, and for four to five year-olds, 20 to 24 (Dalli & Rockel, 2012; Munton et al., 2002). However, it has been noted that research cannot provide a sound empirical basis for recommending universally appropriate group sizes or optimal staff-child ratios (Expert Advisory Panel on Quality Early Childhood Education and Care, 2009), and can at the most 'specify different upper and lower limits appropriate under a range of different conditions' (Munton et al., 2002:107). Difficulties in identifying threshold effects are due to the correlational, non-experimental design of most of the reviewed studies, where adult-child ratios and group sizes are treated as continuous variables (Huntsman, 2008).

Yet, child-staff ratios cannot be viewed in isolation from group size, and group size may mediate effects of ratios; furthermore, the influence of group size and ratios cannot be separated from other structural variables, such as staff education and training, or organisational characteristics of the setting (Munton et al., 2002). Because structural characteristics of childcare environments are rarely independent of one another, findings from studies which 'use regression techniques to predict the relative importance of these dimensions of structural quality must be interpreted with care' (Munton et al., 2002:81). To add to these difficulties, most research in the field demonstrates links between group sizes and ratios and observed quality, thus strengthening the assumption that there is a mediating link between those structural variables and child outcomes. However, only very few have investigated direct links to child outcomes, or directly investigated the mediation model by including measures of child outcomes.

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

For the under-threes, there is some evidence for the effects of group sizes or ratios on child outcomes. The NICHD SECCYD reported a link between smaller group sizes, higher and lower ratios, and higher scores on measures of cognitive and language development, at 24 months old. Furthermore, children in classes that met more standards (including ratios and group sizes), had better school readiness and language comprehension scores at 36 months of age. In a later analysis, the NICHD SECCYD and Duncan (NICHD Early Child Care Research Network & Duncan, 2003) found smaller group size to be consistently, though modestly, associated with higher cognitive development in some models, but not others. And their analysis of child-staff ratio and child outcomes in several analyses across multiple time points and found only limited support for a relationship between ratio and cognitive development outcomes. In a separate analysis of NICHD SECCYD children in home-based care settings however, group size was not found to be predictive of children's cognitive or language development (Clarke-Stewart et al., 2002). In terms of children's socio-emotional development, a recent paper reviewed results from the largest and most representative childcare studies in the US as well as many other smaller studies and found that experience in large groups of children partially accounts for relations of quantity of childcare and children's behaviour problems (Huston et al., 2015).

Similarly, inconsistencies can be found across other studies: in their longitudinal study of 89 African-American children (age six to 36 months) from disadvantaged backgrounds, Burchinal et al. (2000) found that classrooms meeting professional recommendations regarding child-staff ratios tended to have children with better language skills. In a Swedish study of childcare, structural quality (a measure including indicators of group size, ratios, and age range) for childcare was found to relate to children's mathematics skills at age eight years (Broberg et al., 1997). Yet, an analysis of the National Longitudinal Survey of Youth did not show effects of ratios or group size on children's subsequent mathematics and language skills at age eight (Blau, 1999), but unexpectedly found that larger group size during that time was associated with higher reading scores, and a better child-adult ratio with later lower reading scores. Blau (1999) has suggested that structural characteristics in the first three years have little impact on child outcomes. A Greek study revealed that when adult-child ratios and ITERS total scores were jointly controlled, in lower quality centres, caregivers exhibited harsher and overly controlling behavior during their interactions with the children. In addition, with regard to the 'group size' variable it was found that when caregivers supervised fewer children, they were more likely to avoid enforcing discipline (Petrogiannis, 2010, 2013). A Dutch study (Albers et al., 2010) showed no effect of ratios on infants' cognitive development. Lastly, a Norwegian study looking at the associations of structural quality with child development at age two, found that higher child-adult ratios were associated with more parent reported empathy and cooperation. However, they also found that the size of the childcare centre was associated with more parent reported disobedience (Zachrisson et al., 2011). These inconsistent results may result from differing structural quality characteristics that may vary differently in different countries and context. For example, group size is likely to be greater in centres, some countries, e.g. UK allow high child-adult ratios with higher qualified staff, and child-adult ratio may well covary with group size. If multiple factors are not considered together then inconsistent results may well occur. Slot, Leseman, Verhagen, and Mulder (2015) review most of the existing literature on the effects of structural quality on process quality in ECEC, including several European studies, showing mixed results. Based on Dutch data, no clear effects of group size and teacher-child ratio on a comprehensive process quality measure were found.

ECEC FOR CHILDREN AGED OVER THREE YEARS

For children over three in education and care settings, research on direct links between ratios and group sizes, and children's developmental outcomes is limited, and findings inconclusive. Two large-scale studies of pre-K classrooms found no links between measures of child-staff ratio and children's academic, cognitive and language outcomes. Similarly, Houg et al. (2011) in an Australian study of preschool children, could not find links between ratios and developmental outcomes. Montie et al. (2006) found that group size did not relate to children's age seven language scores for the ten countries studied. Other studies did find associations in the expected direction

– with smaller group size in the preschool years predicting that children would subsequently make greater learning gains in mathematics, reading, and literacy (Gallagher & Lambert, 2006; Nye, Hedges, & Konstantopoulos, 2000; Walston & West, 2004). Drawing on a sample of four year-old preschoolers from a Norwegian longitudinal study, Zambrana, Dearing, Nærde, and Zachrisson (2015) examined the relationship between ECEC group size and preschool children's social and language competence. Zambrana et al. (2015) found that group size at three years of age was positively and linearly related to language competence test scores at age four, but it was not found to be related to children's social competence. However, after adjusting for potential ECEC selection factors and process quality indicators (of both the ECEC and home context), Zambrana et al. (2015) found that group size was no longer significantly associated with language competence, but was significantly associated with social competence. Lastly, as mentioned earlier, two Danish studies found that higher staff-per-child ratios in preschool were associated with improved test results in Danish at the age of 15/16 (Bauchmüller, Gørtz, & Rasmussen, 2011, 2014).

With regards to the effects of group size on social-emotional outcomes, (Zachrisson, Backer-Grøndahl, Nærde, & Ogden, 2012) used data from the Norwegian Developmental Study in a Norwegian report (not peer reviewed) to investigate group size as a predictor of social skills, aggression and oppositional behaviour in three year-olds. They found that larger group sizes were linearly associated with lower levels of teacher reported social skills, but not with externalising behaviour. Additionally, they found no relationship between group size and parent reported social skills or externalising behaviour.

Also the manner in which activities are organised (whole group vs. small group) in a setting, as well as the composition of the group determines children's experience and may influence their learning. An analysis of the NICHD SECCYD data (Brownell et al., 2008) showed that children's social functioning with peers in third grade related to the number of hours spent in childcare peer groups of different sizes (alone, dyad, small, medium, large) at age two to four-and-a-half. Results suggested that children who had spent more time in smaller peer groups, may be more socially outgoing and active later on – both positively and negatively.

Reflecting on a finding by Montie et al. (2006) that less time in whole-group activities in preschool was related to better cognitive skills at age seven, Mitchell et al. (2008) argued that it may be how children are grouped within a setting, rather than overall group size, that matters for their learning. And in large-scale studies in England and New Zealand the socio-economic mix of the centre related to child outcomes, with children in settings with a higher range of socio-economic backgrounds likely to make more progress in their learning (Sylva et al., 2004a; Wylie & Thompson, 2003).

Importantly, it is not thought that ratios and group size relate to children's outcomes directly, but that there is an indirect link. Structural indicators are known to influence the quality of care children experience, which in turn relates to developmental outcomes. This model gets strong support by two bodies of research – the one investigating links between structural indicators of quality and process indicators of quality and the other, investigating links between process indicators and developmental outcomes. Yet, research that directly tests for this mediated pathway is very sparse. Importantly, the NICHD study (NICHD Early Child Care Research Network, 2002a) found that the structural variable child-staff ratio related to the quality of caregiver interactions in ECEC, which in turn related to a measure of cognitive competence at four-and-a-half years.

