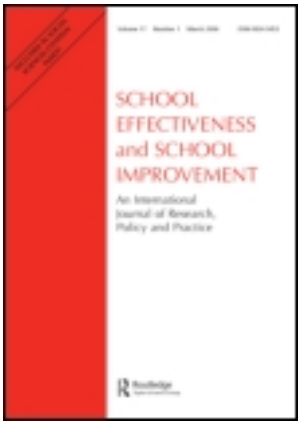

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Can preschool protect young children's cognitive and social development? Variation by center quality and duration of attendance

James Hall [a], Kathy Sylva [a], Pam Sammons [a], Edward Melhuish [b], Iram Siraj-Blatchford [c] & Brenda Taggart [c]
[a] Department of Education, University of Oxford, Oxford, UK
[b] Birkbeck, University of London, London, UK
[c] Institute of Education, University of London, London, UK
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James Hall[a]*, Kathy Sylva[a], Pam Sammons[a], Edward Melhuish[b], Iram Siraj-Blatchford[c] and Brenda Taggart[c]

[a]*Department of Education, University of Oxford, Oxford, UK;* [b]*Birkbeck, University of London, London, UK;* [c]*Institute of Education, University of London, London, UK*

This paper illustrates how high-quality preschool has the potential to serve as an intervention within normal populations. Although it is well known that targeted Early Interventions can protect the development of young children from developmental risks, there remains less evidence concerning universal preschool education. To address this disparity, a longitudinal secondary analysis was conducted that examined the psychological development of 2,862 English preschoolers between the ages of 3 to 5 years. A series of aggregated multilevel structural equation models indicated that at age 5 years, instances of significantly protected development were more strongly evidenced when examining (a) cognitive rather than social development, (b) child rather than family-level risks, and (c) the quality of the processes taking place within preschools rather than just the structures. Finally, for preschools that featured only high-quality structures, any partial protection of development was limited to instances of longer durations of child attendance.

Keywords: child development; preschool quality; multiple disadvantage; risk; protection

Theoretical background

If programs of early education and care (typically "*preschool*" for the over threes; Melhuish, 2004; Sammons et al., 2008) can mitigate the impacts of developmental risks in young children's lives, then these programs could be considered a type of *early prevention* of the detrimental developmental outcomes common to children who experience high levels of such risks (Masten & Gewirtz, 2006). Although the *Early Intervention* that this prevention would be equivalent to (Sammons et al., 2004) has been well demonstrated in intensive and explicit programs of Early Intervention (e.g., the Ypsilanti/High Scope/Perry Pre-school Study, see Melhuish, 2004; the Abecedarian Project, see Rutter & Rutter, 1993), equivalent evidence is much weaker when considering the universal programs of preschool (National Institute of Child Health & Human Development Early Child Care Research Network [NICHD ECCRN], 2002). Further, there remains a need to address this gap in research

*Corresponding author. Email: James.Hall@Education.ox.ac.uk

because young children are much more likely to experience programs of preschool rather than an Early Intervention (Peisner-Feinberg, 2004).

Previous attempts aimed at unraveling whether universal programs of preschool education can protect development have drawn on findings from the two most salient fields of academic research: "developmental psychopathology" and "early education". For example, Borge, Rutter, Cote, and Tremblay (2004) argued that, "Perhaps, it [universal preschool] could compensate to a degree for marked family adversity" (p. 367). Further, Luthar (2006) reported a need for researchers to go beyond measuring the *"quality" of the structures* within preschools (e.g., carer–child ratio, staff qualifications) to instead consider also the *"quality" of the processes* (e.g., staff–child relationships). This same year also saw Schoon (2006) comment that, "Most research on resilience has focused on middle childhood and adolescence, while early childhood is a less researched period" (p. 79).

Around the same time that these commentaries were being made from researchers concerned primarily with *developmental psychopathology*, the issue of whether preschool can protect development was also been commented upon by those concerned mainly with *early education*. For instance, Melhuish (2004) reviewed the developmental impacts of early education and care and was explicit in articulating the question addressed by this paper, "In what ways might early years provision be used for early intervention with children at high risk for developing special needs both intellectual and behavioural?" (p. 56). Further, Peisner-Feinberg (2004) noted that the studies which had examined the developmental impacts of programs of preschool (as of 2004) were limited in their longitudinal focus when compared to Early Interventions.

Peisner-Feinberg (2004) also provided an overview of past attempts that had been made to address whether preschool could protect development (Burchinal, Peisner-Feinberg, Bryant, & Clifford, 2000; Hagekull & Bohlin, 1995; NICHD ECCRN, 2002; Peisner-Feinberg & Burchinal, 1997; Peisner-Feinberg et al., 2001). Considering the findings of all these studies, Peisner-Feinberg was able to conclude that only *inconsistent* benefits of preschool attendance had been returned when concerning the development of high-risk children and that some studies had even failed to provide any evidence in support of this conclusion at all.

Considering just two of the studies reviewed by Peisner-Feinberg in greater detail and beginning with Burchinal, Peisner-Feinberg, et al. (2000), these authors examined the social and cognitive development of young children and analyzed whether both were partial functions of background risks (including child gender, ethnicity, family poverty, and parental values) and/or preschool qualities. This investigation was argued to be the first to have sampled enough children whose development was "at-risk" (1,000+) to reliably establish protection. Only a single instance of protected development was found from the use of measures of the overall quality of both the structures and processes within preschools. The language development of young children from ethnic minority backgrounds was partially protected when these children had attended preschools of higher overall quality. Suggesting reasons for this limited evidence of protection, Burchinal, Peisner-Feinberg, et al. (2000) proposed that their study had lacked sufficient detailed information about the families and the qualities of the preschools that the young children had attended.

