

A REVIEW OF RESEARCH ON THE EFFECTS OF EARLY CHILDHOOD EDUCATION AND CARE (ECEC) ON CHILD DEVELOPMENT

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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 pre-school education (three+ years) is fairly consistent, the research evidence on the effects of childcare (birth to three years) has been 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 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 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 will 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 pre-school 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 programmes. 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, e.g., behavior problems, criminality, 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 produce 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 in the first year.

The low level of much ECEC quality is of concern. Some have argued (e.g., see Haskins and Barnett, 2011) that, in the US for example, government-funded preschool programs (e.g., child care centres, Head Start, and state-funded prekindergarten) offer services that are of "mediocre or worse" quality, that children attending the average center 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, and Thornburg, 2009) maintain that publicly funded preschool in the US narrows the achievement gap between poor and non-poor groups by as little as 5% because of the prevalence of low-quality programs and that preschool could be narrowing the gap by up to 50% 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 programmes and pedagogy and curriculum are seen to be crucial (Leseman, 2009).

For provision for three years onwards the evidence is consistent that pre-school 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 indicates 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 2 years of age onwards is most effective for preschool education.

Characteristics of early years provision and child development

The research demonstrates 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. Facilities that are safe and sanitary and accessible to parents
4. Ratios and group sizes that allow staff to interact appropriately with children
5. Supervision that maintains consistency
6. Staff development that ensures continuity, stability and improving quality
7. A developmentally appropriate curriculum with educational content.

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 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 children's experiences, particularly in the early years, and ECEC is a substantial part of the young child's experiences. 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 wellbeing, 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.

Introduction

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, 2008 p. 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 child care and early education occurring before school. This could include relatives (e.g. grandmothers), family day care, and group or center-based child care 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 work force 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 10 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 many 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 UK and Switzerland being the most expensive for families with 27 per cent and 50 per cent, respectively (www.oecd.org).

ECEC research in historical perspective

Research on ECEC and child development goes back over more than four 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 recognized 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), have been 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 attended subsidized ECEC 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 cognitive and academic outcomes (including language development and school achievement). Moreover, there has 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. hour per week) children spend in ECEC. Quality of ECEC can be considered in terms of structural and process quality. Structural quality comprises the organizational 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 randomised controlled trials (RCTs), most ECEC research is based on observational studies, because having researchers control their 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.

ECEC as an intervention for children from disadvantaged backgrounds

Child care or preschool education (ECEC) 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 and 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; Frede, 1995; Haskins, 1989; Melhuish, 2004; National Research Council, 2000, 2001; Yoshikawa, 1995; Heckman, 2006).

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 randomised 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.

US studies of ECEC as an intervention for children from disadvantaged backgrounds

ECEC for children 0-3 years

Several US programmes have used ECEC from 0-3 years as an intervention for children from disadvantaged backgrounds. The evaluations of programmes 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 programme 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 programmes serving more than 62,000 children in the US. EHS aims to promote children's development and provides child care, 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 up to age three (Love *et al.*, 2002). There have been found to be several positive effects for EHS participation. These include for children:

- Better cognitive and language development
- Better immunisation records and less hospitalisation
- Lower levels of aggressive behaviour
- More sustained play
- 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
- EHS parents also were more likely to be employed or in training
- EHS parents also delayed subsequent child bearing compared to controls

Effect sizes were modest, generally in the 10-20 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 on all outcomes. 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 was no significant positive impact upon the highest risk families who seemed impermeable to this intervention.

There were also differential effects for the different models of intervention. Centre-based programmes had the strongest effects on child outcomes whereas home-based programmes 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. Similarly, no effects were found at grade five on any of 49 measures, including grade repetition and special education. Aos *et al.* (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 six percentage points or 0.10 to 0.13 S.D. for the cognitive and language development outcomes, similar to that reported by Gormley (2007) and Karoly *et al.*, (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 TVIP for Spanish speakers was 0.27.

With regard to non-cognitive outcomes, Barnett (2008) noted that the program had small effects on parent outcomes. When children were five, small improvements (0.10 S.D.) were found in measures relevant to children's behavior problems, parenting, and maternal depression. Also Barnett (2011) found that at ages two and three, some social-emotional benefits were revealed of 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 (ES= 0.11), more sustained attention (ES= 0.16), and higher engagement of their parent during play (ES= 0.20). Also findings from the EHS prekindergarten follow up conducted 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.

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 (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 2-2.5 kg, there were large significant benefits of the enriched educational day care intervention. For the very low birth weight (less than 2kg) infants' results were more equivocal, but with limited evidence of benefit from the intervention (Ramey *et al.* 1992; Brooks-Gunn *et al.* 1994; McCarton *et al.* 1997). 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 IQ (10 points, effect size 2/3). The IQ gain was larger (14 points, 0.93 S.D.) for the heavier "low birth weight" (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) also 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 additional evidence that at age three, the treatment group had fewer behaviour problems and a higher rate of 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 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 which was designed to facilitate intellectual development of very young, disadvantaged children. The project, which began in the 1960s, was designed 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 programme from infancy to age six years with increasing educational input as age increased;

and vocational training, child care and household guidance was provided for mothers. Families were randomly assigned to intervention or control groups.

Regarding the major findings (Garber, 1988; Heber, Garber, Harrington, Hoffman, and Falender, 1972) by age six all of the children from the experimental group had higher IQs than all of the children from the control group. 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, (Ramey and Campbell, 1991; Campbell and Ramey 1994; Ramey *et al.* 2000). The 111 children, whose mothers had a low intelligence quotient (IQ) and low income, were randomised into two groups. One group was placed in a program that involved centre-based care and home visits beginning at three months of age and continuing until the children entered school. The control group received family support, social services, low-cost or free paediatric care, and child nutritional supplements but no additional child care beyond what the parents and the local services provided. The high quality ECEC programme 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 programme 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 programme (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 (Clarke and Campbell, 1998; Campbell, Ramey, Pungello, Sparling and Miller-Johnson, 2002).

Similar effects on cognitive outcomes are 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 for reading, 0.20 S.D. for math and 0.03 S.D. for high school completion (Reynolds *et al.*, 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.

Barnett (2008) reported that the Abecedarian Program produced large initial gains in IQ that have declined over time, with effect sizes of about 0.33 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 very slight decrease in magnitude over time. 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., while the effect on high school completion was surprisingly low at 0.06 S.D..

In addition to cognitive effects the Abecedarian Project produced long-term effects for non-cognitive outcomes. Manning *et al.*s. (2010) 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 *et al.* (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.

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 programme, 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 child care 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 child care intervention. (Ramey & Campbell, 1982; Sparling, Wasik, Ramey & Bryant, 1990). In essence, only the centre-based programme had any significant effect (Wasik *et al.* 1990; Burchinal, Campbell, Bryant, Wasik, & Ramey, 1997).

ECEC for children 3+ years

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

Randomised Control Trials (RCTs)

Perry Preschool Project

The Perry Preschool Project was conducted in Ypsilanti, Michigan. This half-day, five days a week, centre-based programme starting at three years of age 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 programme was demonstrated to have a series of 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 *et al.*, 1993).

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). According to Barnett (2011) the program had positive effects on achievement tests (e.g. 0.33 S.D. on reading and math at age 14) through age 27, and Nores *et al.* (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 Perry Preschool Project 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.

For non-cognitive outcomes, Manning *et al.* (2010) reported that effect size on deviance is 0.64 S.D. and on criminal justice is 0.41 S.D.. While Muennig *et al.* (2009) used 37 years of follow-up data to explore the linkage with adult health. The intervention led to improvements in educational attainment, health insurance, income, and family environment, which, in turn, lead to improvements in an array of behavioural risk factors and health.

Barnett (2008) reported that the preschool group had better classroom and personal 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 standard deviations (S.D.). The number of arrests by age 27 fell by half, and employment at age 40 showed an increase of 14 percentage points.

Karoly *et al.* (2005) reported the effect size on number of arrests by age 27 was -0.54 S.D., on per cent employed is 0.25 S.D. at age 27 and 0.30 S.D. at age 40, on monthly earnings \$1,993 at age 27 was 0.51. In terms of social services use the effect size is 0.44 S.D. on per cent received in past ten years by age 27 and -0.37 on per cent any lifetime use of social services by age 40.

Early Training Project (ETP)

The ETP occurred in Murfreesboro, Tennessee from 1962 to 1964. Sixty-five, three to four year old children were randomly assigned to treated (44) and control (21) groups. Children were selected for participation in the study if they lived in either poor or deteriorating housing or public housing, had a low family income, and had parents with less than a high school education who worked in an unskilled or semiskilled 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. 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, 2006).