P R A C T I T I O N E R Q U A L I F I C A T I O N S A N D T R A I N I N G

Among practitioners working in childcare settings, type and level of education, qualifications and training vary widely between and within countries (Dalli et al., 2011; Huntsman, 2008; Munton et al., 2002). It has been argued that the complexity of the issue and the specificity of the context place limits on generalisations and

conclusions that can be drawn from research carried out in different countries, and for services with significant individual variation (Munton et al., 2002; Tout, Zaslow, & Berry, 2006). Several reviews also note that the positive relationship of education and training with process quality varies across child age groups, but not in a consistent way. They cite a number of studies where effects were identified only for under-threes or only for over-threes (Fukkink & Lont, 2007; Huntsman, 2008; Kreader, Ferguson, & Lawrence, 2005; Saracho & Spodek, 2007).

In the EPPSE study in England (Sylva et al., 2004a) and the EPPNI study in Northern Ireland (Melhuish, Taggart, et al., 2006) the same measures of ECEC settings were used. Across most types of settings the quality as measured by ECERS-R was equivalent for England and Northern Ireland. However, for playgroups the quality of settings was distinctly higher than in England. Further investigation revealed that the level of training of staff in Northern Ireland playgroups was distinctly higher than in England, whereas for other types of setting staff training was similar in both countries. The differences in staff training in playgroups had occurred because the Northern Ireland administration had considerable extra money made available, which they partly used to provide in-service professional development for large numbers of playgroup staff. Thus, differences between these countries in quality of playgroup provision seem to have occurred because of the differences in staff training.

With regard to the question of what professional level is needed to obtain a particular level of quality, thresholds are unclear (Dalli et al., 2011; Phillips & Lowenstein, 2011). Difficulties in identifying threshold effects are due to the complexity of the issue of teacher preparation, which needs to take account of the nature and content of the training that teachers receive and the effects of their workplace environment on their teaching practice (Munton et al., 2002; Whitebook et al., 2009). Research has to simultaneously consider these important contextual issues and this proposes a challenge to the correlational design of many studies.

Setting aside these difficulties, and despite inconsistencies in findings, comprehensive reviews of childcare research that have considered relationships between staff qualification, and ongoing support and training, and observed program quality conclude that both qualifications and support/training have a direct impact on the ability of staff to provide sensitive, responsive, and stimulating care and education, which in turn enhances children's learning and development (Dalli et al., 2011; Howes & Brown, 2000; Munton et al., 2002). The following factors were identified as having a positive impact: the general educational level; specialised caregiver training; both formal and informal training; professional development after initial training; and supervision while working in childcare (Fukkink & Lont, 2007; Huntsman, 2008).

Evidence on direct impacts of practitioner qualification and training on the ability of staff to provide good quality care and education supports the model of an indirect relationship, with practitioner training and education impacting child outcomes through process quality. For the zero to three age group, currently there is little evidence for or against either direct or indirect effects on child outcomes. For example a review by Slot et al. (2015), looking at the relations between staff education level and observed (emotional) process quality, found only weak evidence that higher education level improves emotional support process quality.

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

Studies which have been carried out in England provide evidence in relation to the English national qualifications framework, which has nine levels ranging from entry level, through Level three (post-16), Level six (undergraduate degree) and Level eight (postgraduate degree). A variety of qualification factors have been found to predict higher quality and/or better child outcomes for under-threes, including the presence of a graduate practitioner with qualified teacher status (QTS) the overall mean for qualification level of the staff team, and whether the staff team is qualified to Level three or higher on average (Mathers et al., 2011; Mathers & Sylva, 2007; Smith et al., 2009).

The NICHD research (NICHD Early Child Care Research Network, 1999b) found that care settings meeting the standards for caregiver education and training (education must include some college, and formal, post high school training, including certification or a college degree in ECE) appeared to have modest effects on higher school readiness and language comprehension scores and fewer behaviour problems at 36 months of age. In a separate analysis of NICHD SECCYD children's experiences of home-based non-maternal care, higher educational

level, and specialised caregiver training were related to higher cognitive and language outcomes (Clarke-Stewart et al., 2002). In their longitudinal study of 89 African-American children from disadvantaged backgrounds, Burchinal et al. (2000) found that classrooms that met professional recommendations regarding teacher education tended to have girls with better cognitive and receptive language skills.

In a study conducted in the US, and using data from the National Longitudinal Survey of Youth (NLSY), Blau (1999) looked at the effects of staff training and other structural characteristics of childcare on child development. On the basis of their results the authors concluded that childcare inputs experienced in the first three years of life had little impact on child development. In contrast, a study of 553 infant, toddler, and preschool centre classrooms found that children in classes where caregivers had more formal or even informal training, had more advanced language skills than those where staff had less training (Burchinal, Cryer, Clifford, & Howes, 2002). Similarly, results from earlier research in the field were inconsistent (Burchinal, Roberts, Nabors, & Bryant, 1996; Clarke-Stewart, Gruber, & Fitzgerald, 1994) with some finding effects for practitioner education and training on child outcomes, and others not confirming such links.

Such inconsistencies in findings are likely to be related to contextual differences. Importantly, initiatives that aim to raise the effectiveness of ECEC settings must better specify appropriate content, design and delivery of caregiver training. It has been recommended that they have to provide targeted professional development activities including increased supply of qualified early childhood educators (Expert Advisory Panel on Quality Early Childhood Education and Care, 2009).

Research evidence of specific qualities and attributes that are important in terms of preparing adults to provide high-quality care for infants and toddlers is sparse. Three elements are mentioned in a number of reviews on the quality ECEC for young children. First, that training programs for work with infants and toddlers need to include content which is relevant to the age group and reflect what is known about infant learning and development (Dalli et al., 2011). Secondly, and relevant to the whole age range of preschool education and care, the content of undergraduate programs of early childhood teacher education should include foci on critical reflection and self-evaluation and awareness of diversity (Dalli et al., 2011; Learning and Teaching Scotland, 2010; Mooney et al., 2008). Awareness of diversity is an especially important issue, and there is an increasing criticism that practitioner training may not prepare students sufficiently to cope with issues faced by children and families in poverty and may not keep up with the multiple needs of the increasingly diverse population of children and families (Hallam, Buell, & Ridgley, 2003; Morgan & Fraser, 2007; Siraj-Blatchford & Siraj-Blatchford, 2010).

ECEC FOR CHILDREN AGED OVER THREE YEARS

For the over-threes, evidence that staff education or having a degree in particular will produce better outcomes for children is mixed. It appears that while preschool staff qualifications help they do not ensure necessarily lead to greater gains for children. It appears that where staff training and qualifications lead to improvements in children's daily experiences then benefits for child outcomes are forthcoming, but it is important to note that it is children's daily experiences that drive development.

In the EPPSE study, children made more progress in preschool centres where staff had higher qualifications, particularly if the manager was highly qualified (i.e., degree level). Having trained teachers working with children in preschool settings (for a substantial proportion of time, and most importantly as curriculum leader) had the greatest impact on quality, and was linked specifically with better outcomes in pre-reading at age five (Sylva et al., 2004a). The EPPSE study brought clear evidence that qualified teachers are likely to draw on their knowledge and experience of children and pedagogy to offer the kinds of cognitively challenging adult-child interactions that are linked with gains for children. Particularly effective EPPE centres had strong educational leadership and ongoing professional development and practitioners had good curriculum knowledge and understanding of how young children learn. Staff who had the highest qualifications provided children with more language, mathematics, and cognitive challenge, and 'less well qualified staff were significantly better pedagogues when they worked alongside qualified teachers' (Sylva et al., 2004a:37).

