Evaluating the impact of the Parents and Children Together (PACT) programme on the language skills of 3- to 4-year-old nursery children
A two-armed randomised trial

Evaluation Report

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Executive summary

The project

The Parent and Children Together (PACT; Burgoyne et al., 2018a) programme is an early language teaching programme developed and managed by a team based at the University of Manchester and led by Dr Kelly Burgoyne. The PACT programme is delivered by parents/carers to their pre-school child in the year before they start school. The overall aim of the PACT programme is to improve pre-school children's language development by increasing the frequency and quality of parent/carer-child interaction and communication through the specific programme activities.

The PACT programme was delivered by parents/carers over a period of 30 weeks. Parents/carers delivered structured language activities, based on storybooks provided by the programme, five days a week, for approximately 20 minutes a day. Parents/carers received a two-hour online training session to deliver the programme to their child. Nursery staff received a four-hour training session to help them to support parents.

372 children from 43 school nurseries took part in this efficacy trial. It was a two-armed randomised controlled efficacy trial where 186 children received PACT and 186 formed the 'usual care' comparison group. PACT was aimed at families with a child aged 3-4 years who attended state-maintained school nurseries in disadvantaged areas in the North West of England. Children were eligible if they were moving into the Reception year-group at school in September 2022 (the academic year immediately following the PACT programme).

The primary outcome was overall language skills measured using the LanguageScreen app. The secondary outcomes included expressive and receptive vocabulary, spoken language information and grammar, early literacy skills, the child's home learning environment, and school readiness. A process evaluation was also conducted, including observations, surveys, interviews, and using the PACTApp for tracking individual sessions completed by families.

The trial started recruitment in March 2021. Randomisation took place in October 2021 and the intervention was delivered between November 2021 and June 2022. Post-testing took place in June-July 2022. Delayed post-testing took place in May-June 2023.

Table 1. Key conclusions.

Key Conclusions
When assessed immediately after the intervention, children offered the PACT programme made, on average, no additional months' progress in overall language skills compared to children who did not receive the PACT programme. This result has a moderate to high security rating.
Assessments completed 11 months after intervention delivery showed children who received PACT made, on average, 1 additional months' progress in overall language skills compared to children who did not receive the programme. However, there is some uncertainty in this estimate and it may be that the true effect was no progress. The effect on language skills was higher for those with greater compliance to the PACT programme.
Children offered the PACT programme scored higher on measures of school readiness, expressive vocabulary, and one measure of receptive vocabulary than children who did not receive the PACT programme. Conversely, the results indicated a small negative impact on the child's home learning environment for children who participated in the PACT programme. No difference was found in spoken language information or grammar.
The PACT programme was delivered with a moderate to high degree of fidelity. On average, families completed around two thirds of the PACT sessions and reported delivering the sessions as prescribed. Engagement decreased throughout the 30-week programme and families reported finding it difficult to find time to fit in all programme sessions.
Families and nurseries were very positive about the programme and felt that it led to improvements in children's language and vocabulary, interest in books and that it led to parents and children spending more high-quality one-to-one time together.

EEF security rating

These findings have a moderate to high security rating. This was an efficacy trial, which tested whether the intervention worked under developer-led conditions in a number of schools. The number of schools and children recruited was lower than expected, which meant that at randomisation the trial was not as well-powered as originally intended. There was some evidence of compensatory activities in the control group, evidence for a small amount of contamination, and it was not possible to ensure assessors were blind to the treatment/control allocation of the child, meaning there is

potential for bias in the completion of assessments. This makes it harder to accurately estimate the size of the impact on the pupils in the trial.

Additional findings

When assessed immediately after the intervention, children offered the PACT programme made, on average, no additional months' progress than those in the control group. This is our best estimate of impact, which has a moderate to high security rating. As with any study, there is always some uncertainty around the result: the possible impact of this programme also includes negative effects of three months less progress and positive effects of up to four months additional progress.

However, there was some evidence for a small positive impact of the programme on overall language skills when children were assessed 11 months later. Compared to the outcome when assessed immediately after the intervention, we are less certain of this effect due to the higher variability in estimates of possible months progress which includes zero months progress. Impacts were increased when looking at families that completed more than 90% of sessions.

The PACT intervention, on average, had a positive but low impact on school readiness when measured through a validated questionnaire completed by nursery key workers. The impact evaluation found a small negative impact of the PACT programme on the home learning environment when measured through a validated questionnaire completed by parents. However, the results indicated that shared reading was higher at post-test for the intervention group than the control group. It may be that as a result of doing PACT, parents had less time to do the range of activities captured by the Home Learning Environment Index.

Children eligible for the Early Years Pupil Premium (EYPP) formed a small subgroup in the sample (n=66). Exploratory analysis suggests that for children eligible for EYPP the PACT intervention had no consistent effect on either primary or secondary language outcomes but showed positive effects on the measure of school readiness. These results should be interpreted very cautiously as the number of pupils in the sample was small.

Parents in the intervention group reported having more confidence to support their child's learning at the end of the programme compared to parents in the control group. The duration and intensity of the programme was the only challenge raised consistently, with families reporting sometimes having difficulty fitting PACT into their schedules and engagement with the programme declining throughout the 30-week programme.

Similar to the previous PACT-2 evaluation, the results of this trial indicate that there is evidence to support most of the delivery elements of the PACT logic model but limited evidence to support the expected outcomes. The results of this study do not replicate the first PACT trial (Burgoyne et al., 2018b) conducted with families in children's centres which found a positive impact of the PACT programme on children's language and literacy outcomes.

Cost

The average cost of the PACT programme if provided to five pupils per year, when averaged over three years, was £241.07 per pupil, per year. The programme is therefore rated as moderate cost.

Impact

Table 2. Summary of impact on primary outcome(s).

Outcome/ Group	Effect size (95% confidence interval)	Estimated months' progress	EEF security rating	No of children	P Value	EEF cost rating
Language screen (Latent variable)/ full sample	0.03 (-0.23, 0.28)	0	🔒🔒🔒🔓🔓	339	0.70	£ £ £ £ £
Language screen (Latent variable)/	-0.04 (-0.56, 0.48)	0	N/A	66	0.86	N/A

EYPP subgroup						

Introduction

Background

Early language development is an important underpinning for the future outcomes of children. For example, vocabulary development in early childhood has been found to predict children's later reading and academic skills even when controlling for other factors such as parent literacy and education and children's early literacy (for example, Morgen et al., 2015; Ramsook, Welsh and Bierman, 2019, Snow, Burns and Griffin, 1998; Senechal, Ouellette and Rodney, 2006). In longitudinal studies vocabulary measured as early as 19 months predicts reading comprehension at age 12 and beyond (Suggate et al,. 2018). Poor language skills at school entry have also been negatively associated with children's behaviour in adolescence (Bornstein, Hahn & Suwalsky (2013) as well as adult literacy, mental health and employability (Law, Rush, Schoon, and Parsons, 2009, Armstrong et al (2016)).

While language learning is universal and almost all children develop spoken language, the rate and quality of language development is sensitive to the environment the child is in and the interactions and inputs of the adults around the child (Law et al., 2017). Evidence suggests that children's language develops optimally through plentiful social interactions between children and their caregivers; where parents talk a lot to children, these children have faster vocabulary development (Cartmill et al., 2013) and that the quality of the caregiver input is important with exposure to decontextualised talk helping to support receptive vocabulary development (Rowe, 2012).

The development of literacy skills is dependent on oral language as well as on phonological awareness and on print knowledge awareness (Whitehust and Lonigan, 1998). To learn to read, the child needs to develop these three skills. Exposure to books is a well-established means to developing children's vocabulary and the precursor knowledge of language and print (early literacy skills; for example, McKeown and Beck, 2006, Sénéchal and LeFevre, 2002). Interventions which focused on adults and children reading books together have been shown to impact on such skills. For example, a meta-analysis of studies which looked at the impact of interactive and structured shared book-reading in kindergarten (Mol, Bus and de Jong, 2017) found that where educators were trained to encourage a child's active involvement in joint book reading there were positive effects (effect size Cohen's d=0.54) on children's oral language skills (including expressive and receptive vocabulary) and on early literacy skills. Additionally, this study found that interactive book-reading, one to one with trained researchers, was more effective than interactive book-reading in groups delivered by teachers or researchers at improving oral language; longer programmes delivered over the full school year were shown to have a positive impact on children's phonological skills compared to programmes shorter than 16 weeks however the programme length did not affect oral language outcomes. However, another more recent meta-analysis looking at the impact of shared book reading for children under the age of six (Noble et al., 2019) found smaller effects of these programme (effect size Hedge's g=0.19). However, the authors highlight that many previous studies are of low-dose interventions of only a few weeks and that longer term interventions may see larger effects.

Evidence indicates that parenting and educational environment in the early years have a powerful influence on language development. The quality of the home learning environment and educational resources within the home are important factors (Melhuish et al., 2008b). There is also a link between the quality of the home learning environment and socio-economic status (Foster et al., 2005) with families of lower socio-economic status more likely to have a lower quality home learning environment. Children from disadvantaged backgrounds also enter school with lower levels of attainment than their more socio-economically advantaged peers (Tymms et al., 2014) and this trend persists throughout primary school (Merrell, Little and Coe, 2014). Development and skills at the start of school are predictive of later outcomes (see, for example, Tymms, Merrell and Bailey, 2017).

A large-scale multinational study of 13 countries, including the UK, tested how the home learning environment affected children's vocabulary development during the pandemic (Kartushina et al., 2021). The authors concluded that children whose caregivers read more to them during the early 2020 lockdown had a boost in their receptive vocabulary

development compared to the norms from pre-pandemic times even after controlling for socio-economic status. This suggests that a programme which supports caregivers to spend more quality time reading with their child may support the development of language skills in pre-schoolers.

A recent meta-analysis of the effect of home learning literacy programmes on the emergent literacy skills of children from birth to six years from low socioeconomic backgrounds found a Cohen's d effect size of 0.50 on immediate post-tests (Fikrat-Wevers et al., 2021) from across 48 studies (thirty-two of these studies looked at programmes for 3–6-year-olds while 8 were for mixed aged groups). They found the most promising home reading programmes for low-SES families were ones that focused on a limited set of activities—shared reading, activities that did not combine home activities with teacher/child activities at nursery, activities that did not try to have an impact on anything else but literacy skills, and those that were restricted to one training setting, either home or school.

The closure of schools and early years settings due to the Covid-19 pandemic, and the ongoing knock-on effects that followed, have had far-reaching impacts on education. An interim report commissioned by the EEF has reported that from a sample of 58 primary schools, 96% reported concerns about children's communication and language development on starting school as a result of the pandemic and 89% were concerned about children's literacy levels (Bowyer-Crane et al., 2021). In the same study, 76% of schools felt that pupils starting school needed additional support compared to pre-pandemic cohorts. A Speech Link study of 50,000 pupil language assessments of 4- and 5-year-olds starting school in 2020 found that at least 20% more pupils were arriving at school with the lowest language levels (Speech Link Multimedia, 2021). It seems that there is now a greater need to support the development of language skills in pre-school children. This has been recognised across multiple stakeholder groups including parents, nurseries, schools and policy makers with support for targeting the language abilities of children starting school becoming a focus of action across these stakeholders.,

Multiple studies have found that formal education in the early years can positively impact on children's short and long term educational, social and behavioural outcomes especially when the quality of education is high (Sylva et al., 2010; Melhuish et al., 2015). However, pre-school children during the pandemic were less likely to have attended centre-based childcare (e.g., nurseries, pre-schools, school nurseries) during the first three years of their life. During the first lockdown, only 5% of the number that usually attend Early Childhood Education Centres (which includes Ofsted registered private nursery and preschool settings, school nurseries, and Ofsted registered childminders) were attending (Department for Education 2020) and, although increasing after lockdown, this was still only at 76% of pre-pandemic levels in September 2021. Thus, children were less likely to have experienced the language development and other cognitive benefits which can come from this care (e.g., Davies et al., 2021) and may be in greater need of intervention. This was particularly notable for children from disadvantaged backgrounds who were further hindered by not attending childcare (Davies et al 2021).

The evidence suggests that a sustained, interactive shared reading programme for parents to do with their children in the home, seems to be a promising intervention to support children from disadvantaged backgrounds with their language development, and those who have missed out on early education due to the Covid-19 pandemic. For the intervention to have the best chance of success it should be delivered one-to-one, should provide training for those delivering the programme and should target children's oral language skills while also drawing attention to features of the print. Providing families with books for shared reading and the associated resources may also support disadvantaged families who don't always have access to children's books and may also improve the home learning environment.

Parents and Children Together previous evaluations

Parents and Children Together (PACT) is a UK-based language teaching programme for pre-school children (aged 3-4) that parents or carers[1] deliver to their child at home. The programme includes features of shared reading and activities specific to improving language skills. This programme was developed in line with Early Years policy and practice guidelines (e.g., DfE, 2012) and was previously found to support children's early language and emerging literacy skills (Burgoyne, et al., 2018ab; 2018c). PACT is centred on improving children's language skills through interactive book reading, supplemented with direct teaching of vocabulary and work on narrative skills. The materials are designed to be

[1] Throughout the report we refer to 'parents' but mean the parents and carers that took part in the programme.

easy to use, engaging, and motivating for young children. PACT has a training component for both parents and nursery staff with nurseries encouraged to provide support to their families throughout the 30-week-long programme.

The PACT programme has been evaluated using a randomised controlled trial design twice before. The first trial of PACT was as part of a Nuffield Foundation funded project (reported in Burgoyne et al., 2018b) and is referred to throughout this report as PACT-1. PACT-1 took place in 2015-2016 recruiting families and delivering the programme through 22 children's centres in three local authorities in the North West of England, two of which ranked highly on indices of deprivation. Altogether, 208 children were randomly allocated to either the PACT language programme or a motor skills control programme. The effects of the language programme were tested with a large battery of standardised and non-standardised tests on language outcomes immediately after the programme and on language and early literacy outcomes six months after the programme. At immediate post-test, the language programme produced improvements in language (Cohen's d=.21) and narrative skills (Cohen's d=.36); the former was maintained six months later (Cohen's d=.34). At the six month delayed follow-up, the language programme also produced improvements in some early literacy skills including letter-sound knowledge (effect size Cohen's d=.42) and regular word reading (effect size Cohen's d=.35) indicating that the PACT programme language skill improvement also supported some early literacy skills.

The second trial of PACT, referred to throughout this report as PACT-2, was an EEF- funded RCT that was delivered via state funded nurseries during the academic year 2019/20 (Menzies et al., 2022). PACT-2 aimed to replicate the PACT-1 study on a larger scale (n=450) and drew participants from state-maintained school nurseries (n=47) instead of from Children's Centres. This change in sample was due to the fact that children's centres were no longer receiving the funding that they would have needed to support the programme and school nurseries were deemed to be a good delivery model for the programme. The PACT-2 study used a 'business as usual' control group where control families received a box of books as an incentive at the end of the programme instead of an active control group. The PACT materials were also updated for the PACT-2 trial with new books and associated resources due to several of the original books in the programme going out of print, and the materials were adapted to look more professional and engaging. The celebration events for families that had taken part at the end of each PACT block in PACT-1 were also not included in the PACT-2 trial to minimise contamination between the parents in the intervention and control groups.

The PACT-2 project had originally aimed to use many of the same outcome measures as had been used in PACT-1 expecting to see similar outcomes (see the protocol for the PACT-2 project by Cramman, Robinson-Smith, Menzies, Hugill & Eerola, 2021). However, due to Covid-19 lockdowns and disruptions which began half-way through the project, the immediate post-testing was not possible and the primary outcome, administered only at the 10-month later delayed follow-up, was changed to a different language assessment which could be delivered by school staff instead of researchers visiting the setting. During this 10 month period from when the intervention finished and the delayed follow-up assessment was administered, there was a national focus on supporting children to catch up on missed learning through the UK government's Coronavirus catch-up programme (Education Committee, UK Parliament, 2022) which included additional catch-up funding for schools, the national tutoring programme and a national roll out of an oral language intervention for children in reception. This change in context may have minimised the potential to see the impact of the PACT programme in this project. Covid-19 lockdowns during the trial also led to an interruption of the delivery of the PACT-2 programme and a change in home circumstances for those families doing the PACT-2 programme due to school and childcare closures, requirements to work from home and the furlough scheme.

The PACT-2 impact evaluation (Menzies, et al., 2022) found that there was no difference between the PACT-2 intervention group and the control group in terms of language scores at the delayed post-test period using the LanguageScreen assessment measure. For the Home Learning Environment measure collected at immediate post-test there was a positive but non-significant effect of the programme (effect size Hedges' g=0.10) however, due to high attrition in the Home Learning Environment data collection, these results should be treated with caution. The implementation and process evaluation found that the PACT-2 programme had been very positively received by participants and that parents perceived that it had supported their children's language development and the amount of quality time that parents spent with the child. Parent had engaged with the programme to a similar level as in the PACT-1 programme and seemed to deliver the programme with high fidelity, although the engagement of families throughout the 30 weeks of the programme dropped after each block and seemed to drop further due to the disruption of Covid-19 restrictions to family's lives.

Due to the Covid-19 disruption to the programme delivery and the evaluation of PACT-2, it is difficult to interpret the findings of the PACT-2 evaluation. For example, it is not possible to know whether the PACT-2 programme did have an effect at the end of delivery period or whether the targeted Covid-19 recovery focus for children starting school meant

that any effect was neutralised by the time of the10-month post-intervention delayed post-testing. The changed outcome measures may also not have been sensitive to the impact of PACT-2 compared to those used in PACT-1.

Retialling PACT (PACT-3)

This evaluation of the PACT early language programme is the third randomised controlled trial (PACT-3) and was commissioned as a retrial of the PACT-2 project which was still ongoing at the time. As described above, PACT-2 was heavily affected by the Covid-19 lockdowns and subsequent ongoing restrictions during the academic year 2019-2020 As a result, EEF funded this PACT-3 retrial evaluation of the PACT programme using a very similar research design to PACT-2 and working with some of the same settings (although different families). PACT-3 was an efficacy trial which aimed to run in ideal conditions, recruiting state-maintained school-based nurseries and randomisation of families within the schools to the PACT intervention or a business-as-usual control group. As in PACT-2, this trial used a within-school randomised controlled design with a business-as-usual control group. Data was collected at three timepoints: baseline, immediately after the intervention delivery period and eleven months later at delayed post-test. The within-school randomisation was chosen as the optimal design for this project, taking into account the maximum school numbers that the developer team had the capacity to delivery to, maximising the power of the trial to detect an effect and the theory of change for the programme, with the majority of the intervention delivery and expected change being through the parent/child interaction at home minimising the risk of contamination between the groups. Including a delayed post-test also allowed for the investigation of whether any intervention effects were maintained into school – the PACT-1 project had shown a larger effect of the programme on language skills six-months after completing the intervention. The evaluation included an integrated implementation and process evaluation (IPE). This aimed to investigate how well the PACT programme was delivered both at the nursery level and at the parent/carer and child level. It focused on monitoring compliance and intervention fidelity through administrative data collection, interviews, and surveys at different periods. The IPE also investigated how the PACT programme compared to usual practice, factors that impacted the delivery of the programme and how the programme was perceived by those taking part. Surveys and interview data collection supported these investigations.

The PACT programme that families delivered in the home remained the same in PACT-3 as for PACT-2. However, to mitigate for Covid-19 disruption to the delivery of the trial, there were changes made to the nursery staff and parent training aspects of the delivery, moving to online delivery instead of face-to-face (as it was for PACT-2). Changes were also made to the evaluation outcome data collection – most significantly regarding the baseline and outcome measures used. To mitigate the risk of not being able to have researchers visit nurseries to collect assessment data due to ongoing or further Covid-19 restriction, we used the LanguageScreen assessment again in PACT-3 as the baseline and primary outcome. However, at post-testing we also collected secondary language outcome measures using some of the same assessments as PACT-1. This was to allow us to look at whether the LanguageScreen assessment was sensitive enough to find the changes PACT made in the PACT-1 programme.

Appendix C summarises the differences between the programme delivery and evaluation design in the PACT-3 evaluation compared to the PACT-2 and PACT-1 evaluations.

Intervention

Parent and Child Together (PACT) Programme

The Parents and Children Together programme (PACT; Burgoyne et al., 2018a) is an early language teaching programme delivered by parents[2] to their pre-school child in the year before they start school. It is an intensive programme delivered over a period of thirty weeks with focused language activities based on storybooks provided by the programme to be completed five days a week for approximately 20 minutes a day. Delivery of the programme is at two levels: a) nursery staff recruit families and support parents with the programme and b) parents deliver the programme sessions directly to their child at home. Training is provided for both nursery staff driving the programme (PACT Leads) and for the parents.

[2] While the programme was designed for parents to use, it did not exclude delivery by other family members or carers where suitable e.g., Grandparents, older siblings. However, unless otherwise relevant, the report will refer to parents throughout.

In this trial the PACT intervention was delivered by families between November 2021 and June 2022. PACT Lead training took place in May 2021 and training for parents took place in November 2021. The PACT intervention is described in detail below using the TiDieR checklist headings (Hoffman et al., 2014).

Rationale

Oral language skills provide the foundation for formal education and play a critical role in learning to read (Hulme et al., 2015). Children from low-income backgrounds are at risk of delayed language development and educational disadvantage (for example, Roulstone et al., 2011). Interventions that promote oral language in the early years have considerable potential to enhance children's learning and development, particularly for those from deprived socioeconomic backgrounds (see Fricke et al., 2013; Reese, et al., 2010; van der Pluijm et al., 2019). PACT is an early language teaching programme for parents/carers to deliver to their pre-school child (aged three to four years). Previous results from a within-school randomised controlled trial reported the PACT programme led to significant gains in oral language skills immediately after intervention, which were maintained six months later. The trial also reported improvements in some early literacy skills at delayed follow-up (Burgoyne et al., 2018b).

The PACT programme incorporates key components that are designed to promote children's early language development:

- Shared reading: Parents/carers read books with their child using strategies, which support verbal interaction and active engagement.
- Vocabulary instruction: Selected words are taught using interactive activities to promote new word learning.
- Narrative (storytelling): Activities include sequencing, summarizing and telling/retelling stories.

Who (recipients of intervention)

PACT is an intervention for nursery children and their parents/carers. For this trial, eligible families had a child who was 3-years old in September 2021, who attended a participating state-maintained, school-based nursery (all based in the North West of England) in the year before starting formal schooling. To take part, the parent or caregiver for the child was required to have a sufficient level of English to access the programme materials[3]. The child also should not have had suspected or diagnosed developmental or learning difficulties and must not have had a sibling or step sibling within the same class. For this PACT-3 trial, families must not have participated in the PACT-2 trial.

Parents/carers were ultimately responsible for engaging with PACT and delivering the content to their child.

Nursery level implementers/providers (known as PACT Leads): 1-2 nursery staff in each setting trained to support the project (recruiting, training and supporting families taking part) and responsible for distributing the PACT materials to parents/carers as required, monitoring engagement with the programme informally, supporting parents/carers with programme delivery and in some cases train parents in the programme if the parents have not been able to access the live training delivered by the delivery team.

What (procedures)

Training for PACT Leads

After signing up to the project one or two members of nursery staff (nominated PACT Leads) attended a 4-hour online training session delivered by two members of the developer team. This training session included:

- an initial description of the background to PACT and the overall research project;
- specific guidance on the structure of the PACT programme and how parents should deliver the sessions (PACT Leads refer to a PACT Pack example sent to them in advance of the session to aid their understanding);
- recruiting families to the project including eligibility criteria and how to talk to parents about the project;
- the child assessments that form part of the evaluation;
- information about parent training and training parents unable to make the formal training sessions;
- supporting parents to deliver the programme and in monitoring their progress;

[3] The PACT programme was not specifically targeted at families with English as an Additional Language (EAL) and excluded families where there wasn't a parent with good enough English skills to target the programme. EAL could also include a wide range of family circumstances. An EAL subgroup was therefore not included as a focus of the impact evaluation but exploratory analysis of families where English was not the main language spoken at home was included in the implementation and process evaluation.

- process evaluation activities that would be led by the evaluator team.

These training sessions included interactive elements encouraging feedback and questions throughout, break-out rooms for discussion and role-playing elements of the PACT programme with other participants. They also tackled frequently asked questions from parents about the programme.

Each PACT Lead received a full set of the PACT materials (six PACT activity packs) to help them support parents/carers completing PACT. They were informed not to use the PACT pack for within-school teaching with the cohort taking part in the project.

Training for Parents

Parents/carers assigned to the PACT programme group were expected to attend a 2-hour online training session delivered by one of three trained PACT delivery team members. This session includes:

- an introduction to the PACT programme and the research design;
- why improving pre-school children's oral language skills and school readiness is important;
- key teaching principles for working with your child;
- the details of the programme and what to do for each of the elements including strategies to support prompting your child;
- recording progress through the PACTApp and record forms;
- PACT programme structure and next steps.

Nurseries were sent the first PACT packs for parents two to four weeks before the training sessions, and these were given to parents in advance of their training session. The pack was referred to during the training session. If parents/carers were unable to attend a live session, training could be given by the nursery PACT Lead using materials provided by the developer team (including a recording of the parent training session, key messages document, and slides). If that was not possible, the parent may have been trained by independently watching the recording of the training session and following up with the PACT Lead if they had any questions.

Delivery of PACT sessions by parents

The PACT programme involved 30 weeks of parental delivery of a manualised teaching programme based around provided storybooks. This time was divided into six five-week-blocks (with materials sent out to nurseries for distribution to parents just before each block was due to begin). The blocks each focussed on a different theme. These themes included: Animals (weeks 1-5), The World Around Us (weeks 6-10), Journeys (weeks 11-15), The Body (weeks 16-20), Home (weeks 21-25), and Places and People (weeks 26-30).