ETP data come 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 very different from other intervention programmes considered here. It is federally funded but administered by each of the states independently. As a consequence the nature of Head Start varies substantially between states, and also within states. Head Start is a broad-based early intervention programme to improve outcomes for children in disadvantaged families. It was initiated in the 1960s as an eight week summer preschool programme but rapidly developed to be a year-round programme and has included a wide range of variations. Typically a Head Start programme would include centre-based early child care 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 programme, 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 and Karoly *et al.* 1998 for reviews). However often effects appeared to 'fade out' 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 were showing higher educational attainment. Oden, Schweinhart, Weikart, Markus and Xie (1996) conducted a 17-year follow-up study of Head Start graduates. 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 (1998) 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 of the effects of preschool education. Some were RCTs and some were quasi-experimental evaluations. McKey, Condelli, Barrett, McConkey and Plantz (1985) developed a meta-analysis of 210 studies evaluating Head Start programmes. They concluded that Head Start programmes 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 Duncan, 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 provides a means of controlling for family and other background factors. Using this nationally representative sample they find 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 'fade 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 persist into adolescence. This suggests that the 'fade out' is 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 one possible explanation for fading effects i.e., that children who have attended an early education provision are more likely to attend elementary schools of lower educational quality, with a less favourable socio-economic composition of the student population, 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 show 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 will have varying effects dependent upon the population and context involved. Other evidence supports the view that versions of the programme involving parents did improve children's outcomes (Lee, Brooks-Gunn, Schnur and Liaw, 1990).

A US General Accounting Office (1997) report concluded after the first 30 years of Head Start that very little was known about the impact of Head Start. 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. There was inconsistent support for the longer-term effects. There was also some evidence of health-related benefits in that Head Start participants were 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 programmes. This study (Administration on Children, Youth and Families, 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 programmes as generally high, with some indication of better child outcomes being associated with higher quality programmes. Also there were some benefits reported for parents in terms of increased employment and decreased benefit dependence.

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 as reported by Gormley (2007) shows effect sizes for a pre-reading test were 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 experience at age three or four, 13 of 22 measures of language, literacy, and math effects were significant; these 13 averaged 0.18 S.D. In addition, Barnett (2008) reported that the estimated cognitive effects of nine months of Head Start were ranging from 0.05 to 0.25 S.D.

A smaller randomised study conducted by Abbott-Shim *et al.* (2003; cited in Barnett, 2008) found gains of 0.32 S.D. on vocabulary (compared to those found in Head Start Impact

Study: 0.05 to 0.12 S.D.). Taking into account several concerns, Barnett (2008) concluded that one year of Head Start has initial effects on cognitive abilities that are at least in the range of 0.10 to 0.30 S.D. While Ludwig and Phillips (2008) present estimated effects of between 0.04 to 0.43 S.D. on a range of cognitive, linguistic and educational outcomes at age 4 years.

A randomised evaluation by the US. Department of Health and Human Services estimates test score 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.

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 12-15 were 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 is a RCT study to assess the impacts of Head Start on children and families through to the 3rd grade (age 9 years). Nearly 5000 newly entering children (either age 3 or age 4) from poor families were randomly assigned to the 'intervention group' that had access to the Head Start programme services or the 'control group' that did not have access to the Head Start programme but could receive other early childhood education services selected by parents rather than only receive parental care (US Department of Health and Human Services, Administration for Children and Families, 2010). After attending one year of Head Start, age 3 cohort children benefitted in all the four domains examined (cognitive development, social/emotional development, physical development and parenting practices); for 4 year 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, which were a favourable impact for the 4-year-old cohort on reading, but an unfavourable impact for the 3-year-old cohort on grade promotion.

Quasi-experimental evaluations of Head Start

Cognitive outcomes

According to the results of Head Start Impact Study (U.S. Department of Health and Human Services, Administration for Children and Families, January 2010), the effects for 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 as of 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.

Domitrovich *et al.* (2013) examined how the length of exposure to an enhanced Head Start model affects the academic functioning of disadvantaged children in kindergarten. They found that the average mean effect size across language and literacy measures comparing children with one versus two years was 0.36 S.D.. Also, at kindergarten, the numeracy skills of children who attended preschool for two years were significantly higher (effect size = 0.33) than those who received one year.

A note should be made with regard to 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.

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..

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. 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 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 for three year olds, 0.32 for four year olds.

Summary of results from Head Start

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 evaluations of Head Start reflect the very mixed nature of the programme itself in its myriad of locations around the USA. It is likely that the mixed results reflect differences in study design, lack of control of what happens to the comparison (control) group, different measurements, methods as well as differences in the implementation of the programme including its quality.

Quasi-experimental studies of other US programmes

Child-Parent Centers (CPC)

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-centered, 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 *et al.* 2000, 2001) 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 preschool program has shown effectiveness at improving 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 *et al.*, 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 5, 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 *et al.*, 2001, 2002; Reynolds & Robertson, 2003) 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 have largely persisted up to age 24 (Reynolds *et al.*, 2007). The findings confirmed

- Higher school completion, grade completion, longer college attendance; lower criminality, lower depressive symptoms.

Short term effects show moderate to high effect sizes in a number of studies. Barnett (2008) reports that estimated effects on test scores at kindergarten vary 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..

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), Temple and Reynolds (2007), Pianta *et al.*, (2009), Manning *et al.*, (2010), and Gormley (2007).

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 and on family well-being was 0.11. 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 life skills measure at eighth grade was 0.28 S.D., and effects for crime by age 18 effect of -0.20 S.D. and for violent offense of -0.19 S.D..

Reynolds, A. J., Temple, J. A., Ou, S.-R., Arteaga, I. R., & White, B. R. B. (2011) summarise the CPC findings succinctly. Their results demonstrate consistent and enduring benefits for children who began preschool at age 3 or 4 (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. multi-agency, applied school readiness project.

Miami School Readiness Program

The Miami School Readiness Program is a large-scale, university–community project. It primarily served 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 over time 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* generally improved over time, and teachers rated 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 as having 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 have set up their own preschool programmes. 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 of entering school unprepared while some are universally open to all children. Universal pre-K programmes are considered later. Here we focus on programmes targeted on disadvantaged children and the evaluation involves quasi-experimental studies.

Michigan started a preschool programme for children 'at risk' of school failure in 1985. An evaluation of this programme comparing programme children with non-programme children from similar backgrounds found evidence of positive effects. Teacher ratings indicated improved interest in school, and attainment on a wide range of subjects. Programme 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, 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 and 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 *et al.*, 2000).

The first year of the longitudinal evaluation uncovered some promising findings (Florian, Schweinhart and Epstein, 1997). Intervention children exhibited behaviours more conducive to their 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 significantly 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. Furthermore intervention children were rated as more advanced than the comparison children, and differences on 19 of 30 items were statistically significant.

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 programme had a significantly higher percentage of satisfactory scores on academic performance than students who had not attended the programme. Larger percentages of the intervention group demonstrated proficiency in both math (55 per cent versus 47 per cent) and reading (43 per cent versus 35 per cent). Again, a smaller percentage of the intervention group than comparison group had ever repeated a grade (14 per cent versus 22 per cent). 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 in previous years, was positively correlated to children's social relations scores across years, and with their 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 programme 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 per cent versus 22 per cent) and in math and language arts combined (35 per cent versus 28 per cent).

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 the following: 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 *et al.*, 2011). As such, an evaluation of this program's impact on student outcomes can provide guidance on whether modest programs, perhaps the best that can hoped for in the current budgetary environment, are worth implementing.

A longitudinal study assessing the effects of Texas's targeted pre-Kindergarten (pre-K) on a range of educational outcomes (Andrews, Jargowsky and Kuhne, 2012). The study compared scores in the third grade reading and math for students who had attended the public pre-K and those who had not, including those who stayed at home with relatives, informal care arrangements, Head Start, and private child care programs.

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 reduces the probability of retention. The odds of retention are 24 per cent lower for those who attended public pre-K. Students who attended the Texas pre-K program were also less likely to be assigned to special education in third grade; the odds of assignment were 13 per cent lower for those who attended public pre-K other things equal.

Syracuse Family Development Research Program

The Syracuse Family Development Research Program was a comprehensive child care, education, health and family support programme 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 and Honig 1988). The program operated in a single site in Syracuse, New York, between 1969 and 1976, and has undergone long-term assessments of its effects on participants. The program targeted economically disadvantaged families in order to improve children's cognitive and emotional functioning, create a positive outlook among the children, and decrease juvenile delinquency. 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 specific areas of the Center were designated for specific types of activities. The programme targeted young, African-American, single-parent, low-income families. Mothers were in the last trimester of first or second pregnancy. The evaluation study 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 to provide comprehensive early childhood programming for all children aged four who were living in poverty. The Early Childhood Assistance Programs (ECAP) are modeled after the federal Head Start program and use 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 and 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 it also very small-scale. The 26 students who received ECAP or Head Start services when they were four years of age were compared with 103 students who did not receive 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 their peers who did not receive ECAP or Head Start services.

The transition from ECEC to school

Recent research (Broekhuizen, 2014; Broekhuizen, Mokrova, Burchinal, and the Family Life Project Key Investigators, submitted) found that later school influenced the later impact of ECEC as an intervention for disadvantaged children in the USA. They investigated the combined effects of preschool and kindergarten quality in relation to 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 living in rural areas in the United States.. 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 classroom quality did not differ from children with only a high quality preschool experience. The findings suggest that, by the end of first grade, the high quality preschool experience was the strongest predictor of children's greater social and behavioral skills.

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 6 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 apparently 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 *et al.* (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.