The NICHD SECCYD study brought some evidence that qualified teachers are likely to draw on their knowledge and experience of children and pedagogy to offer the kinds of cognitively challenging adult–child interactions that are linked with gains for children (NICHD Early Child Care Research Network, 2002a). Using structural equation modelling, a mediated path was identified from teacher qualifications through process quality to cognitive competence at age four-and-a-half.

The NICHD Early Child Care Research Network (1999b) also found links between recommended standards for quality met (teacher training, teacher education, group size, and teacher-child ratios) and language comprehension scores at 36 months. There was no evidence of threshold effects. Not meeting any of the quality standards was related to lower than average scores at 36 months for language comprehension, and meeting all of them with above average scores. Child outcomes were partly predicted by caregiver training and education at 36 months. Also a more recent report (NICHD Early Child Care Research Network & Duncan, 2003) includes that teacher education (measured as total years of formal education) demonstrated consistent, positive associations with children's 54 month achievement outcomes, including math and reading skills, and phonological knowledge.

A Danish study by Bauchmüller et al. (2014) analysed the relationship between long-run child outcomes and preschool quality. They measured child outcomes using ninth grade final exam results in written Danish (at age 15 to 16) and constructed measures of quality from administrative register information collected for preschool teachers. Using the administrative registers they devised five indicators of structural quality: '(1) the staff-per-child ratio, (2) the proportion of male staff, (3) the proportion of trained preschool teacher staff, (4) the proportion of ethnic minority staff, and (5) the stability of the staff (inverse staff turnover)'. Using this data they looked for a correlation between the structural quality of children's preschool and their ninth grade test results. They found the proportion of trained teachers had a significant positive (albeit numerically quite small) effect on children's test results in written Danish at age 15 to 16 (Bauchmüller et al., 2011; 2014:457).

There is some consensus that early childhood caregivers and teachers should be trained to the bachelor's degree level and should have credentials in courses that are specific to early childhood. Yet, the evidence is not as conclusive as this consensus suggests. Using data from the National Center for Early Development and Learning's (NCEDL) Multi-State Study of Pre-Kindergarten, Early et al. (2006) found that teachers' education (years of education, highest degree, and Bachelor's degree vs. no Bachelor's degree), was linked to gains in children's math skills across the pre-K year, and the staff professional credentials were linked to children's gains in basic skills. However, education, training, and credentialing were not consistently related to classroom quality or other academic gains for children. Early et al. (2007) carried out a secondary analysis, using seven data sets, to examine the relationships between teacher education, classroom quality and child academic achievement. Of the seven studies, two indicated quality was higher when teachers had a bachelor's degree or higher, one indicated quality was lower when teachers had a bachelor's degree or higher, and four studies found no significant association. These findings suggest a weak and inconsistent relationship between teacher education and ECEC quality measures.

The IEA Pre-primary Project (Montie et al., 2006) found consistent and statistically significant, but small effects of the number of years of full-time teacher training on language scores. Mashburn et al. (2008) examined the pattern of prediction to child outcomes when pre-K classrooms met all nine benchmarks of quality proposed by the National Institute of Early Education Research, as well as a summary score of number of benchmarks met. None of the nine criteria, including whether the lead teacher has a bachelor's degree, the lead teacher has training in early childhood and child development, the assistant teacher has a Child Development Associate (CDA) Certification was associated with children's cognitive or language outcomes.

A meta-analysis (Kelley & Camilli, 2007) was conducted to consider whether higher levels of teacher educational attainment were linked with higher levels of quality, and whether ECEC outcomes for teachers with a bachelor's degree were larger than those for teachers with fewer years of education. Results showed that effects on outcomes for teachers with a bachelor's degree were significantly greater than for teachers with less education.

There are several explanations for this pattern of mixed findings. First, findings may be compromised by confounding between several structural quality characteristics. Second, in addition to education and training before entering early childhood services, many centres provide for additional on-the-job training and supervision, especially for teachers with lower non-specific training.

Supporting the view that it is children's daily experiences that drive development, recent research suggests that targeted intervention to improve teacher interactions with children and instruction in academic skills increases effective teaching and children's social and academic gains (Evanschitzky, Lohr, & Hille, 2008; Hamre, Pianta, Downer, & Mashburn, 2008; Hamre, Pianta, Mashburn, & Downer, 2012; Wasik et al., 2006). Other studies have shown that coaching teachers in interactions is linked to instructional supports for learning and good implementation of curriculum can have significant benefits for children (Koh & Neuman, 2009; Landry, Swank, Smith, Assel, & Gunnewig, 2006; Powell, Diamond, Burchinal, & Koehler, 2010). Clements and Sarama (2008) produced evidence that increasing teachers' knowledge of developmentally relevant mathematics skill progressions can be a key aspect of improving instruction and child outcomes (Clements & Sarama, 2008). Participation in professional development interventions have been shown to support children's school readiness (Downer, Pianta, & Fan, 2008; Hamre et al., 2008; Mashburn et al., 2008).

PART 3 : COMPLEX PATHWAYS FROM ECEC TO CHILD OUTCOMES

Despite all challenges and inconsistencies in findings, the consensus is that, if children experience high-quality non-maternal care, they benefit – especially with respect to their cognitive and language development and their academic achievement. While more research is needed to identify those elements that are most effective in facilitating development in certain domains, there is strong agreement that caregivers have to be attentive to children's needs, emotionally warm, caring, supportive, responsive to verbal and non-verbal cues, and stimulate curiosity and a desire to learn about the world. In addition, supportive environments (good ratios, small group size, qualified staff with opportunities for professional development) increase the likelihood that high-quality care as defined above can take place (Bradley & Vandell, 2007; Mitchell et al., 2008).

FACTORS MODERATING ECEC EFFECTS ACROSS ECEC AGE GROUPS

SUBSEQUENT EDUCATIONAL EXPERIENCE

Although there is much evidence of positive impacts of ECEC, some longitudinal research has shown that these effects may not persist. It has been argued that benefits from ECEC attendance cannot transform children's lives in the long run 'in the absence of additional educational and social supports' (Lowenstein, 2011:93) as positive benefits may fade over time (DeCicca, 2007; Le et al., 2006; Votruba-Drzal et al., 2008). In order to be most effective, good quality in the Early Years has to be followed up with high-quality in subsequent preschool or school systems (Melhuish, 2014). In support of this proposition, one of the most recent analyses of NICHD SECCYD data (Li, Farkas, Duncan, Burchinal, & Vandell, 2013) found the most positive gains of day care were for children who had attended high-quality care across the infant, toddler, and preschool years, with fewer gains for children attending high-quality care for only part of that time. Similarly a cluster RCT found that an enhanced educational environment in the preschool was only related to reduced levels of behaviour problems in kindergarten (five to six years of age) among children attending high-quality schools in kindergarten (Zhai, Raver, & Jones, 2012). Broekhuizen, Mokrova, Burchinal, and the Family Life Project Key Investigators (2014) also *investigated* the combined effects of preschool and kindergarten quality for children's social and behavioral skills using data from the Family Life Project, a large multi-site longitudinal study (N=1,292) of ethnically diverse families in rural areas in the USA. Results indicated that children in a high-quality classroom in both the final

preschool and kindergarten years exhibited more social skills and fewer behavior problems at the end of kindergarten than children experiencing only one or no years of high classroom quality. By the end of first grade, however, children having experienced two years of high preschool quality did not differ from children with only a year of high-quality preschool. The findings suggest that, by the end of first grade, high-quality preschool was the strongest predictor of children's greater social and behavioral skills.