The parent-led teaching sessions were the same as in the previous trials and were designed to take 20 minutes and to be delivered five days a week. Each 20-minute session was divided into sections, with approximate timings given aligned with guided activities and materials:

- 'Introduction', to settle the child and turn their focus to the PACT activities (2 minutes).
- 'Reading Together', to read the book and talk about the story (5 minutes). This shared book reading follows the principles of dialogic reading supporting their child to play an active role in the reading, following their child's interest, asking questions and linking the story to their child's experience.
- 'Vocabulary' to learn a new word from the book or theme and what it meant (5 minutes). New words include a range of word types and are selected to be useful across different contexts.
- 'Stories' to talk about what happens in the story (five minutes). Parents support their child's story knowledge and storytelling skills by helping them to order pictures from the story, describe what is happening in the pictures, and help them to retell the story.
- 'Reward' to talk and recap the session, praise the child and give a reward sticker (3 minutes).

PACT sessions should include all activities listed in the manual and should follow a consistent structure and routine. The content in weeks 1-4 activities focuses on introducing new content, and week five encourages parents/carers and children to revise and build on learning from the previous four weeks.

The parent/carer was asked to record their progress through the programme using the PACTApp mobile application or a paper record form. For each session the parent indicated when the session was completed and whether their child had enjoyed or not enjoyed the session on a dichotomous scale.

Support for parents from nursery
PACT Leads were responsible for distributing the PACT packs to parents throughout the programme. The packs should have been distributed so that families could progress straight onto the next pack on completion of the previous pack. PACT Leads were also asked to provide support and encouragement to families delivering the PACT programme (at their discretion and expected to answer families' questions and encourage families to continue engaging with the programme for the programme duration.

What (materials)
PACT is a manualised teaching programme (Burgoyne, Gardner, and Hulme, 2018), published for this trial by the Book Trust. PACT consisted of 30 weeks of teaching materials which are organised into blocks of five weeks; each block was packaged in a box linked to the theme. Each block of books included four books linked to this theme and these were delivered during weeks 1-4 of the block. These books included a mixture of well-known modern classics, factual storybooks, and new books. Each storybook came with an accompanying activity book, which included all guidance, activities, and resources for the parent/carer to be able to deliver that week of PACT. Each block also contained a 'Bringing it all Together' activity book, which was used in week 5 of the block and focussed on recap, consolidation, and theme-level activities as well as a sticker chart and stickers to track and celebrate progress. In addition, the first PACT block contained a parent guide to the programme.

There are also PACT Lead training PowerPoint slides and a parent recruitment video, as well as Parent/Carer training sessions PowerPoint slides, a recording of the Parent/Carer training and two demonstration recordings of an adult and child participating in PACT language sessions together.

Who (intervention providers)
PACT sessions were delivered to the children by a trained caregiver (e.g., parent, grandparent, other adult family member) in the home.

For each participating school nursery, there was at least one nominated PACT Lead, whose role was to support the participating parents. These PACT Leads participated in a four-hour developer-led online training session for nursery staff.

Training for parents was delivered online by the PACT delivery team at the University of Manchester. The PACT delivery team also provided online training for PACT Leads at the start of the project. If the parent/carer was unable to attend the delivery team training sessions, they were trained by the PACT Lead or provided with a video recording of the training.

Where (location)
PACT school nurseries, and the families within these settings, were recruited within the areas of Greater Manchester, Rochdale, Tameside, Lancashire, Bolton and Warrington. These areas were identified as areas of deprivation due to their low scoring on the Indices of Multiple Deprivation (IMD). Manchester, Rochdale and Tameside were in the lowest IMD decile, Bolton scored in the second IMD decile and various targeted areas of Lancashire including Blackpool, Preston and were also in the lowest two deciles. Warrington was an outlier in the sixth IMD decile Eligible settings were state-funded schools, with nurseries that have provision for age 3+ years. Nurseries who took part in the previous, interrupted PACT trial were given priority to take part again.

Training for the project took place online. Delivery of the PACT sessions was in the home of the children.

How much (duration and dosage)
PACT sessions were designed to be delivered in 20-minute sessions, five days a week, for 30 weeks in total. This was a total of 150 sessions across the year of the project. These 30 weeks were broken into six 5-week blocks, each with a corresponding pack of materials.

Tailoring and adaptation

PACT is a manualised teaching programme (Burgoyne et al., 2018a) delivered as part of an efficacy trial; therefore, optimal treatment fidelity was emphasised. However, parents were encouraged to make surface-level adaptations (e.g., reducing the level of support from the parent to make it more challenging, doing more than one session in a day if necessary) in order to make the programme accessible and engaging for their child. Parents were encouraged not to change the order, to maintain consistency and to stick to the 20-minute timeslots.

The PACT Leads were encouraged to adapt their level of interaction with and support of the families in the PACT trial as they saw necessary.

How well (planned)

The strategies to maximise implementation effectiveness included:

a) Sufficient support of participating families by PACT Leads. Nurseries were invited to train more than one member of staff in the developer-led online training in order to mitigate issues that might arise due to staff absence and affect the continuation of the setting in the PACT programme. During this training day, PACT Leads were given suggestions and recommendations of the type of support they needed to provide for families and what this might look like.

b) Families were allowed flexibility in their delivery of the programme. PACT Leads informed families that multiple carers were allowed to attend training and that they could split delivery of PACT between family members. By training multiple members of the family, it was hoped that this would increase frequency of PACT delivery in the home. Families were given several dates and times for the online training. Any families who could not attend these training days were given a training video to watch, or they were trained by the PACT Lead at a convenient time for them. During delivery, families were encouraged to create a routine for 'PACT time' and to deliver these sessions at a similar time of day.

Theory of Change

Figure 1 below contains the logic model which visually shows the theory of change for the PACT programme developed with the developer team at the start of the project.

The PACT programme is an evidence- and research-informed programme based around children's storybooks with specific language focused activities to complete five days a week over a 30-week period which parents/carers deliver with their preschool child. The overall purpose of the PACT programme evaluated and reported here was to improve pre-school children's language development for the children taking part in the programme.

One of the initial stages of the project was the recruitment of settings to the project. By targeting local authorities and areas which had broad indication of higher levels of social deprivation, it was expected that the programme would be available to settings who support disadvantaged families who may not already have a high-quality home learning environment and who may be at a disadvantage in terms of their current language development as informed by findings from previous research. Training was provided to one or two staff in each setting who were dedicated 'PACT Leads', the main deliverers and primary contacts for the settings, who then informed the setting about the PACT programme, how to support families with delivery, and the recruitment of families to the project. Nursery settings would then recruit families to the project in line with the inclusion criteria who they think would have the time and motivation to engage with the PACT programme and who would benefit from its content and resources.

It was expected that training for parents and the provision and regular use of the focused learning materials would facilitate improved home-based learning by increasing the frequency and quality of parent/carer-child interaction and communication through the specific programme activities and beyond. Training and support for parents/carers was expected to provide them with the required knowledge, skills, and confidence to deliver the programme. The PACT programme training and materials describe how parents should talk about and deliver each session with the aim of parents/carers delivering it in a standard way and improving parent/carer confidence and practice. The provision of

storybooks and activities provided families with learning resources and the range and variety of the storybooks aimed to engage children in the activities. The intensity of the programme (20 minutes per day for five days a week) as well as the length of the programme (30 weeks) aimed to lead to more sustained changes in home learning interactions. Support from nursery staff to parents/carers, particularly in the early stages of the programme, was intended to lead to a more sustained use of the programme by families.

The programme was based on the assumptions that parents/carers and their children engage with the PACT resources and materials at home and that families complete the structured learning activities in the home on a regular basis, which would increase parent/carer-child interaction and communication. It is also based on the assumption that these activities are significantly different to what parents normally do and more likely to support children's development than the other activities being done in the home.

The expected impact was that targeted activities specifically designed to foster language skills provided by PACT would directly improve the child's language and foster a language-rich communication environment in the home. The home learning environment could also be enriched by PACT in the following ways:

- specific provision of the PACT focused teaching and learning opportunities;
- enriched communication in the home;
- availability of more high-quality educational resources;
- consistent parent/carer and child behaviour;
- improved parent confidence; and
- better parent/child relationships (and increased parental warmth).

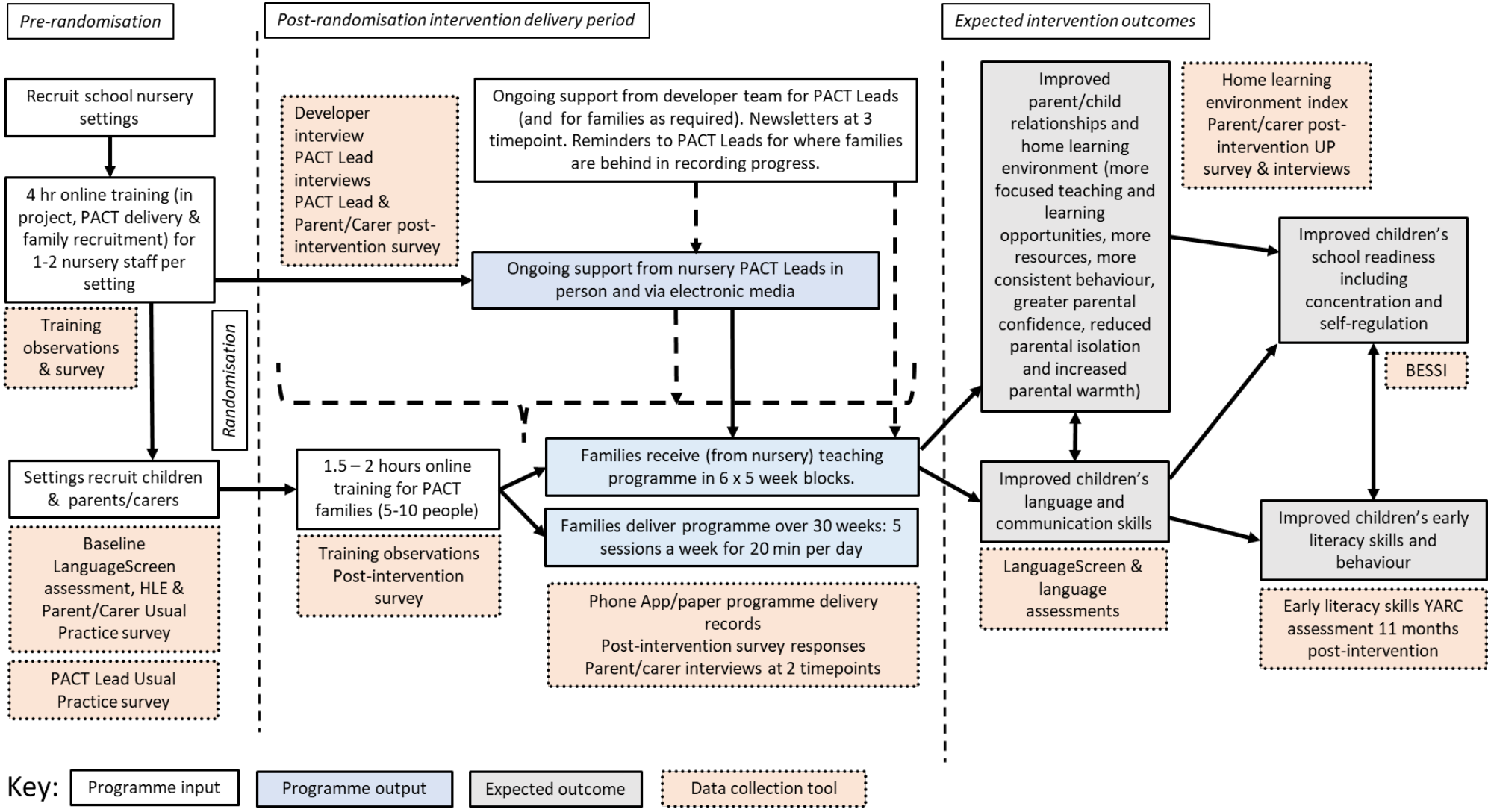

Figure 1. Logic model for PACT delivery through trial (with associated data collection tools)

Together, these factors are expected to lead to the improvement of children's language skills, which in a circular feedback loop allow the child to communicate better with the parent/carer and improve the home learning activities and environment offered. School readiness (including the child's self-regulation and ability to concentrate) is also expected to be improved through the enhanced home learning environment and by more advanced child language development (including concentration and self-regulation). These short-term impacts (HLE, language skills, and school readiness) are also expected to improve early literacy skills during the first year of school and lead to continued development and longer-term improvements to language, literacy, and communication.

The IPE results discuss many of these elements of the theory of change model and what was implemented. The integrated results of the impact evaluation and IPE and how they support this theory of change model are discussed in the Conclusions section.

Control condition

Children and their parents who were allocated to the control condition were from the same settings as the intervention families and received "business as usual" nursery practice and home learning activities as would usually be provided by the nursery if they were not taking part in the programme. Nursery staff were asked not to change their general teaching practice or activities based on the PACT training. Those allocated to the control group were incentivised to take part by receiving a pack of children's books costing an equivalent cost of the PACT materials at the end of the intervention period on completion of the immediate post-testing. Based on the logic model and the underlying assumptions, it was expected that providing books without the associated materials and without structured regular engagement with the books and the activities would not impact the control group in the period after the intervention and before the 11 month follow up period.

Evaluation objectives

This evaluation was designed as an efficacy randomised controlled trial (RCT) of the PACT intervention to investigate the impact of the PACT programme compared to a business-as-usual control. The primary purpose of the trial was to explore the effectiveness of PACT to improve pre-school children's language development. The trial also investigated the impact of the PACT intervention on school readiness, the home learning environment and early literacy skills as secondary outcomes in line with the Theory of Change. The Implementation and Process Evaluation focussed on the fidelity of the implementation delivery, on perceived outcomes and on the usual practice and contextual factors relevant to the trial. The protocol and SAP for the trial are published on the EEF website (https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/pact-parents-and-children-together-regrant).

Research questions for the Impact Evaluation (IE)

The trial's research questions were focused around two time points:

- "Immediate post-testing" which took place immediately after the intervention period;
- "Delayed post-testing" which took place 11 months after the end of the intervention period when children were in school.

RQ1. What was the impact of the PACT intervention on language skills *immediately after the intervention period*, as measured by the LanguageScreen assessment? [Primary Outcome]

RQ2. What was the impact of the PACT intervention on language skills *11 months after the intervention period*, as measured by the LanguageScreen assessment? [Secondary Outcome]

RQ3. What was the impact of the PACT intervention on the specific language domains of receptive vocabulary measured by the British Picture Vocabulary Scale (BPVS), expressive vocabulary measured by CELF Preschool 2 Expressive Vocabulary subscale (CELF EV) and spoken language information and grammar measured by the Renfrew Action Picture test (APT Information, APT Grammar) *immediately after the intervention period*, using researcher-delivered assessments [Secondary Outcome]?

RQ4. What is the impact of the PACT intervention on the specific language domains of receptive vocabulary (measured by the BPVS), expressive vocabulary (measured by CELF EV) and information and grammar in spoken language

(measured by APT Information and APT Grammar) *11 months after the intervention period*, using researcher-delivered assessments [Secondary Outcome]?

RQ5. What is the impact of PACT on school readiness *immediately after the intervention period* measured using teacher-completed Brief Early Skills and Support Index (BESSI)? [Secondary Outcome]

RQ6. What is the impact of PACT on the home learning environment as measured using the parent/carer-completed Home Learning Environment Index (HLE) *at the end of the intervention period*? [Secondary Outcome]

RQ7. What is the impact of PACT on early literacy skills as measured *11 months after the intervention period* using the York Assessment of Reading Comprehension (YARC) assessment? [Secondary Outcome]

For all outcomes the trial will investigate the impact for the sample as a whole and also for the subgroup of children eligible years pupil premium.

Research questions for the Implementation and Process Evaluation (IPE)

RQ1. **Implementation: fidelity and adaptation.** To what extent was the PACT programme delivered as intended? What were the barriers and facilitators to delivering the programme with fidelity? To what extent were there adaptations to the programme?

- PACT Lead training
- Parent training
- Sessions delivered by parents
- Materials
- Support for parents

RQ2. **Outcomes: perceived impact and quality of programme.** How was the PACT programme received and what impact of PACT was perceived by parents/carers and nursery staff?

RQ3. **Usual practice: programme differentiation and spill over.** How does PACT differ from usual practice and control group activity?

RQ4. **Contextual factors.** How does the context of the PACT-3 trial affect understanding and interpretation of the evaluation data particularly considering the following aspects: (1) Covid-19, (2) differences for nurseries that have used PACT previously and (3) impact of the trial design on usual delivery of PACT?

Ethics and trial registration

Ethical approval for this evaluation was received from Durham University's School of Education Ethics Committee on 11th March 2021 with an update to approval on the 1st February 2022 based on the consent process for interviews. Ethical approval from the committee covered all aspects of the PACT project including the delivery team's activities. The delivery team registered the approval from Durham University with the University of Manchester's Ethics Committee.

Nurseries completed a Memorandum of Understanding (MoU, Appendix F.1) to indicate their agreement to take part in the trial and this was signed by a member of the school leadership team. Nurseries were also required to sign a three-way Data Sharing Agreement (Appendix F.2), between the individual nursery, Durham University and University of Manchester.

Parents/carers signed a Participation Agreement Form (Appendix F.3) to take part in the trial. In order to be included in the trial, parents had to indicate that they agreed to share their child's information, their own contact details and for their child to be assessed as part of the project. Parents could then choose to agree or not agree with several other statements, including for their child's assessments to be audio recorded, and for the school to provide school destination data, and EYPP information to the research team.

Additional consents were sought from participants as part of the data collection for Implementation and Process Evaluation. For all surveys, an information sheet was provided on the front page and participants ticked a box to consent

to taking part. All surveys were voluntary and a link to the privacy notice (for online surveys) or a copy of the privacy notice (paper surveys) was provided to participants. For interview, an information sheet was circulated with the email invitation and agreement to take part was gathered by email response and confirmed at the beginning of the interview.

Relevant information sheets and participation agreement forms are provided in the additional appendices:

- PACT Lead post training survey (Appendix F.4)
- PACT lead baseline and post-intervention surveys (Appendix F.5, and F.6)
- Parent/carer baseline and post-intervention surveys (Appendices F.7, F.8. and F.9)
- PACT Lead interviews 1 (January 2022) and 2 (April 2022) (Appendices, F.10 and F.11)
- Parent/carer interviews 1 (February 2022) and 2 (May 2022) (Appendices F.12 and F.13)
- Developer interview (Appendix F.14)

This trial was registered with the ISRCTN following agreement of the original protocol. The trial registration number is ISRCTN52533968 and can be accessed at **https://doi.org/10.1186/ISRCTN52533968** .

Data protection

Durham University and the University of Manchester were joint data controllers for this project. Data subjects were the participants in the project which included children in participating schools, their parents/carers, and staff members (PACT leads) in participating schools. OxEd and Assessment Ltd (OxEd) acted as a data processor for the project for the collection and processing of the LanguageScreen data. UK Transcription acted as data processor for the interview data providing the research team with transcripts for audio recording data.

The legal basis for processing the personal data accessed and generated by the trial was Public Task covered by GDPR Article 6 (1): the processing is necessary for an activity being carried out as part of the Durham University and the University of Manchester's public task, which is defined as teaching, learning and research. This project is carrying out research. No special category data was collected as part of this project.

The roles and responsibilities for the trial for Durham University, the University of Manchester and participating schools were identified, and a three-way data sharing agreement was put into place between the universities and the participating settings. This included a description of the nature of the data being collected and how it was to be shared, stored, protected and reported by each party.

A Data Protection Impact Assessment (DPIA) identifying the privacy risks associated with the processing of personal data and for implementing appropriate controls to manage those risks was undertaken at the start of the project. A privacy notice was provided to all participating schools (Appendix F.15) and participants (Appendix F.16) in the trial; these detailed the processing and storage of data for the evaluation of the trial as well as outlining the rights of participants. Participants were also informed about how the project would use their data in information sheets provided at the start of the project and with the collection of survey and interview data on each occasion.

Data quality has been ensured through adherence to a detailed data management plan. Quality assurance checks on data sets along with data minimisation ensured that only required and up to date information was held by the evaluation team. Wherever possible, participator identification codes rather than participant or school names were used in order to improve confidentiality and increase data security. Project data was stored electronically on secure servers and electronic devices authorised by Durham University with paper copies of project data stored in locked cabinets in the project office in the School of Education Durham University.

This project did not link the participant data collected as part of the trial with the National Pupil Database (NPD) as all participant data required for the project and analysis was collected directly from the participants or their nurseries/schools. However, parents were informed that their child's personal data and other data from the project would be shared with the EEF, stored in the EEF's data archive and would be linked with the NPD for future analysis.

The agreement in place between OxEd and Durham University to allow the project the use of LanguageScreen restricts Durham University from sharing the personal data from LanguageScreen outside of the Durham University team. OxEd did not want the LanguageScreen data linked to the NPD data or to be used in ways that had not been agreed. It will therefore not be possible to be archive the LanguageScreen data in the EEF data archive or to link this data to the National Pupil Database beyond the project.

Project team

Delivery team (University of Manchester)

The delivery team, based at the University of Manchester, was responsible for all aspects of delivery of the PACT programme and several aspects of the programme evaluation. This included the recruitment of schools and participants to the project, maintaining records of participants, the delivery of face-to-face, researcher-delivered assessments at immediate post-test, collecting participant data from schools including school destination, EYPP status, UPN, collecting adherence data from intervention parents through the PACT app and paper record forms, and providing nurseries with storybooks for the control group families. The team consisted of:

Dr Kelly Burgoyne: principal investigator with primary responsibility for the trial within the delivery team, managing project researchers and leading all aspects of project delivery.

Dr Laura Boundy: post-doctoral research assistant supporting recruitment of participants and additional school settings, providing PACT families with training, leading on maintaining records of participants and schools, communicating with schools, distributing PACT materials and storybooks for the control group, the organisation and delivery and coding of researcher-delivered assessment data collection and collecting participant data (including adherence data) from schools and parents.

Nicola Lester (from September 2022): research assistant supporting recruitment of new settings and participants at delayed post-test, communicating with schools, maintaining records of participants and schools, providing training and supporting the organisation and delivery of researcher-delivered assessment data collection and data coding.

Carla Mason (from August 2021 until September 2022): research assistant supporting recruitment of participants, providing PACT families with training, maintaining records of participants and schools, communicating with schools, distributing PACT materials and storybooks for the control group, supporting the delivery and coding of researcher-delivered assessment data collection and collecting participant data (including adherence data) from schools and parents.

Steph Hargreaves (until August 2021): research assistant supporting recruitment of settings and participants and baseline assessment data collection.

Evaluation team (Durham University)

Vic Menzies: principal investigator for the evaluation with primary responsibility for the design, conduct and delivery of all aspects of the evaluation including data collection, data protection, analysis, and reporting.

Dr Helen Cramman: co-investigator contributing to the design and conduct of the evaluation, providing high-level support and advice to the PI during the project as well as quality assurance processing.

Paivi Eerola: research assistant managing evaluation data collection including LanguageScreen, Home Learning Environment and BESSI data for the IE and survey and interview data for the IPE. Paivi also contributed to the analysis of the IPE data and writing the report.

Dr Julie Rattray: co-investigator acting as the evaluation team Psychologist and provided expertise and support regarding the assessments as well as interpretation of the findings.

Dr Helen Gray: data manager for the project ensuring proper management of data in line with the data management plan.

Dr Bilal Ashraf (until September 2023): co-investigator and statistician for the project responsible for writing the SAP, conducting and reporting the IE analyses.

Professor Jochen Einbeck: co-investigator and senior statistician on the project contributing to the SAP and providing support and statistical advice to the trial statistician.

Qing Zhang (from October 2023): statistician for the project responsible for conducting and reporting the delayed post-testing IE analyses.

Methods

Impact evaluation design

Table 3. Trial design.

Trial design, including number of arms		Two-armed multisite randomised controlled efficacy trial
Unit of randomisation		Individuals (within nurseries)
Stratification variable(s) (if applicable)		Pre-test completeness, nursery site
Primary outcome	Variable	Language skills at immediate post-test
	Measure (instrument, scale, source)	LanguageScreen latent language variable combining raw sub-scale scores (Expressive vocabulary 0-24, Receptive vocabulary 0-23, Listening comprehension 0-16, and Sentence repetition 0-14), school-delivered LanguageScreen (Hulme et al., 2020)
Secondary outcome(s)	Variable(s)	Specific language domain skills of expressive vocabulary, receptive vocabulary and spoken language information and grammar (measured by researcher delivered assessments and LanguageScreen) at immediate and delayed post-testing.
	Measure(s) (instrument, scale, source)	[1] Clinical Evaluation of Language Fundamentals 2 UK (Expressive vocabulary subscale, 0-40), researcher delivered assessment (CELF-Preschool 2 UK; Semel, Wiig, & Secord, 2006). [2] British Picture Vocabulary Scale - 3 (raw score 0-168), researcher delivered assessment (BPVS-3; Dunn, Dunn, and National Foundation for Educational Research, 2009).). [3] Renfrew Action Picture Test (information score 0-40, grammar score 0-38), researcher delivered assessment (APT; Renfrew, 2010). [4] LanguageScreen sub-test scores
	Variable(s)	Early literacy skills at the delayed post testing
	Measure(s) (instrument, scale, source)	York Assessment of Reading for Comprehension raw subscale scores (Letter-sound knowledge 0-17, Early word reading 0-30, Sound deletion test 0-12), researcher delivered assessment (YARC; Hulme et al., 2009) at the delayed post-test.
	Variable(s)	Home Learning Environment
	Measure(s) (instrument, scale, source)	Home Learning Environment Index (0-49), parent completed survey (HLE, Melhuish et al, 2008a) immediately after the intervention.
	Variable(s)	School Readiness
	Measure(s) (instrument, scale, source)	Brief Early Skills and Support Index total score (0-30), survey completed by nursery key worker (BESSI, Hughes & White, 2015) immediately after the intervention.

Baseline for primary outcome	Variable	Language skills
	Measure (instrument, scale, source)	LanguageScreen, latent variable combining raw sub-scale scores (Expressive vocabulary 0-24, Receptive vocabulary 0-23, Listening comprehension 0-16, and Sentence repetition 0-14), school-delivered LanguageScreen app at baseline (Hulme et al, 2020).
Baseline for secondary outcome(s)*	Variable	Home Learning Environment
	Measure (instrument, scale, source)	Home Learning Environment Index (0-49), parent completed survey completed at baseline (HLE, Melhuish et al., 2008a).