Quasi-experimental studies

Germany

In Germany, the Socio-economic Panel *SOEP* survey of private households provides information on all household members, consisting of Germans, foreigners, and recent

immigrants. It is a wide-ranging representative study with annual follow-ups (DIW Berlin). The public kindergartens analyzed in the SOEP primarily targeted four- and five year olds. The kindergartens were designed to promote both the social and the cognitive development of children and they were mostly available on a half-day basis. In West Germany, where the studies were conducted, only about 20 per cent of all kindergarten places were full-day care in 2001. Hence working parents usually need additional care arrangements such as neighbours, grandparents etc. although by law, the German kindergarten is supposed to support parents' labor market participation and help parents meet their 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 organizations. It is intended to prepare children for school even though it is not compulsory. Providers of kindergartens receive high public subsidies and kindergartens are supposed to be available for every child. In Germany, family day care for children between four and five years plays a minor role and is rather used for toddlers (Spiess, Buchel, and Wagner, 2003). The main research question concerned the effect of kindergarten attendance on the probability of later attending a school with extended academic requirements, the so called "Gymnasium," or restricted requirements, "Realschule" and "Hauptschule" (Landvoigt, Muehler, and Pfeiffer, 2007; Spiess *et al.*, 2003)." (Burger, 2012)

The focus of a study, using SOEP data, by Felfe and Lavile, (2012) was the child care system in West Germany, a setting with low levels of provision of center-based care (in 1990, slots were available for 1.8 out of 100 children age zero-three years old, in 2002 for 2.8 out of 100 children). It employed a marginal treatment effects framework (MTE). Children from an advantaged socio-economic background, in terms of maternal education and household net income, derived lower returns to child care attendance than children from a less advantaged family background. In particular, children from an advantaged background have lower returns to child care in terms of comprehension and independence (their ability to dress alone). One explanation might be that higher SES families invest already early on in their children's skills and thus, any benefits their children might derive from child care might not be captured by the available skill measures.

The results shown so far are relevant for policies targeted at expanding center-based care. They indicate that children who have the lowest returns from attending child care are sent to child care first. Yet, children who would benefit the most -younger children and children from disadvantaged backgrounds- are least likely to be sent to child care.

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

In the Netherlands, a variety of early education and care programmes was researched in the Dutch Cohort Study of Primary Education (PRIMA) (Driessen, 2004). The common aim of these different programmes was to stimulate the socio-emotional and the cognitive development of children. Various institutions targeted different age groups between birth and eight years. Most of the programmes were available on a part-day basis: day care centers provide child care for children between birth and four years of age. They are generally open every work day and usually administered by private organizations. The use of day care centers is subsidized by the national government, based on their income; parents have to contribute to the cost of day care centers. 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. Early childhood education and care programmes, finally, are special services typically aimed at children from disadvantaged backgrounds and usually conducted in preschools or elementary schools. The programmes are intended for children up to eight years of age. Three-quarters of all programmes are at least partly financed by municipal authorities, and one-quarter by the ministry of welfare. The Dutch Public Preschool Study (DPPS) drew on public preschools, also referred to as kindergartens, which are integrated in the primary school system, forming the first two grades of primary school (van Tuijl and 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 5-year-old children who attend the kindergarten classrooms of primary schools. Using retrospective analysis, reconstructing attendance to targeted preschool programmes from age 3 to 6 and controlling for global family background characteristics based on school records, no statistically significant effects of targeted preschool education were found on language and cognitive outcome measures and school achievement (Driessen, 2004). A recent retrospective analysis of the effectiveness of targeted pre-school and kindergarten programmes for 3- to 6-year-olds, based on a cohort of 5-year-olds with more detailed measures of the preschool programmes attended than in the PRIMA-study, neither showed significant effects of participation in targeted programmes (Bruggers, Driessen, & Gesthuizen, 2014). The retrospective approach in these studies, however, is vulnerable to hidden (self-) selection mechanisms and lack of control of programme implementation. Other evidence (Slot, 2014) indicates that placement in targeted preschool programmes is selective. That is, children with the lowest scores on tests for screening of delays in cognitive and language development are most likely to enter these programmes, regardless their socioeconomic 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.

Van Tuijl and Leseman (2007), in a smaller scale prospective study, focused on Turkish-Dutch and Moroccan-Dutch 4- to 6-year-old children ($N = 312$) in the two-and-a-half year (20 hours per week) public kindergarten programme of primary schools and used age-norm-referenced intelligence measures to examine the growth and catch-up effects relative to age-norms that were related to attendance of kindergarten. They reported gains relative to the age-norms with standardized effect sizes of .58 for total IQ, and of .36 and .44 for Verbal and Fluid IQ respectively. Effect sizes were largest for the youngest non-Dutch speaking children, entering the programme at age 4. In addition, *gains* in verbal and fluid intelligence predicted receptive Dutch vocabulary and pre-mathematical skills at age 6, with the strongest effects for the youngest non-Dutch speaking children in the study (standardized beta's for this group were .34 (gain in verbal IQ on vocabulary) and .38 (gain in fluid IQ on maths) respectively, after controlling for age four verbal and fluid IQ).

De Haan, Hoofs, Elbers and Leseman (2013) followed two cohorts of preschoolers of low income immigrant families ($N = 91$), aged 3 and 4 years respectively at the start of the study, attending preschools and kindergarten classrooms in primary schools. Children were attending classrooms with or without an educational programme intended to increase language and pre-math skills, and classrooms with a socioeconomically mixed or mainly disadvantaged composition. Classroom observations were conducted to determine the amount of time spent to 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 .35 to .52 for teacher initiated academic activities and from .30 to .62 for classroom composition. Interestingly, working with or without an education programme did not explain the variance in teacher initiated activities, nor affect children's growth in academic skills, pointing to weak programme implementation.

France

The French kindergarten, the "ecole maternelle," is available to all children from three to six years and it has an explicit educational mission although not all of the necessarily focus on the promotion of pre- academic skills (some primarily emphasize 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).

As part of evaluations of the effects of the system, possible benefits for disadvantaged groups have been investigated. Caille (2001) reported a stronger effect of an earlier start in "ecole 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 in France, it has also been shown (Dumas and Lefranc, 2010) that the large-scale expansion of a universal, free preschool programme 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.

Blok *et al.* (2005) conducted a meta-analysis comparing targeted centre and home-based programmes for disadvantaged children for the age range 0-6 years. Centre-based programmes and combined centre-based and home-based programmes were more effective by about 0.5 S.D. on cognitive and educational outcomes than home-based programmes, but they found no consistent effects for socio-emotional outcomes.

Summary of evidence for disadvantaged children

The evidence on child care in the first three years for disadvantaged children indicates that high quality child care can produce benefits for cognitive, language and social development. Low quality child care produces either no benefit or negative effects. High quality child care with associated home visits may well produce the greatest benefit for children under three years of age.

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 relatively few cases have these persisted 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 programmes. 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.

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 and Vandell, 2007; Phillips and 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 and 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 child care

ECEC for children 0-3 years

Findings on the relationships between attendance or amount of early child care and children's development are mixed: negative effects, no effects and positive effects (particularly for children at risk) have been identified (Bradley and Vandell, 2007; Melhuish, 2004b; Ruzek, Burchinal, Farkas, and 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 was 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 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 pre-school (LaFreniere & Sroufe, 1985; Waters, Wippman & Sroufe, 1979). The perspective that daily separations may harm the development of a secure attachment influenced much early research on infant child care.

Two 1980's meta-analyses summarized 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 and Boyle, 2008, for a comprehensive review of day care and attachment in the US). Concerns over sample sizes and the quality of these studies contributed to the hallmark study known as the National Institute of Child Health and Human Development Study of Early Child care and Youth Development (NICHD SECCYD), comprising approximately 1300 children sampled from ten sites across the US.

This is a landmark study and 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.

The nature of employment rights, parental leave and child care availability in the US mean that parents who wish to return to employment after the birth of a child and use child care will typically do so from the time when the child is a few months old. They will then usually continue to be employed and use child care. This results in a situation where those children who receive child care in the first year are likely to be largely the same as those receiving child care in the second and third years so that amounts of time in ECEC remain stable throughout early childhood (Bradley and Vandell, 2007; Phillips and Lowenstein, 2011). This limits the options to investigate age of starting and timing effects for child care. Hence analyses of quantity of child care become similar to analyses of the intensity of child care (hours per week) as the variation due to age of starting has less influence on the quantity of child care measure.

With regard to measuring the quality of child care, the study used several measures of process and structural quality. However a substantial number of child care 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 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 and 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, or in countries with predominantly part time (e.g., two days a week) use of day care, such as the Netherlands) 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. Also other studies find that higher rates of insecure attachment are associated with poor quality day care (Harrison and Ungerer, 2002, extended analyses in Love *et al.*, 2003). In summary, day care may compromise attachment security, but only in instances of poor quality infant care either at home and/or in day care.

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

Other aspects of Social and Emotional Development

Other reports have focused on subsequent aspects of social and emotional development. 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 NICHD SECCYD study, as in other US studies and other countries (Belsky, 2001). Sometimes associations remain when outcomes are measured in later childhood and adolescence (see Zachrisson, Dearing, Lekhal, and Toppelberg, 2013, for review). However, while earlier reports from the NICHD SECCYD did that negative effects on externalizing behaviors were independent of ECEC quality, emphasising quantity and type of care (Belsky, Vandell, 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; Vandell et al., 2010).

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 3 separate studies in Norway, Zachrisson, Backer-Grøndahl, Nærde, and Ogden, (2012), Zachrisson *et al.*, (2013) and Solheim, Wichstrøm, Belsky, and Berg-Nielsen, (2013), failed to find associations between quantity of care and externalizing behaviour. Also associations between day care quantity and behaviour problems are not consistently replicated in studies using statistical methods that mimic the effects of randomisation (Zachrisson *et al.*, 2013). However, another Norwegian study did find negative behavioural effects of child care quantity (Solheim, Wichstrøm, Belsky, & Berg-Nielsen, 2013), reflecting the findings of a much earlier study in Norway (Borge and Melhuish, 1995).