The English EPPSE study (Sammons, Sylva, et al., 2007; Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, & Hunt, 2008) has evidence looking at the effect of preschool attendance on children's outcomes in mathematics and reading was highest if the preschool they attended was high-quality and/or effective and if they then attended a more academically effective primary school. Here effectiveness refers to the degree to which the preschool or school boosts the child's development having controlled for initial attainment and demographics. They also found that, for the children who attended a *medium* quality preschool centre, they had enhanced attainment only if they then attended a *medium/high* effective primary school. Importantly, there was some evidence that the quality of preschool can compensate for the possible adverse influence of attending a less effective primary school. Equally, attending a more effective primary school could compensate for the possible adverse influence of not attending a preschool or of attending a low-quality preschool.

Results from the Chicago Parent Center intervention (Reynolds, Ou, & Topitzes, 2004) show how early effects on academic skills in the short-term facilitate the transition and adaptation to school, resulting in higher expectations and better outcomes, and the prevention of early referral to special education. Similarly results from the Early Childhood Longitudinal Study-Kindergarten (ECLS-K) Cohort in the US similarly point out that the longer-term effects of preschool experience can depend on classroom experiences during at least the first years of school (Magnuson et al., 2007b). In this study, initial disparities between children who had attended preschool and those who had not persisted for those children who experienced large classes and low levels of reading instruction in elementary school.

FAMILY DEMOGRAPHIC FACTORS AND ECEC EFFECTS OVERALL

Analysis of NICHD SECCYD data (Hynes & Habasevich-Brooks, 2008) showed that children experience many changes of childcare quality, and only few children experience continuous high-quality childcare. In particular, in the USA at least, children from low socio-economic status families are more likely to experience low-quality care. Family background and parenting experiences have been found to be much stronger predictors of children's outcomes than non-maternal care factors (NICHD Early Child Care Research Network, 2002b) especially for socio-emotional development (Barnes et al., 2010; Stein et al., 2013). Thus, environmental systems of home and ECEC are not independent from each other (Dowsett et al., 2008; NICHD Early Child Care Research Network, 1997, 2002c; Sylva, Stein, Leach, Barnes, & Malmberg, 2007) and should be taken into account.

Recently, research has investigated in detail how family and ECEC systems interact in affecting children's development focussing on race or ethnicity and socio-economic status. An important question for Early Years policy is whether attendance of childcare aimed at the general population can have a compensatory effect for children from more disadvantaged families or otherwise more risky social backgrounds, and narrow the gap between disadvantaged and advantaged groups. A positive response to this question is supported by findings from intervention programs aimed at the disadvantaged population, though it must be noted that they are not generally offered to advantaged families so differential effects cannot be determined. On the other hand, it can be argued that interactions might operate the other way round – children who are less at risk or have greater initial abilities might benefit more from attending ECEC because of their ability to build on their advantages or skills (skill begets skill) (Cunha & Heckman, 2007). The 'Matthew effect' refers to a phenomenon whereby initially advantaged children benefit more from an intervention so that initial differences become greater, which has been identified in one follow-up of the NICHD SECCYD study to first grade (Downer & Pianta, 2006). Niklas, Segerer, Schmiedeler, and Schneider (2012) analysed longitudinal data of over 900 children in Germany to compare those with different migration backgrounds over the kindergarten and early primary years. Overall, children from immigrant families performed worse than their native-born German peers. However, when other demographic family factors were controlled for the differences in mathematics disappeared although differences in literacy persisted, which the authors interpret as failing to support the 'Matthew effect'.

It is possible that compensatory and ‘Matthew effects’ may both occur under differing circumstances and it is too simplistic to adhere to one or the other. Rather we should seek to understand the process of change and how factors affect that process.

CHILD FACTORS AND ECEC EFFECTS OVERALL

Gender and temperament have also been investigated as possible moderators. Where the effect of high-quality childcare is compensatory, boys may profit more than girls because boys tend to be less developmentally advanced than girls of the same age, putting them at greater risk for poor educational outcomes (Matthews, Ponitz, & Morrison, 2009). Conversely, with a ‘Matthew effect’ this interaction would be the other way round – with girls benefitting more. It might be hypothesised that children with more difficult temperament might benefit less from non-maternal care because they are less adaptable to new environment, but this ignores the nature of the non-maternal care.

A number of studies have shown that high-quality childcare can have compensatory effects for boys; those who attend high-quality childcare present fewer behaviour problems, whereas, in contrast, quality of childcare has been found to have low or no effects on behaviour problems in girls (Votruba-Drzal et al., 2004; Votruba-Drzal, Coley, Maldonado-Carreño, Li-Grining, & Chase-Lansdale, 2010). Boys tend to score lower than girls in terms of self-regulatory abilities, therefore they may benefit more from well-structured childcare environments (Votruba-Drzal et al., 2004; Votruba-Drzal et al., 2010) in (Broekhuizen, van Aken, Dubas, Mulder, & Leseman, 2015). Broekhuizen et al. (2015:226), using a sample of children in centre-based childcare from the Dutch longitudinal study pre-COOL, investigated ‘whether affective self-regulatory abilities and gender were unique moderators of childcare quality effects, or whether the moderating effect of gender could (partly) be explained by the on average lower levels of affective self-regulation of boys’. They found that gender and self-regulation are unique moderators of childcare quality, meaning that the moderating role of gender cannot be explained by differences in self-regulation. Additionally, their findings mirrored the mechanisms of differential susceptibility found by Belsky (1997) and Belsky et al. (2007), whereby ‘children with certain temperamental dispositions are, in general, more susceptible to their environment, both for better and for worse’ (Broekhuizen et al., 2015) meaning that children with low self-regulation demonstrate greater decrease in social competence than those with higher self-regulation when both attend low-quality childcare, and conversely greater increase in social competence when both attend high-quality childcare.

Currently research on complex interactions is sparse, and evidence for either the compensatory or accumulated advantage (‘Matthew effect’) proposals is limited (e.g. see review by Roßbach, Kluczniok, & Kuger, 2008). However, on the whole more results are in support for the compensatory hypothesis, with more disadvantaged children benefitting more from the experience of ECEC.

THE INTERACTION OF ATTENDANCE OF ECEC WITH FAMILY AND CHILD CHARACTERISTICS, BY AGE GROUPS

Here we consider whether the effects of just attendance at ECEC are moderated by other factors, dividing evidence as much as possible according to child age

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

FAMILY BACKGROUND AS MODERATOR

Over the years, analysis of the NICHD SECCYD data investigated the relevance of a number of family risk variables including the quality of parenting, income, education, ethnicity and marital status as moderators of childcare effects and did not find much support for compensation. For example, an early analysis (NICHD Early Child Care Research Network, 2002c) did not find that the experience of non-maternal care moderated negative effects of family risk to language outcomes at 24 or 36 months. A more recent analysis (Vandell et al., 2010) found no interaction effects – paths from ECEC experience in infant, toddler and preschool years (quantity and quality) to cognitive achievement outcomes at age 15 were not significantly different for children from more or less risky family background (including measures of family income, single motherhood, and parenting quality). Other studies provide more evidence that attendance of formal childcare under the age of three could represent a preventative means for limiting effects of disadvantage on children's development. An early study which carried out moderator analysis using data from 317 US children enrolled in kindergarten found that months in ECEC during the infant, toddler and preschool period predicted better mathematic skills for children of less educated mothers and with a relatively poor literacy environment, but not for those children from more advantaged backgrounds (Christian et al., 1998).