*Each secondary outcome has a separate baseline measure. See Outcomes section below.

The trial design (indicated in Table 3 above) replicated that of the previous trials by using a two-armed multisite randomised controlled efficacy design; with randomisation allocation at the individual child level (with children nested within nurseries). Individuals were equally allocated (on a 1:1 ratio) to the intervention group – where they received the 30-week PACT programme – or the 'business as usual' control group – where they received a box of children's story books at the completion of immediate post-test, equivalent in the value (£130) of the PACT materials.

This design was selected to be the best design to balance the chance to detect the impact of PACT with a manageable intervention delivery model which was within the number of schools that the developer could support. A cluster randomised design was considered but would have required a larger sample. The within-school design was judged to be more powerful than cluster randomisation, when there is negligible heterogeneity in intervention effects between schools (as in PACT-1) and if there is no dilution of the intervention effects due to contamination between intervention and control groups. The risk of contamination between the groups was deemed low due to the nature of the intervention taking place in the home and the provision of materials to only to individual families. The PACT activities and resources accompanying the story books were mostly single use therefore not useful to be shared with other parents/carers after completing them. Data collection from the PACT-2 trial indicated that contamination was minimal in that trial, which used a similar within-schools randomisation design (Menzies, et al., 2022) with only 14% of control parents reporting having seen any of the PACT materials and 5% having the opportunity to use any PACT materials. Interviews with parents during PACT-2 also indicated that parents had not shared the programme materials or talked about the programme with other parents due to this being stress as important in the parent training. It was also deemed unlikely that the PACT Lead training would lead to contamination in classroom practice for control group individuals, as the training for PACT Leads focused mostly on the practicalities of delivering the programme and that the PACT programme strategies should be familiar to Early Years staff already while not necessarily being used by parents. This was evidenced previously with 97% of nursery staff indicating that they were already familiar with all or most of the PACT strategies presented in training. To further mitigate the risk of potential contamination between the intervention and control groups, the evaluation team worked closely with the developers to ensure that consistent and clear messages were communicated at both school and parent/carer recruitment stages particularly around the research design and the importance of control group families not having access to the PACT programme. Investigation of any contamination between the intervention and control group in PACT-3 is discussed in the IPE and sensitivity analyses report on whether this impacted the results.

The primary outcome measure for the trial is language skills as measured by the LanguageScreen app which was delivered to children by staff in the nursery settings. This measure was used as the primary outcome measure in the PACT-2 trial after Covid-19 disruptions meant that researcher-delivered face-to-face assessments were not possible. Secondary outcomes include language skills as measured by face-to-face researcher delivered standardised assessments as planned in PACT-2 and as used in the Burgoyne et al., (2018b) initial trial of PACT. This allows us to investigate whether the LanguageScreen measure is sensitive enough to pick up the different elements of language skills and also capture grammar scores not measured by LanguageScreen. Secondary outcomes also include language skills captured by LanguageScreen subscales as well as early literacy skills measured 11 months after completion of the intervention delivery period. All language outcomes are investigated both immediately after the intervention period as well as 11 months later. The PACT-1 trial found that the effect of the intervention on language skill was maintained and increased six months later. This trial therefore aims to investigate the impact after a longer delay of 11 months chosen so that the timing of assessment would be convenient for researchers to visit schools to complete assessments

with minimal impact on the school. Further secondary outcomes explored the expected outcomes specified in the logic model, namely the home learning environment – measured by the Home Learning Environment Index completed by parent/carers at two time points – and school readiness – measured by the Brief Early Skills and Support Index (BESSI) questionnaire filled by nursery staff. All outcome measures are described in detail in the Outcome measures section.

Participant selection

Initial Nursery/School recruitment

The trial originally aimed to recruit 50 nursery settings as this was the maximum the developer team could deliver the programme to and was deemed enough power to allow for some attrition as found in previous early years trials.

To take part in the trial, nurseries needed to:

a) Be administratively part of a school setting (to minimise loss to follow-up at delayed post-testing when children were then in school)
b) Be state-funded
c) Be located in areas with high scores on the Indices of Multiple Deprivation (including Warrington, Bolton, Rochdale, Lancashire, Tameside, and Blackpool)
d) Agree to all study requirements outlined in the Memorandum of Understanding (MoU) which describe their commitment to the delivery of PACT and participation of a minimum number of families (*n*=4) to the trial and administration of measures
e) Agree to and sign a project specific Data Sharing Agreement (DSA)

Nursery recruitment was undertaken by the developer team and took part between March and June 2021 in two stages. Firstly, eligible settings who had participated in the previous EEF funded PACT trial were invited to take part. Inviting settings that had previously taken part aimed to reduce the burden of recruitment of new settings and help deliver to the tight timescale for recruitment. Some of these invited nurseries had delivered PACT in the 2019/2020 school year (n=37) and so the PACT Lead and other school staff may have previously been involved with PACT delivery. Others were schools which children in the previous trial, attended after nursery and were only involved in the post-testing (but not the delivery of the PACT programme) for the previous trial (n=43). These settings were invited to one of two online information events which were attended by seven settings. Twenty-nine nurseries signed an MoU from this initial recruitment effort (four from the schools that had not previously delivered PACT). Three of these schools later withdrew (See Figure 2).

For the second stage of recruitment, the project was opened to settings not involved in the previous trial. Local authority (LA) leads across LAs in the North-West region advertised the project to eligible schools in their areas, the EEF website advertised for settings to take part and the project was advertised through the PACT Twitter page. Another information event was also held which was attended by 15 schools. Forty-seven expressions of interest (EOI) were received from the second stage of recruitment. Following this, 21 new settings signed an MoU, and the 50-setting target was reached. Nine settings who returned their MoU after the target was reached were added to a reserve list.

All participating settings were required to attend one of the online PACT Lead training sessions in May 2021, however one school was unable to release a member of staff for this training and withdrew from the project. They were replaced by a reserve list school new to PACT-3 and representatives from these 50 settings attended PACT Lead training and started the child recruitment phase due by July 2021. Following the training, seven schools withdrew and were replaced by six reserve schools leaving 49 schools participating in the project in by July 2021. Reasons for withdrawal were (1) not being able to recruit the minimum number of families due to low intake, difficulty engaging families, families with limited English language or children with special educational needs (n=6) and (2) an imminent Ofsted inspection and not having the time to devote to the project (n=1).

The child recruitment period was extended to September 2021 as not all settings had managed to recruit enough children by the end of July 2021. By the end of September 43 settings were able to recruit the minimum number of children (with a further 6 settings withdrawing before randomisation).

Initial recruitment of children and families

The trial aimed to recruit ten families from each nursery originally aiming for a sample of 500 children from 50 nurseries.

Inclusion criteria for families to take part in the project were:

a) The participating child must be 3 or 4 years old by September 2021, signed up to attend a participating nursery and due to start school in reception in September 2022;
b) Parent/carer(s) must be able to access the resources by having a basic level of English;
c) That the family does not have more than one child in the target year group;
d) That the child does not have a suspected or diagnosed developmental or learning difficulty;
e) That the family did not take part in a previous PACT trial.

PACT Leads in each Nursery were responsible for recruiting children and their families to the trial, aiming for 10 but requiring a minimum of 4 children to sign up. School staff were requested to provide trial information (developed by the evaluation team and the developers) to all parents/carers of children who are three or due to turn three years old by September 2021, are pre-registered to start nursery in September 2021 and meet the inclusion criteria. The PACT Lead training also provided information about recruiting families and eligibility criteria.

Schools were asked to recruit families by July 2021, however, at this stage only 26 settings had recruited the minimum number of children. Schools reported finding recruitment more difficult than expected and felt that this was due to difficulties with establishing relationships with the families of children than were due to start in the setting in September due to post-Covid-19 changes to practice e.g., home visits of children and limited access to settings as well as having smaller intake numbers than previously. The deadline for recruitment was extended to September 2021 to allow schools time to communicate with new families. To sign up to the trial parents/carers return a signed participation agreement to the setting who shared scanned copies with the developer research team.

Nurseries recruited 381 children/families to the trial. However, before randomisation, nine children withdrew from the project due to leaving the setting (1 child), parents wanted to withdraw from the trial (4 children), or they were found not to be eligible (4 children). Therefore, 372 children from 43 nurseries were randomised (see randomisation section below for details) into intervention and control groups with 186 children in each group. The average number of children recruited to the trial per nursery was 8.6 (range minimum maximum 19).

After the randomisation, two children (1 in intervention group and 1 in control group) were withdrawn from the project due to being too young for the intervention, and therefore ineligible.

Additional recruitment through the project

Immediate Post-testing
At the time of the immediate post-testing, six children had left their original school and moved to a new setting during the year. Where details were available, the new setting was contacted by the developer team and given an information sheet about the project with the aim of recruiting the setting to take part and facilitate post-testing and delayed post-testing of these children. Three of these new settings signed an MoU, allowing three of the six children to remain in the trial, however three children were lost to follow up.

Delayed Post-testing
At the time of the delayed post-testing, 33 children had moved to attend reception in a different school. Where the new school was known, these schools were contacted by the developer team and given an information sheet about the project. Out of the 25 new schools, 14 schools signed an MoU agreeing to take part in the project, facilitating the further assessment of 17 participating children, while 16 children were lost to follow-up at this point.

Outcome measures

Primary outcome

Language Skills Latent Variable (LanguageScreen)
The primary outcome is language skills as measured using a language skills latent variable created from the subscale scores in the LanguageScreen (LS) assessment collected immediately following the end of the intervention in June and July 2022. Using a latent variable approach enables estimation of impacts of PACT across the different components of language development as measured by the latent outcome. It assumes that language skills may be better assessed as a latent construct that uses shared variance of the subtests and can reflect important elements of language skills that may be difficult to measure relying on observed variables. A latent variable is used here because we believe it better captures (all dimensions of) the language skills construct better than any existing single "measure". This is a similar approach to the previous two PACT trials. A latent variable based on LanguageScreen data was also used as an outcome measure by West et al., (2021) in an evaluation of another language intervention.

Improved language skills, including improved vocabulary and other language skills, is one of the key aims of the PACT programme, and improvement on a language skills latent variable outcome has shown the impact of PACT in the original PACT trial (Burgoyne *et al*., 2018b). The specific use of LanguageScreen to measure Language Skills as the primary outcome in this trial is for a number of reasons. Firstly, LanguageScreen measures four aspects of language skills giving a broad measure of language skills and two subscales are specifically aligned to the intervention's particular focus on vocabulary. Secondly, the measure is delivered by school staff in the classroom and does not require external researchers to visit the school. With varying and ongoing Covid-19 restrictions, this was deemed to give a good likelihood of being able to collect data even if researchers would be unable to visit the schools. Thirdly, as it is delivered by school staff and schools are incentivised to assess children then it is hoped that there may be less attrition due to children being absent on the day of external researcher assessment. LanguageScreen has been used to collect assessment data in PACT-2 and in participating schools and there has been a high response rate.

LanguageScreen is a standardised app-based assessment delivered by a member of school staff (and provided by OxEd Assessment: **https://oxedandassessment.com/language_screen**). The LanguageScreen assessment is made up of four subtests which are reported separately with separate standardisation for each subtest:

1. Receptive Vocabulary - 23 items where the child chooses which of four pictures matches a spoken word, which is automatically scored (raw score range 0-23);
2. Expressive Vocabulary - 24 items asking the child to name pictures scored by the test administrator (raw score range 0-24);
3. Listening Comprehension - the child listens to three stories, each followed by a series of questions about the story to assess understanding of the story (16 items) scored by the test administrator (raw score range 0-16); and
4. Sentence Repetition - the child is asked to repeat verbatim 14 spoken sentences scored by the test administrator (raw score range 0-14).

The primary outcome is a latent language variable derived as a weighted sum of the four LanguageScreen subtests, with weights obtained through a confirmatory factor analysis (CFA).

The LanguageScreen assessment was administered using an app on a tablet by a member of staff in the child's school. Full instructions were included within the app for the delivery of the assessment without the need for external training. Verbal instructions and items for the child were played aloud through the app, which was expected to minimise variability in the delivery of the assessments across all the settings. There was guidance in each section for the adult delivering the assessment as well as guidance on what to mark as a correct or incorrect answer for each item. Assessors using the app were encouraged to use a practice version to run through the assessment in advance of assessing any children. The four assessments were presented in a set order and took around 25 minutes in total to complete. The assessment administrator was required to mark on the app whether the child answered the questions correctly for the cases where the child gave a verbal answer. Data from the app was then uploaded to the LanguageScreen website automatically and scoring and results were generated automatically by LanguageScreen.

For the delivery of LanguageScreen the evaluation team uploaded all the children's information into the assessment software and liaised with schools during the testing period to support their delivery of LanguageScreen. Where schools had difficulties with accessing the LanguageScreen assessment on their hardware the evaluation team couriered tablets to schools for them to conduct the assessments. At post-test and delayed post-test, it was not possible to blind the assessor to the intervention allocation of the child as they were a member of staff working in that setting. While this does introduce the potential for bias in the completion of the assessment, it is unlikely that all members of staff carrying out the assessment would know the child's allocation, especially at delayed post-test when the child had moved from nursery into school.

Secondary outcomes

Specific domains of language skills (LanguageScreen subtests)
LanguageScreen subtests scores of Receptive Vocabulary (LS-RV), Expressive Vocabulary (LS-EV), Listening Comprehension (LS-LC) and Sentence Repetition (LS-SR) as collected immediately after the intervention are used as individual secondary outcomes. The logic model indicates that PACT will impact on the whole language skills of the child however different programme activities are targeted towards specific language domains including listening comprehension, vocabulary, narrative skills and sentence level language skills. The raw subtest scores of each domain of LanguageScreen are therefore used to investigate whether there is a greater improvement in these specific domains of language skill. This is a difference from the protocol where it was stated the standardised scores would be used. The use of standardised scores reduces the variability in data losing some of the detail of the score to categorise the scores. This may reduce the chance to see an effect – it was therefore decided to switch to the use of raw scores here as for the other outcomes in this trial and this was updated in the SAP.

Researcher delivered individual language skill measures
The raw scores on three measures of language skills in the domains of expressive vocabulary, receptive vocabulary and spoken language information and grammar, as delivered by researchers face-to-face in schools, are used to investigate impact in these specific domains of language skill and to triangulate with the primary outcome measure to investigate whether the school delivery of LanguageScreen introduces bias due to knowing the treatment assignment of the child being assessed. These measures also allowed the investigation of whether the LanguageScreen measure is sensitive enough to detect the impact of PACT, as the PACT 2 trial found no impact using the LanguageScreen measure, whereas impact was seen in the original PACT trial using these researcher-delivered measures. The specific researcher delivered measures are:

(a) The British Picture Vocabulary Scale – 3 (BPVS) is a standardised measure of receptive vocabulary appropriate to 3-year-olds up to adult. The programme activities specifically target vocabulary learning and involve increased exposure to a variety of books and resources. This measure consists of a set of pictures from which the child is asked to point to the picture representing a given word. This assessment gives a raw score between 0 and 168 with a higher score indicating a wider receptive vocabulary and lower score indicating a narrower receptive vocabulary.

(b) The Clinical Evaluation of Language Fundamentals Preschool 2 UK (CELF-EV)[4] expressive vocabulary subscale score. CELF-Preschool 2 UK provides a measure for expressive and receptive language skills in young children. This is a standardised and validated assessment with the proposed age group and a UK sample. Children are presented with a picture and asked to orally identify the picture or something in the picture. This assessment gives a raw score between 0 and 40 with a higher score indicating a greater expressive vocabulary.

(c) The Renfrew Action Picture Test (APT) is a standardised test that requires children to give samples of spoken language in response to picture stimuli. The test considers grammatical structures used and the expressive vocabulary used. The test is suitable to use with children between the ages of 3 and 8. This assessment provides two raw scores – information score (range 0-38) and grammar score (0-39). The grammar aspect of this assessment is not captured by the primary outcome LanguageScreen and it was therefore necessary to capture this through a secondary outcome.

[4] https://www.pearsonclinical.co.uk/store/ukassessments/en/Store/Professional-Assessments/Developmental-Early-Childhood/CELF-Preschool-2-UK/p/P100009267.html

These assessments were conducted at immediate post-test following the intervention delivery period and at delayed post-testing 11 months after the intervention period.

The delivery of these researcher delivered measures was the responsibility of the developer team who recruited and trained a team of Research Assistants (RAs) to collect this assessment data. RAs recruited had experience of working with young children and included teachers as well as undergraduate and postgraduate students studying education, psychology and speech and language therapy. For each assessment period, training for all RAs consisted of an off-site training session which included the background to each assessment, watching videos of the assessments being conducted, instructions for the delivery, recording, and scoring or each assessment, as well as practice time and overall logistics. Following this training, each RA conducted and audio-recorded a practice delivery of all the assessments. These audio-recordings were listened to by the evaluation team and scored using an agreed protocol (see Appendix F.14) and personalised feedback given to each assessor. Where there were any concerns, the developer time worked further with the RA to make sure they completely understood the training before doing any assessment. Additional on-site training was also delivered where the RA observed the delivery of assessments by a member of the developer team with two children, and then the developer observed the delivery of at least one assessment by the RA and provided feedback making sure the RA was doing the assessment correctly before working independently. RAs were blinded to the allocation of the child. Where possible, the assessments were conducted in the pre-specified order. At immediate post-testing this was one session for BPVS, CELF-EV and the APT which took approximately 20 minutes to complete per child. At delayed post-testing the assessments were conducted in two sessions per child of approximately 15 minutes: the first session included BPVS, APT and YARC-LSK and the second session included CELF-EV, YARC-EWR and YARC-SD. Where children required more frequent breaks these were accommodated, and children were rewarded with stickers for completing the assessments. The developer team was responsible for the data entry and scoring of these assessments after which assessments were securely transferred to the evaluation team.

Most parents/carers (99.3%) gave permission for assessments to be audio recorded and these recordings were used for conducting scoring of some assessments by the developer team and for quality assurance by the evaluation team. Quality assurance was completed by two researchers in the evaluation team for a randomly selected 10% sample of the assessments conducted by each assessor. Using the agreed framework, a quality score (0-21) was created for that assessor on each assessment. An average assessor quality score was then generated using the mean of the assessor score for each assessor. Assessor quality scores were high with all assessors scoring between 20 and 21 on the quality score. Sensitively analysis indicated there was no impact of the quality of the assessor on the outcomes.

Early literacy skills

Early Literacy Skills (measured at the 11-month post-intervention delayed post-test) were measured using three subscales of the York Assessment of Reading Comprehension (YARC) Early Reading assessment: Letter-Sound Knowledge (YARC-LSK), Early Word Recognition (YARC-EWR) and Sound Deletion (YARC-SD). The YARC assessment is a standardised and validated measure of alphabetic knowledge, single word reading and phonemic awareness skills and is particularly appropriate for use in the 4-to 6-year-old age group.[5] This assessment was only used at delayed post-test as the assessment material is not appropriate before this stage.

a) In the Letter-Sound Knowledge test the child is presented with lower case letters and digraphs, one at a time, and is asked to say what sound the letters and digraphs make. The core test of letter-sound knowledge is used, giving a raw score of between 0 and 17 with a higher score showing greater letter-sound knowledge.
b) In the Early Word Recognition test the child is shown up to 30 words graded in difficulty and asked to say what the word is. This provides a raw score of between 0 and 30 – a higher score indicates the child can read a greater number of words. In this assessment, half of the words are phonemically regular (can be decoded) and

[5] In line with the PACT-1 study, there were some changes to the standard YARC discontinuation rules described in the YARC manual (Hulme et al, 2009). These changes were made to minimise assessment fatigue on the children considering the number of assessments they were completing in one day. On the early word recognition test, the manual states discontinuation after 10 consecutive errors, but for this study this was reduced to 5 consecutive errors – children were still shown all words and asked to read any they could on subsequent pages but weren't asked to individually read each word after 5 consecutive errors. On the sound deletion test, the original version has no discontinuation rules but for this trial the assessment was discontinued after 4 consecutive errors.

half of the words are phonemically irregular (exception) words. Separate scores are presented for regular and irregular words for the full sample, while for the EYPP subgroup the full assessment score was used.

c) In the Sound Deletion test, the child hears a word (while being presented with an accompanying picture of the word) and is asked to repeat the word with a sound taken away. The test consists of 12 items and the child is given a raw score from 0 to 12 – a higher score shows greater phonetic awareness.

In the previous PACT-1 trial, the largest effect sizes were found at delayed post-test on these measures which are indicators of early literacy skills rather than the pre-literacy language skills measured by the other outcomes. For the Early Word Reading assessment, significant effects were found specifically for the phonemically regular words. These measures align with the logic model and the expectation that improved language skills and school readiness will lead to improved early literacy skills.

The YARC assessments were conducted by the same blinded developer team RAs in the same visits as administering the researcher-delivered language skills assessments at delayed post-test. Scoring was completed (blinded to the participants and group allocation) by the developer team and the data transferred to the evaluation team via secure file transfer.

Home Learning Environment Index (HLE)

As described in the logic model, the PACT intervention is expected to work by improving the home learning environment of the child, helping parents to provide a greater number of home learning opportunities, and increase their confidence and tools to support their child's learning. To measure this, the trial used the Home Learning Environment Index (HLE Index; Melhuish et al., 2008a) at post-test as a secondary outcome measure.

The HLE Index is a validated measure developed as part of the Effective Provision of Pre-school Education (EPPE) study and has been used in several large studies including the Millennium Cohort Study, (see Joshi and Fitzsimons, 2016). The HLE Index asks parents/carers to report the frequency of seven routine activities which are conceptually linked to learning (including being read to, going to the library, playing with numbers, painting and drawing, being taught letters, being taught numbers, and songs/poems/rhymes). These seven items were positively linked with predicting under- and over-achievement of children aged five (Melhuish et al., 2008a). The frequency of the seven activities is coded on a 0-to-7-scale and gives a total score of between 0 and 49 where 49 indicates a higher quality home learning environment.

HLE Index data was collected as part of a larger online survey sent to parents' email addresses at baseline and at post-testing. Where no response was returned online (or where no email address was available), a paper copy of the survey was sent to families with postage provided for the return. A copy of the questions used in the HLE Index is included as part of the surveys in appendices F.4, F.5 and F.6.

Brief Early Skills and Support Index – School Readiness

In the logic model, the PACT programme expects to lead to improved school readiness for participating children, helping their concentration and self-regulation. The Brief Early Skills and Support Index (BESSI) questionnaire is a standardised measure of children's school readiness including concentration and self-regulation (Hughes and White, 2015) which was completed by nursery staff immediately after the intervention. It contains 30 items which assess how well children are making the transition to school. This questionnaire has been developed and validated for reception and nursery children. Questions are answered for an individual child to reflect the child's behaviour over the previous week and statements are answered on a four point strongly agree to strongly disagree scale. This scale contains 4 subscales measuring Behavioural Adjustment (BESSI-BA, 12 items), Language and Cognition (BESSI-LC, 6 items), Daily Living Skills (BESSI-DLS, 6 items), and Family Support (BESSI-FS, 6 items). This study used the raw scores each of these subscales separately with a lower score indicating greater school readiness.

For the delivery of BESSI, school PACT Leads were emailed a link to an online survey to be completed for all the participating students in their settings. A member of staff who knew the child was asked to complete the survey. Some settings had difficulties accessing the online survey and were provided with a paper copy which was returned by post.

Baseline measures

For primary outcome

As described in the sample size section, a strongly correlated baseline measure was needed to increase the power of the trial. Language skills at baseline were therefore assessed using a latent variable measure from the LanguageScreen

assessment, the same as for the primary outcome. It was expected that this would give the best chance of a good correlation between the baseline measure and outcome measure[6]. Participants completed the LanguageScreen assessment in September 2021 before randomisation (as described in the Primary Outcome section above), and the LanguageScreen latent variable score at baseline used in the primary analysis.

For secondary outcomes
For language secondary outcomes, where a LS subscale closely aligned with the specific language domain secondary outcomes measure, the aligned subscale completed at baseline is used in the secondary analysis. Specifically, the LS Receptive Vocabulary (LS-RV) subscale raw score is used as baseline for the BPVS outcome, and the LS Expressive Vocabulary (LS-EV) subscale is used as baseline for the CELF Expressive Vocabulary (CELF-EV). Where no specifically aligned subscale was available for the secondary language outcomes, the baseline LS latent variable score will be used as the baseline score. For the HLE secondary outcome, parents completed this at baseline as part of the baseline usual practice survey. There was no baseline measure used for the BESSI subscale outcomes. See Table 5 for details of how baseline variables were used in the secondary outcome analyses.

Sample size

Sample size calculations were conducted using Optimal Design software reflecting a within school multi-site randomization design.

At design stage, the project aimed to recruit a sample of 50 nursery settings with 10 children per nursery setting aiming for 500 children overall. This was the maximum capacity that the developer team had for delivery of PACT, and it was felt that this sample size would allow for some attrition. Calculations assumed a 5% Type 1 error, 80% Power, 10% intra-school correlation, 60% pre-post-test correlation and used a two-sided test. The intra-cluster correlation of 10% is based on the average value observed in EEF trials (Xiao et al., 2016). The pre-post-test correlation value is that found in the PACT-1 (Burgoyne et al., 2018b) previous trial which used very similar language outcome measures to this primary outcome over the same period of time. Based on these assumptions, the sample size of 50 setting and 10 children per setting, would detect a minimum difference of 0.18 standard deviations between the PACT and the control group (scenario 1a in Table 4). This minimal detectable effect size (MDES) was lower than the effect sizes found in the previous Burgoyne et al. (2018b) trial, which found an effect size of 0.21 on language scores immediately after the intervention period.