Perhaps the most important previously conducted investigation into whether universal preschool can protect the development of young children was that

conducted by the NICHD ECCRN (2002). Not only was the paucity of previous research mentioned as a driving factor behind their investigation, but so too were the limited *scope* of the risks that had been previously studied. Despite investigating a smaller sample of 943 young children (when compared to the paper of Burchinal, Peisner-Feinberg, et al., 2000), the NICHD ECCRN still sought to address gaps in the pre-existing research literature. In particular, three types of "*Family risk factors*" (psychosocial, socioeconomic, and sociocultural) were studied alongside measures of the quality of the *processes* that took place within the sampled preschools. However, like the Burchinal, Peisner-Feinberg, et al. (2000) study, the NICHD ECCRN also found only limited evidence of protected development, a finding that they referred to as "contrary to expectations" and which was partly attributed to an insufficient combination of severe risks with higher quality preschools.

In response to such previous research, this paper builds upon past findings and summarizes the results of a large-scale study that aimed to determine if the quality of preschool programs (particularly high quality rather than low) could protect the cognitive and social development of a broadly representative sample of young English children (for fully detailed results, see Hall, 2009). Given the current extent of the literature concerned with whether preschool can protect the development of children, there was a need to consider the results of this study in their entirety as well as the associated implications. Aimed at addressing the limitations of previous research, a longitudinal secondary analysis was undertaken that examined:

(1) the cognitive and social skills of 2,862 young children between 3–5 years
(2) child- (ecological) level and family-level risks
(3) the quality of the processes and structures within 141 preschools
(4) the varying lengths/durations that young children attended their preschools

The objectives of this study and the nature of the data that was considered (see below) also meant that it adopted a research design consistent with educational effectiveness research (EER). The effectiveness of various early-years educational structures and processes were considered upon child progress and development in statistical analysis that echoed the value-added models of EER (Chapman et al., 2011; Creemers, Kyriakides, & Sammons, 2010; Scheerens & Bosker, 1997; Teddlie & Reynolds, 2000). Longitudinal and educationally hierarchical data (children nested within preschools) were analyzed in statistical models that controlled for child development at entry to education as well as background characteristics. That this study should adopt an EER design while also addressing issues of concern to *developmental psychopathology* should also be of little surprise given the historical associations of these two fields (see the paper by Sammons and colleagues, this issue. as well as Rutter & Maughan, 2002; Rutter, Maughan, Mortimore, & Ouston, 1979).

Method

Sample

For an investigation (of broad remit) into whether universal programs of preschool education could protect young children's cognitive and social development, a reanalysis was conducted of the (anonymized) longitudinal data collected by the Effective Provision of Pre-School Education project (EPPE; see Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004). This was a longitudinal English study

that began in 1997 with the aim of investigating the effects of preschool education and care on the development of young children between the ages of 3 and 7. Five geographical regions (representative of England) were sampled and covered urban, rural, and suburban areas. From these areas, 141 preschools were then randomly selected. The qualities of the processes and structures within the 141 programs of universal preschool were assessed, and the development of a randomly sampled selection of children was measured (after informed consent was obtained from parents). Further details of the EPPE research design and methodology are given in Sammons et al. (2005) and Siraj-Blatchford, Sammons, Sylva, Melhuish, and Taggart (2006). The final sample for this analysis consisted of 2,862 preschool attendees (see Sylva et al., 1999).

When the terminology of ''developmental psychopathology'' is applied, the young preschool-attending children had 21 recorded ''*potential risks*'' to their cognitive and social abilities measured when they were on average 36 months of age (see below and Table 2 for details). Development was measured at this age (36 months) and again when these children were, on average, 58 months.

The remaining measures (pertinent to this study) were: a single measure of the global/overall quality of the EPPE preschools, five indicators of the quality of processes, and seven indicators assessing structures. So as to properly assess the impact of these qualities, the EPPE project also measured the duration that each child was in attendance at their preschool.

Measures

Cognitive and social development

When they entered the EPPE study (at mean age 36 months), each child had their cognitive abilities assessed by trained researchers using the British Ability Scales (BAS; Elliot, NFER-NELSON, Smith, & McCulloch, 1996) to return a measure of General Cognitive Ability (GCA). These scales were again used when children began primary school at mean age 58 months, and these again returned a measure of GCA (with both having been shown to be reliable and consistent age-appropriate assessments).

Social development was measured shortly after the preschool attendees entered the EPPE study through the Adaptive Social Behavior Inventory (ASBI; Hogan, Scott, & Bauer, 1992) – a measure that was completed by a preschool center worker who knew the child well. Five factors underlay the items of this inventory, and these cover the following social skills and behaviors: Co-operation & Conformity, Peer Sociability, Confidence, Antisocial Behavior, and Worried/Upset Behavior.

At mean age 58 months, the items in the ASBI assessment battery were re-examined for their suitability to this now older sample of children. Deciding the ASBI was less appropriate for children aged 58 months, the EPPE team adapted the ASBI into a scale that they termed the Child Social Behavior Questionnaire (CSBQ; see Sammons et al., 2003). The CSBQ measured behaviors that were beginning to emerge in children as they entered primary school, was administered by the children's primary school teachers, and included 10 items that were additional to those included in the ASBI. Two of the subscales of the CSBQ (Self-Regulation and Antisocial/Worried Behavior) are here independently assessed as outcome measures

reflecting social development and feature alongside an independent analyses of these same young children's GCA.

Risks to development

This study divided potential risks according to the ecological level of their origin. Risks were either closely (proximal) or distantly (distal) related to the children in accordance with *Ecological Systems Theories*. Seven of the measured risks in this study were hypothesized to be (at least) proximal to the *child*, whilst 14 were judged to be more distal and thereby more proximal to the *family*. Each of these two sets of risks (7 child-level, 14 family-level) were then hypothesized to have impacts on development that were best measured with all same-level individual risks being considered in combination with one another.