Analysis of the Early Childhood Longitudinal Study provides some evidence that longer duration of ECEC may impact differently on children from lower- and higher-income families. Amount of ECEC showed a stronger positive effect on children's reading and mathematics scores at age five for children from low- and middle-income families (Loeb et al., 2007; Votruba-Drzal et al., 2008). The study also investigated ethnicity as a possible moderator: English-proficient Hispanic children benefited more in terms of cognitive development from centre attendance than white or black children with similar characteristics (Loeb et al., 2007). Furthermore, again using data from the Early Childhood Longitudinal Study, Votruba-Drzal et al. (2013) found beneficial effects of centre-based care settings for children's mathematics and reading skills at age five for the group as a whole, but with a stronger effect for children from lower income, less educated, and less enriching family contexts. Other US studies have shown that quality of care moderates the effect of long hours in care (McCartney et al., 2010; Votruba-Drzal et al., 2004; Votruba-Drzal et al., 2010) and that high-quality day care can protect children against the negative effects of low-quality home environments (Watanabe, Phillips, Morrissey, McCartney, & Bub, 2011). A recent review of the largest and most representative childcare studies in the US and many smaller studies (Huston et al., 2015) concluded that the effects of quantity of care on children's behaviour problems were population specific: for disadvantaged children and those from minority ethnic families, extensive childcare was not associated with more externalizing problems – in some cases it predicted lower levels, possibly compensating for other disadvantages (Huston et al., 2015).

Analysis of data from the New Zealand longitudinal 'Competent Children, Competent Learners' project supports the hypothesis of compensating effects, results indicating that if children from disadvantaged families begin ECEC early and attend four or more years, they are likely to have similar scores in literacy and communication to those from more advantaged backgrounds (Wylie & Thompson, 2003).

A Canadian cohort study showed that attendance of full-time non-maternal care in the first year was associated with higher vocabulary scores at age four and five, but only among children from low SES, and not for those with higher SES backgrounds (Geoffroy et al., 2007). For outcomes a year later, the study showed that formal care

across infant, toddler, and preschool years related to higher school readiness, receptive vocabulary, and reading scores at age six and seven, but only for those children whose mothers had lower levels of education (Geoffroy et al., 2010). Caille (2001) has reported a stronger effect of an earlier start in the French pre-primary system, at age two compared to age three, on early school skills and class retention in the first grades of primary school, especially for low-income and immigrant ethnic minority children. Finally, the potential of early ECEC experience to reduce cognitive inequalities between disadvantaged and advantaged children has been identified for the UK children in the Millennium Cohort Study (Côté et al., 2013; Hansen & Hawkes, 2009) and in a recent Australian study into the effects of childcare (Houng et al., 2011).

With regards to behavioural problems, Zachrisson and Dearing (2015) conducted a Norwegian study to investigate the effects of family income dynamics and changes in early child behaviour problems, as well as whether high-quality ECEC buffered children from the effects of changes in family income. By looking at a sample of 75,296 children from the MoBa-study, they found that within-family changes in income-to-needs predicted changes in externalizing and internalizing problems for children aged 18 to 36 months, and this was particularly true for children from low-income families. Additionally, they found that ECEC buffered the effect of income-to-needs changes on internalizing problems in low-income children, however it had no buffering effect on externalizing problems.

In Spain it was found that the expansion of publicly funded full-time (good quality) childcare increased enrolment in childcare, with positive effects on children's cognitive development for children with less educated parents, and for girls (Felfe, Nollenberger, & Rodríguez-Planas, 2013).

CHILD CHARACTERISTICS AS MODERATOR, BY AGE GROUPS

When considering moderation by child characteristics for impact of attendance from birth to three years evidence comes largely from interventions for disadvantaged groups and few conclusions can be reached.

Temperament is often defined as 'constitutionally based individual differences in reactivity and self-regulation, in the domains of affect, activity, and attention' (Rothbart & Bates, 2006:100). In relation to socio-emotional outcomes Blair (2002) analysed data from the IHDP intervention described earlier, and found that the benefits were moderated by child temperament in that positive effects are most pronounced for children rated highly for negativity in infancy.

Anderson (2008) compared the effects of the Abecedarian project for boys and girls from disadvantaged backgrounds and found that effects varied significantly for boys and girls depending upon the outcome and age of measurement. For example, boys show a more favourable improvement at ages five and six years but at ages 12 and 15 the girls show greater improvement. On the other hand, for effects as the sample reached adulthood, and social outcomes (college graduation, employment crime) became prominent, the balance of benefits shifted towards boys doing better from the intervention.

In contrast, Vandell et al. (2010) report that in the NICHD SECCYD study of the general population associations between ECEC experience and child outcomes did not vary significantly between girls and boys, but this analysis does not distinguish by age of attendance.

ECEC FOR CHILDREN AGED OVER THREE YEARS

FAMILY BACKGROUND AS MODERATOR

Recent investigations into the effects of US pre-K studies support the compensatory hypothesis. For example, children who participated in the Tulsa's state-funded pre-K program were better prepared for school upon primary school entry, and there is evidence that positive effects were larger for low-income children and also to

some extent for children from minority backgrounds (Gormley et al., 2005; Gormley et al., 2008). Similarly, an investigation into the effects of a universal pre-K program in Georgia found that for disadvantaged children (residing in small towns and rural areas) universal pre-K availability increased both maths and reading test scores at fourth grade as well as the probability of students being on-grade for their age. For other groups, increases in some measures of achievement were also found, but findings were less consistent (Fitzpatrick, 2008). Findings from an evaluation of Virginia's pre-K initiative showed particular attendance benefits for children with minority backgrounds (Huang et al., 2012). Furthermore, in the North Carolina More at Four pre-K program, high risk groups who entered pre-K at a deficit, gained at similar or even greater rates, and for some measures caught up with lower risk groups in kindergarten (Peisner-Feinberg & Schaaf, 2008).

Analysis of a nationally representative dataset, the Early Childhood Longitudinal Study-Kindergarten-Cohort (Magnuson et al., 2007a) indicated that participation in both pre-K and other types of centre-based care, was associated with higher reading and mathematics skills at school entry; larger and longer-lasting effects on academic gains were found for economically disadvantaged children. A study of more than 600 twin pairs (Early Childhood Longitudinal Study, Birth Cohort twin sample; Tucker-Drob (2012) provides further evidence that preschool experience may reduce inequalities in early academic achievement by providing children from disadvantaged families with higher-quality learning environments than they would otherwise receive in the home environment. Attending preschool at age four was associated with reductions in shared environmental influences on reading and math skills at age five. Effects led to reductions in achievement gaps associated with minority status, socio-economic status, and ratings of parental stimulation of cognitive development.

In England, support for compensation is mixed when analysing the Millennium Cohort Study. Becker (2011) found that preschool attendance did not lead to a catching-up process for those with lower education background. However, without preschool attendance the gap between the groups widened further. Importantly, preschool attendance positively affected the vocabulary development of children with lower educated parents while there was no significant preschool effect for children of higher educated parents.

In France, it has also been shown (Dumas & Lefranc, 2010) that the large-scale expansion of a universal, free preschool program led to nearly universal preschool attendance in three and four year-olds and this appeared to reduce socio-economic inequalities as children from less advantaged backgrounds benefitted most.

In Germany too there is evidence that children from disadvantaged backgrounds in particular benefitted from more than a year of preschool attendance (Bos et al., 2003; Kratzmann & Schneider, 2009). For those with minority background, preschool attendance increased their chances to catch up with their peers in terms of maths and literacy development at the end of year one (Niklas et al., 2012); preschool attendance also increased their chances of higher educational attainment (Spiess et al., 2003). Similarly, in Switzerland, the impact of preschool expansion was associated with improved intergenerational educational mobility, with children from disadvantaged backgrounds benefiting most (Bauer & Riphahn, 2009).

There is increasing evidence that preschool settings with a mixed intake of social backgrounds have better results for disadvantaged children (de Haan et al., 2013; Schechter & Bye, 2007; Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004b) possibly because more able children support less able children in their development, or because the more advantaged parents can influence the quality of the preschool. In Germany it was found that positive effects of preschool attendance for immigrant children's language development depended on the composition of the group: strongest effects were found for those immigrant children in groups with a low percentage of immigrant, and with a high percentage of children from a relatively high socio-economic background with good cognitive abilities. Importantly, a higher percentage of immigrant children did not affect language development in those children without immigrant backgrounds (Niklas, Schmiechler, Pröstler, & Schneider, 2011).