Table 4 explored varying the pre-post-test correlation to look at the potential impact of not including a baseline assessment (scenario c with pre-post correlation of 0) or including a less correlated measure in the analysis (scenario b with pre-post correlation of 0.3). Investigation of these figures led to the decision that it was necessary to include a well-correlated covariate in the analysis and using the same assessment at pre-test gave the trial the power necessary to detect the level of effect size found in PACT-1 (Burgoyne et al., 2018b).

[6] Correlation between the language skills latent variable at baseline and post-test was 0.8.

Table 4. MDES using a variety of pre-post-test correlation assumptions and varying recruitment levels of schools and pupils.

Scenario	Significance level (α)	Power (1—β)	Effect size variability estimate	Pre-post correlation (R^2)	ICC	no children per school (n)	MDES if 43 schools (J)	MDES if 44 schools (J)	MDES if 45 schools (J)	MDES if 48 schools (J)	MDES if 50 schools (J)
1a	0.05	0.8	0.05	0.6	0.1	10	0.20	0.19	0.19	0.18	**0.18**
1b	0.05	0.8	0.05	0.3	0.1	10	0.25	0.25	0.24	0.23	0.22
1c	0.05	0.8	0.05	0	0.1	10	0.29	0.29	0.28	0.27	0.26
2a	0.05	0.8	0.05	0.6	0.1	9	**0.21**	0.20	0.2	0.19	0.19
2b	0.05	0.8	0.05	0.3	0.1	9	0.26	0.26	0.25	0.24	0.23
2c	0.05	0.8	0.05	0	0.1	9	0.31	0.30	0.29	0.28	0.27
3a	0.05	0.8	0.05	0.6	0.1	8	**0.22**	0.21	0.21	0.2	0.2
3b	0.05	0.8	0.05	0.3	0.1	8	0.28	0.27	0.26	0.25	0.25
3c	0.05	0.8	0.05	0	0.1	8	0.33	0.32	0.31	0.29	0.29
4a	0.05	0.8	0.05	0.6	0.1	7	0.23	0.22	0.22	0.21	0.21
4b	0.05	0.8	0.05	0.3	0.1	7	0.29	0.28	0.26	0.25	0.25
4c	0.05	0.8	0.05	0	0.1	7	0.34	0.34	0.32	0.31	0.31

It was not possible to recruit as many schools and children as expected at design (see Figure 2 below). At randomisation 372 children had been recruited from 43 nurseries with an average of 8.7 children per setting. The MDES at randomisation using the same assumptions was between 0.21 and 0.22, similar to that from the previous Burgoyne et al. (2018b) trial.

This trial was not powered to detect an effect size on the sample of children who are eligible for Early Years Pupil Premium (EYPP), and schools were not able to share information on the EYPP of children at recruitment. Sample size calculations (in Optimal Design software) for the EYPP group at randomisation were based on the assumed numbers of children eligible for EYPP which was 16% in the previous PACT trial (meaning an assumed number of 60 children at randomisation). Actual EYPP eligibility data for the sample was collected in June 2022 at the end of the nursery year which showed 66 children were eligible for Early Years Pupil Premium (EYPP).

The MDES and assumptions at design, randomisation and analysis can be seen in Table 10. At analysis the MDES was 0.16. It is worth noting the pre-post-test correlation at analysis is 0.80 which is higher than the .60 assumed in the sample size calculations which may be because the same assessment was used at both time points. This lowered the minimal detectable effect size from that originally assumed. The ICC at analysis was also greater than assumed (0.17 compared to the 0.1 assumed) (similar to the PACT-2 trial) which may reflect differences in early years settings compared to school settings.

Randomisation

Randomisation was completed anonymously and blindly by a member of the Durham University Statistician team. The code used in randomisation is in Appendix G.1. The evaluation team informed the developer team about the allocation of each child, and they informed the nurseries and invited intervention parents into the parental training.

Randomisation was stratified so that there was equal number of participants assigned to intervention and control group within schools (where possible) as well as across the full sample. Stratification also accounted for completeness of pre-testing so that participants who had not completed the pre-testing at the time of random allocation were balanced between the intervention and control groups. This approach was used due to the tight timeline of the assessments and the 30-week delivery of the programme meaning that the random allocations could be sent out to nurseries while testing was still being completed. This allowed us to maintain a larger sample in the trial rather than excluding those without pre-test data at the time of randomisation. This approach was also used in the PACT-2 trial.

All participating children were allocated into one of the two groups (intervention or control) on a 1:1 ratio. A randomised block design was applied, with nursery and pre-test subgroups serving as blocks, however with an additional element of paired randomisation to account for the presence of blocks of odd size.

The completeness of pre-test variable was originally coded as follows: 0 = not tested; 1 = tested; 2 = tried to test but child was shy/uncooperative. According to this categorization, 15 participants had pre-test status 0, 355 had pre-test status 1, and 2 had pre-test status 2. Since only two children had pre-test status 2, group 2 (members of which had an intention to be tested but the child did not engage with the assessment) was merged with group 1 (actually tested) and both groups were considered to have a pre-test status of 1 for further analysis. There was concern that those that had not been tested at the time of randomisation, may be systematically different from those where assessment had been conducted or attempted.

Considerations in deciding a randomisation strategy were as follows, with decreasing priority:

- Every child must have an equal probability of being assigned to the control or intervention group.
- For any child added to the study after the initial randomisation, study personnel should not be able to determine the group to which that child will be allocated prior to the child's enrolment. This is to avoid any confounding of results; if a nursery knows that their next recruit will be allocated to the intervention group, this may influence their decision to recruit another child.
- We wish to allocate children to intervention and control groups in as close as possible to a 1:1 ratio.
- We aim to allocate children to intervention and control groups to as close as possible to a 1:1 ratio within each nursery.
- We aim to allocate children to intervention and control groups to as close as possible to a 1:1 ratio across pre-test statuses.
- We aim to allocate children to intervention and control groups to as close as possible to a 1:1 ratio amongst children of the same pre-test status within each nursery.
- We aim to allocate children to intervention and control groups to as close as possible to a 1:1 ratio amongst children at nurseries of similar size.

Given the considerations above, our choice of randomisation strategy was as follows:

1. We defined nursery-pre-test groups containing children in the same nursery and of the same pre-test status. For instance, nursery-pre-test group S02_1 contained children at nursery S02 with pre-test status 1.
2. For any nursery-pre-test group from which an even number of children are currently included in the study, we drew a random sample of half the size of the group without replacement from each such group and the children were split between control and intervention groups in equal number.
3. We then considered all nursery-pre-test groups containing an odd number of individuals. For each such group, we matched it with a second nursery-pre-test group of similar size and pre-test status. We did this by listing nursery-pre-test groups with pre-test status 0 by size and pairing the first off with the second, the third with the fourth, and so on, until there was one left. We paired this nursery-pre-test status group with the nursery-pre-test group with pre-test status 1 of the closest size. We then listed remaining nursery-pre-test groups with pre-test status 1 in ascending order of size, and matched the first with the second, the third with the fourth, and so on.
4. For each pair of nursery-status groups, we randomly assigned one of the pair to have one excess child assigned to the control group and the other to have one excess child assigned to the intervention group. We then stepped through pairings in ascending order of size to check if any nurseries had two odd-numbered groups both assigned to excess control or excess intervention (that is, one group with pre-test status 0 and another with pre-test status 1). When this occurred, we switched the pair assignments of the larger group and its pair.
5. For each nursery with an odd number of children favouring controls, assign one more individual at that nursery to the control group than to the intervention group, making assignments randomly across individuals. Make the corresponding assignment for schools favouring interventions.
6. For any additional child added to the study, assign them randomly to either the control or intervention group with equal probability.

This strategy guaranteed the following properties:

- The 372 individuals in the study were split into control and intervention groups of equal size (If '372' had to be replaced by an odd number, the size of control and intervention groups would differ by 1, with an equal probability that either group is larger);
- In each nursery, the number of children in control and intervention groups differed by at most 1.
- Whenever a nursery had 1 more control-group child than intervention-group, a matched nursery with a similar number of children had 1 more intervention-group individual than control-group.
- The 15 children with pre-test status 0 were split into control and intervention groups of size differing by 1, with equal probability of the larger group being control or intervention.
- The 355 children with pre-test status 1 were split into control and intervention groups of size differing by 1, with equal probability of the larger group being control or intervention.
- Within each nursery, the children with pre-test status 0 were split into control and intervention groups of either equal size or size differing by 1, with equal probability of the larger group being control or intervention.

- Within each nursery, the children with pre-test status 1 were split into control and intervention groups of either equal size or size differing by 1, with equal probability of the larger group being control or intervention.
- Children additional to the original 372 had an equal probability of assignment to each group, and the control/intervention assignment cannot influence the choice to recruit additional children.

Statistical analysis

Checking for imbalance at baseline

Baseline data is presented by intervention and control group using descriptive statistics. Cross-tabulation of background characteristics (including gender and by Early Years Pupil Premium (EYPP)) is presented. We also performed cross-tabulation between the pre-test status ('pre-test completed', 'pre-test not completed' at time of randomisation and 'no pre-test data available' due to being uncooperative) and the intervention status. Additional data on children and school characteristics is described. For continuous variables, we report means and standard deviations of raw scores and standardised scores where available, and for categorical data, counts and percentages. Correlations between scores of baseline sub scales and measures are presented in Appendix G.7.

Primary analysis

The primary outcome is a latent language variable derived by combining four variables from scores on LanguageScreen subscales (1. Expressive vocabulary, 2. Receptive vocabulary, 3. Listening comprehension, 4. Sentence repetition). Correlations between outcome measures are included in Appendix G.7. The weightings of this latent variable are extracted from the loadings matrix of a confirmatory factor analysis (CFA) based on the four raw Language Screen subscales and will be considered as fixed and known henceforth. The latent variable is then obtained as weighted sum according to these weights.

Model fit is assessed using the following criteria: root mean square error of approximation (RMSEA) <0.08; standardized root mean square residual (sRMR) <0.08; comparative fit index (CFI) ≥0.90; and Tucker-Lewis index (TLI) ≥0.95 (Hu and Bentler, 1999; Kline, 1998). The same weightings obtained from the post-test CFA are applied to the baseline scores, although a CFA is also carried out on the baseline scores to check for the consistency of the weightings obtained.

The outcome latent language variable is analysed using a multilevel model. The pre-test LanguageScreen language latent variable (formed from the assessment collected at pre-test) is included as a covariate for baseline adjustment.

The effect size and its confidence/credible intervals are computed using unconditional variance of the outcome data by fitting the multilevel models using the R package eefAnalytics (Robust Analytical Methods for Evaluating Educational Interventions using Randomised Controlled Trials Designs). School and school-by-intervention enter as random effects into the multilevel model.

The analyses of outcomes follow an Intention to Treat (ITT) principle, as suggested by the EEF Statistical Analysis guidelines. Since the study was a multisite trial, we use multilevel models (MLM) adjusted for prior attainment which will account for the variability in average child attainment across schools participating in the trial and variation in the intervention effect across schools. The choice of analytical model is considered an optimal choice following the study design. The model specification for the empty unconditional model (required for effect size denominators) and for the conditional model including intervention and pre-test as a covariate is shown below.

$$y_{ij} = \begin{cases} \beta_{00} + b_{0j} + \epsilon_{ij0} & \text{for unconditional model} \\ \beta_0 + \beta_1 t_{ij} + \beta_2 pretest_{ij} + b_{1j} + b_{2j} t_{ij} + \epsilon_{ij} & \text{for conditional model} \end{cases}$$

Here, y_{ij} = Outcome variable (continuous), for ith child in jth school where $j = \mathrm{I}, \ldots, M$ and $I1,2, \ldots, n_j$.

M = number of schools,

n_j = number of children in each school,

$\epsilon_{ij} \sim N(0, \sigma_1^2)$ = conditional residual error,

$\epsilon_{ij0} \sim N(0, \sigma_0^2)$ = unconditional residual errors reflecting individual child differences in post-test, and

t_{ij} = intervention variable for child i in school j.

$b_{1j} \sim N(0, \sigma_{11}^2)$, $b_{2j} \sim N(0, \sigma_{22}^2)$ = random effects capturing the variation between schools from conditional models, and $b_{0j} \sim N(0, \sigma_{00}^2)$ = random effects from unconditional models.

β_1 = regression coefficient for the intervention variable for child i in school j.

$pretest_{ij}$ = pre-test variable for child i in school j.

β_2 = the regression coefficient for the pre-test variable for child i in school j.

The previous PACT2 trial was investigated using a similar approach. This modelling approach enables estimation of impacts of PACT across the different domains of language skills as measured by the latent outcome. It assumes that the language skills may be better assessed as a latent construct that uses shared variance of the subscales and can reflect important elements of language skills that may be difficult to measure relying on observed variables. This multilevel approach also allows us to test whether the estimated effects of the intervention are constant across schools.

Secondary analysis

All non-latent variable secondary outcomes were analysed using multilevel models with school and school-by-intervention as random effects. The effect size and the associated confidence intervals are calculated using unconditional variance of the outcome data to ensure consistency of results with the latent variable model, where the confidence interval for the effect of the intervention will be based on unconditional variance. The immediate impact of the PACT intervention on the secondary outcomes (HLE (t2), BESSI-BA (t2), BESSI-LC (t2), BESSI-DLS (t2), BESSI-FS (t2), BPVS (t2,t3), CELF-EV (t2,t3), APT-Info (t2, t3), APT- Grammar (t2, t3), LS-RV (t2, t3), LS-EV (t2,t3), LS-LC (t2,t3), LS-SR (t2, t3), YARC-LSK (t3), YARC–EWR (t3), YARC–SD (t3)) are analysed using a multilevel model accounting for intra-school correlation as per in the EEF 2018 Statistical Analysis guidance document. Where available, an appropriate pre-test variable is included in the model as a covariate for baseline adjustment (see Table 5 below for specific details of baseline covariates used).

Table 5. Pre-test variables for secondary outcomes.

Secondary outcome	Pre-test variable to be included
HLE (t2)	HLE at pre-test
BESSI (all subscales, t2)	-
BPVS (t2, t3)	LS-RV at pre-test
CELF-EV (t2, t3)	LS-EV at pre-test
APT (grammar and information scores, t2, t3)	LS latent variable at pre-test
LS-RV (t2, t3)	LS-RV at pre-test
LS-EV (t2, t3)	LS-EV at pre-test
LS-LC (t2, t3)	LS-LC at pre-test
LS-SR (t2, t3)	LS-SR at pre-test
YARC (all subscales) (t3)	LS latent variable at pre-test

Estimation of effect sizes

The effect sizes for the primary and secondary outcomes are obtained from fitted multilevel models, using Hedges' g effect size defined as:

$$\boldsymbol{ES} = \frac{\widehat{\boldsymbol{\mu_T}} - \widehat{\boldsymbol{\mu_C}}}{\sqrt{\boldsymbol{\sigma_w^2} + \boldsymbol{\sigma_s^2} + \boldsymbol{\sigma_I^2}}}$$

Where $\widehat{\mu_T} - \widehat{\mu_C}$ is the adjusted average difference between the intervention and control groups. σ_w^2 is residual variance, σ_s^2 denotes between school variance and σ_I^2 denotes the variance of school by intervention effects. As per analysis guidelines by the EEF, our main analysis for estimating effect size used the unconditional variance generated from an empty model in the denominator, while estimates for the numerator of the effect size are obtained from the conditional multilevel model. We also compute the effect size using conditional variance.

Estimation of ICC

There is no explicit estimation of ICCs in a latent variable model. However, we estimate ICCs for the analysis of the individual outcome data using multilevel models. The pre-test estimation of ICCs is based on a model with only the overall mean and with schools as random effects. The estimation of ICCs for post intervention data is done with and without fixed effects, but with schools as random effects. ICCs will be computed at school level.

Sub-group analyses

All the outcome data is analysed by Early Years Pupil Premium (EYPP) eligibility model. Alongside fitting the latent variable model separately for the subgroup category of those who received EYPP, an interaction model is also considered. Effect size for children eligible for EYPP is reported in accordance with EEF requirement.

Analysis in the presence of non-compliance

The parent-reported compliance data measured to what extent each parent/ child in the intervention group adhered to the required sessions of the intervention. Compliance data on number of sessions delivered based on data submitted by parents about each session using the PACT app and paper record forms (total number of sessions completed) is used in a Complier Average Causal Effect (CACE) analysis. The CACE analysis is implemented using an instrumental variable approach by comparing the outcomes between the intervention group and control group with a focus on random variation in compliance data. In other words, it assesses when conditioning on the number of PACT session delivered, what the impact of the PACT intervention is on language development (Pokropek, 2016). This is done for primary outcome data at immediate post-test and delayed post-test.

Additional analyses and robustness checks

Impact of stratification variable
To explore the influence of incorporating the stratification variable “pre-test completeness”, additional analyses are undertaken to determine if the effect size estimate would differ. The results demonstrated that, for the most part, the findings remained consistent, with only minor implications for the confidence interval range. Moreover, both conditional and unconditional intra-class correlation coefficients (ICCs) were computed and compared, revealing no significant disparities between them (full sample: Appendix D– Tables 2 and 3, EYPP sample: Appendix G.14 -Tables 18 and 19).

Impact of ‘additional intervention’ variable
Additional analyses with the inclusion of the additional variable “additional intervention” in the model were conducted to assess whether a child receiving an additional language intervention during their reception year after completion of the PACT intervention, would show different effect sizes at the delayed post-testing (T3). The results in Appendix G.15 (tables 20 and 21) showed that our findings are robust, with only small variations.

Contamination analysis
'Contamination' refers to the parents in the control group being exposed to the PACT materials, which were intended solely for the parents in the experimental group. Such contamination could potentially impact the outcomes of the research, as it alters the clear distinction between the experimental and control groups. Thus, the contamination analyses were conducted to check whether this contamination influenced the overall findings. To do this, sensitivity analyses were conducted by employing new multilevel linear models (MLMs) with a redefined dataset for T2 and T3, which excluded the parents in the control group who reporting having seen or used the PACT materials. This approach facilitated a more accurate comparison between the true control group and intervention group. The difference between the results of the new models with our original findings can reveal the extent to which the contamination might have influenced the original outcomes. The results in Appendix G.15 (Tables 22 to 25) showed that our original outcomes are robust, with minor difference for one measure (LS SR).

Age adjustment analysis
Sensitivity analysis of age adjustment was to check whether the inclusion of age variable (months since the third birthday) into the MLM makes a notable difference in the analysis. There is a notable imbalance of age distribution within groups: male pupils in the intervention group are younger than the other three groups (female control group, female intervention group and male control group), see Appendix G.15 Figure 31. There is a moderate correlation (from 0.34 to 0.39, see Appendix G.15 Table 26) between age and LS four subscales at the baseline (T1). Therefore, the analysis of age's impact on outcomes will be limited. We first considered the age variable as fixed effect in MLM to check whether age would have impacted our preliminary findings. Subsequent analyses entailed conducting new MLMs with an interaction term between age and intervention, examining the coefficient to determine whether the impact of the PACT interventions varied across different ages. The findings in Appendix G.15 (Tables 27 and 31) affirmed the robustness of our original conclusions, with only slight fluctuations observed in the confidence intervals. Including the interaction term, the model results indicated a trend that the effect of the PACT intervention may decrease with age increasing. However, the evidence for this trend was inconclusive as all confidence intervals contained zero, suggesting that the trend was not statistically significant (see Appendix G.15, Table 28).

Sex adjustment analysis
Sensitivity analysis of sex adjustment aimed to ascertain if adding the sex variable into the MLM results in a significant change in the original outcomes. Given the imbalance in the distribution of pupils across sex groups (Female 195 vs Male 173), the inclusion of an interaction term between sex and intervention in the MLM was deemed inadvisable. The results in Appendix G.15 (Tables 29 and 32) showed that our findings remained consistent.

Missing data analysis

Missing data occurring in the pre-test and outcome (post-test) measures is investigated. Pre-test missing data is presented using cross-tabulation between missing data completeness status (completed, partially completed and no pre-test data) and the intervention groups. We also investigate percentage of missing data in each of the individual components of the primary outcome data, and further analysis regarding imputations was completed when >5% of the outcome data are missing. The latent variable approach with the full information maximum likelihood estimation used for the CFA step implicitly assumes that the underlying mechanism for the missing data does not depend only on the observed data. This missingness mechanism is commonly termed 'missing at random' (MAR) and the full information maximum likelihood method (Cham et al., 2017) estimates the parameters of the latent variables conditioning on the observed data for each of the latent outcomes. It also assumed that all outcomes are linearly related with each other and are multivariate normally distributed, which enables it to condition missing data on observed data assuming multivariate normal distribution (Cham et al., 2017). In order to check whether the assumption of MAR holds, we also performed multiple imputation on the composite outcomes and then apply latent variable model to estimate the impact of the intervention. We would expect that results from multiple imputation and the full information maximum likelihood estimation lead to similar conclusions if the underlying missingness mechanism is missing at random. We consider ten imputations for each outcome using chained equations or the Markov chain Monte Carlo (MCMC) method, which allows non-monotone imputation between pre-test and post-test data (Jakobsen et al., 2017). To impute pre-test data for a particular outcome, the pre-test scores for other outcomes are used in the imputation model. However, both pre-test and post-test data are used in the imputation model for any of the post-test outcomes. The imputation approach is sequential such that all the pre-test scores are first imputed and then used in turn to impute the post-test outcomes. Note that the effect size from each of the imputation is presented as range of values for sensitivity analysis. We do not consider a dropout model for the multiple imputation because of the nature of the latent variable model. The collective missing data is more important in the latent variable model rather than individual dropout model. Lastly, we use all the available data on the latent primary outcome for missing data imputation.

Implementation and process evaluation

Design

The design of the IPE aimed to collect data about each input, output and outcome aspect of the logic model. The data collection tools which captured the different elements of delivery and impact are shown in the orange boxes in the logic model in Figure 1 above.

Table 6 below shows further detail of the IPE research questions and data collection methods. There is a longitudinal element of the design, which involved interviews and surveys with PACT Leads and with Parents/Carers conducted at two time-points during intervention delivery to look at any changes in delivery across the period of the intervention.

Table 6. IPE research questions and data collection methods overview.

Implementation/ logic model relevance	Research questions addressed	Research methods	Data collection methods	Participants/ data sources	Data analysis methods
Fidelity and adaptations	IPE: RQ1 Implementation: fidelity and adaptation -PACT Lead training	Observation	Semi-structured observation schedule and field notes	Both main PACT Lead training sessions observed	Deductive coding using research question as framework
		Online questionnaire	PACT Lead post-training survey	PACT leads attending training sessions (survey responses n=39 from 38 settings)	Frequencies of responses Inductive coding of free text responses
	IPE: RQ1 Implementation: fidelity and adaptation -Parent training	Observation	Observation schedule	Three parent PACT training sessions (one from each trainer) observed	Deductive using research question as framework
		Administrative data	Parental training attendance records	Parent doing PACT (N=185)	Analysed by percentage of type of training received/attended
	IPE: RQ1 Implementation: fidelity and adaptation - Sessions delivered by parents -Support for parents -Materials	Post-intervention survey	Intervention parents post intervention online questionnaire	All intervention parents invited (n=118/185)	Descriptive statistics, frequencies of responses Inductive coding of free text responses Triangulating with parent interviews
		Telephone interviews	Semi-structured interviews at two time-points with PACT Leads and parents	13 PACT Leads across 20 interviews 24 parents from 12 settings across 39 interviews	Combination of inductive and deductive coding using thematic analysis Triangulating with survey data
		Administrative data	PACT app delivery data/paper record forms	Electronic or paper records from all intervention group parents/carers (N=153/185)	Descriptive statistics on number of sessions completed (also used for CACE analysis)
		Face-to-face interview	Semi-structured interview	Developer team (2 participants)	Combination of inductive and deductive coding using thematic analysis
Perceived impact and quality of the programme	IPE: RQ2 How was the PACT programme received and what impact of PACT was perceived?	Post-intervention surveys	Online questionnaire	PACT Leads in all participating settings (survey responses n=39) Intervention parents/carers (n=118/185) Control group parents/carers (survey responses n=120/185)	Descriptive statistics, frequencies of responses Inductive coding of free text responses Triangulating with interviews
		Telephone interviews	Semi-structured interviews at two time-points	As above	Combination of inductive and deductive coding using thematic analysis

					Triangulating with survey data
		Face-to-face interview	Semi-structured interview	Developer team (2 participants)	Combination of inductive and deductive coding using thematic analysis
Usual practice: programme differentiation and spill over	IPE: RQ3 How does PACT differ from usual practice and control group activity?	Baseline usual practice surveys	Online questionnaire	PACT Leads in all participating settings (survey responses n=36) All parents/carers (survey responses n=249/370)	Descriptive statistics, frequencies of responses Inductive coding of free text responses Triangulating with interviews
		Telephone interviews	See information above		
Contextual factors	IPE: RQ4 How does the context of the PACT-3 trial affect understanding and interpretation of the evaluation data particularly considering the following aspects: (1) Covid-19, (2) differences for nurseries that have used PACT previously and (3) impact of the trial design on usual delivery of PACT?	Baseline usual practice surveys	See information above		
		Telephone interviews	See information above		
		Administrative data	School provision of additional language intervention data for each child	Schools provided data for participating children towards the end of Reception year (n=351/370)	Descriptive statistics, frequencies of responses Inductive coding of responses Sensitivity analysis of delayed post-testing impact analysis investigating whether additional interventions moderated effect sizes at t3

Research Methods

Administrative records

Attendance in the online training for PACT Leads and parents was monitored by the developer team as they set up and ran the sessions. Records of attendance at these sessions and of those who received the training video with follow up from the PACT Leads were then shared with the evaluation team once all training was finished.

The intervention group families were asked to use a mobile telephone application called PACTApp to record their engagement with the PACT programme. On completion of a session, they were asked to use the app to record that they had finished that particular session, and whether the child had enjoyed (happy face) the session or not (sad face). The app also allowed notifications to remind parents to record progress. The developer team downloaded this data from the app regularly to monitor the engagement and where engagement seemed to be low, PACT Leads were asked to follow up with parents to encourage them to record their PACT sessions or to ask if they needed support with PACT. The first review of the engagement data by the developer team was completed in January. Any missing engagement was queried by the PACT Leads and parents were encouraged to backfill their engagement with PACT sessions up to then. In cases where parents could not access the phone app, they were distributed paper copies of the record form by their PACT lead to record the same information. Paper record forms were collected by the PACT Leads and copies of the forms returned to the developer team.