Although the traditional means of measuring the impact of risks acting in combination upon development can be considered to be cumulative indices of dichotomized and summated risks (e.g., Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987), this method has faced criticism (e.g., Burchinal, Roberts, Hooper, & Zeisel, 2000). As such, the confirmatory factor analyses (CFA) featured in this investigation used ''formative'' (rather than ''reflective'') measurement (see Kleine, 2006) specified in Mplus v.4 (see Muthén, 2006). This approach returned separate measures of child- and family-level risks acting in combination to affect each of the three age 5 year measures of child development: General Cognitive Ability, Self-Regulation, and Antisocial/worried behavior (producing 2 x 3 = 6 measures of risk). These estimates of developmental risk were fully integrated into the statistical models estimating preschool effects.

Specified to address the problems inherent to cumulative risk indices (Burchinal, Roberts, et al., 2000), the employed CFA procedure returned combined measures that were based upon individual risks being allowed to vary in their individual contributions (unlike in the creation of cumulative risk indices) and did not necessitate the dichotomization of continuously measured risks such as birthweight (again, unlike in the creation of cumulative risk indices). The paper by Hall et al. (2010) directly compares the risk-measurement strategies of constructing cumulative indices versus formative confirmatory factor analysis and finds in favor of the latter. ''Formative'' and ''reflective'' measurement are opposing terms encountered in the context of statistical factor analysis and refer to the hypothesized relationship between the underlying factor and the observed indicators. The more commonly encountered reflective measurement assumes that the underlying factor influences the observed measurements, whereas formative measurement assumes the inverse: that the observed measures drive the underlying factor. The implications of these opposing hypotheses for statistical factor analyses are discussed in Edwards and Bagozzi (2000), Hall et al. (2009), Hall et al. (2010), and Kleine (2006).

Quality of, and duration in, programs of preschool

The *global/overall quality* of the preschools that the children attended was measured through trained fieldworker assessment via the Early Childhood Environmental Rating Scale-Revised Edition (ECERS-R; Harms, Clifford, & Cryer, 1998). This measure assessed seven distinct aspects of provision, and an *overall/global measure* of quality was obtained from these by taking the mean of the items.

Five measures of the quality of the processes that took place within preschools were also assessed via fieldworker assessment and involved two observational instruments: (a) The Early Childhood Environmental Rating Scale-Extension (ECERS-E; Sylva, Siraj-Blatchford, & Taggart, 2006) and (b) The Caregiver Interaction Scale (CIS; Arnett, 1989). Like the ECERS-R, the ECERS-E provided a mean score based on a number of subscales which assessed the curricular provision in early literacy, mathematics, science, and diversity. By contrast, the CIS assessed the interactions of caregiving staff with the young children and returned four subscales reflecting the quality of these relationships – qualities which were analyzed individually in this study. These relationship subscales refer to Positive Relationships, Punitive Relationships, Permissive Relationships, and Detached Relationships.

In addition to the overall/global quality and the quality of the processes taking place within the preschools, seven measures of the quality of the structures within preschools were also assessed (via observation). These seven structural measures were: The *manager's* highest academic (a) and childcare (b) qualifications; the mean *caregiving-staff* age (c), highest academic (d) and childcare (e) qualifications; the number of care-giving staff (f); and the number of children enrolled at the preschool (g). Finally, the duration that young children attended their preschool was recorded as the number of months that each child had spent in the preschool whose quality was assessed.

In summary, this study analyzed 13 measures of the quality of preschools: 1 measuring global/overall quality, 5 measuring process quality, and 7 measuring structural quality. Two of these 13 measures were simple means of a number of component subscales (the ECERS-R and the ECERS-E), which, given the detailed factor analysis conducted of developmental risks, benefits from further explanation. Both the ECERS-R and E are internationally used, researched, and validated standard measures (Pearlman, Zellman, & Le, 2004; Sylva et al., 2006). Unlike risks to development, these separate measures *were not* combined into a single measure of preschool quality. This decision was made because creating an overall construct of "preschool quality" (e.g., through factor analysis) would have been a less sensitive measurement of quality than considering each of the 13 measures independently. In turn, this less sensitive treatment of preschool quality would then have hindered the likelihood of accurately detecting whether quality could protect development because an overall measure of quality would have obliged significant protective effects to be consistent across all component indicators. In other words, deriving an overall measure of preschool quality would have meant that it would not then have been possible to detect any variation in protection that was offered by different aspects of quality (e.g., structures vs. processes).

Analytic approach

The secondary analyses of this investigation were shaped by considerations that originated from the data and design of the EPPE study and by the findings of past research. For example, previous investigations into developmental risks and resilience prompted combined measures of developmental risk to be differentiated according to their ecological levels (e.g., Kuperminc, Wilkins, & Alvarez-Jimenez, 2009). Partially in response, this investigation identified statistically-significant instances of protected development via statistically significant multiplicative-interaction terms of the form: *Combined Risk* × *Protective Factor*.

Further important determinants of these analyses included a need to control for the effects of nesting children within preschools, missing data imputation, and the analyses explicitly adopting a developmental perspective. This developmental perspective was achieved through value-added analyses that estimated protection against risk whilst controlling for earlier levels of development. A series of aggregated multilevel structural equation models (SEM) were specified in Mplus v.4 (Muthén & Muthén, 2004), which were designed to take into account all of the above factors into consideration. These analyses featured adjusted standard errors which took into account the multilevel structure of the data while reliably (Graham, 2007) estimating missing data using the full information maximum likelihood algorithm (FIML; for details, see Hall, 2009).