Some studies found comparable negative behavioural effects of child care quantity (Loeb et al., 2007; Yamauchi & Leigh, 2011), while several other studies found no effects of child care quantity (Romano, Kohen, & Findlay, 2010; Votruba-Drzal, Coley, Maldonado-Carren, Li-Grining, & Chase-Lansdale, 2010; Zachrisson, Dearing, Lekhal, & Toppelberg, 2013). Also in the Netherlands, (Broekhuizen, 2014; Broekhuizen, Aken, Dubas, and Leseman, in press), it was found that high quality child care was related to better teacher-rated social competence one year later at age 3 while high quantities of child care was linked to more teacher-rated externalizing behavior both concurrently at age 2 and one year later at age 3. No interactions between child care quality and quantity were found for teacher-rated behaviors. However, for parent-rated behaviors, more days in high quality child care were related to less externalizing behavior. Follow-up analyses showed that the difference in externalizing behavior for children in relatively low or high quality child care became significant when children spent three days or more in this high quality child care setting.

When comparing these studies, it appears that the most consistent negative behavioural effects are found for teacher reports (Loeb et al., 2007; NICHD ECCRN, 2006), and for families from relatively high SES families (Loeb et al., 2007; Yamauchi & Leigh, 2011). Thus, these mixed findings appear to be due to not only variations in study design, but also differences in measurement, informants and sample characteristics. Moderation of ECEC effects by sample characteristics is discussed later in this review.

Cognitive, language and educational development

Overall, however, the collection of studies included in our review suggests 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-three years (Leseman, 2009; Mathers, Eisenstadt, Sylva, Soukakou, and 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 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 programme services, for instance, tended to close the performance gap between children of more educated and less educated mothers (Carnegie Results, 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. (Tremblay, Kurtz, Masse, Vitaro and Phil 1995; Hauser-Cram, Pierson, Walker, and Tivnan, 1991). 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 Study of Early Child care (SECC) on developmental effects of day care in 10 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, 2005a). 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, 2005a). 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, and 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 $d = .14$ to $.19$ 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 also matters: more hours per day lead to greater academic benefits (Loeb, Bridges, Bassok, Fuller, and Rumberger, 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, and 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, and Bryant, 1998). And a study of 229 US children enrolled in child care 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, and Kagan, 2008).

Alongside a body of strong evidence of beneficial effects of early ECEC attendance exist research findings that point to no effects, or negative effects (Bornstein, Hahn, Gist, and

Haynes, 2006; Driessen, 2004; Lefebvre and Merrigan, 2002; Bruggers, Driessen & Gesthuizen, 2014). 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 child care, even in child care 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, 2005a).

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 and 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 and Thompson, 2006), an analysis at age 16 showed that effects were no longer visible (Hogden, 2007).

The Longitudinal Study of Australian Children reported better learning outcomes at age 6 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 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, and 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 and Malmberg, 2011b).

In Sweden researchers found that longer duration of ECEC attendance before the age of four related to enhanced cognitive and language development. Advantages persisted into later childhood (Broberg, Hwang, Lamb, and Bookstein, 1990; Broberg, Wessels, Lamb, and Hwang, 1997), but could not be found any more in adolescence or adulthood (Hwang, 2006).

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.*, 2012). 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 and Oesch, 2008). Again in Germany, Lalive (2010) found that ECEC attendance in the first years increased language skills among two-three year old children, and school grades in middle childhood. In Italy, the availability of additional child care slots for the zero-two age group was shown to be effective in raising children's language scores, but not for their maths skills (Brilli, 2012).

Finally, a meta-analysis on the effectiveness of early childhood educational programmes reported that programmes with a duration of more than three years had larger effects on cognitive development than those programmes 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, programme 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 3+ years

Socio-emotional development

Much research has considered the effects of specific preschool programmes for disadvantaged groups. A meta-analysis of US studies found, on average, a small but positive effect on socio-emotional outcomes of attending such programmes, compared to not attending (Camilli, Vargas, Ryan, and 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 and Dearing, 2014, also including a recent literature review). Also a meta-analysis by Blok *et al.* (2005) of centre-based, home-based and combined centre-home-based programmes, 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 programmes 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 (Mitchell, Wylie, and Carr, 2008; Pianta, Barnett, Burchinal, and Thornburg, 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 programmes – with substantial effects for both cognitive and socio-emotional outcomes, and possibly thought to adulthood (Camilli, Vargas, Ryan, and Barnett, 2010; Nores and Barnett, 2010).

US studies

In the US, state-funded preschool programmes 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 programmes. State pre-kindergarten (pre-K) programmes 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 programmes are targeted on low-income children or others at risk of entering school unprepared (considered in section on disadvantaged children), while other pre-K programmes are open to all children.

Some rigorous evaluations of state-funded pre-K programmes 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 programme (control group) and those who just completed it (treatment group), but are similar in age. Results point to positive effects of programme 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, and Lamy, 2007; Gormley, 2008; Gormley and Gayer, 2005; Gormley, Gayer, Phillips, and Dawson, 2005; Gormley, Phillips, and Gayer, 2008; Huang, Invernizzi, and Drake, 2012; Hustedt, Barnett, Jung, and Figueras, 2008; Winsler *et al.*, 2008; Wong, Cook, Barnett, and 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 programmes are not necessarily representative, and some are clearly very high quality programmes (e.g. Oklahoma's pre-K program Tulsa). However, they provide evidence of what pre-K can do on a large public scale.

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 and 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 programmes however found only limited evidence for long-term impacts (Hill, Gormley and 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, and Figueras, 2007; Hustedt, Barnett, Jung, and 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, and Waldfogel, 2004; Magnuson, Ruhm, and 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 fadeout 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 and 0.20, respectively, for disadvantaged children, compared to 0.12 and 0.10 for all children.

Huang *et al.* (2012) also used the ECLS data to investigate the effects of a state-funded pre-K programme, the Virginia Preschool Initiative (VPI), and found that programme 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, and Maynard, 2010; Herbst and 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 criticised for their limitations (Johnson and 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 subsidy 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 and LaTourrette, 2000).

A US study of a representative sample of twins found that preschool attendance at age 4 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). And 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 and well-researched state-funded pre-K programme is New Jersey's Abbott Preschool Program. It is of broad national and international interest because the programme 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 programme as well as before- and after-school care and summer programmes 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 programme served more than 40,500 three and four year old children in a mix of settings including public schools, private child care centers, and Head Start agencies (Frede *et al.*, 2007).

A longitudinal study of the programme, 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 for the language, 0.56 for print awareness, and 0.36 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 of 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, and 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 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 *et al.*, 2013). Achievement gains were particularly large for children who attended the programme 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 (e.g., Sylva, Melhuish, Sammons, Siraj-Blatchford, and Taggart, 2004a; Sylva, Melhuish, Sammons, and Siraj-Blatchford, 2007; Melhuish, Sylva, Sammons, Siraj-Blatchford, Taggart, Phan, and Malin, 2008). 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 7, 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 *et al.*, 2008a; Sammons *et al.*, 2007b; Sammons *et al.*, 2008c). 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 *et al.*, 2011a; 2014). Also similar results of benefits of ECEC attendance on children's general cognitive skills were also found in a similarly designed study in Northern Ireland (EPPNI) (Melhuish, Taggart, Siraj-Blatchford, and Sammons, 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 positive, but short lived impact on mathematic test scores (Goodman and Sianesi, 2005). Cognitive benefits from participation in ECEC programmes 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, and 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 of the French pre-primary system was reported to increase levels of literacy and maths knowledge at the start of primary school (Jeantheau and Murat, 1998) reduced class retention of low income and immigrant children in primary school (Caille, 2001) and persistent effects indicating that preschool helps children succeed in school and obtain higher wages in the labour market (Dumas and 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 associated with strong benefits for later educational and job outcomes (Havnes and 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 on the other hand (Driessen, 2004; see also Bruggers *et al.*, 2014), using a retrospective design, found no significant effect of ECEC participation on children's cognitive competences at age ten years. While a Danish study (Datta, Gupta and 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 and Biedinger, 2006; Becker and Lauterbach, 2004; Bos *et al.*, 2007; Büchner and Spieß, 2007; Spiess, Büchel, and Wagner, 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 and Wößmann, 2004; Rindermann and Ceci, 2009; Schütz, Ursprung, and Wößmann, 2008; Waldfogel and 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 generalizable.

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, and 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 and Galiani, 2007; Berlinski, Galiani, and 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 and Galiani, 2007; Berlinski, Galiani, and Gertler, 2006, 2009; Berlinski *et al.*, 2008).

A recent study in Cambodia (Rao *et al.*, 2012a) showed that ECEC had positive effects on developmental outcomes, with centre-based care being most effective. And 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, and Zhang, 2012b). Attendance of an age appropriate preschool programme was more effective than earlier school starting age. Also, research in a poor district of China by Luo, Zhang, Liu, Zhao, Shi, Rozelle, and Sharbono (2011) found that children with preschool attendance achieved higher educational readiness scores than those without preschool attendance, after controlling for the observed 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 programme attendance.