The app engagement records up until 30th June 2022, were downloaded by the developer team and securely shared with the evaluation team. Any paper records were scanned and shared similarly, and the evaluation team entered the paper records on the spreadsheet that included the phone app records. The dataset was cleaned, deleting duplicates. Out of 185 intervention families, there was PACTApp/paper record data from 152 families (82.2% of the participants).

Data was also collected from schools at the end of children's first year at school which indicated whether the child had received additional language intervention during the school year. Descriptive statistics for those that received additional intervention are reported for the intervention and control groups as part of the IPE context section. Sensitivity analyses using this data were carried out to look at whether having language intervention during the first year of school moderated the effects of the programme (reported in the Impact Evaluation Results).

Observations

Observations of the PACT Lead training sessions were conducted using semi-structured observation schedules (appendices F.12 and F.13). Observations were also conducted of three developer-led parent training sessions (sampled to observe one session conducted by each member of the developer training team). These observations were conducted by one member of the evaluation team. These were undertaken and analysed to consider consistency between different training sessions; whether the training sessions content followed the planned training slides; engagement in the training and how participants' queries were responded to in different training sessions.

Surveys

All surveys were based on the instruments used in PACT-2 trial and adapted based on any previous issues with questions and the specific research questions for PACT-3.

PACT Lead Post-Training survey

PACT Leads who had attended the PACT Lead training session (n=54) were asked to complete an online survey (appendix F.1) sent out by the evaluation team. The survey asked the PACT Leads to share:

- their role in school and their background,
- the impact they hoped PACT would achieve
- their views of the online training and how useful it was
- their views of how the online training compared to previous PACT training (for previous PACT Leads only)
- and their confidence in delivering the required administration and support for the programme.

Fifty responses were received initially (93%), however, 11 of these responses were from settings that withdrew from the project (following training and before randomisation). Removing these responses left 39 responses from 38 nurseries[7] (see Table 7).

PACT Lead Usual Practice surveys

PACT Leads from all participating schools were asked to complete an online 'Usual Practice' survey at baseline (September 2021, appendix F.2) and post-intervention in June-July 2022 (appendix F.3). The baseline survey asked PACT Leads about: 1) nursery intake and recruitment to the trial (to provide context information about the sample); 2) the support they received during the set-up stage (for IPE: RQ1); 3) the time and cost of setting up PACT (for the cost evaluation); 4) nurseries' usual practice for supporting parents and children at home (for IPE: RQ3). The post-intervention survey asked PACT leads to answer questions about: how families engaged with PACT (for IPE:RQ1), the support the setting provided for PACT families (for IPE: RQ1), the amount of time and resource spent delivering PACT (for the cost evaluation), the perceived impact of PACT (for IPE: RQ2) and any changes to usual practice or practice for families not receiving PACT. Surveys also asked PACT Leads to flag if they had delivered PACT previously to support with understanding what schools delivering PACT for a second time, may do differently (IPE: RQ4).

Usual practice surveys at baseline and post-test were sent to the PACT Lead main contacts in 43 nurseries. Reminders were sent to those who had not responded, and any additional 2nd PACT Leads contacts were then contacted at this point (n=30) to encourage a response. Responses for the baseline survey were received from 84% of nurseries while for the post-intervention survey the response rate was 88% of nurseries (see

[7] Two PACT Leads responded from one nursery.

Table 7). Data from the PACT Lead surveys were analysed using descriptive statistics. For the usual practice surveys, only one response per nursery was sought although multiple PACT Leads were contacted. Where more than one member of staff per nursery responded to the Baseline and Post-intervention surveys, only the first response received was analysed.

Table 7. Survey responses to the three PACT Lead surveys. The number of participating nurseries was 43.

	Post-training survey	Baseline Survey September 2021	Post-intervention Survey May 2022
Number of invitations sent	42[8]	47	43
Number of individual responses	39 (from 38 settings)	36 (from 36 settings)	39 (from 38 settings)
Response rate (PACT Lead level)	93%	77%	91%
Response rate (nursery level)	100%[9]	84%	88%

Parent Usual Practice Surveys

Parents/carers were asked to complete a 'Usual Practice' survey at baseline (September 2021, appendix F.4), and post-intervention in June-July 2022 (at the end of the intervention delivery period, appendices F.5 and F.6). Surveys were administered online with a link sent to the parent email contact the team had. Where no response was received to the online survey, a paper copy was sent to the family home with a stamped addressed envelope for return. Participation in the parent surveys was incentivised at both timepoints through a prize draw to win one of four £25 Amazon vouchers.

Parent/carer surveys at both time-points for both control and intervention parent/carers included the Home Learning Environment index (Melhuish et al., 2008a) which was also used as a measure of usual practice (as well as a secondary outcome measure). The HLE was supplemented with additional questions about how long parents read with their child and frequency of activity relating to teaching their child to read. At baseline, background characteristics (number of people in household, highest household qualification, number of children's books at home) were also captured in the survey alongside measures of confidence in supporting their child's learning and parents' reasons for taking part in the project.

For the post-intervention surveys (June-July 2022), separate surveys were delivered to the control and intervention groups. Both groups were asked to answer the same HLE and additional usual practice and confidence questions as at baseline. The intervention group were asked to provide feedback on their delivery of the intervention and the impact the programme had, while the control group were asked about their usual practice to do with reading at home and home learning as well as access to the intervention materials to assess contamination. Both groups were also asked about their nursery's usual practice with home learning activities.

Data from the surveys were analysed using descriptive statistics, frequency counts where appropriate and inductive coding for free text responses. Response numbers and response rates to parent usual practice surveys are given in Table 8.

Table 8. Survey responses to the PACT parent/carer surveys at baseline and post-intervention. Response rates shown for both intervention and control groups.

	Baseline survey (September 2021 – before randomisation)		Post-intervention survey (June-July 2022)	
	n/N	Response rate	n/N	Response rate
Intervention group	120/185	65%	117/185	63%
Control group	128/185	69%	119/185	64%
Overall	248/370	67%	236/370	64%

[8] For settings that did not later withdraw from the trial
[9] 5 settings were recruited after PACT Lead training and did not complete the survey

Interviews
All interviews were conducted using a semi-structured interview schedule (included in Appendices F7 – F10). Interviews with PACT Leads and with parents were telephone interviews which were conducted by one member of the evaluation team. The developer interview was conducted in person by two members of the evaluation team. All interviews were recorded and transcribed. The interview data were then analysed using thematic analysis. The interview data were coded using inductive thematic codes, which were arranged according to the research questions using Nvivo software (QSR International Pty Ltd., 2020). Coding and analysis at each stage was quality assured by a second member of the evaluation team.

For each participant group, findings from the interview data related to the research questions are triangulated with those from the surveys. PACT Lead interview data are also triangulated with the parent/carer interviews and surveys to help understand whether the nursery staff and families viewed their experience similarly.

PACT Lead interviews
Ten interviews with PACT Leads were conducted at two time points in January 2022 (10-12 weeks into the programme) and May 2022 (25-30 weeks into the programme) with PACT Leads from 13 settings. Seven PACT Leads participated in interviews at both time points (as planned), while six PACT Leads only participated at one time point only. Where the PACT Lead interviewed at the first timepoint was unavailable at the second time point, new interviewees were recruited from other nurseries. PACT Leads were chosen from a range of the geographical areas (with PACT Leads recruited from Warrington and Lancashire (n=7), Tameside (n=2), Manchester (n=2), Blackpool (n=1) and Bolton (n=1). The recruited sample also aimed to have PACT Leads from schools which were completely new to PACT (n=7) and schools that had previously delivered PACT (n=6). All PACT Leads interviewed were teachers in the schools who worked in Early Years (three were reception class teachers, six were nursery class teachers and four only specified EYFS). Additionally, four of the PACT Leads were EYFS Lead, two were SENCOs and one was an acting headteacher. Interviewees tended to be experienced teachers with seven having more than 16 years classroom experience, four having between 6- and 10-years' experience and two having less than 5 years' experience. This was representative of the PACT Lead sample (see IPE results section).

The PACT Lead Interview schedules are presented in appendices F.7 and F.8. These interviews aimed to capture the fidelity of intervention delivery, feedback about the PACT programme and the perceived impact of PACT. Interviews also gathered details on the costs to schools (e.g. monetary, staff time) associated with implementing PACT. The interviews were aimed to be twenty minutes long with average length of interview being 24 minutes. .

Parent interviews
Twenty interviews with parents/carers in the intervention group were conducted in February 2022 (12-16 weeks into the programme) while 19 interviews were conducted in June/July 2022 (towards the end of the programme). Fifteen of the parents from the first interviews also participated in the second interview while 5 participants from the first interviews were unable to participate in the second interviews. An additional 4 parents were recruited for the second interview timepoint only. Parents/carers invited to interviews were from nurseries in which PACT Leads had already been interviewed. The sampling strategy aimed to ensure than the sample contained representation from families who have English as an additional Language (n=5) and families where their child was eligible for Early Years Pupil Premium (n=5). Seventeen of the parent's interviewed had also completed the baseline survey family background information. Of these 17 interviewees, 10 were from a household where the highest level of education was a higher education, two were from households where the highest level of qualification was A-levels, three were from households where the highest level of education was GCSEs and two were from households where the highest level of education was vocational training. The number of children's books in the households of those interviewed, varied between one household having 0-10 books and another having 11-20 books to five families having 21-50 books, four having 51-100 books and six having more than 100 children's books.

Parent interview schedules are presented in appendices F.9 and F.10. During the interviews parents reported their progress through the PACT programme. For the first interview, topics included: parent views on training and support, delivery of PACT, how PACT compared to usual practice and child response to the PACT programme. For the second interview, topics included: progress and continued use of PACT, support accessed for PACT, perceived impact of PACT, sharing of materials, reliability of usage records and challenges /barriers.

Progress ranged from 5 -16 weeks at first interview and from 9 to 29 weeks at the second interview. Parent interviews aimed to be around 15-20 minutes and were on average 15 minutes long. Parents/carers were offered a £15 Love2Shop voucher for participating in both interviews.

Developer interview
An interview with the developers of the PACT programme was held in September 2022, with two members of the developer team. The developer interview schedule is presented in appendix F11. The interview was around 90 minutes long and aimed to capture the developers' views on a range of topics including:

- changes made to PACT delivery due to the trial context
- reflections on new online training
- comparing PACT to usual practice
- feedback from schools and parents/carers
- reflections on the PACT Lead role
- reflections on different contexts between the different PACT trials
- consideration of delivery models for PACT beyond the trial
- extra costs

Cost evaluation design

Cost data was collected within the IPE data collection as well as in a specific cost workshop between the developer and the evaluation teams which captured information about the PACT-2 and PACT-3 models during the same workshop (August 2021). The online cost workshop explored the PACT logic model in detail to extract the 'ingredients' that formed the intervention and explored their costs. As the developer does not currently market the programme commercially, the workshop was used to develop an estimate of the cost to the developer of providing the training, materials, and support necessary for delivery investigating the amount of time and resources spent: preparing for and delivering the training, the distribution of PACT Packs, as well as providing ongoing support and communication with participating nurseries. The workshop also explored what schools, PACT leads, and parents/carers would require for delivering the PACT programme (pre-requisites) as well as the cost for delivery in the same setting over a second and third year.

The baseline usual practice survey for PACT leads as well as the post-training PACT Lead survey contained questions to explore the counterfactual of delivery from the school setting. Parent/carer usual practice surveys also explored the counterfactual for non-PACT families.

Time spent delivering the PACT programme for school settings was gathered in the PACT lead usual practice surveys. This included the staff time spent on training and programme set-up via the baseline survey (number of days for different staff) and staff time spent on delivery through the year separately for the initial 10-week delivery period (collected in total number of days) and the ongoing delivery from 11 weeks to the end of the project (collected in number of days per month). Staff time was collected separately for PACT Leads and other staff. Role in setting was also gathered to estimate cost for the time. The surveys also asked about whether any supply cover was required by settings and, if so, the number of days. Unexpected or 'hidden' costs were explored in the interviews with parents and surveys and interviews with PACT leads.

Parent/carer time commitment in delivering the intervention is reported separately from school delivery costs and not included in the cost estimate analysis. We report separately the programme expectation for time required for parent/carer delivery and the reported mean amount of time spent preparing for and delivering sessions as reported in the post-intervention PACT parent survey for the mean number of sessions reported in the PACT app or paper records.

To calculate the cost per child for the trial, we assumed that five children would access the programme per year per school and that the programme would be delivered across 47 schools, as was delivered during this trial. We assumed that PACT lead training would be required only for the first year of programme delivery. The programme would serve different children each year and would require new PACT packs for each child.

Timeline

Table 9. Project timeline.

Dates	Activity	Staff responsible / leading
March – April 2021	School / nursery recruitment	Developers
May 2021	PACT Lead training	Developers
June 2021	PACT Lead training survey	Evaluators
June – September 2021	Child/family recruitment	Developers
September – October 2021	Pre-testing (LanguageScreen)	Evaluators
October 2021	Baseline surveys: PACT Leads and parents/carers (HLE)	Evaluators
11th October 2021	Randomisation	Evaluators
October – November 2021	Parent/carer training	Developers
November – June 2022	Intervention	Developers
January 2022	First round interviews: PACT Leads	Evaluators
February 2022	First round interviews: Parents	Evaluators
April 2022	Second round interviews: PACT Leads	Evaluators
May 2022	Second round interviews: Parents	Evaluators
May/June 2022	End of intervention surveys: PACT Leads and parents/carers (HLE)	Evaluators
June – July 2022	Post-intervention testing period: LanguageScreen, BESSI, CELF, BPVS, APT	Evaluators / Developers
June/August 2022	Collecting children's school destination	Developers
September 2022	Developer interview	Evaluators
September – April 2022	Data cleaning, quality assurance and analysis	Evaluators
January – June 2022	Report writing	Evaluators
February – April 2023	Recruiting new schools where children had moved	Developers
May 2023	10-month delayed post testing (LanguageScreen, CELF-EV, BPVS, APT, YARC)	Evaluators / Developers
July – October 2023	Delayed post-test data cleaning, quality assurance and analysis	Evaluators
October – February 2024	Updating report with delayed post-testing data	Evaluators
March 2024	Data submission to Data archive	Evaluators

Impact evaluation results

Participant flow including losses and exclusions

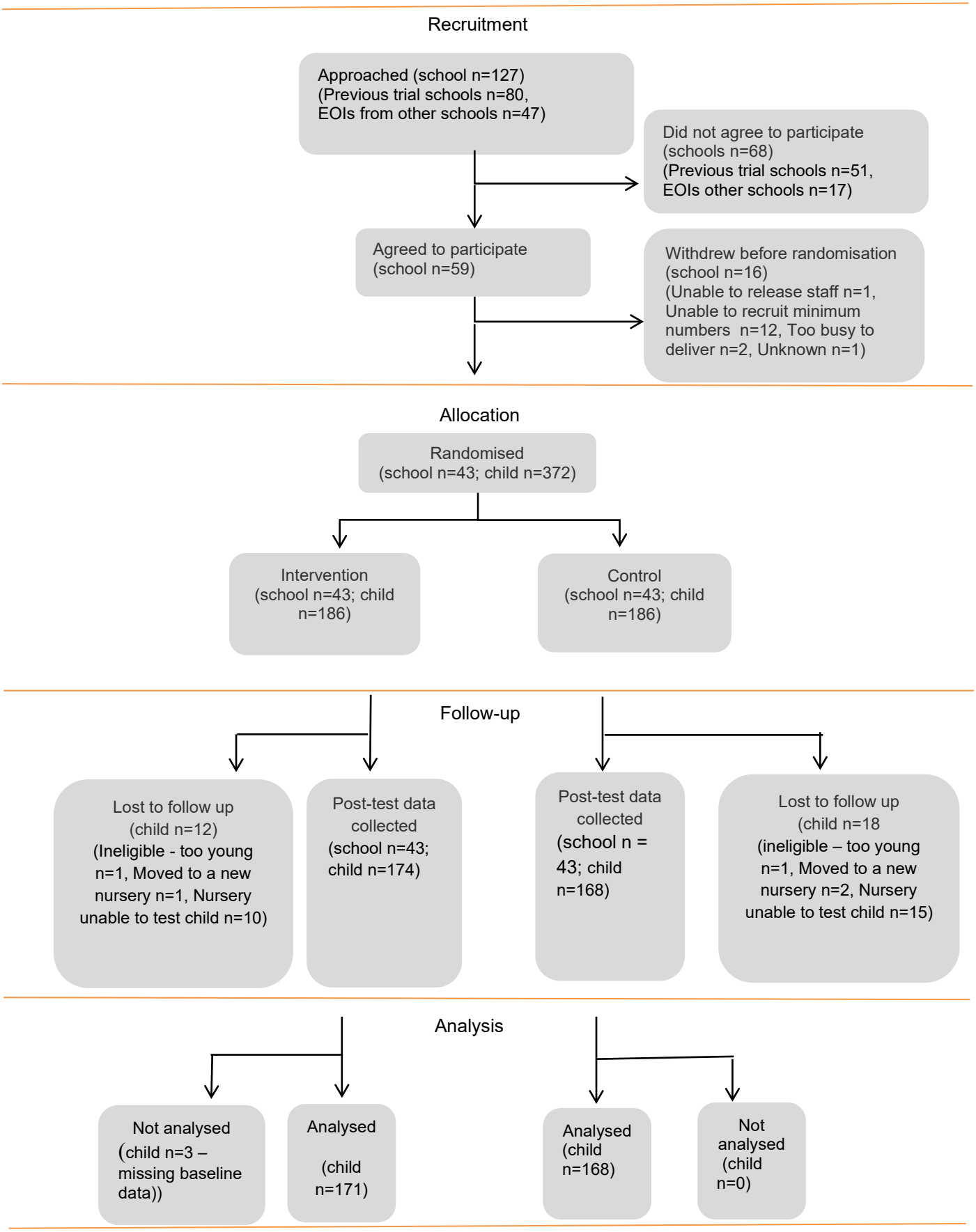

Figure 2. Flow Diagram

Participant flow through the trial is described in detail in the recruitment section and in the attrition section as well as illustrated in the flow diagram above.

Table 10. Minimum detectable effect size at different stages.

		Protocol		Randomisation		Analysis	
		Overall	EYPP[10]	Overall	EYPP	Overall	EYPP
MDES		0.18	-	0.21-0.22	0.72	0.16	0.71
Pre-test/post-test correlations	Level 1 (child)	0.60	-	0.60	0.60	0.80	0.76
	Level 2 (class)	NA	-	NA	NA	NA	NA
	Level 3 (school)	NA	-	NA	NA	NA	NA
Intracluster correlations (ICCs)	Level 2 (class)	NA	-	NA	NA	NA	NA
	Level 3 (school)	0.10	-	0.10	0.10	0.17	0.19
Alpha		0.05	-	0.05	0.05	0.05	0.05
Power		0.8	-	0.8	0.8	0.8	0.8
One-sided or two-sided?		Two-sided	-	Two-sided	Two-sided	Two-sided	Two-sided
Average cluster size		10	-	8-9	-	-	
Number of schools	Intervention	48	-	43	-	43	18
	Control	48	-	43	-	42	18
	Total:[11]	48	-	43	-	43	
Number of children	Intervention	240	-	185	-	171	32
	Control	240	-	185	-	168	34
	Total:	480	-	370	60[12]	339	66

[10] At protocol we did not have any information available as to the likely size of the EYPP group to base these calculations on.
[11] Within school randomisation design therefore all schools are intervention and control settings.
[12] Estimated at randomisation based on proportion of EYPP in previous PACT trial (16%)

Attrition

Table 11. Child level attrition from the trial (primary outcome).

		Intervention	Control	Total
Number of children	Randomised	186	186	372
	Analysed	171	168	339
Child attrition (from randomisation to analysis)	Number	15	18	33
	Percentage	8%	10%	9%

At randomisation, there were 372 children included in the trial (367 had completed some baseline assessment). After randomisation, but before post-testing, two children (one intervention group and one control group) were discovered to be too young for the study and should not have been accepted to the trial – they were both withdrawn.

By the time of the post intervention testing, six children had moved to different settings where attempts were made to recruit those nurseries and retain the children to the project – 3 settings (and children) agreed to take part in the study and 3/6 children were lost at this point. Post-test LanguageScreen data was missing for an additional 25 children due to staff shortages or child illness. Additionally, it was not possible to analyse the data for three children from the intervention group as they were missing baseline data on all four LanguageScreen subscales . The overall attrition rate for the primary outcome was 9%.

Child and school characteristics

School-level characteristics

School-level characteristics are provided in Table 12. Due to the within-setting randomisation design, all schools are both intervention and control settings. All nurseries in this trial were state-funded and attached to a primary school. FSM and school Ofsted rating is provided for the full school rather than specifically relevant to the nursery. Most schools participating in the project were ‘good’ or ‘outstanding’ in terms of Ofsted ratings, and their progress in Key Stage 2 reading was similar to the national pattern across the schools’ population. The average percentage of free school meals eligibility for the schools in the trial was 30.07% which was higher than the national average of 21.6%. This indicated that the school recruitment strategy to target areas of higher deprivation was successful. Almost all schools were in urban locations although four were in rural areas. Schools were mostly community schools or voluntary aided schools, while five were academy converters, four were voluntary controlled schools, four were academy sponsor led and one was a foundation school.

Child-level characteristics

Child-level characteristics are presented by control and intervention group in Table 13. In terms of demographic characteristics, there was little difference between the intervention and control groups in terms of, whether English was the main language spoken at home, or children eligible for Early Years Pupil Premium. In terms of gender, the control group has a higher ratio of females to males in the group, while the intervention group is evenly balanced. The control group were also slightly older than the intervention group on average. Both intervention and control groups were similarly split between the high household qualification, with the majority (57.5%) of children coming from a household where the highest qualification is a higher education degree. This may indicate that the sample that took part in the study was more highly educated than expected from the national average data from the 2021 census in which only 33.8% of the population above aged 16 had higher education qualifications. The sample is also more highly educated than the PACT-1 sample where only 24% of the parent respondents in the sample had undergraduate or post-graduate degree qualifications. Intervention group and control group are also similar in their patterns of response to the number of children’s books in the household. Not many of the sample had fewer than 21 children’s books in the house, while around 25% of the sample had between 21 and 50 books, around 30% of the sample had between 50 and 100 books and

around 30% had more than 100 children's books in the household. Compared to the PACT-1 sample, families in this trial had more children's books at home: in PACT-1, 23% of the sample had fewer than 21 books, 38% had 20-50 books, 24% had 50 to 100 books and only 15% had more than 100 children's books in the household. Given the higher levels of education and number of children's books for the recruited sample it may be that while the schools recruited had high levels of disadvantage, the families signing up to the project may not have been those most disadvantaged. It also may be that the nursery intake does not reflect the same level of disadvantage as the full school.

Table 12. School Level Characteristics

School-level (categorical)	National-level mean		
			Count (%)
Ofsted rating		Good Outstanding Requires improvement No data available	33 7 2 1
School type		Community school Voluntary aided school Academy converter Voluntary controlled school Academy sponsor led Foundation school	17 12 5 4 4 1
Location		Urban city and town Urban major conurbation Rural hamlet and isolated dwellings Rural town and fringe Rural village	20 19 2 1 1
KS2 Reading progress score	10% 9% 64% 7% 10% -	Well below average Below average Average Above average Well above average Missing data	3 (7.0%) 4 (9.3%) 28 (65.1%) 5 (11.6%) 2 (4.7%) 1 (2.3%)
School-level (continuous)			Mean (SD)
FSM eligibility	21.6%[13].		30.07%

In terms of baseline measures, the intervention and control groups performed similarly with little difference in the baseline scores of both groups. The distribution of pre-test scores for all children is included in Appendix G.4.

[13] National average at January 2022 for state-funded primary schools from (**https://explore-education-statistics.service.gov.uk/find-statistics/school-pupils-and-their-characteristics**)

Table 13. Baseline characteristics of groups as randomised.