Figure 1 presents a stylized representation of the SEM that were specified to examine the relationships between latent combined risks, the development of children's cognitive and social abilities, and the quality of – and duration of children's attendance at – preschool. A series of analyses were conducted in which the 13 measures of quality were independently examined to determine whether each could significantly moderate the effects of either of the two combined risks (child-level, family-level) as they impacted each of the three measures of age 5 development (in total, this produces $13 \times 2 \times 3 = 78$ possible combinations of preschool quality, developmental risk, and entry to school outcome. For full detailed results, see Hall (2009). A more detailed description of just one of these statistical models is provided in Technical Appendix 1.) Furthermore, duration of attendance at preschool was also tested alongside each measure of quality, both as an additional moderator of risk but also as a moderator of the effects of quality. As a result, when testing the

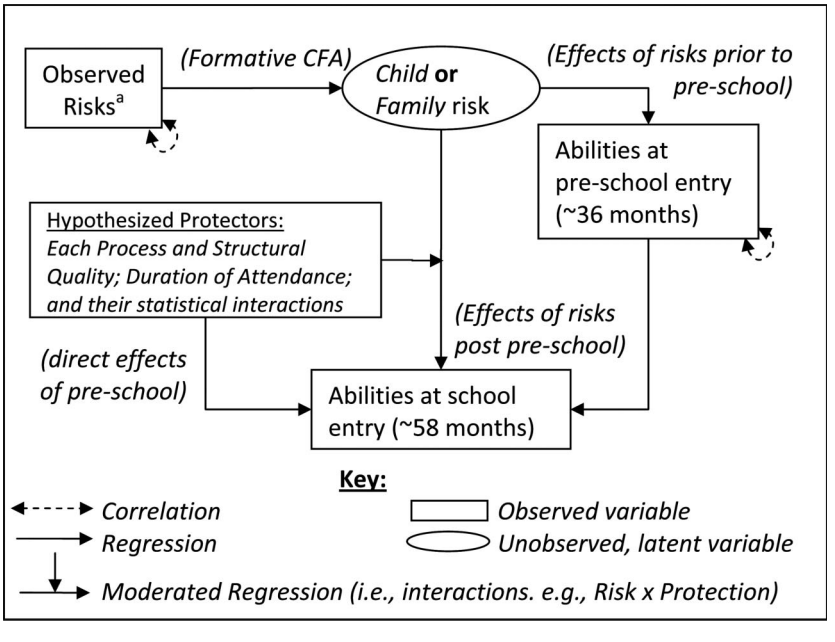

Figure 1. *Stylized* path diagram illustrating the structural equation models used to establish whether preschool could protect developmental abilities at entry to school.
Note: [a]Observed Risks = 21 in total: 14 "Familty", 7 "Child".

hypotheses of risk moderation, three multiplicative statistical interaction terms were used: (a) [quality × risk], (b) [duration × risk], and (c) [quality × duration × risk].

Results

Model fit

Although SEM typically estimates how closely specified statistical models fit the data to which they are applied, this was not possible in all the analyses here reported. When *latent* interaction terms were specified (i.e., *latent* risk × *observed* quality), it was not possible to calculate *absolute* fit indices. As a result, there was a lack of comprehensive evidence for determining the success of a model at replicating the patterns of data used with it. However, Kenny (2008) criticizes fit indices as sole indicators of the validity of SEM, and this suggests that their omission from these analyses need not prohibit an interpretation of the results that were obtained.

Table 1 presents the fit indices of the SEM that were specified to test the *initial* impacts of combined risks upon development (prior to testing for protective effects) and to reveal their compositional structures. Table 1 reveals that the same statistical model (illustrated in Figure 1) was able to accurately replicate the data that were used within it despite the two different domains of development.

An examination of the fit indices shown in Table 1 reveals that the comparative fit index (CFI) was consistently identified as being close to its upper limit of 1 (0.99, 0.98), as was the Tucker-Lewis Index (TLI; 0.98, 0.97). Both of these results suggest a high degree of model fit between the hypothesized models and the patterns in the data within them. At the same time, the root mean square error of approximation (RMSEA) can be seen to lie within a range that has also been associated with a high degree of model fit (0.017 to 0.031).

Estimating combined risks

Table 2 reveals the individual formative factor loadings of each of the variables that were theorized as a potential risk to young children's development. Whilst some individual risk factors were identified as significant across the cognitive and social domains and for all three measures of development at entry to school (e.g., birthweight), others were instead limited to just one of these domains (e.g., number of siblings) or for just one developmental outcome (e.g., whether or not a mother was working).

In addition to the differential contributions of individual risks across each developmental domain and each developmental outcome, Table 2 also reveals sizeable differences between the individual contributions of each risk to their respective combined measure. For example, home learning environments (see Melhuish, Sylva, Sammons, Siraj-Blatchford, Taggart, & Phan, 2008) made sizeable contributions (relatively large standardized beta regression coefficients) to the overall level of developmental risk that was specific to the family. By comparison, variables indicative of socioeconomic status (parental salary, education, occupational level) made contributions that were consistently smaller in their magnitudes. This particular differentiation in the size of risk contributions suggests that (for child development) it was what parents did, rather than who parents were, that was of greatest importance (see also, Melhuish, Sylva, Sammons, Siraj-Blatchford, Taggart, Phan, & Malin, 2008; Sammons et al., 2002, 2003).

Table 1. Model fit indices for the structural equation models including only developmental abilities and developmental risks.

	With Child-level combined risks			With Family-level combined risks		
Tests of model fit	1 Cognitive Model	2 Self-Regulation Model	3 Antisocial Behavior Model	4 Cognitive Model	5 Self-Regulation Model	6 Antisocial Behavior Model
1. Chi-Square Test of Model Fit	2274.50	150.74	134.05	47.81	119.66	118.91
degrees of freedom	*25*	*55*	*55*	*13*	*65*	*65*
p value	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
2. Comparative FitIndex	0.99	0.98	0.98	0.99	0.99	0.99
3. Tucker-Lewis Index	0.98	0.97	0.97	0.97	0.98	0.98
4. Root Mean Square Error of Approximation	0.025	0.025	0.020	0.031	0.017	0.017

Table 2. Potential child- and family-level risks to developmental outcomes at school entry.