The search for the ideal starting age, duration and intensity of attendance

In the case of starting age, the “skill begets skill” human capital production models (Cunha and 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 programmes, 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 programmes has shown that starting age is a more powerful predictor of outcomes than duration; but differences in ECEC effects for programmes starting before the age of three as compared to those starting later were only modest and lower than expected (Leak *et al.*, 2010).

There have always 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, and this finding is quoted in many reviews (Bradley and Vandell, 2007; Jacob, 2009; Melhuish, 2004b; Phillips and Lowenstein, 2011; Vandell, 2004). In terms of children’s school readiness and receptive language scores at age three, analysis of the NICHD data showed that maternal employment at nine months was related to lower school readiness scores at 36 months, with the effects more pronounced when mothers were working 30 hours or more per week (Brooks Gunn, Han, and Waldfogel, 2002). In another study of NICHD data, medium rather than high amounts of ECEC related to better outcomes, and children with medium amounts of ECEC did not have better outcomes than those primarily in maternal care (Adi-Japha and Klein, 2009).

Overall, studies that have previously assessed effects of maternal employment in the first year on child outcomes have showed negative effect on infant development. 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 child care 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 child care.

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, and Burgess, 2005; Harrison *et al.*, 2010; Waldfogel, Han, and Brooks-Gunn, 2002; Wylie and Thompson, 1998). Some results indicate that a preschool starting age of two-three years is the most beneficial for children. The NICHD ECCRN 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, and 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, and Votruba-Drzal, 2013).

The English EPPSE study found a small effect for longer duration of ECEC on academic outcomes, however no additional effect of the time before two years of age was found (Sammons, Siraj-Blatchford, Taggart, Barreau, and Grabbe, 2007a; Sammons *et al.*, 2007b; Siraj-Blatchford, Sammons, Taggart, Sylva, and 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 effects of attending universal (high quality) child care on children's language development started after the age of one – with positive effects of child care 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.

Much of the research addressing those questions has focused explicitly on centre-based ECEC programmes 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 programme 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 and Spieß, 2007; Caille, 2001; Driessen, 2004; Sylva *et al.*, 2004a; Votruba-Drzal and Lindsay Chase-Lansdale, 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 and Lamy, 2006; Biedinger and Becker, 2006; Bos *et al.*, 2003; Owen, Klausli, Mata-Otero, and Caughy, 2008) others found evidence that more than three years were most beneficial (Sammons *et al.*, 2002; Wylie *et al.*, 2006; Wylie and 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, (2014) conducted research at six public kindergartens in Beijing. They found that entering preschools 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, (2011) examined the relationship between preschool enrolment age and four-year old children's cognitive and behaviour development for 1,391 pre-school children from 74 kindergartens. This study revealed the curvilinear effects of preschool starting age on children's cognitive and behaviour development. Entering preschool between 2 and 2.5 years old resulted in the most beneficial effect (effect size = 0.26 S.D.) and starting before or later, while beneficial, did not produce such strong effects.

Further research more fully 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 *et al.*, 2008a; Sammons *et al.*, 2008c; Wylie *et al.*, 2006), possibly reflecting the accumulating effects of school and other experiences that may 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 (NCEDL) 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 programmes 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 5th grade (Le, Kirby, Barney, Setodji, and Gershwin, 2006).

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, and Barnett, 2006; Walston and West, 2004). However, often these effects are short lived (Bingham and Hall-Kenyon, 2013; Cooper, Allen, Patall, and Dent, 2010; DeCicca, 2007; Votruba-Drzal *et al.*, 2008; Wolgemuth, Cobb, Winokur, Leech, and Ellerby, 2006), and there is some evidence that they depend on family background (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 of the 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 0-3 years

Concerns about early non-maternal care have been raised in particular in regards to group settings for the youngest children. While 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, and 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. 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 and Keane, 2011; Gregg *et al.*, 2005; Hansen and Hawkes, 2009; Houn, Jeon, and Kalb, 2011; Loeb, Fuller, Kagan, and Carrol, 2004; Love *et al.*, 2003; Sylva *et al.*, 2011b).

Results from ECEC targeted on disadvantaged groups as covered earlier is 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) in a meta-analysis of targeted programmes for disadvantaged children concluded that centre-based programmes and combined centre-based and home-based programmes were more effective by about 0.5 SD than home-based programmes, overall for ECEC for the age range 0-6 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 the UK, Hansen and Hawkes (2009) analysed data from the Millennium Cohort Study (MCS) and tested the effectiveness of different types of child care 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 score at age three. The English FCCC study found that children who had been in centre care had better cognitive development, based on the Bayley MDI, at 18 months compared to children in several types of home-based care (Sylva *et al.* 2011b)

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 child care arrangements were not effective.

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 child care have concluded that differences in effects of centre-based and home-based care settings may be due 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, and Chang, 2004). And the NICHD study (NICHD Early Child care Research Network, 2000a) found that at 6 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 month, 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.*, 2012).

The NICHD study reported that when children were in child care 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 child care homes were no longer evident (NICHD Early Child care Research Network, 2004).

In the NICHD study, findings with regards to 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 subsequent analysis, Tran and Weintraub (2006) found that child care 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 *et al.*, 2007a; Sammons *et al.*, 2007b; 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 child care such as a nursery or playgroup.

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 and 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 *et al.*, 2011b).

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 as to whether it is beneficial 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 programmes (Dowsett *et al.*, 2008). However the FCCC study in the UK and the US NICHD study both found that socio-emotional problems at 36 months were unrelated to which type of child care had been experienced (Barnes *et al.*, 2010; NICHD ECCRN 2005c). 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, and Warwick, 2008). Undeniably, we do not know enough how home-care settings relate to children's development, and how to best support carers in home-based care.

ECEC for children 3+ 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 child care 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, 2003c) 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 5. 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.

Variation in the quality of ECEC

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 and Vandell, 2007; Melhuish, 2004b; Phillips and Lowenstein, 2011). Also Broekhuizen, Dubas, van Aken, and Leseman (in press) 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 child care quality has indicated that high process quality child care (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 ECCRN, 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 ECCRN, 2006; Peisner-Feinberg *et al.*, 2001), with positive behavioural effects sometimes extending to adolescence (Vandell *et al.*, 2010).

However, sometimes find no effects for some socio-emotional outcomes (NICHD ECCRN, 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 U.S. showed that ECEC process quality was not reliably associated with children's social skills and problem behaviours one year later. One possible explanation for 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 very thorough review covering the birth-to-five age range, Zaslow *et al.* (2010) 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 programme 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 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 child care did not account for associations between attendance of centre care and children’s cognitive outcomes (Abner, Gordon, Kaestner, and Korenman, 2013). Furthermore, quantity did not predict cognitive outcomes above quality measures. Yet, another analysis of the NICHD data (NICHD, 2005a) 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 child care 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-three age group, the quality and stability of care are particularly crucial (Anders, 2013; Burchinal *et al.*, 2009).

The importance of high quality Early Childhood Education and Care (ECEC) is widely recognised within the field of childhood development. The positive impact of child care quality on various aspects of children’s development is one of the most consistent findings in developmental science. In good to excellent child care, children score higher than their peers in mediocre or poor child care 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 child care provides children with warm and positive relationships with their child care providers, a safe and healthy environment, and opportunities for children to learn (Shonkoff and Phillips, 2000). While the ECEC field contains varying views for defining what makes up programme 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 child care (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 take account of a wide spectrum of quality dimensions, including process as well as structural aspects of the environment (e.g. ITERS-R, FDCRS).

ECEC for children 0-3 years

For the zero-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 (Tietze *et al.*, 2012). 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 *et al.*, 2011b). Additionally in the Netherlands, Slot *et al.*, studied two- to three-year-olds in day care and preschools, and found small but significant positive effects of CLASS observation measure of quality of emotional support on vocabulary growth, and of quality of instructional support on attention skill growth over one year (Slot, 2014; Slot, Mulder, Verhagen, Boom, and Leseman (in press).

ECEC for children 3+ 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 in the field have been carried out. While significant positive and long-lasting effects have been found, longitudinal effects are not found conclusively, and 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 and Lamb, 2011; Anders, 2013; Belsky, 2009).

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 8, 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; 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 *et al.*, 2008b; Sammons *et al.*, 2014a, 2014b, 2014c; Sammons *et al.*, 2014d; Sammons *et al.*, 2011b; Sylva, Melhuish, Sammons, Siraj-Blatchford, and Taggart, 2011a). 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 *et al.*, 2002a; Melhuish *et al.*, 2002b; Melhuish *et al.*, 2006; 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 (Wylie and 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, Rosbach, Ebert, and Weinert, 2013; Anders *et al.*, 2012). In terms of children's language development however, such associations were not evident (Ebert *et al.*, 2013).

Recent meta-analyses of a number of large scale ECEC studies (Burchinal, Kainz, and 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 programme 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 child care 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 and 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).

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 and Hofer, 2012; Keys *et al.*, 2013; Weiland, Ulvestad, Sachs, and Yoshikawa, 2013; Zaslow *et al.*, 2006).