Nevertheless, a review on the effects of various preschool programs on cognitive development (Burger, 2010) evaluated the extent to which these programs could help to overcome inequalities among children from different social backgrounds. Out of 26 studies that took account of families' socio-economic status, only seven documented a particular benefit for disadvantaged children, leading to the conclusion that the compensatory hypothesis is not strongly supported internationally.

Using data from the Danish Longitudinal Survey of Children (DALSC), Datta Gupta and Simonsen (2010:41) found that compared to home care, being enrolled in preschool at age three did not lead to significant differences in child outcomes at age seven, even when accounting for mothers' level of education and the child's gender. Contrastingly, family day care was found to 'significantly deteriorate' non-cognitive skills, e.g. 'measures of emotional symptoms, conduct problems, hyperactivity/inattention problems, peer relationship problems, and pro-social behavior' (Datta Gupta & Simonsen, 2010:30) for boys whose mothers' had lower levels of education (high school or below, or vocational degrees).

CHILD CHARACTERISTICS AS MODERATOR

The Perry Preschool Project was provided from age three and four years for children from extremely disadvantaged families. Anderson (2008) reports some differences in long-term effects for boys and girls. During the school years the benefits of the intervention tended to be greater for girls than boys. However as the sample reached adulthood, and social and economic outcomes (college graduation, employment, income, crime) became more important, the balance of benefits shifted towards boys doing better from the intervention. Conversely, in his analysis of results for the Early Training Project, which was for similarly disadvantaged populations, Anderson (2008) found the balance of benefits in educational outcomes up to age 21 years largely favoured girls more than boys. However few studies have evidence into adulthood.

THE INTERACTION OF QUALITY OF ECEC WITH FAMILY AND CHILD CHARACTERISTICS, BY AGE GROUPS

Here we consider whether the effects of the variation in quality of ECEC experienced by the child are moderated by other factors, looking at evidence for younger and older preschoolers.

ECEC FOR CHILDREN AGED ZERO TO THREE YEARS

FAMILY BACKGROUND AS MODERATOR

Some evidence of moderation of ECEC quality effects by family background derives from a number of studies using NICHD SECCYD data. For example, in relation to socio-emotional development, while the study showed no main associations between either quantity (including type of care and age of entry) or quality of care and attachment security at ages 15 and 36 months (Friedman & Boyle, 2008), when quantity was high in the first 15 months and either day care was of low-quality or unstable, or parental sensitivity was low, then the likelihood of insecure attachment was increased. This could be regarded as finding that high levels of day care may compromise attachment security, but only in instances of poor quality infant care either at home and/or in day care.

For another aspect of socio-emotional development, recent Dutch research (Broekhuizen, van Aken, Dubas, van de Schoot, & Leseman, 2014) showed that high-quality childcare was associated with improved concurrent internalizing behaviour when children experienced highly consistent parenting, but not when children had less consistent parenting. Possibly the absence of compensatory effects was due to the high level of positive parenting and relatively low level of child internalizing and externalizing behaviours reported by parents in this study, which leaves less room for compensation.

Regarding cognitive outcomes, analysis of NICHD SECCYD data at 54 months did not identify any interaction effects between family background and process quality during infant, toddler and preschool years (NICHD Early Child Care Research Network, 2004). Similarly, a more recent follow-up as part of the NICHD SECCYD (Vandell et

al., 2010) found no support for the compensatory hypothesis – paths from quality of care in infant, toddler and preschool years to cognitive achievement outcomes at age 15 years were not significantly different for children from more or less risky family background (including measures of family income, single motherhood, and parenting quality).

However, another study analysing the NICHD SECCYD data (Dearing et al., 2009) did find some evidence that economically disadvantaged children benefit more from higher quality care. The higher the quality of non-maternal care during early childhood, the weaker the associations were between family income and school readiness, reading and mathematics achievement in middle childhood. While finding evidence supporting the potentially beneficial effect of high-quality ECEC for disadvantaged children, Watamura et al. (2011) also show how disadvantaged children can suffer from a form of double jeopardy that can lead to poorer social-emotional outcomes if they experience both home and ECEC environments that confer risk.

In Greece, Petrogiannis (2010,2013) studied children with and without nursery care experience. Aspects of both caregiving environments influenced language, cognitive and social-emotional development. When considering only the group-cared children, analyses revealed that the quality of the home environment and quality of the group care environment interacted in their effects to influence children's language development.

Using data from the Welfare, Children, and Families study in three US cities, Votruba-Drzal et al. (2004) found no main effect of childcare quality for two to four year-olds and children's trajectories in reading and mathematics, but did find significant associations for those children with highly stimulating home environments. The authors argued that for low-income children, even relatively high-quality ECEC available to them might not be able to make up for other environmental disadvantages. Furthermore, they argued that in order to have a more significant effect, children from more disadvantaged groups might need high-quality childcare over a longer period.

Bornstein et al. (2006) found that a measure of structural childcare quality across the first four-and-a-half years – namely the child-adult ratio – related positively to children's cognitive scores at 54 months for children from higher SES backgrounds. Thus it appeared that children from more advantaged backgrounds benefitted from child-adult ratio variation differently from children from lower SES backgrounds. This could reflect a compensation effect whereby lower SES children benefit more from more favourable child-staff ratios.

Often studies do not disentangle effects of quality of care during infant and toddler years from the effects of quality during preschool age. Yet, it is important to know whether high-quality care in the first years of life is important quite apart from the separate effects of high-quality preschool care. An analysis of the NICHD SECCYD data that focused on under-threes (McCartney et al., 2007) found some evidence that higher quality childcare buffers children from negative effects of low-income – the interaction between low-income and childcare quality between six and 36 months was found to be predictive for school readiness, receptive language, and expressive language at 36 months.

However, in line with some previous results from the NICHD SECCYD, a recent analysis of data from the US nationally representative ECLS-B cohort (Ruzek et al., 2014) showed no evidence that poverty moderated the effects of quality of toddler care on children's cognitive outcomes at age two. It should be noted that low-income children were less likely to experience medium- and high-quality care, leading to the conclusion that public funding that increases the supply of high-quality ECEC might help to narrow the cognitive skills gap early on.

Finally, a recent Portuguese study, reported that centre-based childcare quality for preschoolers and the quality of the home environment, but not centre-based childcare quality for infants related to children's language and literacy outcomes at preschool age – and that the effect of the home environment was moderated by the quality of the preschool: positive associations among home environment quality and children's developmental outcomes were found to reduce substantially when children attended low-quality preschool classrooms (Pinto et al., 2013).

CHILD CHARACTERISTICS AS MODERATOR

Temperament is often defined as ‘constitutionally based individual differences in reactivity and self-regulation, in the domains of affect, activity, and attention’. Within this definition, reactivity refers to ‘responsiveness to change in the external and internal environment’, and self-regulation to ‘processes such as effortful control and orienting that modulate reactivity’ (Rothbart & Bates, 2006:100). Thus the terms temperament, reactivity and self-regulation are inter-related.

There can be moderation of cognitive effects through temperamental variation. An analysis of the NICHD SECCYD indicated that quality childcare substantially predicted (better) reading in the case of children with difficult temperaments but did not predict these outcomes over time in the case of children scoring low on difficulty as infants (Pluess & Belsky, 2010). The authors argue that these somewhat surprising finding might be due to the fact that ‘specific characteristics of difficult temperament may be indicators of a general heightened sensitivity of the nervous system to environmental stimuli, such that experiences, be they supportive and nurturing or otherwise, register more strongly than in the case of infants with less sensitive nervous systems’ (Pluess & Belsky, 2010:388). Such ‘differential susceptibility’ would lead more reactive or difficult children to be more susceptible to both negative and positive environmental influences. Recent findings from the FCCC study suggest that children with early difficult temperament had better cognitive development at school entry if they had experienced continuous centre-based care from infancy, which those who had been predominantly cared for in home-based settings were likely to have lower cognitive scores (Eryigit-Madzwamuse & Barnes, 2014). This suggests that children with a difficult temperament may benefit from the potentially more structured and educationally stimulating environments in centres, or their characteristics mean that they receive more attention.