Child- and Family-level measures		Formative Factor Loadings (*standardized β s*)		
		Cognitive Models	Self-Regulation Models	Antisocial/ Worried Models
Potential child-level risks				
Male gender		**0.28*** **	**0.73*** **	**0.59*** **
English additional language?		**0.48**[a]	**0.45**[a]	**0.55**[a]
Birth weight		**−0.37*** **	**−0.34*** **	**−0.21***
No. of siblings		**0.25****	0.16	0.25
Birth order		0.12	0.14	0.19
Ethnic Minority:	Afro-Caribbean?	**0.25*** **	−0.03	−0.02
	Bangladeshi?	**0.12***	0.00	−0.01
	Indian?	0.01	−0.04	−0.01
	Mixed ethnicity?	**0.14****	0.01	0.02
	Other ethnicity?	0.09	0.10	**0.13***
	Pakistani?	**0.31****	0.09	0.10
"Any event affected your child's development?"		−0.03	0.00	−0.01
Potential family-level risks				
Family salary		**−0.17****	−0.17	**−0.25***
Mother's occupational status		**−0.19****	−0.19	−0.28
Partner's occupational status		−0.10	0.06	0.06
"Highest status in family?"		−0.01	−0.14	−0.10
Mother's qualifications		**−0.25*** **	**−0.17***	−0.14
Partner's qualifications		0.00	0.06	**0.24***
Mother working?		−0.02	−0.13	**−0.23****
Partner working?		**−0.09***	0.02	0.00
Either parent working?		−0.08	0.01	0.09
Two parent family?		0.02	0.00	0.00
Mother's age		−0.08	**−0.17***	−0.18
Partner's age		0.02	**0.21***	**0.24***
No. of non-parental carers		**−0.14*** **	0.04	0.04
Home Learning Environment		**−0.45**[a]	**−0.69**[a]	**−0.68**[a]

Note: [a]Unstandardized factor loadings set to 1 so there is no returned significance.
*$p < .05$; **$p < .01$; ***$p < .001$.

Measuring the impacts of combined risks on cognitive and social development

Table 3 displays the various impacts of the two combined risks that were specific to each of the three measures of development that were assessed at entry to school (at mean age 58 months) as illustrated in Figure 1. Of note are the much larger impacts of risks (in terms of the size of the coefficients) upon measures of development assessed at 36 months rather than 58 (again, see Figure 1). This disparity is partially due to risk impacts at 58 months being estimated alongside the impacts of (a) developmental measures assessed at 38 months and (b) the combined risk to developmental abilities at 38 months.

While family-level risk demonstrated generally greater impacts upon measures of development at 38 and 58 months than did child-level risk (Table 3), the size of these impacts was not consistent. Specifically, the child and family levels of risk were less associated with the antisocial/worried behavior of young children at 58 months than they were with self-regulation or GCA. This suggests that while risks maintain an independent effect on development at entry to school that is over and above the

Table 3. Direct impacts of combined child- and family-level risks to measures of cognitive and social development at 36 and 58 months of age.

		Measures of child development at 36 and 58 months of age (*standardized βs*)					
		General Cognitive Ability (GCA) at child age 36 months					GCA at 58 months
Models considering Cognitive Development	Child-Level Risk:	−0.38***					−0.06***
	Family-Level Risk:	−0.53***					−0.10***
Models considering Self-Regulation at 58 months		Co-operation & Conformity at 36 months	Peer Sociability at 36 months	Confidence at 36 months	Antisocial Behavior at 36 months	Worried/ Upset Behavior at 36 months	Self-Regulation at 58m
	Child-Level Risk:	−0.23***	−0.22***	−0.17***	0.01	0.02	0.09***
	Family-Level Risk:	−0.24***	−0.20***	−0.23***	0.06*	0.02	−0.14***
Models considering Antisocial/ Worried Behavior at 58 months		Co-operation & Conformity at 36 months	Peer Sociability at 36 months	Confidence at 36 months	Antisocial Behavior at 36 months	Worried/ Upset Behavior at 36 months	Antisocial/ Worried Behavior at 58 m
	Child-Level Risk:	−0.23***	−0.24***	−0.18***	0.00	0.01	−0.01
	Family-Level Risk:	−0.24***	−0.22***	−0.24***	0.05	0.02	0.04*

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

effect of earlier levels of development (when considering cognitive skills and self-regulation), this is not the case for antisocial/worried behavior. The implication of this finding, that antisocial/worried behavior may be more driven by earlier levels of development rather than the direct effects of risks, is, however, a question that requires further investigation.

The role of programs of early education in protecting cognitive and social development

Each of the 13 qualities of preschool had its direct and risk-moderating effects estimated upon each measure of development assessed at entry to school and for each (ecological) level of combined risk ($13 \times 3 \times 2 = 78$ possible combinations). Five separate sets of SEM were constructed to test the five combinations of these risk and quality effects:

(1) an initial model including only direct effects from one of the two combined risks (either child- or family-level) and 1 aspect of preschool quality (out of 13) as both impact on one of the three measures of child development at age 58 months;
(2) as (1) but also testing the relevant *risk* × *quality* interaction;
(3) as (1) but also testing the relevant *risk* × *duration* interaction;
(4) as (1) but also testing the relevant *quality* × *duration* interaction;
(5) as (1) but also testing the relevant three-way interaction between *risk, quality, and duration*.