		Intervention Group		Control Group		
Child-level (categorical)		(missing) n/N	Count (%)	(missing) n/N	Count (%)	
Gender		(1)		(0)		
Female		91/184	49.45%	104/185	56.21%	
Male		93/184	50.54%	81/185	43.78%	
English is main language at home		(2)		(1)		
No		11/183	6.01%	9/184	4.89%	
Yes		172/183	93.98%	175/184	95.10%	
Eligible for EYPP		(3)		(4)		
No		148/182	81.31%	144/181	79.55%	
Yes		34/182	17.58%	37/181	20.44%	
Pre-test status at randomization		(0)		(0)		
Not able to test		8/185	4.32%	6/185	3.24%	
Tested		176/185	95.13%	178/185	96.21%	
Did not comply with assessment		1/185	0.54%	1/185	0.54%	
Highest qualification in the household		(66)		(57)		
A levels or equivalents		18/119	15.12%	16/128	12.50%	
Apprenticeship		4/119	3.36%	2/128	1.56%	
GCSEs or equivalents		12/119	10.08%	25/128	19.53%	
Higher Education Degree (or above)		71/119	59.66%	71/128	55.47%	

No formal qualifications		3/119	2.52%	2/128	1.56%	
Vocational qualifications		11/119	9.24%	12/128	9.38%	
No. children's books in household		(65)		–57)		
0 - 10		7/120	5.83%	9/128	7–03%	
11 - 20		8/120	6.67%	10/128	7–81%	
21 - 50		28/120	23.33%	34/128	26–56%	
51 - 100		38/120	31.67%	38/128	29.69%	
More than 100		39/120	32.50%	37/128	28.91%	
Child-level (continuous)		**n/N (missing)**	**Mean (SD)**	**n/N (missing)**	**Mean (SD)**	**Effect size**
Age in months at baseline (T1)		181/185 (4)	42.83 (3.41)	184/185 (1)	43.35 (3.41)	-0.19
HLE (T1)		115/185 (70)	29.13 (10.04)	127/185 (58)	29.31 (9.08)	-0.07
LS EV raw (T1)		181/185 (4)	10.11 (4.43)	184/185 (1)	9.80 (4.79)	0.07
LS RV raw (T1)		181/185 (4)	14.29 (3.97)	184/185 (1)	13.78 (4.02)	-0.05
LS SR raw (T1)		181/185 (4)	5.19 (3.47)	184/185 (1)	5.38 (3.81)	0.06
LS LC raw (T1)		181/185 (4)	4.03 (3.49)	184/185 (1)	4.20 (3.52)	0.01
Language latent (pre)		171/185 (14)	-0.04 (3.62)	168/185 (17)	0.02 (3.87)	0.03

Outcomes and analysis

Primary analysis

The primary outcome measure is a language latent variable constructed using the LanguageScreen sub-items for which higher score indicates better language skills. The creation of the language latent variable is described in appendix G.3. The latent language variable had an overall mean score of 0.00 with a standard deviation of 3.74. The distribution of the pre-test language latent variable, as depicted in appendix G.4, aligns with the normal distribution assumption stipulated by the model, demonstrating minimal deviations from this assumption. There were no significant differences between the groups: the intervention group had a relatively lower mean score than the control group (-0.01 vs 0.02), results available in Table 14. The overall effect size, computed using Hedges g formula, was 0.03 (-0.23, 0.28). It is notable from Table 14 that, while the unadjusted mean from the Intervention group falls below the one from the Control group, the model-based effect size, after taking pre-test into account, is positive in favour of the intervention. While these results are insignificant, they can be explained by a small imbalance of the baseline (pre-test) measurements in favour of the control (see Table 14), which, when adjusted for, tip the effect size in favour of the intervention.

Table 14. Primary outcome analysis

	Unadjusted means				Effect size		
	Intervention group		Control group				
Outcome	N (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	Total n (intervention; control)	Hedges g (95% CI)	p-value
Primary outcome: LS latent variable	171 (14)	-0.01 (-0.56, 0.53)	168 (17)	0.02 (-0.57, 0.60)	339 (171; 168)	0.03 (-0.23, 0.28)	0.70

Secondary analysis

Immediate post-test analysis (T2)

Results for secondary outcomes are summarized in Table 15 including the mean values and confidence intervals for intervention and control groups for all secondary outcomes at T2. The largest effect was seen for the BESSI assessment subscales with effect sizes ranging from -0.14 to -0.11 for the different subscales (where a lower score showed greater school readiness). Both the BPVS at post-test 0.11 (-0.14, 0.36), and LS EV subscale 0.10 (-0.15, 0.34) showed similar positive effect sizes and the CELF EV also showed a small positive effect size 0.03 (-0.22, 0.29). Other secondary outcomes showed negligible effect sizes including the other LS subscales (ES ranging from -0.05 to -0.01) and the two APT subscales (grammar score 0.01, information score -0.01). There was a small negative effect for the Home Learning Environment Index measure in favour of the control group -0.07 (-0.35, 0.21). None of these secondary outcome effects were statistically significant. The distributions of the secondary outcome variables (as shown in appendix G.4) closely adhere to the model's assumption of a normal distribution, exhibiting only minor deviations. It is worth noting that these distribution characteristics have minimal or negligible effects on the analysis performed.

Table 15. Secondary outcome analysis for immediate post-test measures

	Unadjusted means				Effect size		
	Intervention group		Control group				
Outcome	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	Total n (intervention; control)	Hedges g (95% CI)	p-value
HLE T2	185 (69)	29 (27.27, 30.72)	185 (66)	31.02 (29.18, 32.84)	235 (116; 119)	-0.07 (-0.35, 0.21)	0.50
CELF EV T2	185 (2)	18.69 (17.64, 19.73)	185 (7)	18.50 (17.45, 19.54)	361 (183; 178)	0.03 (-0.22, 0.29)	0.67
BPVS T2	185 (9)	62.32 (59.78, 64.86)	185 (16)	60.52 (57.87, 63.16)	345 (176; 169)	0.11 (-0.14, 0.36)	0.23
APT information	185 (3)	24.49 (23.65, 25.33)	185 (7)	24.67 (23.80, 25.53)	360 (182; 178)	-0.01 (-0.26, 0.25)	0.96
APT grammar	185 (3)	19.84 (18.97, 20.71)	185 (7)	19.89 (18.97, 20.81)	360 (182; 178)	0.01 (-0.24, 0.25)	0.94

BESSI BA	185 (23)	1.93 (1.53, 2.33)	185 (23)	2.36 (1.86, 2.87)	324 (162; 162)	-0.14 (-0.40, 0.13)	0.33
BESSI LC	185 (23)	0.63 (0.46, 0.81)	185 (23)	0.78 (0.58, 0.97)	324 (162; 162)	-0.11 (-0.37, 0.15)	0.26
BESSI DLS	185 (23)	0.63 (0.45, 0.81)	185 (23)	0.79 (0.59, 1.00)	324 (162: 162)	-0.13 (-0.38, 0.12)	0.22
BESSI FS	185 (23)	0.65 (0.47, 0.84)	185 (23)	0.82 (0.61, 1.02)	324 (162; 162)	-0.12 (-0.40, 0.16)	0.33
BESSI total	185 (23)	3.86 (3.15, 4.56)	185 (23)	4.75 (3.84, 5.67)	324 (162; 162)	-0.15 (-0.43, 0.13)	0.19
T2 LS RV	185 (11)	16.5 (15.98, 17.02)	185 (17)	16.54 (15.99, 17.08)	342 (174; 168)	-0.05 (-0.29, 0.19)	0.88
T2 LS SR	185 (11)	8.42 (7.88, 8.96)	185 (17)	8.56 (8.00, 9.13)	342 (174; 168)	-0.01 (-0.28, 0.26)	0.95
T2 LS LC	185 (11)	7.82 (7.20, 8.44)	185 (17)	8.08 (7.43, 8.79)	342 (174; 168)	-0.03 (-0.29, 0.23)	0.74
T2 LS EV	185 (11)	13.65 (13.07, 14.22)	185 (17)	13.39 (12.71, 14.07)	342 (174; 168)	0.10 (-0.15, 0.34)	0.17

Delayed post-test analysis (T3)

The latent language variable at the delayed post-test period (T3), constructed similarly to T2 using four sub-items of the Language Screen (LS) with 333 observations, exhibited a mean score of 0.00 and a standard deviation of 2.57. Its distribution aligned with the normality assumption confirming its appropriateness as a dependent variable for subsequent multilevel linear models. At the delayed post-test (T3), the difference in mean scores between the intervention and control groups was observed, 0.08 vs -0.08, indicating a positive impact of the intervention, see Table 16. Furthermore, the overall effect size at T3, calculated through unconditional variance and Hedges' g formula, was 0.09 (-0.14, 0.33), surpassing the effect size at T2 (0.09 vs 0.03). This suggests a more pronounced impact of the PACT intervention on language skills 11 months after the intervention period. The increase in effect size from T2 to T3 implies a progressively beneficial influence of the intervention on children's language abilities. Despite this, the effect size indicates a low impact and was statistically insignificant, with a p-value of 0.21, implying there is not strong enough evidence to say that there is an impact of the PACT intervention over time.

Examining the results for secondary outcomes at T3 in more detail, different measure scores exhibited varying effect sizes. The YARC EWR Regular score of 0.12 (-0.17, 0.41), YARC EWR Exception score of 0.06 (-0.20 to 0.32), LS EV of 0.10 (-0.15 to 0.35), and LS SR score of 0.10 (-0.15 to 0.36) all showed positive effect sizes. Meanwhile, the APT Information score at 0.04 (-0.19 to 0.29) and the YARC LSK score at 0.05 (-0.25 to 0.36) demonstrated small positive effect sizes. In contrast, APT Grammar score (-0.13, ranging from -0.37 to 0.11) and YARC SD score (-0.11, from -0.35 to 0.14) exhibited negative effect sizes. Other secondary outcomes such as LS sub-items (RV at -0.05 and LC at -0.05), CELF EV score (-0.03), and BPVS score (-0.03) showed negligible effect sizes (see Table 16). All effect sizes for these secondary outcomes had high p-values (ranging from 0.20 to 0.73) and were statistically insignificant, indicating that these results may be due to chance and not truly the impact of the PACT programme.

The results are further elucidated through data visualisation in the form of a bar plot, which succinctly illustrates the effect sizes of each measure at T2 and T3, see Figure 3.

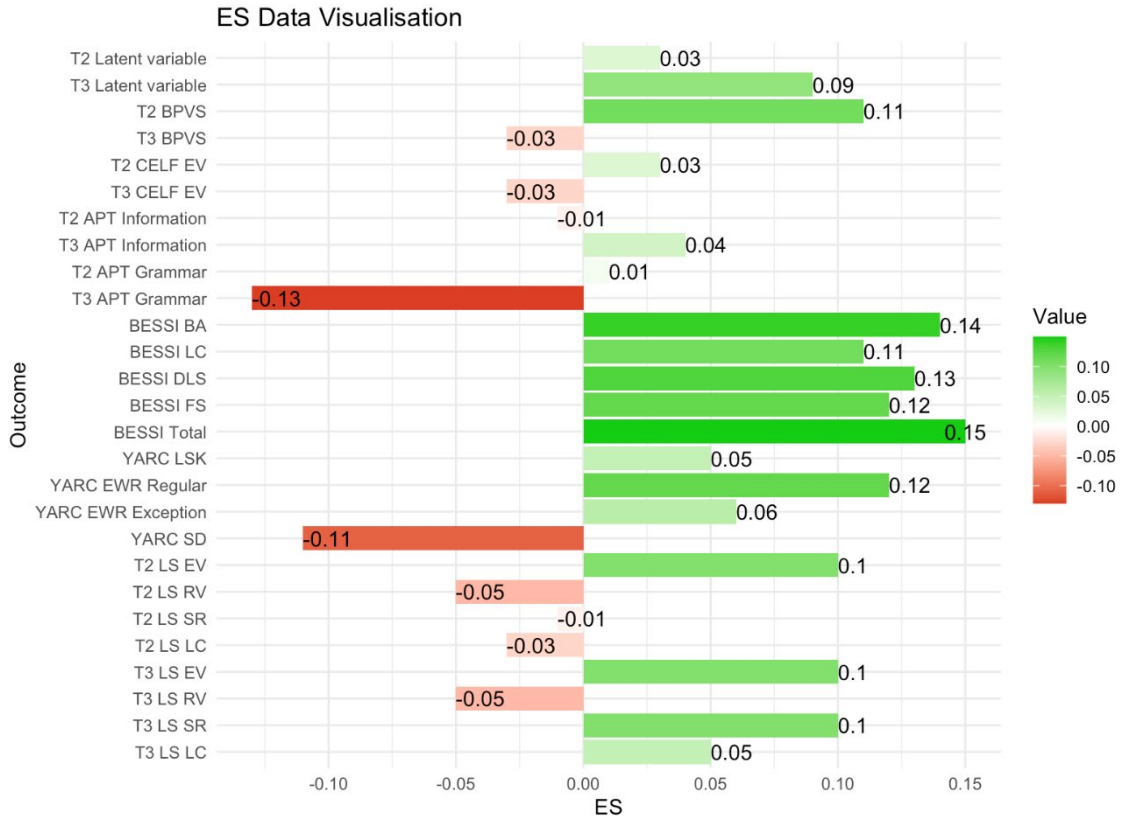

Figure 3. Bar plot of effect sizes showing impact of PACT on outcome measures

Table 16. Secondary outcome analysis for delayed post-test measures

	Unadjusted means				Effect size		
	Intervention group		Control group				
Outcome	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	Total n (intervention; control)	Hedges g (95% CI)	p-value
T3 LS Latent Variable	185 (20)	0.08 (-0.28, 0.43)	185 (17)	-0.08 (-0.50, 0.35)	333 (165; 168)	0.09 (-0.14, 0.33)	0.21
CELF EV	185 (10)	24.06 (23.12, 25.00)	185 (12)	24.39 (23.36, 25.43)	348 (175; 173)	-0.03 (-0.27, 0.22)	0.73
BPVS T3	185 (8)	76.26 (74.23, 78.29)	185 (12)	76.61 (74.48, 78.74)	350 (177; 173)	-0.03 (-0.30, 0.24)	0.70
APT information	185 (10)	27.99 (27.17, 28.82)	185 (12)	27.76 (27.01, 28.50)	348 (175; 173)	0.04 (-0.19, 0.28)	0.69
APT grammar	185 (10)	22.74 (21.88, 23.60)	185 (12)	23.61 (22.79, 24.43)	348 (175; 173)	-0.13 (-0.37, 0.11)	0.20

YARC LSK	185 (11)	14.79 (14.44, 15.15)	185 (12)	14.68 (14.32, 15.04)	347 (174; 173)	0.05 (-0.25, 0.36)	0.59
YARC EWR Regular	185 (10)	9.47 (8.86, 10.09)	185 (12)	9.18 (8.57, 9.79)	348 (175; 173)	0.12 (-0.17, 0.41)	0.17
YARC EWR Exception	185 (10)	2.97 (2.42, 3.51)	185 (12)	2.80 (2.34, 3.37)	348 (175; 173)	0.06 (-0.20, 0.32)	0.58
YARC SD	185 (12)	4.44 (4.04, 4.84)	185 (13)	4.81 (4.44, 5.17)	345 (173; 172)	-0.11 (-0.35, 0.14)	0.31
LS EV	185 (18)	16.25 (15.74,16.77)	185 (17)	15.96 (15.36, 16.57)	335 (167; 168)	0.10 (-0.15, 0.35)	0.22
LS RV	185 (18)	18.66 (18.20, 19.12)	185 (17)	18.57 (18.15, 18.99)	335 (167; 168)	-0.05 (-0.28, 0.18)	0.66
LS SR	185 (18)	10.3 (9.9, 10.7)	185 (17)	10.21 (9.73, 10.68)	335 (167; 168)	0.10 (-0.15, 0.36)	0.27
LS LC	185 (18)	10.85 (10.39, 11.31)	185 (17)	10.86 (10.33, 11.38)	335 (167; 168)	0.05 (-0.18, 0.28)	0.65

EYPP Sub-group analyses

Immediate post-test analysis (T2)

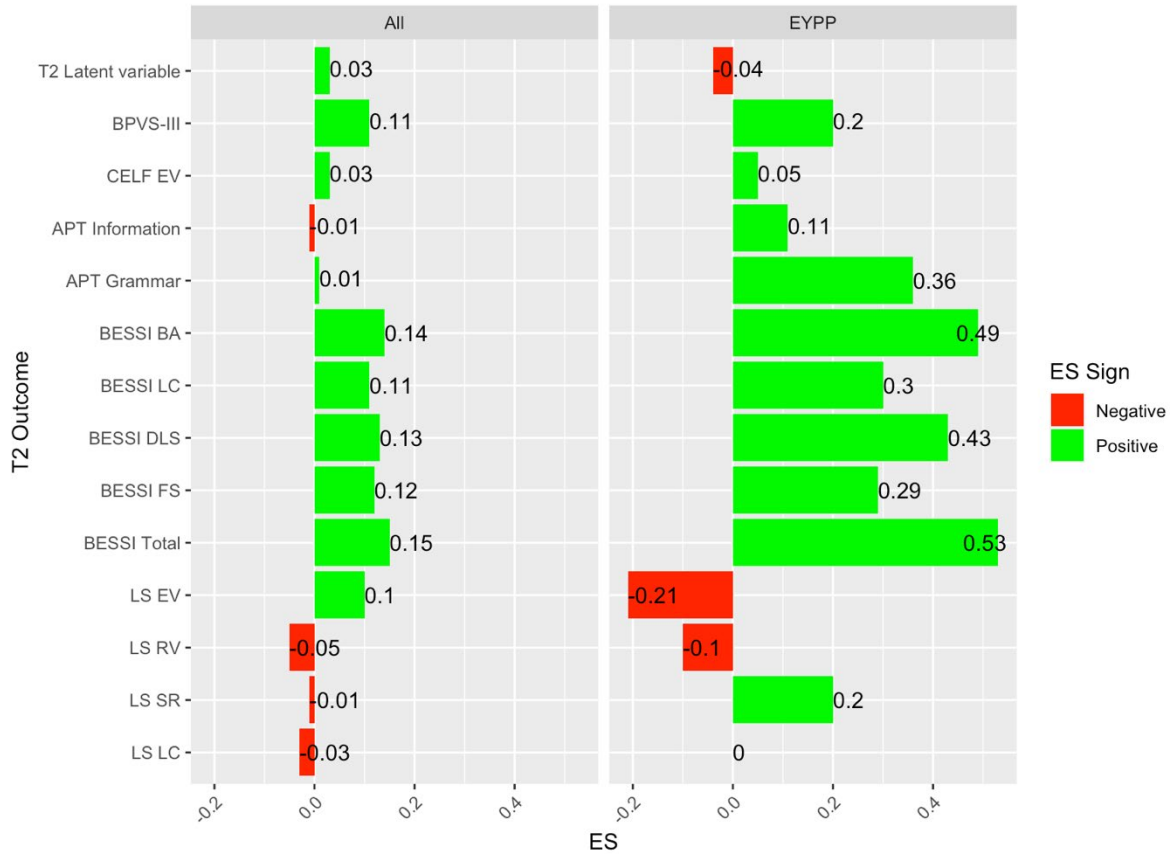

Figure 4. Bar plot of effect size at T2 in the EYPP group vs All children

Exploratory analyses were conducted for all the outcome data[14] with regard to children's Early Years Pupil Premium (EYPP) eligibility ('EYPP children'). Overall, data was available for 71 children who were eligible for EYPP. The results presented here need cautious interpretation as the sample is small and the evaluation was not powered to conduct EYPP-specific subgroup analysis (MDES 0.72). The average primary outcome language latent variable score of EYPP children was -0.43 (2.69) in the intervention group and -1.11 (3.48) for the control group. Effect sizes and confidence intervals are displayed in Appendix G.14 and effect sizes for each measure for the EYPP group compared to all children are visualised in Figure 4.

Compared to the overall results among all children, the primary outcome of the language latent variable effect size was negative in this group (-0.04 vs 0.03 among all children). The effect sizes for the language measures conducted face to face (BPVS, APT information, APT grammar and CELF EV) were positive for this group and larger than for the full sample (ES ranging from 0.05-0.35) However, effect sizes for the LanguageScreen subscales were mixed (ES ranging between -0.27 and 0.20) and inconsistent with the face-to-face measures of similar domains. There is a higher impact in the EYPP group than the full sample on the BESSI outcomes with subscale effect sizes ranging between -0.29 and -0.49 for the EYPP group compared to between -0.11 and -0.14. The BESSI results show a positive effect for the intervention group despite the negative effect size as for this measure, a lower score shows greater school readiness. All effect sizes for this EYPP group at T2 were statistically insignificant.

[14] HLE2 effect sizes are not reported for the EYPP subgroup as the statistical model didn't converge for these outcomes.

Delayed post-test analysis (T3)

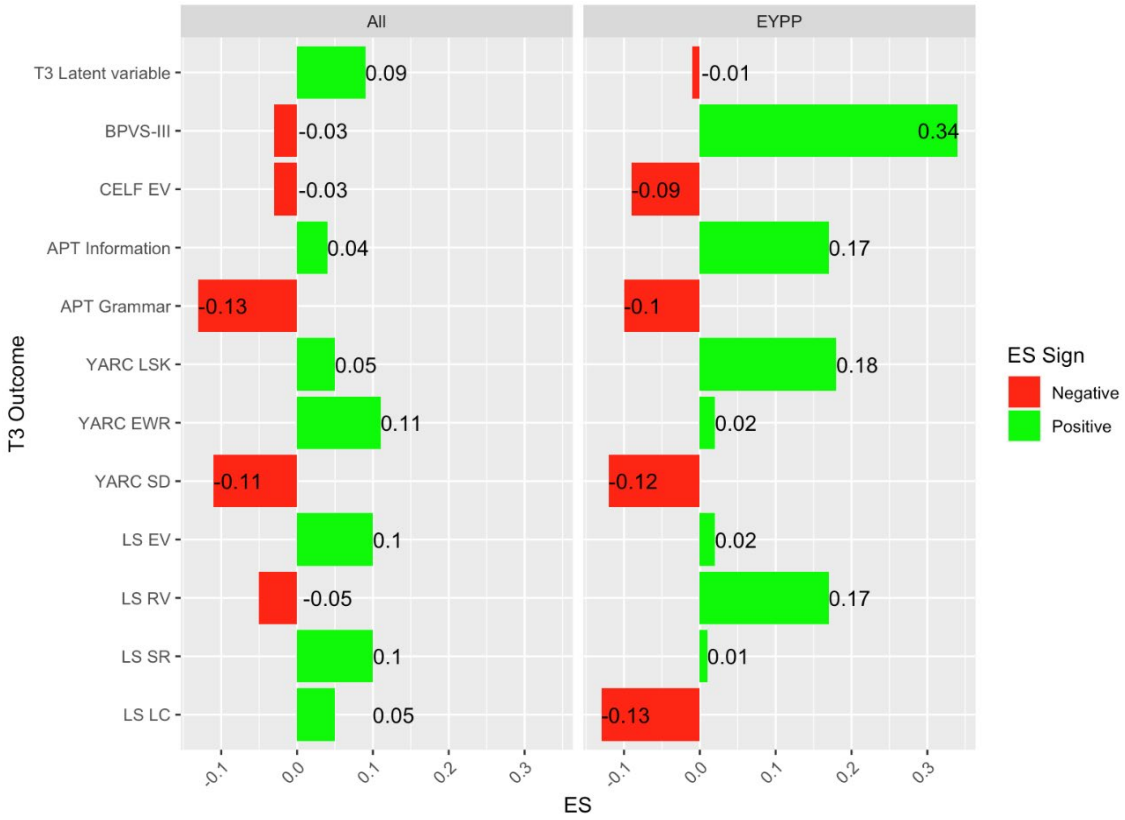

Figure 5. Bar plot of effect size at T3 in the EYPP group vs All children

At the delayed post-test (T3), EYPP data was available for 71 children. The unadjusted means of the T3 latent language variable score of EYPP children was -0.26 (-1.20, 0.67) in the intervention group and -0.47 (-1.48, 0.54) in the control group. Effect sizes and confidence intervals are displayed in Appendix G.14 and effect sizes for each measure for the EYPP group compared to all children are visualized in Figure 5 above.

Compared to the overall results among all children, the T3 language latent variable effect size was negative in this EYPP group (-0.01 vs 0.09 among all children), seeFigure 5. The effect sizes for BPVS, APT information, YARC LSK, and LS RV were notably positive in the EYPP group, surpassing those observed in the overall results among all children, with effect sizes ranging from 0.17 to 0.34. Particularly, the effect sizes for BPVS and LS RV scores were negative in the overall sample, yet they were positive in the EYPP sample, indicating a substantial and positive impact of the intervention on the receptive vocabulary of EYPP children. Conversely, in the CELF EV, APT Grammar, YARC SD, and LS LC language tests, the effect sizes in the EYPP sample were negative. This is especially noteworthy in the case of LS LC, where the effect size was positive in the overall sample but negative in the EYPP sample. Other secondary outcomes, such as LS sub-items (EV at 0.02 and SR at 0.01) and YARC sub-items (EWR at 0.02 and Total at 0.01), demonstrated positive but negligible effect sizes in the EYPP group. All effect sizes for this EYPP group at T3 were statistically insignificant.

Analysis in the presence of non-compliance

Immediate post-test analysis (T2)

The Complier Average Causal Effect (CACE) analysis was performed as a sensitivity analysis to assess the relationship between outcome and adherence to the intervention immediately after the intervention. The CACE analysis results reported in Appendix Table G.2 indicate that there was a positive association between effect size and compliance level, that is, the effect size would be higher with increased compliance. For instance, compared with overall effect size of 0.03 (-0.23, 0.28), the effect size adjusted for 60% compliance was 0.04, and for 80% compliance it would be 0.05. However, even at the highest level of compliance the effect size was 0.06 and therefore low in terms of impact.

Delayed post-test analysis (T3)
The relationship between effect size and compliance level at delayed post-test (T3) was more positively correlated. For participants with greater than 0% compliance, the effect size was 0.11 (-0.05, 0.26). As the compliance level increased, the effect size slightly increased, indicating a trend that suggests a more positive effect of the intervention among those who were more compliant. At the highest compliance level (P > 90), the effect size was substantially higher at 0.33 (-0.15, 0.84) (see Appendix G). This indicates a stronger effect among the most compliant individuals.

When comparing these findings to the overall effect size of 0.09 (-0.14, 0.33), it becomes evident that 11 months after the programme, the intervention's impact is not uniform across all participants. Instead, it appears to be more pronounced and potentially more beneficial for those who adhere more closely to the intervention protocol. This highlights the importance of considering participant compliance in evaluating the effectiveness of interventions, as the overall effect size may underestimate the impact for those who are most compliant. However, it is crucial to note that all confidence intervals contained zero, suggesting that the observed effect sizes, while indicative of a potential pattern, were statistically insignificant.

Additional analyses and robustness checks

Stratification analysis
Additional analyses were carried out to assess whether the effect size estimate would vary by inclusion of the ‘pre-test completeness’ stratification variable and the results remained largely the same, with minor differences on the range for confidence intervals. Overall, no noticeable differences were observed in both the immediate and delayed post-tests (T2 and T3), as detailed in Appendix D (full sample) and Appendix G.14 (EYPP subgroup).

Additional-intervention analysis
At the delayed post-test (T3), additional analyses were conducted to assess whether a child receiving an additional language intervention in reception after completion of the intervention, would exhibit different effect sizes. Examining effect sizes across all children, the results remained consistent with our secondary outcome analysis, demonstrating only small variations within the confidence interval ranges. This suggests that our initial findings are robust and that additional language intervention during reception did not unduly influence the findings (see Appendix G.15, tables 20 and 21).