As well as moderating ECEC effects for cognitive outcomes temperamental reactivity may moderate effects for socio-emotional outcomes in that children with more difficult (reactive) temperaments show more behaviour problems in relatively low-quality care, but also better socio-emotional skills when exposed to high-quality care (Phillips et al., 2012; Pluess & Belsky, 2009). Also studies have found that children with a more reactive or difficult temperament were more vulnerable for low-quality childcare exhibiting less social competence and more behaviour problems than their less reactive or difficult peers (Almas, Grusec, & Tackett, 2011; Deynoot-Schaub & Riksen-Walraven, 2006). Infant temperament has also been investigated as a moderator of quality effects on child cognitive outcomes. In recent research in the Netherlands, Broekhuizen et al. (2015) found that children’s self-regulation moderated the effects of ECEC quality measured at two to three years on social competence measured one year later. Children low on affective self-regulation showed less social competence with low-quality, but they showed more social competence with high-quality childcare. However for children high on self-regulation there was no association between quality of childcare and social competence.

ECEC FOR CHILDREN AGED OVER THREE YEARS

FAMILY BACKGROUND AS MODERATOR

While it is often argued that high-quality childcare experiences are likely to have stronger effects on children who are at risk of poorer outcomes because of less optimal family environments (Hungerford & Cox, 2006) the evidence is mixed. Using US data, Peisner-Feinberg et al. (2001) found moderating influences of family characteristics upon ECEC effects for some outcomes. For reading and literacy outcomes at age four and mathematics skills at age eight, children with parents from lower educational backgrounds benefited most from high-quality ECEC, supporting compensatory effects.

Findings from the English EPPSE study indicate that preschool attendance by itself cannot necessarily overcome the influence of background, however higher quality Early Years experiences (defined either by observed quality and measured effectiveness) can help to combat the effects of disadvantage. It was found that for academic outcomes at age ten to 11, having attended a high-quality preschool was found to be of particular benefit for

disadvantaged children (Sammons, Sylva, et al., 2007; Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, Hunt, et al., 2008). Similarly, at age 14 in terms of children's outcomes in mathematics or science, pupils of lower qualified parents were sensitive to benefits of the quality of the preschool attended (Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, Toth, et al., 2011). For literacy outcomes, both preschool quality and preschool effectiveness were statistically significant only for pupils of higher qualified parents (Sammons, Sylva, Melhuish, Siraj-Blatchford, Taggart, Toth, et al., 2011). In contrast at age 16, ECEC was found to have a particular impact for students from low-qualified parents, who, if they had attended a high-quality preschool, had better grades in GCSE English and maths compared to similar students who had not attended any preschool.

In line with the compensation hypothesis, Crosnoe, Leventhal, Wirth, Pierce, and Pianta (2010) found that, for six year-olds mathematics and reading achievements, consistent high stimulation across the home, preschool and the first grade school environment was particularly important for children from low-income families. The EPPSE study also used case studies to explore why and when certain children 'succeeded against the odds' while others fell further behind. Findings here indicated that high-quality preschool experiences particularly helped disadvantaged children, but mainly boys' educational outcomes (Siraj-Blatchford et al., 2011:3).

Some research indicates that in terms of children's language development, those with minority backgrounds benefited most from high-quality preschool (Ebert et al., 2013). In terms of children's mathematics competence on the other hand, it has been found that those of privileged background profit from high-quality preschool compared to children with migration background (Lehrl, Kuger, & Anders, 2014). Other research has not found support for differential effects of preschool quality depending on children's family backgrounds. Burchinal and Cryer (2003) did not find evidence that children's ethnic backgrounds influenced the effect of high-quality preschool experience. The European Child care and Education (ECEC) study group (1999) did not find significant interaction effects between ECEC quality and family background. And a recently published meta-analysis (Keys et al., 2013) did not produce consistent evidence that family background or child characteristics moderated the effects of ECEC quality on children's language and mathematics outcomes.

Keys et al. (2013) examined associations between observed preschool quality for approximately 6,250 three to five year-olds and school readiness skills at kindergarten entry, using data from four large-scale studies. They did not find clear evidence for moderation of preschool quality effect on child outcomes depending on demographic characteristics of the family or child entry skills and behaviours.

It has been argued that differences in findings may be due to differences between countries' income levels: higher income countries might find larger effects for disadvantaged and migrant children because in lower income countries (disadvantaged) families have less access to good quality childcare (Burger, 2010). This gets support from a study carried out with a US and a Danish sample (Esping-Andersen et al., 2012) where it was found that positive effects of high-quality formal ECEC at age three were particularly strong for the lowest-income children and those at the bottom of the test score distribution in Denmark, while such differential effects could not be found for the US sample. On the contrary, there, beneficial effects eroded by age 11, particularly for disadvantaged children. Such different results for these countries may well reflect the greater access (as compared with the US) to higher quality ECEC (and possibly schools), for disadvantaged children available in Denmark

CHILD CHARACTERISTICS AS MODERATOR

The EPPSE study found evidence that the benefits of high-quality ECEC were more noticeable for boys through to age 16 years (Sammons, Sylva, Melhuish, Siraj, Taggart, Toth, et al., 2014). As noted earlier, two Danish studies conducted by Baumüller et al. (2011, 2014) also found that, in terms of their school performance at age 15 to 16, boys benefitted more from preschool quality than girls.

Findings from research on parenting suggest the importance of individual differences in children's self-regulation for moderating ECEC effects upon socio-emotional outcomes, children low on self-regulation being more vulnerable to negative parenting behaviours, showing more externalizing behaviours than those average or high on self-regulation (e.g. Karreman, Van Tuijl, Van Aken, &

Dekovic, 2009; Rubin, Burgess, Dwyer, & Hastings, 2003). One plausible explanation is that children with low self-regulation need more external regulation of their emotions and behaviours (Crockenberg, 2003; Rothbart & Bates, 2006). This external regulation will vary in ECEC environments, depending upon the degree of support the ECEC environment provides. Hence studies find evidence of the moderating effect of self-regulation on the association between ECEC process quality and children's socio-emotional adjustment. One study showed that children low on self-regulation showed more negative emotional arousal and less situational social competence than their better-regulated peers when they experienced high intensity peer interactions (i.e. high levels of displayed energy and activity) in their preschool or kindergarten classroom (Fabes et al., 1999). Among kindergarten children, however, there was no evidence of moderation by child self-regulation for the link between several indicators of classroom quality and children's teacher-rated adaptive classroom behaviours at the end of kindergarten (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009).

C O N C L U S I O N

Scholars have long debated the benefits of preschool, or prekindergarten, education. Several small-scale studies have documented that preschool contributes to better educational, occupational, and social outcomes for disadvantaged children over the long-term and is cost-effective (Heckman, 2006). Large-scale, long-term studies, however, are unusual; yet such studies have the greatest potential to appropriately inform policy development. This report considers international research on the impact of ECEC provision upon children's development and, while not exhaustive, is an extremely comprehensive review, using studies reported from a wide range of sources including journals, books, government reports and diverse organisation reports.

Early research was primarily concerned with whether children attending non-parental care developed differently from those not receiving such care. Later work recognised that childcare is not unitary and that the quality or characteristics of experience matters. Further research drew attention to the importance of the interaction between home and out-of-home experience and the child's own characteristics. High-quality childcare has been associated with benefits for children's development, with the strongest effects for children from disadvantaged backgrounds. There is also evidence that sometimes negative effects can occur. The results of studies partly depend upon the context and ECEC systems in place in different countries, but there is sufficient commonality of findings across countries to indicate that many results are not culture-specific.