Although it is acknowledged that the division of these analyses was not ideal or optimal, this solution was obliged by the complexities inherent to the methods that were used to measure combined risks and the possibility of their moderation. Any potential deterioration in the validity of the results through this division of analyses is also partially mitigated by (a) improvements made to measuring combined risks (see Hall, 2009; Hall et al., 2010), (b) the variety of qualities that were examined, and (c) the statistical sensitivity of the analytical procedures that are here reported. Further, the adoption of this approach is based on the lack of findings from a similar past study conducted by the NICHD ECCRN (2002), who described their lack of findings as "contrary to expectations" (p. 144). Here, we attempted to conduct the most thorough exploration possible (given our data) in response. Compare it to the paper by the NICHD ECCRN, for example. We report on over 3 times the number of children (NICHD: 943, EPPE: 2857) and 13 times more measures of quality (NICHD: only composite quality, EPPE: composite, staff–child relationships, educational processes, structures).

Table 4 presents a summary of the significant instances of protection that were evidenced as related to the quality of the *processes* taking place within preschool. Higher quality processes were linked to more frequent instances of partial protection when the risk to development was specific to the child rather than to their family. Furthermore, the quality of processes was found to offer partial protection to GCA at entry to school that systematically differed from the partial protection that was offered to social skills. Whilst the quality of preschool processes was able to partially protect GCA even when children's duration of attendance was short, this was not so for self-regulation or antisocial/worried behavior.

Table 4. Psychological development at age 5: significant interactions between risks, the quality of pre-school processes, and the duration that children attended pre-school.

		Measures of Child Development assessed at school/reception class entry at mean age 58 months (only statistically significant results, unstandardized Bs, all measures *z* scored a priori)					
		General Cognitive Ability		Self-Regulation		Antisocial/Worried Behavior	
Combined Latent Risk (**X**)	Process Quality of Pre-school (**Y**)	main effect of (**Y**)	interaction effect (**X.Y**)	main effect of (**Y**)	interaction effect (**X.Y**)	main effect of (**Y**)	interaction effect (**X.Y**)
Child Level	Positive Relationship		0.04*(a)	0.07*	0.04**(b)		–0.06***(b)
	Punitiveness			–0.07*	–0.04***(b)		
	Permissiveness	−0.05*		−0.07**			
	Detachment	−0.06**	−0.03*(a,d)	−0.07**	− 0.04**(b)		0.06**(b)
	Global Quality						
	Educational Quality		0.02*(a)	0.06*			−0.05*(b)
	Duration	0.09***					0.04*(c)
Family Level	Positive Relationship			0.06*			
	Punitiveness						
	Permissiveness			−0.06**			
	Detachment			−0.06*			
	Global Quality		0.03***(a)				
	Educational Quality		0.02**(a)				
	Duration	0.07***					

Note: (a) two-way interaction: risk × quality; (b) three-way interaction: (risk × quality) × duration of pre-school attendance; (c) two-way interaction: risk × duration of pre-school attendance; (d) See Technical Appendix 1 for full results from this SEM and a graphical depiction of this interaction term. For full results from all models and statistical interaction terms see Hall (2009).
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 5 summarizes the significant instances of protected development that this investigation found as stemming from the quality of the *structures* within preschools. Despite instances of significant partial protection being found for each of the measures of development that were assessed at entry to school, there was also substantial variation between how frequently these occurred. For example, the qualities of the structures within preschools offered more frequent instances of partial protection to GCA rather than to self-regulation or antisocial/worried behavior. These findings indicate that GCA was more likely to be protected (against the effects of risks) than were social skills, and this suggests that the quality of structures (such as staff qualifications) might not contribute towards the correction of some dysfunctional social skills in young children as strongly as they do towards dysfunctional cognitive abilities.

When the instances of protection that were found for the qualities of processes (Table 4) and structures (Table 4) are compared, noticeable differences can be observed between the types of protection offered. The primary difference common across both tables is that there were many more instances of protected cognitive rather than social development (46% vs. 15%). Furthermore, this higher rate of protection itself varied such that the protection associated with the quality of structures was consistently coupled with longer durations of preschool attendance, whereas those associated with the quality of processes were not. This suggests two conclusions. First, that the qualities of the processes that take place within preschools are better placed to protect children's cognitive and social development from the impacts of child- rather than family-level risks. Second, the protection of social development is more reliant upon children experiencing higher quality preschool environments for longer durations. This second conclusion also extends prior findings from the main EPPE project, which found that the combination of high quality with high duration showed the strongest positive effects on children's cognitive development at entry to school (Sammons et al., 2002).

Considering the size of the partially protective effects that our results attribute to the qualities of preschool, it was not possible to estimate standard effect sizes for the interaction effects shown in Tables 4 and 5 due to the specification of a latent interaction term (Muthén, 2007). Instead, the significant main and interaction effects shown in Tables 4 and 5 may be directly compared in magnitude: The interaction effects are roughly half the size of the main effects. It is also worth stressing that the significant main and interaction effects shown in Tables 4 and 5 are equivalent to the value-added scores (rather than raw scores) that are increasingly common in educational effectiveness research (EER) as they are both effects found while controlling for development at preschool entry and background effects (see Figure 1). As such, both the main and protection effects are reduced in magnitude as they represent only additional gains rather than raw effects.

Overall, these findings suggest that the quality of preschools was better placed to (a) protect cognitive rather than social development, (b) protect development against the effects of child- rather than family-level combined risks, and (c) protect development through higher quality processes rather than structures. Nonetheless, it is also relevant to note that there is a link between structures and quality, with higher levels of staff qualification (especially of center managers) predicting higher observed quality (Sylva et al., 2004).

Table 5. Psychological development at age 5: significant interactions between risks, the quality of pre-school structures, and the duration that children attended pre-school.