Contamination sensitivity analysis
At the immediate post-test analysis (T2), the overall effect size in the contamination analysis was marginally smaller at 0.01 (-0.25, 0.27), compared to our primary finding of 0.03. The effect sizes for other secondary measures at T2 were similar with our original analysis, indicating that this contamination was unlikely to have influenced the study’s outcomes. However, for LanguageScreen sub-item SR measure, the effect size in the contamination analysis was 0.08 (-0.20, 0.36), larger than the original finding (0.08 vs -0.01). In contrast, among EYPP children, significant differences were observed between our original findings and this contamination, suggesting that this contamination may have had an impact on the outcomes for this group but the sample size here is too small to draw conclusions (see Appendix G.15, Tables 22 and 23).

At the delayed post-test analysis (T3), the overall effect size in the contamination analysis remained consistent with our original finding at 0.09. Similar congruence was observed for other secondary measures at T3, suggesting a negligible effect of contamination on these outcomes. In addition, among EYPP children, the results were similar with our original findings, but for LanguageScreen sub-item SR measure again, the effect size in the contamination analysis was 0.07 (-0.47, 0.61), larger than our original finding (0.07 vs 0.01), suggesting that this contamination may have had an impact on this measure (see Appendix G.15, Tables 24-25).

Age adjustment analysis
At the immediate post-test (T2), the inclusion of the age variable in MLM did not influence the overall effect size, which remained consistent with our original finding of 0.03 (-0.23, 0.28). Similarly, for the secondary measures at T2, the effect sizes were consistent with our original outcomes, displaying only slight variations within the confidence intervals. In addition, the interaction term's coefficient in the MLM for the overall effect was -0.04 (-0.14, 0.06), implying a reduction in the PACT intervention's impact as age increases. However, all confidence intervals contained zero, indicating that these observed trends were not statistically significant (see Appendix G.15, Tables 27-28). Among EYPP children, no

evident difference was observed, as shown in Appendix G.15 (Table 31). This indicates that while age may play a role in how children respond to the intervention, the variations observed do not statistically substantiate a significant age-related effect.

Sex adjustment analysis
At the immediate post-test (T2), the overall effect size aligned with our initial discovery, recorded at 0.03 (-0.23, 0.28). Additionally, for both the full sample and EYPP (Early Years Pupil Premium) children, there was no noticeable variation in the effect sizes of the secondary measures, as detailed in Appendix G.15 (Table 29 for the full sample and Table 32 for EYPP children).

Missing data handling

Immediate post-test analysis (T2)
We used confirmatory factor analysis (CFA) model to construct the latent variables. All these computations were performed using a statistical software MPlus, this tool essentially uses the Full Information Maximum Likelihood (FIML) estimation where data are missing for some of the items included for construction of latent variables. Further details about the methods and procedure are discussed in Johnson and Young (2011). In this dataset, there are 31 missing values out of 370 in the immediate post-test latent variable.

The use of the full information maximum likelihood estimation (method in MPlus) implies that any missing values in the dependent variable can be effectively ignored as missingness implying an unbalanced data structure, which, statistically, poses no problems for a multilevel model; this again follows the Missing At Random (MAR) assumption conditional on the covariates included in the model. The advantage of FIML estimation as an unbiased and more efficient method than others has also been reported by other researchers (Enders and Bandalos, 2001).

Both the pre-test and post-test variables used the FIML estimator at the CFA stage, which implicitly assumed that the missingness mechanism can be characterized as MAR. The analysis of effect size was then performed on the constructed primary outcome post-test language latent variable implying an unbalanced data structure using MLM that still follows the MAR assumption conditional on the covariates included in the model, therefore, statistically it causes no problem to influence the model. Johnson and Young (2011) and Enders and Bandalos (2001) showed that FIML is superior, more efficient than other estimation methods, and provides unbiased estimates. Therefore, no further multiple imputation of data was performed.

Delayed post-test analysis (T3)
Similarly, we applied CFA model for the construction of the latent variable at delayed post-test. In the data set, there are 37 missing data points in the T3 latent variable.

Implementation and process evaluation results

Fidelity/Adherence: To what extent was the PACT programme delivered as intended? (IPE:RQ1)

In this section, the extent to which the PACT programme was delivered as intended at the different stages of the programme is considered. Consideration of the training that was delivered to nursery staff and parents is explored initially. We then consider the delivery of the PACT programme sessions, including the number and frequency of sessions completed, the activities completed within a session, and the extent to which adaptations were made in the delivery of the programme. We also discuss the level and type of support provided by the nursery to families across the programme. Throughout this section we discuss barriers and facilitators as relevant and the extent to which adaptations were made to the delivery.

PACT Lead Training

To look at the extent to which PACT Lead training was delivered with fidelity, we used administrative records provided by the delivery team, observation data of the two PACT Lead Training sessions, and data collected from the post-training surveys. Perceptions of the training were also gathered from the first round of PACT Lead interviews.

As planned, two 4-hour sessions of the online PACT Lead training were delivered in May 2021. These sessions were attended by at least one member of staff from all settings recruited at that time (including 38/43 settings in the final sample) (see appendix G.8). Where settings were recruited after the PACT Lead online training (5 settings), these settings had an adapted training delivery, where they viewed the video recording of the training and had a follow-up call with the developer research team to check understanding and answer school queries.

The online PACT Lead training sessions were delivered by two members of the developer team who had previously delivered the PACT Lead training face-to-face in the PACT-2 trial. Both four-hour training sessions were observed, and it was found that training was delivered with consistency to the plan in both sessions and differed in the content only when participants posed questions. The delivery of the session alternated between the two presenters with one of them leading a section while the other supported the online chat answering questions from participants arising during the training which facilitated the session well. The use of breakout rooms for discussion of project concerns between participants was used well by assigning nursery staff who had taken part in PACT-2 to each breakout room to help answer questions from the novice PACT Leads. Findings from the observations concluded that the PACT Lead training sessions were delivered as intended in the PACT logic model.

The PACT Leads should have received a copy of a PACT pack to refer to during the session in advance of attending the training. However, the post-training survey indicated that two PACT Leads had not received this in advance.

Post-training survey responses from those respondents that remained in the trial (39 PACT Leads from 38 settings), indicated that the majority of those attending the PACT Lead training (and therefore taking on the PACT Lead role), were experienced teachers who had on average 16 years of classroom experience (ranging from 3-32 years) and who worked in the early years with nursery classes or reception classes or across the Early Years Foundation Stage.

Following the PACT Lead training, most PACT Leads felt ‘very’ or ‘fairly’ confident to support parents with PACT and complete the required PACT administration. Participants were happy with the way the new online training had been delivered. The majority (n=29, 74.4%) of participants felt that the length of training was *“about right”*, while around a quarter of participants (n=9, 23.1%) reported the training was “*too long”* – further feedback through survey responses indicated that some participants would have preferred a break during the session to help process the information. Almost all participants (n=37, 94.9%) felt the pace of the training was about right and that there were enough opportunities for interaction (n=36, 92.3%). All participants felt that the content of the training was *useful* or *very useful* in relation to the information about the programme, parent training and support and the evaluation with only one participant finding the training about recruiting families to PACT ‘not very useful’. See appendix G.8 for more detailed results tables of survey responses.

Only 3 PACT Leads reported having any difficulties with the PACT Lead online training sessions (one with registering, one with accessing and one with technical difficulties during the session).

PACT Leads praised the training as a very useful and positive experience describing the session as enjoyable, informative, and providing the opportunity for them to ask questions. These features came through in the PACT Lead training survey responses and in PACT Lead interviews:

> *"Brilliant training that has probably been one of the best I've ever attended on Zoom"*
> (PACT Lead training survey)

> *"The training prepared you as much as you possibly can without actually doing it yourself"*
> (1st PACT Lead interview)

Although participants felt that the online training was a compromise caused by COVID restrictions and would have preferred to be face-to-face, the online session was seen as effective at conveying the same information (by those who had previously also attended the face-to-face sessions) with the benefit of less travel time.

Interviews with PACT Leads that had taken part in the PACT-2 PACT Lead training previously, felt it was still useful to attend this session and they regarded it as a refresher for the previous training sometimes picking up on different aspects to the first time around.

Parent training

To look at the extent to which parent/carer training was delivered as intended, and attended by parents and carers, administrative records provided by the delivery team were used as well as observation data from three of training sessions (with different trainers), and information from the developer interview. To look at any barriers and facilitators to delivering and attending the training, Parent and PACT Lead survey data was used as well as PACT Lead and Parent interview data.

The training registers kept by the delivery team indicated that parents/carers of almost all children (178/185) in the intervention group received some training to deliver PACT reading programme for their child. For the majority of the sample, (n=145), parents attended a live online session delivered by the developer team as described in the programme model. Where parents were unable to attend a live online session, they were sent a pre-recorded video of the training session to watch in their own time and the PACT Lead followed up with the parents after this. Of the forty families that did not attend the live online session, twenty-nine families reported to their PACT Lead that they had watched the pre-recorded video. Four families were also trained directly by the PACT Lead. The remaining seven participants had been sent the training video, but no confirmation was received that they had engaged with this.

For the live online parent training sessions, three members of the delivery team had planned to run 56 training sessions online between 2nd – 19th November 2021, however some of these were cancelled due to lack of registrations. Each nursery had one session targeted at their families, and extra sessions outside office hours were arranged for anybody who could not attend their targeted session. On average, each session was attended by 2.5 parents. The developer team reported finding it difficult to follow up with families that did not attend the online training as they were relying on PACT Leads to communicate with families and then report back to them. While 29 participants reported watching the video, the web analytics indicated that only three or four families watched the full video, but it was not possible to determine who these people were. It therefore seems likely that for the 29 participants trained via the video, most did not access the full training session. In terms of why participants didn't attend the online sessions, PACT Leads reported during their interviews that the timings for the online sessions didn't always fit into family life for some families. An interview with a parent who was trained by watching the video in their own time, found the training video easy to follow and was aware that their PACT Lead could answer questions and provide further help after watching the video.

Three parent training sessions – each delivered by a different developer team member – were observed by a member of the evaluation team. The content of the training did not change between the sessions. While two of the sessions lasted for an hour and 20 minutes, the third one was nearly two hours due to technical setbacks with a participant trying to join the call requiring a delay and the need for the trainer to provide technical support plus a recap of the early part of

the session to catch the participant up. Otherwise, the three training sessions had the same content, which was: Introduction to PACT programme principles, Reading the story, Vocabulary, Storytelling, Reward, Recap, Recording the process. Similar parent questions from across sessions were responded to in a similarly by different trainers.

Following training, the majority of parents/carers responded in the post-intervention survey, that they were "*very confident"* (74, 63.2%) or "*somewhat confident"* (n=41, 35%) to do PACT with their child (n=117)[15].

In the parent interviews, the dominant view of the parent training was positive. Parents were excited about starting the programme following the training and most parents had not needed to pose any questions in the training. However, a few parents thought the training did not teach them anything they didn't already know, and one parent thought the training was too long.

Although the parental training overall went as planned, the developers acknowledged (in the developer interview) some disadvantages of using the online training model for parents. They felt it was more difficult when they were not able to physically meet parents in their setting and have the PACT Lead there to support and answer questions face-to-face. During the online sessions they also found it sometimes difficult to tell parents whether parents were engaging with the sessions due to parents not having their cameras on.

> *"Often if one or two parents chose not to have their screens on halfway through none of the parents would have their screens on. At which point you do kind of feel like you are just speaking to an empty room."*
>
> *(Developer interview)*

The online delivery was also felt to be more intensive in terms of the administration side (setting up online meetings and sending out links, monitoring response and attendance and dealing with technical issues).

PACT Sessions delivered by parents across the 30-week programme (Dosage)

We now look at the extent to which families delivered the full programme of 150 teaching sessions across the 30-week programme using data families were providing while they were completing the programme through the PACTapp and the record forms. We also look at whether there are any differences for disadvantaged subgroups within our sample in terms of delivery. Finally, we use a parent post-intervention survey question which asks parents/carers to indicate which of the PACT weeks they had completed, to investigate the accuracy of the PACT app records.

Phone app/paper records were available for 152/186 participants (Table 17). The average number of PACT sessions completed by participants is 98.1 (out of a maximum 150; SD 48.6) while the average number of weeks where participants completed at least some PACT activity was 20.0 weeks (out of the maximum of 30 weeks; SD 9.6). Thus, the records suggest that families completed around 65-66% of the programme which is similar to that in the previous two PACT trials (PACT-1, on average, participants completed 17.48 weeks or 58.3% of the whole programme, Burgoyne et al. 2018b while in PACT-2 this figure was 18.71 weeks or 62.4%, Menzies et al. 2022).

Table 17. Sessions from the phone app and paper records per each pack.

PACT Pack Number	% of possible PACT sessions completed (n=3800)	% of intervention group participants engaging with any sessions in pack (n=152)	Mean number of sessions completed per pack (out of 25) (n=152)	Mean number of sessions completed per pack for those that completed at least one session in that pack (out of 25)
1	94% (3558/3800)	99% (151/152)	23.4	23.6 (n=151)
2	80% (3044/3800)	87% (132/152)	20.0	23.1 (n=132)
3	68% (2596/3800)	74% (113/152)	17.1	23.0 (n=113)
4	64% (2413/3800)	68% (103/152)	15.9	23.4 (n=103)
5	50% (1909/3800)	56% (85/152)	12.6	22.5 (n=85)
6	36% (1385/3800)	43% (65/152)	9.1 (1385/152)	21.3 (n=65)

[15] Two participants responded that they hadn't been trained in doing PACT.

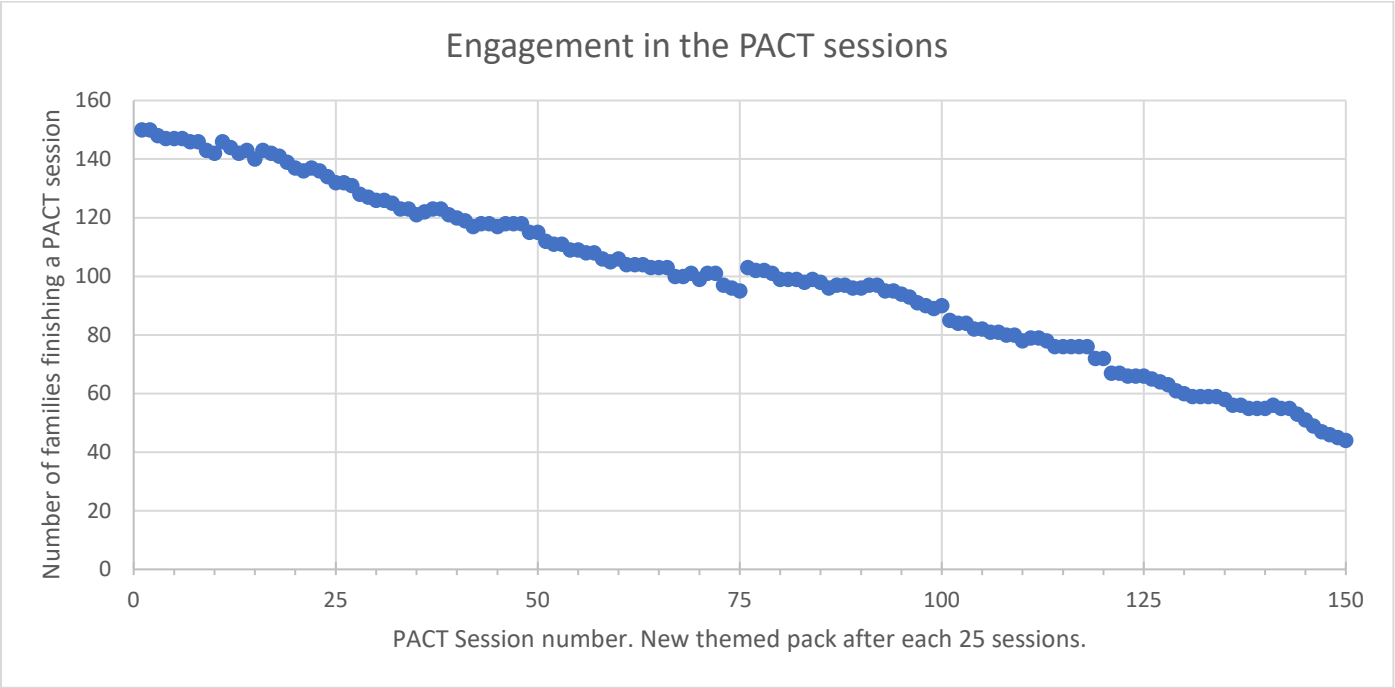

Figure 6. Number of families who finished each of the 150 PACT sessions based on the Phone app/paper records. A new pack with books sharing a theme was given after every 25 sessions. Over time the number of engaged families dropped from 150 to 44.

Figure 6 above shows how engagement across the programme diminished steadily during the intervention period showing the number of families that reported doing each of the 150 PACT sessions. Ten percent of participants dropped out after each themed PACT pack. Table 17 also shows that for each pack the percentage of sessions completed by participants declines with an average of 9.1 out of a possible 25 sessions being completed for the final pack. The engagement of the families who continued with the programme throughout, stayed steady around 23 sessions per pack. The average number of sessions per week for those families that were still engaged on that week was 4.90 (max 5.0, SD 0.50).

PACT Leads were asked about how families engaged with PACT in the PACT Lead post-intervention survey and their responses seem to agree with this decrease in engagement with PACT throughout delivery (Table 18 below). Just under half of PACT Leads reported that most families engaged well throughout the project although more than a third reported families engaging well at the beginning but reducing over time. Explanations from the PACT Leads for this reduction in engagement over time included families with multiple children and those who were working full-time finding it difficult to find time to do PACT. PACT Leads reported that some families continued reading the books but did not do all the activities. PACT Leads also commented that families fell behind on recording their sessions.

Table 18. PACT Lead post intervention survey: "In general, how have families engaged with the PACT activities?" (n=38).

	n	%
Most families have engaged well throughout the project.	18	47.4%
Most families engaged well at the beginning of the project but reduced engagement over time.	14	36.8%
Most families engaged less well at the beginning of the project but have increased their engagement over time.	1	2.6%
Most families have not engaged well with PACT activities throughout the project.	3	7.9%
None of the above. Please describe below.	2	5.3%

In the parent post-intervention survey more than half of parents (62/117 or 53%) said they had stopped doing PACT at some point. The most common responses given were temporarily stopping doing PACT because of health issues or breaking the family routine for holidays. Other less common reasons given by parents for stopping were not having had time, child behaviour issues, or family events having caused a temporary break in engaging with the programme. These same themes were also found in the analysis of the parent interview data:

> *"I had Covid so I was isolating from my daughter, for six days. She then got COVID anyway. So we did not do PACT for about eight days then."*
>
> (1st Parent interview)

> *"We missed a couple of weeks around Easter because [grandson] went away on holiday, had holidays."*
>
> (2nd Parent interview)

PACT Leads were asked in the post intervention survey if any of their families completely stopped engaging in the programme. Twelve PACT Leads (out of 38 respondents) reported that in total 18 families had stopped engaging with PACT and did not want to receive further new packs. PACT Leads reported in the survey that the main reason families gave for completely stopping doing PACT was the lack of time to do the programme. PACT Leads elaborated in the interviews on the reasons that some families didn't have time for the project including both parents working and difficult circumstances at home. One parent who stopped doing PACT also explained in the post-intervention parent survey that they could not find time to fit PACT in the family routine with two parents working fulltime and the child attending childcare.

> *"She was working, her husband was working. She had grandparents looking after the boy in question and his siblings. I said, "Well, if they know how to deliver it, grandad or grandma could…" She went, "Oh, no, no, no. It is enough for them to make them tea and they are finding it too difficult."*
>
> (PACT Lead, 2nd interview)

> *"We did some of the first week and could not continue. We are 2 full time working parents, kids spend most of their time at school unfortunately and by the time they get back, there's only enough time for tea, bath and bed, because unfortunately they are up at 5:30 am earliest, 6:45 am latest during the week to be in the car whilst one of us is being dropped off at work. Haven't been able to manage time to do the basic reading, spellings, homework etc so PACT on top of it, whilst it's a great idea in theory has been of no use to us. Most of their reading has been done very kindly with the breakfast and after school club teams."*
>
> (Post intervention parent survey)

In the PACT Lead interviews, some PACT Leads reported that some parents who didn't engage with PACT, had been reluctant from the beginning and showed little engagement in training or in providing feedback to the PACT Lead. One PACT Lead speculated that these parents had only signed up to the project to please the teacher.

Delivery of teaching sessions across the programme for EYPP and EAL subgroups

We investigated whether the number of PACT sessions completed by the subgroup of participants who were eligible for EYPP (used in the study as a proxy for disadvantage), differed from the number of sessions completed by those not eligible for EYPP. EYPP-eligible participants completed less of the PACT programme than those not eligible for EYPP and completed fewer weeks of any PACT activity (see Table 19).

We also looked at whether the number of PACT sessions delivered by the subgroup who self-reported that English was not the main language spoken at home, differed from those for whom English was the main language at home. There was very little difference in the number of PACT sessions delivered by this subgroup, although the mean number of sessions for the English not being the main language at home was slightly higher, showing greater engagement with PACT for the non-English language households (see Table 19).

Table 19. Average PACT dosage for EYPP and English not main language at home subgroups compared to the rest of the sample.

Subgroup analyses		Intervention group n (%)	Mean number of PACT sessions completed	Number of weeks completing at least one PACT session
EYPP	Eligible	34/185 (18%)	84.6 (SD 46.6)	17.1 (SD 9.2)
	Non-eligible	148/185 (80%	101.0 (SD 48.7)	20.6 (SD 9.6)
	Missing or permission not given	3/185 (2%)	-	-
EAL	English **not** main language at home	29/185 (16%)	100.7 (SD 49.6)	20.5 (SD 9.9)
	English **as** main language spoken at home	154/185 (83%)	97.6 (SD 48.8)	19.9 (SD 9.6)
	Missing	2/185 (1%)	-	-

Accuracy of PACT App/Record form data

Parents/carers were asked in the post-intervention survey which PACT weeks they had completed with their child (using the list of books for each week). We noted that some families reported completing more of PACT in their surveys than they had reported through the PACTApp/Record forms data. Also, parent interviews and surveys indicated that some parents had technical issues with using the App for recording their sessions while others reported forgetting to record sessions on the App. We therefore compared this data to the PACTApp/Record form data described above for participants where both data were available. Our process for doing this is detailed in appendix G.9. The analysis indicates that using the PACTApp/Record form data may be underestimating the total dosage by a small amount but that it is unlikely to make significant difference to any conclusions.

Quality and fidelity of content delivery during sessions across the programme

This section looks at the delivery and the quality of the sessions delivered during the project. To do this, data from the parent post-intervention survey questions about delivery of the programme is triangulated with data from the parent and PACT Lead interviews.

Parents reported in the post-intervention survey that the length of a typical PACT session was on average 22.0 minutes (SD 9.7, n=116), very close to the 20 minutes sessions specified by the PACT programme. Parents also reported spending additional 5.2 minutes on average (SD 4.0, n=111) preparing for the session and completing a mean of 4.1 sessions per week (SD 1.3, n=115[16]) (out of the provided five sessions)).

Parents were asked in the post-intervention survey how often they did all the activities described in the PACT session. Over 80% (n=117) responded, they did all the activities either all (29.1%) or most (53.0%) of the time with 12% responding that the did all of the activities some of the time and 5.1% occasionally and less than 1% never doing all the

[16] One outlier removed for being more than 3SDs from the mean

activities. Parent interview data also supported this data with parents generally describing that they did all the specified activities in each session.

Adaptations made to PACT delivery in the home

Parents were asked in the post intervention survey, if they made any changes to how they did the PACT programme with their child. While most parents/carers (74/116 or 63.8%) stated that they did not make any changes, changes were made by more than 36.2% (42/116) of the respondents. The most common adaptations made were skipping activities when the child was no longer interested and completing more than one session in a day to keep up with the programme. The parent post intervention survey asked about how often parents were delivering more than one session in a day. Around half of respondents reported occasionally doing more than one session in a day, while an additional 20% of respondents reported doing this regularly see Table 20. Other less frequently reported adaptations made to delivery of the PACT programme were re-reading the week's story book less frequently than specified, often due to their child's lack of interest, and skipping the fifth day session of some weeks and the fifth week bringing it together sessions when the activities were more of a review of the book or theme.

> *"Even where I have marked in the app that we didn't complete the "PACT session", we have always made sure that we have read the books and talked about bringing some of the key things together. […] I know that there were often some instances of "bringing it together" that we didn't spend a lot of time on because my daughter was no longer engaged after 5 days of doing the same story/similar activities."*
>
> (Post-intervention Parent survey)

Table 20. Post intervention parent survey: "How often did you do more than one PACT session in a day?" (n=117).

	#	%
Regularly	24	20.5%
Occasionally	59	50.4%
Never	34	29.1%

In the parent interviews, most parents described sticking to the specified PACT format. A small number of parents described that they changed the structure of the sessions or the structure of the five-week packs. One family split their PACT session into two by combining a bedtime story session with afternoon session of activities the following day:

> *"So the stories we read at night before bed. And then when she comes home from nursery, we do the activities. […] It sounds a bit backwards, but we have the book with us, but she likes to settle down and read at night. […] So for us, she can read the story at night and then in the day when she comes home from nursery, we ask, you know, "Do you remember the book?" And we do a quick recap over it. And then do the activities in the afternoons."*
>
> (1st Parent interview)

Another parent described delaying the recap sessions on the fifth week and bringing those activities in when they had already started a new pack. She wanted to keep her child engaged and also to test how much the child remembered from the earlier books.

> *"The only thing I think I've done differently than planned is, you know the last week of each pack, which is your recap week? […] So we do the weeks one to four, the books, and then you should do week five, which is obviously your recap of the four books, etc. But I don't do that then, I'll start the next box, and do the books in there. And then do the recap of the previous box. […] Because I just think it's leaving a gap and just seeing if she's taken it in because there's been a gap. And we've had new books thrown in the mix. And then, like I say, we go back over them. And she tends to be more interested in it because it's going back to something she's done previously, but not straightaway."*
>
> (2nd Parent interview)

The adaptations made by families to delivering the programme seem small and fairly infrequent and mostly around trying to fit the programme into the family's routine or keeping the child's interest in the PACT programme.