While the research on preschool education (over three years) is fairly consistent, the research evidence on the effects of childcare (zero to three years) upon development has been equivocal with some studies finding negative effects, some no effects and some positive effects. Discrepant results may relate to age of starting and also probably at least partly to differences in the quality of childcare received by children. In addition childcare effects are moderated by family background with negative, neutral and positive effects occur depending on the relative balance of quality of care at home and in childcare. Recent large-scale studies find effects related to both quantity and quality of childcare. The effect sizes for childcare factors are about half that for family factors. However, family effects incorporate genetic factors. Hence, family and childcare effects may be more equivalent than this comparison implies. Family factors and childcare quality covary, low-income families tending to have lowest quality care. The analysis strategy of most studies attributes variance to childcare factors only after family factor variance has been extracted, and, where the two covary, this will produce conservative estimates of childcare effects.

There are some methodological issues. Evaluations of intervention programs, whether large-scale or small-scale, have used RCTs or quasi-experimental design and achieved relatively consistent evidence. RCTs due to their

rigorous design produce more convincing evidence, however, on the other side; this can limit generalisability of the evidence to real-world applications. For universal/regular programs with the general population, non-experimental designs are the norm and the selection bias is an important issue to take into consideration because it limits the determination of causality in findings.

SUMMARY OF EVIDENCE FOR DISADVANTAGED CHILDREN

The evidence on ECEC in the first three years for disadvantaged children derives largely from intervention studies using high quality ECEC as the intervention. This research indicates that high-quality ECEC can produce benefits for cognitive, language and social development. Where the effects of potentially low-quality ECEC has been studied, often it appears to produce either no benefit or negative effects.

With regard to provision for three years onwards disadvantaged children benefit particularly from high-quality preschool provision. Also children benefit more in socially mixed groups rather than in homogeneously disadvantaged groups. Some interventions have shown improvements in cognitive development, but in some cases such benefits have not persisted throughout children's school careers. This appears to be partly from subsequent poor school experiences for disadvantaged children limiting earlier benefits from high-quality ECEC experience. However early childhood interventions do boost children's confidence and social skills, which provides a better foundation for success at school (and subsequently in the workplace). Reviews of the research often infer that it is the social skills and improved motivation that lead to lower levels of special education and school failure and higher educational achievement in children exposed to early childhood development programs. However there is clear evidence that cognitive, language and academic skills can also be enhanced by ECEC experience and these are likely to play a role also in the later educational, social and economic success that is often found in well-implemented ECEC interventions. Studies into adulthood indicate that this educational success is followed by increased success in employment, social integration and sometimes reduced criminality. There is also an indication of improved outcomes for mothers. The improvements appear to occur for those problems that are endemic for the particular disadvantaged group.

The low level of much ECEC quality is of particular concern. Some have argued (e.g. see Haskins & Barnett, 2010) that, for example in the US, government-funded preschool programs (e.g. childcare centres, Head Start, and state-funded prekindergarten) offer services that are of 'mediocre or worse' quality, that children attending the average centre may gain little cognitive boost, and that greater benefits could be gained by improving the quality of these programs. Others (e.g. Pianta et al., 2009) maintain that publicly funded preschool in the United States narrows the achievement gap between poor and non-poor groups by as little as five per cent because of the prevalence of low-quality programs and that preschool could be narrowing the gap by up to 50 per cent if quality were improved. Furthermore, it has been argued that while ECEC for children at risk can contribute importantly to combating educational disadvantage, this can only occur if certain circumstances are met. The design of the program and the approach to pedagogy and curriculum are seen to be crucial (Leseman, 2009).

SUMMARY OF EVIDENCE FOR THE GENERAL POPULATION

The evidence on ECEC in the first three years indicates that for children who are not disadvantaged in their home environment, high-quality ECEC benefits children's cognitive, language and social development in both the short- and long-term. There has been some evidence that high levels of childcare, particularly group care in the first two years, may elevate the risk for developing antisocial behaviour. However subsequent research indicates that this may be related to high levels of poor quality care, particularly in centres, particularly in the first year.

For provision for three years onwards the evidence is consistent that preschool provision is beneficial to educational and social development for the whole population. An example of the multi-national nature of positive ECEC effects is provided by an OECD (2011) report on PISA results that found that students who had attended some pre-primary school outperformed students who had not, by about a year of achievement. Studies

indicate that the benefits are greater for high-quality provision. Some evidence in the UK indicates that part-time provision produces equivalent effects to full-time provision. Also there is evidence from several countries that a starting age from two years of age onwards produces the strongest improvements.

CHARACTERISTICS OF EARLY YEARS PROVISION AND CHILD DEVELOPMENT

Children's daily experiences drive child development. To optimise the child experience it is possible to act upon several characteristics and hence improve the quality of ECEC. Aggregating evidence across much research indicates that the following quality characteristics of Early Years provision are important for enhancing children's development:

1. Adult-child interaction that is responsive, affectionate and readily available
2. Well-trained staff who are committed to their work with children
3. A developmentally appropriate curriculum with educational content.
4. Ratios and group sizes that allow staff to interact appropriately with children
5. Supervision that maintains consistency in the quality of care
6. Staff development that ensures continuity, stability and improving quality
7. Facilities that are safe and sanitary and accessible to parents

To promote stronger outcomes, ECEC should be characterized by both structural features of quality and ongoing supports to teachers to assure that the immediate experiences of children, those provided through activities and interactions, are rich in content and stimulation, while also being emotionally supportive. In addition, teachers who encourage children to speak, with interactions involving multiple turns by both the teacher and child to discuss and elaborate on a given topic, foster greater gains during the preschool year, across multiple domains of children's learning.

In addition to in-classroom professional development supports, the pre-service training and education of ECEC staff is of critical concern. However, here evaluation research is still scant. There are a range of recent innovations – for example, increasing integration of in-classroom experiences in higher education teacher preparation courses; hybrid web-based and in-person training approaches; and attention to overlooked areas of early childhood teacher preparation such as work with children with disabilities, work with children learning two languages, or teaching of early math skills. However, these innovations have yet to be fully evaluated for their impact on staff capacities or ECEC quality

COMPLEX PATHWAYS IN CHILD DEVELOPMENT

Child development is affected by children's experience, particularly in the Early Years, and ECEC is a substantial part of the young child's experience. Also as children enter school experiences in that environment will also influence longer-term outcomes. ECEC experiences play an important role in promoting child well-being, but background factors are also important. The relevant factors do not function alone, but interact with each other. Hence the potential effects of ECEC experience are partly moderated by family factors such as deprivation and parental sensitivity as well as child factors such as gender, temperamental reactivity and self-regulation. Sometimes the moderating variable may itself be influenced by ECEC experience, e.g. self-regulation, and when this occurs the distinction between moderating and mediating variable becomes blurred. In the case of self-regulation it appears to be important in the process by which early family and ECEC experiences get transmitted into later educational social and economic success.

POLICY RELEVANCE

The increasing evidence on ECEC has fuelled increasing interest in the universal provision of preschool education as a means of advancing school readiness for children and their later attainment of social, economic, and occupational success (Heckman, 2006; Zigler, Gilliam, & Jones, 2006). Indeed, some argue that preschool is not only an intervention for disadvantaged groups and a means of advancing social welfare for all but also a critical contributor to the economic health of the nation (McCain & Mustard, 1999). For example, Ben Bernanke, the chairman of the US Federal Reserve System, has argued that 'the payoffs of early childhood programs can be especially high' (Bernanke, 2011). Some countries appear to have adopted this perspective as they pursue focused efforts to provide ECEC provision as widely as possible.

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