		Measures of Child Development assessed at school/reception class entry at mean age 58 months (only statistically significant results, unstandardized Bs, all measures *z* scored a priori)					
		General Cognitive Ability		Self-Regulation		Antisocial/Worried Behavior	
Combined Latent Risk (**X**)	Structural Quality of Pre-school (**Y**)	main effect of (**Y**)	interaction effect (**X.Y**)	main effect of (**Y**)	interaction effect (**X.Y**)	main effect of (**Y**)	interaction effect (**X.Y**)
Child Level	*Manager:* Highest Academic Qualification		0.03*(b)	0.08*			
	Highest Childcare Qualification		0.03**(b)	0.07*			
	Staff: Mean Age		0.02**(a)	0.04*			
			−0.03*(b)				
	Mean Highest Academic Qualification						
	Mean Highest Childcare Qualification		−0.03*(b)				
	Number of Staff						
	Number of Children			1.09*			−0.11*(b)
	Duration	0.09***					0.04*(c)
Family Level	*Manager:* Highest Academic Qualification						
	Highest Childcare Qualification	−0.05*					
	Staff: Mean Age			0.04*	− 0.05*(b)		
	Mean Highest Academic Qualification						
	Mean Highest Childcare Qualification		−0.02*(b)				
	Number of Staff		−0.01*(b)				
	Number of Children		0.38**(a)				
	Duration	0.07***					

Note: (a) two-way interaction: risk × quality; (b) three-way interaction: (risk × quality) *x* duration of pre-school attendance; (c) three-way interaction: risk × duration of pre-school attendance.
*$p < .05$; **$p < .01$; ***$p < .001$.

Discussion

The main aim of this study, whose results are summarized in this paper, was to demonstrate if and how programs of universal preschool could mitigate the impact of developmental risks and so thereby offer protection to young children's cognitive and social development. The results of the SEM analyses revealed that there were many more instances of significantly protected (though bear in mind that this can only be described as ''partial'' as significant risk impacts remained, see Table 3 and Rutter & Maughan, 2002) cognitive (46%) rather than social/behavioral development (15%). Further, perhaps the most important protective finding was that the global/overall quality of preschool (incorporating assessments of both structures and processes) has the potential to partially protect the general cognitive abilities of young children from the significant impacts of family-level risks (see Table 4). Given that the combined family-level risk measured in these analyses was also broadly analogous to socioeconomic status (though also encompassing additional aspects of social capital), this suggests that the attendance of young children at higher quality programs of universal preschool *has the potential* to partially combat the effects of social inequalities in a manner similar to Early Interventions such as the High/Scope Perry Pre-school Project (although not necessarily to the same extent). This, therefore, makes it possible to conclude that programs of universal preschool *have the potential* to serve as a type of intervention within normal populations by offering a form of primary prevention (see Sylva, 2000).

However, the protective effects of high-quality preschool that are evidenced in this study must not be *over*-emphasized – they must be interpreted in light of past research. For example, researchers such as Caughy, Dipietro, and Strobino (1994) have reported that although higher quality programs of early education and care can benefit the educational attainment of disadvantaged children, even greater levels of attainment can be expected if such children are in Early Interventions due to the fundamental differences between targeted Early Interventions and programs of universal preschool.

It should also be noted that the partially protective impacts identified in this study are likely to vary across different types of preschool. Although the partially protective effects would be expected to be greatest in those types which provided, on average, the highest quality of care and education, the possible association of risk with type remained a question that was left unasked. Earlier analyses from the main EPPE project indicated that effects associated with types of preschool were less strong than those related to quality, and that type effects were nonsignificant when quality was taken into account (Sammons et al., 2002, 2003).

Considering the limitations of this study, three stand out as prominent. First, the above investigation made no attempt to consider variation of the preschool effects across types of preschool (e.g., playgroups versus nursery schools). Second, no attempt was made to explore preschool quality effects by developmental risk (e.g., children varying in the quality of their early years provision by parental income). Third, development was examined over only a relatively short period of time (a mean of 22 months) when considering longer term developmental pathways (e.g., from birth to adulthood). All three of these limitations can be addressed by future research, however, which might also consider whether the statistical associations found here are replicable across other samples, other domains of child development, other time frames, and different categories of combined risk (e.g., biological development and biological risks such as stress reactivity and allostatic load).

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Technical Appendix (TA) 1. Example SEM: child-level risk-moderating effects of staff–child detached relationships upon general cognitive ability (GCA) at exit from preschool