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 6 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 0-3 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, and Mooney, 1990) and three years of age (Melhuish, Martin and 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, and 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 and Rockel, 2012; Stephen, Dunlop, Trevarthen, and 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 child care 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 the individual child (e.g. ORCE). The focus of measurement 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, and 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, Pinquart, and Lamb, 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 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 NICHD study, scores on the ORCE measure was found to be a consistent modest to moderate predictor of children's language and cognitive development (McCartney, Dearing, Taylor, and Bub, 2007; NICHD Early Child care Research Network, 2000b, 2002b, 2003b, 2005a, 2005b, 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 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, and 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, and 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 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) have argued that the evidence of the long-term effect of early child care 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 child care in their communities" (p.750) rather than in high quality interventions, and this suggests that "the quality of early child care experiences can have long-lasting (albeit small) effects on middle class and affluent children as well as those who are economically disadvantaged" (p.750) (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 *et al.*, 2011b).

In the Netherlands, the 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). 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, and 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.

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 *et al.*, 2013)

In contrast, some European studies have found little to no effect of the relationship quality in early years settings. In Germany, the NUBBEK-study found little to no evidence that the quality of care for under-threes, measured by the German version of the ITTERS-R and the CIS, was related to child outcomes (Tietze *et al.*, 2012). However, while the CIS focuses clearly on the interactional quality between caregiver and children, the ITTERS-R assesses quality more globally, and includes structural aspects as well as process dimensions. Similarly, in a Swiss study (Pierrehumbert, Ramstein, Karmaniola, Miljkovitch, and Halfon,

2002) no associations between measures of the quality of caregiver relationships at age two and children's cognitive outcomes at age 3 was found.

While a longitudinal study in Sweden (Broberg *et al.* 1990) found no associations between process quality at age 2 and language development at age four, it did find positive associations later at age 8 (Broberg *et al.*, 1997). A small Australian study of 48 toddlers and 37 pre-schoolers found that it was highly beneficial for young children's cognitive development for positive attitudes to be displayed towards children by the teachers (Kowalski *et al.* 2005; Dalli 2011).

ECEC for children 3+ 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 pre-schoolers – 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 and 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 the 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 and 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.

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, and 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 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 and Burchinal, 2010).

A recent study investigated links between general and domain-specific elements of teacher-child interactions and children's developmental outcomes (Hamre, Hatfield, Pianta, and Jamil, 2014). Among a diverse group of four year old pre-schoolers, responsive teaching was related to development in cognitive domains, and cognitive facilitation was associated with gains in early language and literacy skills.

Furthermore, 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 and Porche, 2011; Vandell *et al.*, 2010).

Pedagogical practices and curriculum

ECEC for children 0-3 years

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, and Hamre, 2010).

For the zero-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, Wild, Glenny, and Kyriacou, 2009). While too little known about the specifics of early years pedagogy within ECEC environments, there is some indicative evidence. The NICHD 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 *et al.*, 2000). Whitehead (2002) 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 child care 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 3+ years

Effective pedagogy includes interactions explicitly aimed at supporting learning in both higher-order thinking skills 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). 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 and West, 2004). 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, 2009). Also Dickenson (2011) and Dickenson and Porche (2011) cite a meta-analysis and their own work on pre-K language curricula aiming at fostering complex (academic) language. It is concluded that there are no effects overall on later language and literacy when there is low implementation fidelity with teachers having difficulties in adapting instruction practices. However more focused interventions (e.g., vocabulary instruction, shared book reading) are more successful.

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 *et al.*, 2011a; Sammons *et al.*, 2014d; Sylva *et al.*, 2004a; Sylva *et al.*, 2012). Similarly, Clements and Samara (2011) found that the best practices for mathematics instruction explicitly incorporate foundational math conceptual learning within everyday activities so providing activities to 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).

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 programmes 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, Magnuson, and Ou, 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 and Speer, 2000). Another study showed that instruction that blended child-initiated and teacher-directed instruction within a comprehensive programme model links to higher levels of school readiness and early school achievement (Graue, Clements, Reynolds, and Niles, 2004).

Curricula can play a crucial role in ensuring that children experience high quality care which 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 and 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 and Sarama, 2008; Starkey, Klein, and Wakeley, 2004) as well as language and literacy curricula (Bierman *et al.*, 2008; Fantuzzo, Gadsden, and McDermott, 2011; Farver, Lonigan, and Eppe, 2009; Lonigan, Farver, Phillips, and Clancy-Menchetti, 2011; Preschool Curriculum Evaluation Research Consortium, 2008; Wasik, Bond, and 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). Moreover, However, 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 child care settings (Justice *et al.*, 2008). While the authors point to difficulties in taking interventions to scale, they also list some important recent research results in 'real

word' conditions, which promise that substantial effects can be achieved (Clements *et al.*, 2011; Weiland and Yoshikawa, 2013).

A recent report systematically reviewed research on the outcomes of ECEC preschool programmes (mainly in the US). On the basis of 38 studies and 27 programmes the authors reported that in terms of academic outcomes at the end of preschool and/or kindergarten, some programmes (six) showed strong evidence of effectiveness, and some programmes (five) moderate evidence of effectiveness. Where effects were found, programmes 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, and Laurenzano, 2010).

In Germany, a curriculum targeting learning in language, literacy, maths and science domains was shown to be effective in terms of children's language and maths development up to age eight (Roßbach, Sechtig, and Freund, 2010; Sechtig, Freund, Roßbach, and 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 Class rooms 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. Pre-school education programmes 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 et al., 1988; Justice 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 et al., 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 & Fler, 2009), but acknowledging at the same time 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). Yet, despite this consensus, early childhood care and education programmes 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 programmes 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 programme effects are assessed in short or long term. Although didactic and academic programmes 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 programmes, 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 programme and a traditional approach, characterized by the researchers as 'laissez faire'. In the short term, the didactic programme 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 pre-school approaches for their effect on children's development and mastery of language, literacy and maths skills at the end of pre-school. 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 pre-school (DAP approach) demonstrated greater mastery of basic skills at the end of pre-school than did children in programmes with a didactic approach where academics were emphasized and skills were directly taught. However, the advantage of child-centred over academic pre-schools was small, and both programmes 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 pre-schools had better results in initial learning in grades 1 and 2, 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 3 (age 9). In grade 3 the advantage in retention and referral rates disappeared and in grade 4 (age 10) children with child-centred and mixed-model pre-school experience outperformed children from academic pre-schools 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 pre-schools upon transition to grade 4, 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 pre-schools apparently were better prepared to face the new challenges in grade 4.

There may be also a timing effect, meaning that education programmes working with very young children, under age 4 or 5, should work predominantly in a child-centred (DAP) way, whereas programmes 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 pre-school from age 3 to 5, and after pre-school either a developmental or a basic skills oriented kindergarten from age 5 to 6, before starting in primary school. The results of the study indicated that a DAP curriculum in pre-school up to age 5 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 5 to 6), after two years in a DAP-focused pre-school, had slightly better learning outcomes in several subjects in primary school and no detectable negative social-emotional outcomes compared to programmes with a continued DAP focus. The latter programmes were slightly better with respect to problem solving and language comprehension, as in Marcon's (2002) study.

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 3- to 5-year-old children, using a randomized controlled design, clearly support the effectiveness of the Montessori curriculum compared to eclectic conventional approaches in view of currently valued developmental and educational outcomes such as academic skills, 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 effects. Lillard (2012) shows that high fidelity implementations of the Montessori curriculum, preserving the original concept, are more effective than adaptations and eclectic approaches.

"Tools of the Mind" (Bodrova & Leong, 2006) 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 3- and 4-year-olds to either Tools or an academically focused programme, Tools was found superior both in academic outcomes and in executive functions at age 5 (Diamond et al., 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 et al., 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 et al., 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 et al., 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 pre-schooler 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 (Dickinson et al., 2003; Bus, Leseman & Neuman, 2012), which can also be considered to be "developmentally appropriate practice".

Stability and continuity of care

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 and Lowenstein, 2011; Whitebook, Gombay, Bellm, Sakai, and Kipnis, 2009). The acknowledgement of the importance of stability of caregiving arrangements and the continuity of caregivers for infants and toddlers is based on the views that young children need to form bonds of attachment and trust, that interactions with children have to be based on the caregiver understanding of the individual child and its idiosyncrasies (Melhuish, 2004a; Trevarthen *et al.*, 2003), and that caregiver experience and teamwork are important aspects of the quality of care (Whitebook and 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 child care 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 settings proposes many challenges to teamwork and quality. The EPPE case studies showed that particularly effective centres had long serving staff (Siraj-Blatchford, Sylva, Muttock, Gilden, and Bell, 2002). The International IEA-Pre-Primary Project (Montie *et al.*, 2006) reported that the experience of the staff in early childhood settings related to children's cognitive and language development at age seven. Lower turnover rates have been associated with higher process quality, especially in day care (Melhuish, Mooney, Martin, and Lloyd, 1990; Goelman et al., 2006; Phillips et al., 2000).

Children's attendance patterns, multiple care arrangements, and changes in child care also impact on the continuity. Tran and Weintraub (Tran and Weintraub, 2006) used data from the NICHD study to explore the effects of quality, stability and multiplicity of child care on children's development and found that certain forms of unstable child care (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 wellbeing of frequent transitions in multiple care arrangements.

An Australian longitudinal study on school readiness and transition to school (Bowes and Wales, 2009) found some evidence that children who spent more time in centre-based care and had more child care 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 child care 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, Wyver, Masselos, and de Lacey, 2005). While the current body of research provides some answers with regards to amount of care, virtually nothing is known about the issue of programme regularity (number of attendance days per week).

The physical environment

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 (Expert Advisory Panel on Quality ECEC, 2009; Dalli and Rockel, 2012; Dalli et al., 2011).

Reviews on ECEC for infants and toddlers (Dalli and 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 pre-schoolers, 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 child care 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 child care 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.

Otherwise, there is limited direct evidence on links between the quality of the physical environment and young children's learning and achievement. 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 (Trevvarthen *et al.*, 2003). More research on the physical environment in ECEC is needed.

Adult-child ratios and group sizes

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 and Vandell, 2007; Dalli *et al.*, 2011; Huntsman, 2008; Phillips and 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 SECC 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 and 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 1:17 and 1:10 (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 6-8 children, and for two to three year olds, 10-12; three year olds, 14-18, and for four to five year olds, 20-24 (Dalli and 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). 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 child care 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). 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 0-3 years

For the under-threes, there is little strong evidence for the effects of group sizes or ratios on child outcomes. The NICHD Early Child care Research Network (NICHD Early Child care Research Network, 1999) 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 ECCRN and Duncan (NICHD Early Child care Research Network, 2003c) 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 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).

Similarly, inconsistencies can be found across other studies: In their longitudinal study of 89 African American children (age six-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 child care, structural quality (a measure including indicators of group size, ratios, and age range) for child care 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 Dutch study (Albers *et al.*, 2010) showed no effect of ratios on infants' cognitive development. 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 co-vary with group size. If multiple factors are not considered together then inconsistent results may well occur. Slot *et al.* (2014) 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 3+ 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, (Houng *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 and Lambert, 2006; Nye, Hedges, and Konstantopoulos, 2000; Walston and West, 2004).

Also the manner in which activities are organised (whole group versus small group) in a setting, as well as the composition of the group determines children's experience and may influence their learning. Reflecting on a finding by Montie *et al.* (2006) that less time spent in whole-group activities in preschool 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 and 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.

Practitioner qualifications and training

Among practitioners working in child care 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, and 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 and Lont, 2007; Huntsman, 2008; Kreader, Ferguson, and Lawrence, 2005; Saracho and Spodek, 2007).

In the EPPSE study in England (Sylva, *et al.*, 2002) and the EPPNI study in Northern Ireland (Melhuish *et al.*, 2003) the same measures of child care settings were used. Across most types of settings the level of 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 counties. 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 and 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 child care research that has considered relationships between staff qualification and training, and observed programme quality conclude that both qualifications and 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 and Brown, 2000; Munton *et al.*, 2002). The following factors were identified as having a positive impact: the general educational level; specialized caregiver training; both formal and informal training; professional development after initial training; and supervision while working in child care (Fukkink and 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-three age group, currently there is little evidence for or against either direct or indirect effects on child outcomes. As indicated in the review by Slot *et al.* (in press), who have looked at the relations between staff education level and observed (emotional) process quality, and found weak effects that higher education level improves emotional support process quality.

ECEC for children 0-3 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 8 (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 and Sylva, 2007; Smith *et al.*, 2009).

THE NICHD (NICHD Early Child care Research Network, 1999) 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 children's experiences of home-based non-maternal care, higher educational level, and specialized 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 child care on child development. On the basis of their results the authors concluded that child care 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, and Howes, 2002). Similarly, results from earlier research in the field were inconsistent (Burchinal, Roberts, Nabors, and Bryant, 1996; Clarke-Stewart, Gruber, and 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 have to be able to 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 programmes 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 programmes 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, and Ridgley, 2003; Morgan and Fraser, 2007; Siraj-Blatchford and Siraj-Blatchford, 2010).

ECEC for children 3+ years

For the over-threes, evidence that staff education or having a degree in particular will produce better outcomes for children is mixed.

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 the 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 EPPE 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 the practitioners had good curriculum knowledge and knowledge and understanding of how young children learn. Staff who had the highest qualifications provided children with more experience of language, mathematics, and cognitive challenge and “less well qualified staff were significantly better pedagogues when they worked alongside qualified teachers” (Sylva *et al.*, 2004a).

The NICHD 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 (1999) also found direct links between the number of recommended standards for quality (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 Study of Early Childhood and Duncan (NICHD Early Child care Research Network, 2003c) 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.

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 versus 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 CDA was associated with children's cognitive or language outcomes.

A meta-analysis (Kelley and 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.

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 (Hamre, Pianta, Downer, and Mashburn, 2008; Hamre, Pianta, Mashburn, and 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 and Neuman, 2009; Landry, Swank, Smith, Assel, and Gunnewig, 2006; Powell, Diamond, Burchinal, and 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 and Sarama, 2008). Participation in professional development interventions have been shown to support children's school readiness (Downer, Pianta, and Fan, 2008; Hamre *et al.*, 2008; Mashburn *et al.*, 2008).

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 stimulating curiosity and a desire to learn about the world (Belsky, 2009). In addition, supportive environments (good ratios, small group size, qualified staff with opportunities for professional development) increase the likelihood that high quality as defined above can take place (Bradley and Vandell, 2007; Mitchell *et al.*, 2008).

However, longitudinal research has also shown that positive effects of early care tend to fade out over time. 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) as positive benefits may fade over time (Le *et al.*, 2006; DeCicca, 2007; 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 data (Li, Farkas, Duncan, Burchinal, and Vandell, 2013) found the most positive gains of day care 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. Also 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)

The English EPPSE study (Sammons *et al.*, 2007b; Sammons *et al.*, 2008c) provided evidence that the effect of preschool attendance on children's outcomes in mathematics and reading was highest if the preschool they attended was high quality or effective and if they then attended a more academically effective primary school. They also found that, for the children who attended a *medium* quality preschool centre, they showed enhanced attainment only if they then attended a *medium/high* effective primary school – and even this effect was small. 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 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 groups of children who experienced large classes and low levels of reading instruction in elementary school.

Analysis of NICHD data (Hynes and Habasevich-Brooks, 2008) showed that children experience many changes of child care quality, and only few children experience continuous high quality child care. In addition, children from low socio-economic status families are more likely to experience low-quality care. Furthermore, paths from ECEC to children's long term outcomes involve systems outside the non-maternal care settings. Family background and parenting experiences, for example, 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.*, 2012). A recent investigation into the effects of consistent environmental stimulation across home, preschool and first class settings showed that children had higher maths achievement if they were consistently stimulated in all three settings, and higher reading achievement with consistent stimulation in home and child care (Crosnoe, Leventhal, Wirth, Pierce, and Pianta, 2010). Similarly, Votruba-Drzal and Lindsay Chase-Lansdale (2004) found that high quality child care predicted significant increases over time in children's reading skills under conditions of highly stimulating home environments. The authors argue that within the normative range of child care quality available to low-income children in their communities, even relatively high quality care might not be able to make up for other environmental challenges.

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, and Malmberg, 2007) and only more recently research has investigated with

more detail and rigour how these different systems interact in effecting children's development. Where interactions are examined, the focus is on demographic moderators such as race or ethnicity, gender, and socio-economic status. A moderator variable affects the relationship between two variables, so that the nature of the impact of the predictor on the outcome varies according to the level of the moderator

The question of high relevance for early years policy is whether attendance of child care aimed at the general population can have a compensatory effect for children from more disadvantaged families or otherwise more risky social backgrounds. This hypothesis is strongly supported by findings from intervention programmes aimed at the disadvantaged population. It predicts that those children more at risk might benefit more from attending (high quality) ECEC. On the other hand, it has also been argued that interactions such as those might be 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 and Heckman, 2007). This hypothesis gets support from an analysis of NICHD data which showed that preschool academic functioning served as a mediator for between child characteristics, family background and first-grade child outcomes (Downer and Pianta, 2006). Also in the Chicago Parent Center intervention Reynolds et al., (2004) show how early effects are transported to long-term effects, with early effects on academic skills work in short term facilitating the transition and adaptation to school, resulting in higher expectations and better outcomes, and the prevention of early referral to special education. In the long term, improved school careers and continuous parental support add to and sustain the short term cognitive effects.

Gender and temperament have also been investigated as possible moderators. If the effect of high-quality child care is compensatory, boys will profit more than girls because boys tend to be less developmentally advanced than girls, putting them at greater risk for poor educational outcomes (Matthews, Ponitz, and Morrison, 2009). If the effect of high quality is stronger for those children who are at advantage already, this interaction would be the other way round – with girls benefitting more. For children with more difficult temperament the assumption might be that they might benefit less from non-maternal care because they are less adaptable to new environment.

Today, research that investigates such complex interactions is sparse, and evidence for either the compensatory or accumulated advantage hypothesis is limited. 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

ECEC for children 0-3 years

Family background as moderator

Over the years, analysis of the NICHD data investigated a number of family risk variables including the quality of parenting, gender, income, education, ethnicity and marital status as moderators of child care effects and did not find much support for compensation effects. For example, an early analysis of NICHD data (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 of NICHD data (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). Brooks Gunn *et al.* (2002), on the other hand, found that maternal employment at nine months was related to lower school readiness scores at 36 months, with effects more pronounced for children whose mothers were less sensitive, boys, and children with married parents.

Other studies provide more evidence that attendance of formal child care under the age of three could represent a preventative means for limiting effects of disadvantage on children's development. For example, 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 mathematic skills for children from families of less educated mothers and relatively poor literacy environment, but not for those children from more advantaged backgrounds (Christian *et al.*, 1998). However, Watamura, Phillips, Morrissey, McCartney, and Bub (2011) discuss how disadvantaged children can be subject to double jeopardy leading to poorer social-emotional outcomes for children who experience both home and child care environments that confer risk.