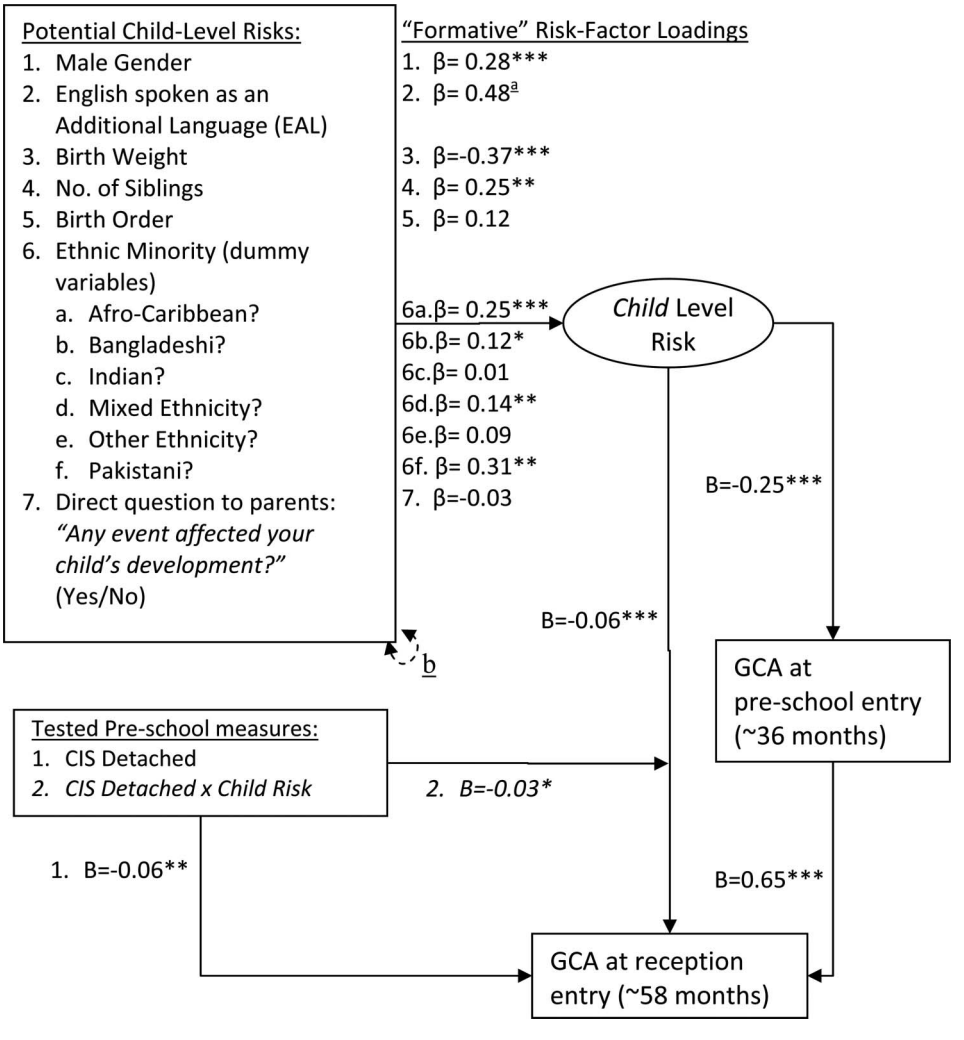

Figure TA1. Child-level risk, staff–child detached relationships, and general cognitive ability.
Notes: [a]Unstandardised factor loadings set to 1 so there is no returned significance; [b]All correlations between child-level risks also modeled, see Table TA1; β: Standardized regression coefficients; B: Unstandardized regression coefficients (all variables z-scored a priori). *$p < .05$; **$p < .01$; ***$p < .001$. Absolute model fit indices (e.g., χ^2, CFI, RMSEA) and percentage variance(s) explained were not returned in these analyses.

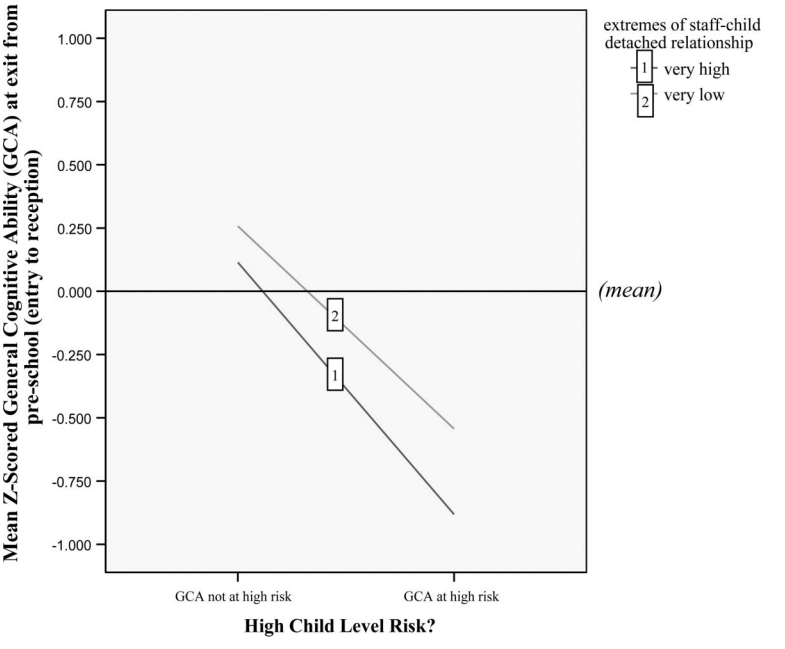

Figure TA2. Child-level risk, staff–child detached relationships, and general cognitive ability: graph of the significant interaction effect between child-level risk and staff–child detached relationships as both significantly impact children's general cognitive ability at exit from preschool (at mean age 58 months).
Note: ''Very high'' staff–child detached relationship defined as: scores > mean + 1 standard deviation; ''very low'' staff–child detached relationship defined as: scores < mean − 1 standard deviation; ''high'' child level risk defined as: child level risk for GCA > mean + 1 standard deviation.

Table TA1. Correlation coefficients (Pearson's *r*) between potential child-level risks.

	1.	2.	3.	4.	5.	6a.	6b.	6c.	6d.	6e.	6f.	7.
1. Male Gender	1											
2. EAL	−0.01	1										
3. Birth Weight	0.09**	−0.07**	1									
4. No. of Siblings	0.03	0.05**	0.03	1								
5. Birth Order	0.02	0.05**	0.03	0.79**	1							
6. Ethnic Minority (dummy variables)												
a. Afro-Caribbean?	−0.02	0.01	−0.07**	−0.01	0.04*	1						
b. Bangladeshi?	−0.05*	0.29**	−0.06**	0.02	0.02	−0.02	1					
c. Indian?	0.00	0.28**	−0.06**	0.01	0.03	−0.04	−0.01	1				
d. Mixed Ethnicity?	−0.03	−0.03	0.00	−0.04*	0.00	−0.07**	−0.02	−0.04*	1			
e. Other Ethnicity?	−0.01	0.29**	−0.02	0.03	0.05	−0.05*	−0.02	−0.03	−0.05*	1		
f. Pakistani?	−0.01	0.43**	−0.07**	0.05*	0.04*	−0.04*	−0.02	−0.02	−0.04*	−0.03	1	
7. Direct question to parents: *"Any event affected your child's development?"*	0.03	−0.06**	−0.01	−0.06**	−0.10**	−0.07**	−0.02	−0.06**	0.02	0.01	−0.03*	1

Note: EAL: English spoken as an additional language.
*$p < .05$; **$p < .01$.