Data from the Early Childhood Longitudinal Study brought some evidence that longer duration may impact differently on children from lower- and higher-income families. Amount of ECEC showed a positive effect on children's reading and maths scores at age 5 (Loeb *et al.*, 2007; Votruba-Drzal *et al.*, 2008), with stronger effects for children from low- and middle-income families. 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, and 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 math and reading skills development age 5 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. Similarly, other US studies show that quality of care moderates the effect of long hours in care (McCartney *et al.*, 2010; Votruba-Drzal *et al.*, 2004, 2010) and that high quality day care can protect children against the negative effects of low quality home environments (Watamura *et al.*, 2011).

Data from the NZ longitudinal Competent Children project indicates that if children from disadvantaged families attend four or more years of ECEC, they can have similar scores in literacy and communication as those from more advantaged backgrounds (Wylie and Thompson, 2003).

A Canadian cohort study showed that attendance of full-time non-maternal care in the first year 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 with mothers with low levels of education (Geoffroy *et al.*, 2010). While an analysis of the National longitudinal survey of youth data (Bernal and Keane, 2010) reported negative effects of maternal employment and child care on children's cognitive ability, they also found that this effect is more pronounced for children with higher cognitive abilities, and those with more educated mothers.

Finally, results for the potential of early ECEC experience to reduce cognitive inequalities between disadvantaged and advantaged children also stem from data from the UK sample of children in the Millennium Cohort Study (Côté, Doyle, Petitclerc, and Timmins, 2013; Hansen and Hawkes, 2009) and in a recent Australian study into the effects of child care

(Houng *et al.*, 2011). However, in the MCS it was also found that experience of certain types of care positively related to child outcomes only for some of the more advantaged groups (Hansen and Hawkes, 2009)

Child characteristics as moderator

When considering moderation by child characteristics of the impact of attendance from birth to three years evidence comes largely from interventions for disadvantaged groups

Temperament

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). 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.

Gender

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 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 3+ years

Family background as moderator

Recent investigations into the effects of US pre-K studies support the compensatory hypotheses. For example, children who participated in the Tulsa's state-funded pre-K programme 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 effects of a universal pre-K programme 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) And findings from an evaluation of Virginia's pre-K initiative showed particular attendance benefits for children with minority backgrounds and those with SEN (Huang *et al.*, 2012). Furthermore, in the North Carolina More at Four pre-K programme, high risk groups who entered pre-K at a deficit, gained at similar or even greater rate, and for some measures caught up with lower risk groups in kindergarten (Peisner-Feinberg and 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. And a study of more than 600 twin pairs (Early

Childhood Longitudinal Study, Birth Cohort twin sample; Tucker-Drob (2012) brought 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, findings from 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.

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. In France, it has also been shown (Dumas and Lefranc, 2010) that the large-scale expansion of a universal, free preschool programme 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), and that for those with minority background, preschool attendance increased the 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 and Riphahn, 2009).

There is increasing evidence that preschool settings with a mixed intake of social backgrounds have better results for disadvantaged children (Schechter and Bye, 2007; Sylva, Melhuish, Sammons, Siraj-Blatchford, and Taggart, 2004b; De Haan, Hoofs, Leseman, and Elbers, E., 2013), 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.

Nevertheless, a review on the effects of various preschool programmes on cognitive development (Burger, 2010) evaluated the extent to which these programmes 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.

Child characteristics as moderator

Gender

In the Perry Preschool Project for children from extremely disadvantaged families, Anderson (2008) reports some differences in 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 found the balance of benefits in educational outcomes up to age 21 years largely favoured girls more than boys.

The interaction of quality of ECEC with family and child characteristics

ECEC for children 0-3 years

Family background as moderator

Some evidence of moderation of ECEC quality effects by family background derives from a number of studies using NICHD data. For example, in relation to socio-emotional development as discussed earlier, while the NICHD 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 and 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 somewhat 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, 2014) showed that high quality child care was associated with improved concurrent internalizing behavior when children experienced highly consistent parenting, but not when children had less consistent parenting. Possibly the absence of compensatory effects was due to the relatively high levels of positive parenting and relatively low levels of child internalizing and externalizing behaviors as reported by parents in this study, which leaves less room for “compensation”.

Regarding cognitive outcomes, further analysis of NICHD data for 54 months, there was not 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 analysis of NICHD data (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 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 of NICHD 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. However while finding evidence supporting this beneficial effect of high quality ECEC for disadvantaged children, Watanabe *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.

Using data from the Welfare, Children, and Families study in three US cities, Votruba-Drzal and Lindsay Chase-Lansdale (2004) found no main effect of child care quality for two-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 the more disadvantaged group might have to experience high quality child care over a longer period. In line with this hypothesis, Crosnoe *et al.* (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.

On the other hand, Bornstein *et al.* (2006) found that a measure of structural child care 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. If a higher child: staff ratio is interpreted as an indicator for more formal group care, their results could mean that children from more advantaged backgrounds benefit more from higher amounts of early group care.

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 data that focused on under-threes (McCartney *et al.*, 2007) found some evidence that higher quality child care buffers children from negative effects of low income – the interaction between a measure of low income and child care 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, 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. However, they found 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.

Child characteristics as moderator

Temperament

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, p. 100). Thus the terms temperament, reactivity and self-regulation are inter-related.

Temperamental reactivity

Studies have found that children with a more reactive or difficult temperament were more *vulnerable* to adverse environmental influences, exhibiting less social competence and more behaviour problems than their less reactive or difficult peers (Almas *et al.*, 2011; Deynoot-Schaub & Riksen-Walraven, 2006). Infant temperament has also been investigated as a moderator of quality effects on child cognitive outcomes.

An analysis of NICHD data indicated that quality child care substantially predicted (better) reading in the case of children with difficult temperaments but did not predict these outcomes in the case of children scoring low on difficulty as infants (Pluess and 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 and Belsky, 2010). 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 (Erygit-Madzwamuse and 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 moderates 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). Similarly in recent research in the Netherlands Broekhuisen (2014) 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 child care. However for children high on self-regulation there was no association between quality of child care and social competence. These results are in line with the differential susceptibility hypothesis, which states that children with certain individual (temperamental) characteristics are more susceptible to environmental influences (e.g., Belsky, 1997; Belsky et al., 2007).

ECEC for children 3+ years

Family background as moderator

While it is often argued that high-quality child care experiences are likely to have stronger effects on children who are at risk of poorer outcomes because of less optimal family environments (Hungerford and Cox, 2006) currently the evidence here 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.

Findings from the English EPPSE study indicate that 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 boys, children with special educational needs, and disadvantaged children. While high quality preschool benefited all children, the benefits were greater for these groups (Sammons *et al.*, 2007b; Sammons *et al.*, 2008b). 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 *et al.*, 2011a). While for literacy outcomes, both preschool quality and preschool effectiveness were statistically significant only for pupils of higher qualified parents (Sammons *et al.*, 2011a). Finally, at age 16, attendance 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.

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 boys' educational outcomes (Siraj-Blatchford *et al.*, 2011).

While 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). Other research on the other hand 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) has examined associations between observed preschool quality for approximately 6,250 three to five year olds and their 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 child care (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 3 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

Gender

The EPPSE study found evidence that the benefits of high quality ECEC were more noticeable for boys through to age 16 years (Sammons *et al.*, 2014d).

Child self-regulation

Findings from research on parenting suggest the importance of individual differences in children's self-regulation. Several studies found that children low on self-regulation were more vulnerable for more negative parenting behaviours, showing more externalizing behaviours than those average or high on self-regulation (e.g., Karreman, van Tuijl, van Aken, & Deković, 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 et al., 2009).

Conclusion

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. 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 pre-school education (3+ years) is fairly consistent, the research evidence on the effects of childcare (0-3 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 programmes, whether large scale or small scale, have used randomized control trials 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 the universal/regular programmes 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 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 pre-school 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 these persisted throughout children's school careers. This appears to be partly from subsequent poor school experiences for disadvantaged children overcoming 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 programmes. 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.

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 produce 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 in the first year.

The low level of much ECEC quality is of concern. Some have argued (e.g., see Haskins and Barnett, 2011) that, for example in the US, government-funded preschool programs (e.g., child care 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, Barnett, Burchinal, and Thornburg, 2009) maintain that publicly funded preschool in the United States narrows the achievement gap between poor and non-poor groups by as little as 5% because of the prevalence of low-quality programs and that preschool could be narrowing the gap by up to 50% 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 programme and the approach to pedagogy and curriculum are seen to be crucial (Leseman, 2009).

For provision for three years onwards the evidence is consistent that pre-school 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 2 years of age onwards produces the stronger the improvement.

Characteristics of early years provision and child development

The research demonstrates 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. Facilities that are safe and sanitary and accessible to parents
4. Ratios and group sizes that allow staff to interact appropriately with children
5. Supervision that maintains consistency
6. Staff development that ensures continuity, stability and improving quality
7. A developmentally appropriate curriculum with educational content.

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. Not only do ECEC experiences play an important role in promoting child wellbeing, but also some other background factors are 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 and 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 (Mustard and McCain, 1999). For example, Ben Bernanke, the chairman of the U.S. 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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