PACT Leads were also asked about whether they had adapted the PACT delivery to suit their nursery. Most PACT Leads (35/38 or 92.1%) did not adapt their delivery from the standard model, but three (7.9%) responded that they did. One of these PACT Leads reported making changes for a couple of families who had speech and language issues,

giving parents permission to share the materials at the child's level and to provide more modelling. The other two reported giving parents the next pack following completion of the previous pack meaning families were on slightly different timescales, and not pushing families who were struggling to complete PACT, to continue in the programme.

Barriers to delivery of PACT by parents

In this section the difficulties that were faced by parents and children in delivering PACT are explored. This section draws on data from questions in the post intervention surveys completed by parents and PACT Leads, as well as the interviews with parents and PACT Leads.

Parent were asked in the post intervention survey, whether they had experienced issues whilst doing PACT (Figure 7). In this question, the list of issues that parents could choose from were those that had been raised in the PACT-2 trial or were linked to the logic model. The biggest issue, reported by around three quarters of respondents, was finding the time to do PACT; trying to fit the five sessions into a week was reported as a frequent issue for a quarter of respondents. This is in line with the adaptations families made described above, for example, skipping the fifth session in a week or doing multiple sessions in one day.

Parents occasionally had issues with their child's interest in the book, their child's concentration on PACT activities and their child not wanting to do PACT (35-48% of the respondents reported these as occasional issues) although it was rare that these were more frequent issues. The difficulty level of the PACT activities was also reported as a mainly occasional issue for parents; 32% of respondents felt the activities being too easy for their child was an occasional issue while 15% found this a frequent issue. A smaller percentage of the sample (15%) occasionally or frequently found that the PACT activities were too difficult for their child. Parent confidence to do PACT was reported by the majority of parents as not being an issue.

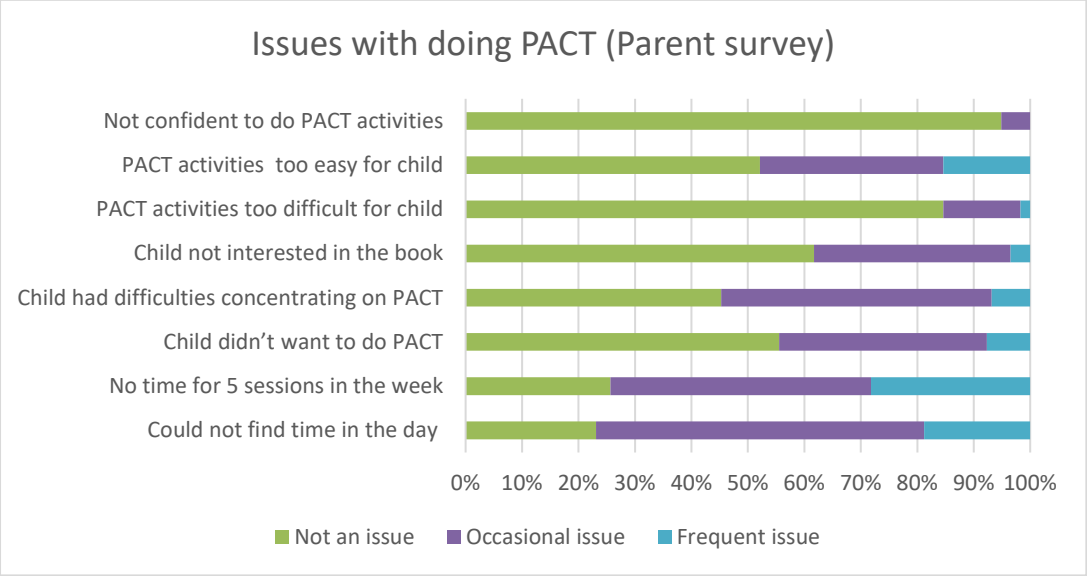

Figure 7. Post-intervention parent survey: "Did you experience any of the following issues with doing PACT?" (n=117)

Forty-three parents responded in the post intervention survey about other difficulties they had in doing PACT. Most responses related to child behaviour and the books becoming too familiar with repeated reading: *"My child struggles to stay interactive for long periods of times and struggles with concentration unless he really enjoys the book."*

Also lack of time was again raised as an issue for many parents: *"Our daughter attends nursery 4 days a week and is often collected by grandparents so fitting in 5 sessions a week was tricky, but we have really enjoyed the sessions we have completed!"*

In the interviews parents were also asked about any difficulties or barriers they face in doing PACT. The dominant view of interviewees was that PACT was not difficult to do but that the main obstacle was finding time to do it.

> *"No. I haven't [found anything difficult about doing PACT], but this might not go into this question. But I have spoken to a few of the other mums that are doing it, and I think- I'm on a career break at the minute, I go back to work in April. And for the people that are working, if you speak to them, I think they're finding it difficult to find the time."*

(1st Parent interview)

Parents/carers who were in full time work found that their children were tired after a full day at the nursery making doing PACT difficult. In some families where there were multiple children, the child and their siblings had activities during the week that took some of the available time in the evening, or the parent found it difficult to just have time with the PACT child.

> *"I think just the help and support that I probably need is just time really and somebody watching the other children, not really with the actual PACT itself. It's more with having time to sit down with her."*
>
> (2nd Parent interview)

> *"I don't think it's the actual programme or any of the books, I think it's more of her mood, how she's feeling, if she's tired after school or something."*
>
> (1st Parent interview)

PACT Leads also described some of the difficulties that families had in doing PACT in their interviews. They also cited parents working and struggling to fit PACT in and well as describing illnesses affecting PACT delivery, and family events like divorces and house moves making things more difficult. A small number of PACT Leads also reported that parents struggled with getting their child to concentrate on PACT materials at home even when the child is able to concentrate on similar activities in nursery.

Fidelity of PACT materials

PACT materials were distributed by the developer team to nurseries to hand out to parents. Feedback from the developer team and from PACT Leads who were interviewed, indicated that this process worked well and that nurseries received the packs and distributed them to families as they needed them.

However, some occasional issues were reported during the project with the physical quality of the PACT materials. Some PACT Leads reported that packs were sometimes damaged when they received them and that they needed to retape the boxes or provide additional bags to store the materials. The developer team had received similar feedback about the materials which they raised during the developer interview. Two families reported during the parent interviews that they had not had the correct content in their packs for the delivery of the programme. This included a report of a family not receiving all the books in a pack, and a family receiving the same book in a different pack. As only a subsample of participants was interviewed, it is possible that other families also had some issues with the material but had not reported this to the team.

> *"I think it was the 'Bear Hunt' actually because that was in the first box, and then it was in the second box as well. We had already done loads of stuff with it. But because it had been repeated, we had to keep doing it. But by that point he was bored of that book. […] Yes, we had 'Bear Hunt' twice."*
>
> (2nd Parent interview)

The PACT Lead interviews revealed that most PACT Leads felt that the resources provided for PACT were really good resources and of a high quality.

Provision of support for families

This section explores the fidelity of the nursery staff to engaging with the PACT Lead role and delivering support for families during the project. Data for this section is provided by the PACT Lead post-intervention survey and interviews triangulated with the parent post-intervention survey and interviews.

PACT Leads reported on the type of support they provided to PACT parents in phases, during the first five weeks and after the first five weeks of the programme in the post-intervention PACT Lead survey selecting from a fixed list of support options (see Table 21). All PACT Leads reported checking in with parents about PACT at pick up and/or drop off times at nursery in the first five weeks in the programme, and most PACT Leads reported continuing to offer this support after the first five weeks (92%). The most common other support offered by settings was supporting individual families which was reported by around a third of PACT Leads throughout the programme. Around a third of PACT Leads also offered support to families with completing their record forms or using the PACTApp to record their progress. In the first five weeks, around a quarter of PACT Leads supported families by celebrating successes with PACT and this

increased to 31.6% of PACT Leads beyond the first five weeks. Other strategies were offered by a smaller number of settings (see Table 21). Around 10% of nurseries reported that no support was needed during the first five weeks of PACT. Other than providing training to families at the beginning of the programme, the type of support offered by settings did not change much from early in the programme to later in the programme.

Table 21. PACT Lead post-intervention survey: "What- if any- support did you offer families doing PACT during the first 5 weeks of delivery (first PACT pack before Christmas)?" (n=37) and "What – if any- support have you offered families doing PACT after the first 5 weeks of delivery (PACT packs 2-6 after Christmas)?" (n=38)

	Number of nurseries using each method (% nurseries using each method)	
Support offered to PACT parents	First five weeks (n=38)	Beyond five weeks (n=38)
Checking in with parents at pick up/drop off	38 (100%)	35 (92.1%)
Working with individual families	14 (36.8%)	12 (31.6%)
Help filling in record forms or App	13 (34.2%)	15 (39.5%)
Troubleshooting issues	10 (26.3%)	9 (23.7%)
Celebrating successes	9 (23.7%)	12 (31.6%)
Training parents who hadn't attended the online training	8 (21.1%)	N/A
Preparing resources for families	7 (18.4%)	7 (18.4%)
Promoting PACT via website/school social media	5 (13.2%)	4 (10.5%)
No support was needed	4 (10.5%)	0 (0.0%)
Modelling the activities	3 (7.9%)	2 (5.3%)
Inviting parents to share ideas and strategies as a group	1 (2.6%)	1 (2.6%)
Other support	1 (2.6%)	1 (2.6%)

PACT Leads described the support they gave to the PACT families in more detail in the PACT Lead interviews. Almost all PACT Leads described checking in on parents and how they were getting on with PACT. However, most PACT Leads also felt that support was not needed by many families. Some PACT Leads described how they felt that parents were reluctant to ask for or accept help from the PACT Leads. A very small number of PACT Leads described the bespoke support that they provided for families in their nurseries, with one describing how she had invited PACT families into the school for a coffee morning and another described photocopying the PACT materials to make them easier to use.

PACT Leads were asked in the post intervention survey about the common issues/questions that parents had during the first five weeks and after the first five weeks of PACT. The most common response was that parents did not have issues. Where multiple PACT Leads reported similar issues, these were issues with finding time for PACT, needing to provide parents with encouragement and reassurance with the programme, needing some support with understanding programme activities and technical issues with using the PACTApp.

Parents/carers were also asked in the post intervention survey about how their nursery helped them with PACT during the year using a fixed list of options. Their responses (see appendix G.10) triangulated with the information the PACT Leads were providing.

The most common support offered to and received by parents was informal support provided by the setting at drop-off/pick up times. In a small number of cases other support that was more personalised to the individual family or circumstances was offered and received by a small number of families. When asked in the post intervention survey, about how appropriate the level of support provided was, the majority of respondents felt that the level of support was *about right* (91.5%; 107/117) while six (5.1%) parents thought there was more support than necessary, and four (3.4%) parents felt there was not enough support. For the parents who felt more support was necessary, two of the three suggested informal check-ins about PACT progress that were commonly offered by nurseries.

The PACT Lead Role

In PACT Lead interviews and surveys, the role of the PACT Lead was explored. PACT Leads felt that their role was important to the programme and that it was necessary to have someone who was the link between the parents and the programme. PACT Leads felt like there were not many challenges to doing this role, although they reported that it was sometimes challenging to get hold of working parents about the programme and that staff absences due to illness made it more difficult to administer to programme. They appreciated the support of the delivery team throughout the project. Greater detail of the PACT Lead Role can be found in appendix G.11

Summary of fidelity/adaptation findings and comparison to the PACT-2 Trial

The PACT programme as part of this trial was delivered with a reasonably high level of fidelity to the programme materials and guidance.

PACT Lead training was provided as specified and was attended by almost all PACT Leads, with alternative suitable training provided to all settings who missed the original training. Live online training for parents was also provided as specified and was attended by most families taking part in the trial. There was a group of participants that did not attend live training who were provided with a video of training to watch, and the PACT Lead followed up with most of these participants. PACT leads and parents felt confident to deliver the programme following the training. Although there were some disadvantages to the online training option, participants felt that the training was appropriate and prepared them for the programme.

There was considerable variability in how much of the programme participants delivered. There was high engagement in PACT at the beginning of the programme, but this diminished as the 30-week programme progressed. On average participants completed around two thirds of the programme sessions and completed a mean of 20/30 weeks of the programme activity. Participants reported sticking closely to the PACT materials and instructions with few adaptations made. However, many participants did report doing more than one PACT session in a day. Finding the time to do PACT was the biggest challenge for families. Less frequently reported challenges were keeping the child engaged in the activities and the activities being too easy for the child.

PACT materials were distributed as intended for the programme but there were some issues with the completeness of these packs for a very small number of parents who did not receive all the materials. PACT Leads provided appropriate support to families with PACT mostly through informal support at nursery drop-off/pick up times. There were few difficulties reported by PACT leads in doing this role. PACT Leads felt that the role of the PACT Lead was important to the programme delivery.

Overall, fidelity was very close to the PACT-2 trial. Participants completed slightly more of the programme in this trial which makes sense as it was not disrupted by Covid-19 lockdowns. Participants reported similar challenges with doing PACT with the biggest challenge being finding within the family routine to do PACT and continuing to engage with this over a prolonged period of time.

Outcomes: perceived impact and quality of programme (RQ2)

This section begins by exploring participants reasons for taking part in the project and how they felt about the programme. It then moves on to discuss the perceived impact of the programme, first by considering the opinions of parents/carers, and then those of the PACT leads. Perceived impact includes the impact of the programme on the children participating, on the parents/carers and wider families participating and the impact on nurseries and PACT Leads.

Where survey data is available this has been presented first to provide data representative of the wider sample and then triangulated with interview data to give more context and deeper understanding. Where only interview data is available this is presented as both the dominant view and range of views of the sample interviewed.

Reasons for taking part in the project

Nurseries
In the post-training survey, the PACT Leads were asked about why their nursery decided to take part in the PACT-3 project. Three key reasons for taking part were given. Firstly, nurseries that had taken part in the previous PACT

evaluation valued their previous participation and wanted to take part again. Secondly, nurseries wanted to benefit children and support their speech and language development. Thirdly nurseries wanted to help parents to engage with their children and support their language learning. Other less frequently reported reasons were to encourage early reading skills and a love for books, because of the quality of the resources and to support parent/child bonding.

PACT Leads also responded to a question about what their school would like to achieve through delivering the PACT Programme. Language benefits for the children, such as communication and improved vocabulary were the dominant response. Other responses from multiple PACT Leads were hoping that parents would benefit from the programme, that it would help build better links between nursery and home, and that PACT would help children enjoy books more, which would improve their early reading skills and help them get school ready. Receiving the PACT resources and benefiting from the training were also responses from individual participants.

> *"An opportunity for more children to enjoy new books and have quality time with their parents at home. Parents to feel empowered and valued in their child's learning at home. Develop a good relationship with the PACT parents. Children to start school September 2022 with an interest in books, in depth knowledge of some books and wide vocabulary."*
>
> (PACT Lead training survey)

Parents
The baseline parent usual practice survey asked parents to choose their top three reasons for taking part in PACT (from a list of 23 options based on what parents told us in the previous PACT project; see Appendix G.12).

The dominant view of parents was that taking part would support their child's education and development including their child's early reading skills and their readiness for school. Parents also wanted to boost their child's positive attitude towards learning, their communication and speech, their attention and behaviour and give their child a love for books.

Perceptions of the PACT Programme

Participants in the programme were generally positive about the PACT programme. PACT Leads reported having received mostly positive feedback (66%, n=25) from the parents, around a third saying they received mixed feedback (29%, n=11).

When recording their completion of PACT sessions (on the PACTApp or paper records), parents indicated whether their child enjoyed the session or not. Almost all the PACT sessions were recorded as having been enjoyed by the child (97.4 %). The number of sessions reported as not enjoyed was very low, 2.6% (range 1.6% – 3.1%) on average across the different packs.

Children's enjoyment of the programme was also a dominant view in the parent interviews and the majority of parents interviewed reported that their child actively asked to do PACT. A few parents (a sixth of those interviewed) felt that their child felt important completing PACT as homework. A quarter of parents interviewed reported that their child often lost concentration while doing PACT and a small number reported a lack of enjoyment for the child.

Parents who were interviewed were very positive about the overall PACT programme and materials. The dominant view was that the materials were excellent. The range of views included some parents finding some elements of the programme too demanding or too easy for their child. There were mixed views from some parents about the narrative story element (where the child recaps the story in three sentences about the beginning, middle and end) with some parents reporting this was difficult and other appreciating doing this.

Many parents valued the material so much they wanted to save it for future use for other children.

> *"Oh, I'm completely happy with PACT. I think so many members of my family know about it. It's like, "Oh, we're doing this." "You pass it on." I've got a handful of mums waiting, "You pass it onto us." I said, "Okay, I'll give you week one, then you can have this, then you guys swap." That's why I want to be organised with it. If I've got it all in folders week by week, I can go through it again later on. It's something I can still do when she's in reception, in Year 1."*
>
> (1st Parent interview, EAL)

The post-intervention PACT parent survey allowed parents to comment freely about the project. As above, the dominant views expressed were enjoyment of the project, gratitude and praise for the quality of the materials. However, some parents also expressed that the found the intensity of the programme too much and difficult to complete so many sessions each week within the family routine.

Most parents interviewed did not have any suggestions on how to improve the programme, however a few parents commented that they would have liked a more relaxed, less time pressured delivery:

> *" It doesn't sound very much when you say, "I'll do one night a week for five nights," but when you actually put it into [practice], sometimes it is difficult. And then you do get behind and then, as a parent, you feel under pressure then. […] So I think if it was something that was rolled out as a normal thing, not necessarily have time restraints, you just get through it when you get through it. "*
>
> (2nd Parent/carer interview EYPP)

PACT Leads were also positive about the programme. When asked about the usefulness of PACT programme to their nursery and the families involved in the post-intervention survey all PACT Leads stated that PACT had been useful, with most reporting PACT being quite useful (48.6%) or very useful (43.2%) to the families in their nursery (n=37).

In explaining their answer, PACT Leads reported they were impressed by the materials and believed parents had gained skills to help with their child's education: *"It has given them more ideas when reading a book to extend their learning (PACT Lead post intervention survey).*" PACT Leads also believed families had enjoyed the quality time they were spending together reading books.

In addition to all positive comments, a few PACT Leads were disappointed that families were not as engaged as they had hoped for:

> *"It would be more useful if the families engaged, and we had more families to initially choose from."*
>
> (PACT Lead post intervention survey)

What impact of PACT was perceived by parents/carers and nursery staff?

Data was collected from parents about the perceived impact of the programme through the parent surveys and interviews. In the PACT parent post-intervention surveys, parents described the impact of the programme separately for their child, and for themselves and their family through free text response. For both intervention and control families, parents were asked in the baseline and post-intervention surveys about their confidence in supporting their child's language learning and learning more generally and this data is analysed to investigate the impact on parent confidence. Parent interviews also provide more depth to the survey findings and are used to triangulate this data.

PACT Leads were also asked to describe the impact of the programme for children and families as well as for themselves and their nursery, in the post-intervention surveys through free text response. This data is used to triangulate with the data collected from parents.

Impact on children

As part of the post-intervention survey, parents were asked to describe any changes (positive or negative) for their child that they felt were the result of doing PACT. Of the one hundred responses, two thirds described that their child enjoyed reading more because of PACT, while half of respondents reported improvements in children's language (often specifically mentioning including improvements to their child's vocabulary, speech and communication, or storytelling)

and a third of respondents reported that they had noticed improvements in their child's learning in general (including improved confidence with learning or improved concentration).

> *"My child has learned more words and can explain things. I'm now more worried that he'll forget my mother's language, because mostly he speaks English, and I can see him using the words we've learned together. It also helped my child learn things about world around."*
>
> (Post intervention parent survey)

> *"[Son's] speech has been improved and finds it a lot easier to have conversations now with adults, it's had a really good effect and he's really enjoyed all the books."*
>
> (Post intervention parent survey)

> *"[Daughter] loves reading and so it was great to have the chance to read for more of a purpose. She has got better at looking for things that we may [have] seen in the books and uses the words that we have had on the word collectors in the right context so that has been lovely to see."*
>
> (Post intervention parent survey)

A smaller number of parents also mentioned that PACT had a positive impact on the amount or quality of the one-to-one time their child received, and that PACT had been fun and the activities enjoyable for their child.
A minority (10%) of respondents reported having not seen change in their child sometimes because their child was already engaged with reading books and activities and sometimes because their child wasn't interested in the materials:

> *"Personally, I don't think there has been any changes in [daughter], she has always been interested in books and is always asking questions."*
>
> (Post intervention parent survey)

No parents reported any negative impact of the programme for their child.

In the parent interviews, the same themes of improved language, improved learning more generally (including readiness to learn) and growing interest in books were observed. For language parents most frequently mentioned improved vocabulary but also improved speech and communication as well as reading skills. While some parents interviewed weren't sure how much of their child's improvement in language skills could be specifically attributed to PACT rather than natural child development or nursery, several parents provided examples of occasions when they could specifically see PACT learning and activities being used in other aspects of the child's life to highlight how they saw the impact of PACT. This included the use of PACT vocabulary in other situations and learning from the different PACT activities.

> *"It's difficult to see really, because I'm with him on a day-to-day basis. But sometimes I'm surprised by the vocabulary he is getting from it, sort of thing, some of the words that he found difficult when we were doing it, like 'belong'. That was one of the words I think, and 'around' I think was another one. Things that he wouldn't normally say, he is sort of like putting. So, I think it is developing his vocabulary with the words that they have on the collect card."*
>
> (2nd Parent interview)

> *"Yesterday […] at dinner time she was, like, "Look at us, you're the beginning, I'm the middle and my other son, he's the end."*
>
> (1st Parent interview, EAL)

A smaller number of parents interviewed also described how their PACT had improved their child's confidence.

> *"I think it has given her the confidence to go wrong, I'm with my mum and I'm at home. If it's wrong, it's wrong and if it's right, it's right. […] When I first did the first PACT time, she couldn't remember what the word was, the special word, she would get really upset before she had even, like, tried to remember it. She was, like, "I can't*

remember it." And she would cry. And now she's like, "Oh, maybe it's this or was it this?" I'm, like, "Oh, yes, you do remember it, see, so you can." So, yes, it is massively different."

(1st Parent interview, EAL)

Another theme that emerged from the interviews with parents was improvements in the child's behaviour and concentration for reading stories.

"He knows that they're [books] important to him, so he understands the importance of being able to read now. […] Once we get them out now that's it, he's quiet and he just sits and listens. Then he'll point stuff out in the books and then we'll get onto other packs. He gets right into it, his little face [concentrating…] It's helped him find his confidence more with words, because before, like I said, he wouldn't entertain things like that. […] He won't sit, but because he knows that there's something else coming after the story, it makes him want to pay attention and figure out what's going on."

(2nd Parent interview, EYPP)

PACT Leads described a similar impact for participating children to that described by parents. In the post intervention survey describing the impact of PACT on children and participating families (n=35) many PACT Leads described seeing positive changes in children's learning, and how children talked about books as a result of PACT. They had also seen families enjoying the time spent together and appreciating the tool in supporting their child's learning.

"It has given better guidance and support for parents when sharing stories with their children at home. It has encouraged the children to enjoy reading and foster a love of books. I have liked when children have used vocab and been more confident to talk about overlapping themes and topics when in class."

*(*Post intervention PACT Lead survey)

"We have definitely seen improvements in communication & language. PACT children are more engaged in whole class story time sessions."

(Post intervention PACT Lead survey)

PACT Leads also reported on the negative impact of the programme causing stress to some families who struggled to find the time to do the PACT activities. Some PACT Leads also commented on how they felt that the PACT project involved children whose parents were already engaged with their child's education and not necessarily those that needed it most.

While interviews with PACT Leads did also raise the same themes of improved language and behaviour, as well as increased interest in books, PACT Leads described how it was difficult to see if these changes were specifically the result of PACT.

Impact on parents and families

The parent post-intervention survey also asked parents to describe any impact that taking part in PACT had for them and their family (n=94). Most parents reported that PACT had a positive impact for them and their families. One third of the parents reported enjoying the increased one-on-one time spent with their child. A third of the parents had also enjoyed watching their child learning new things. A fifth of the parents reported PACT as beneficial for the family and siblings when others joined in the PACT activities. Similar numbers of parents also reported that PACT had shifted what they do to read more books. A small number of parents described that PACT had shown them the value of talking around books, while one parent where English was not their first language reported that PACT had also helped her own English language skills.

"Sometimes I feel like the PACT time helped me more than my child. That was a together time spend regularly with him which made our connection even stronger. Another thing is that I learned word and expressions with him as well. I'm not an English native speaker, but PACT time helped me gain a great vocabulary."

(Post intervention parent survey)

A few negative impacts on the parent and family were also raised by some parents in the survey. They included reports of it being difficult for parents when their child didn't want to engage with the programme.

"I became more tense and less relaxed when reading to my child as I felt like I had a list of things to complete!"

(Post intervention parent survey)

A few parents also felt that the time requirement of PACT and pressure they felt to do PACT caused them anxiety and while some parents felt guilt for not being able to spend time with all their children equally and falling behind on the programme.

In a more specific survey question, parents were also asked whether PACT had changed the way they read other books with their child (post-intervention parent survey, n=116). Eighty-one families (70.7%) said that PACT had changed the way they read other books with their child, 34 (29.3%) said PACT had not changed the way they read other books. For those that described how their practice has changed (n=78), around three quarters of parents responding said that the amount of interaction between them and their child while reading had increased. A third said they look more at the details in the pictures and look for letters and words. A quarter said they are using their creativity to get more out of the stories. This indicates change beyond PACT to more generalised parent behaviour supporting the home learning environment.

"We talk about story now rather than just reading it. [Son] asks questions and we make our own stories from the pictures rather than reading the words."

(Post intervention parent survey)

In the interviews, as well as commenting on the benefits they had seen for their child, a small number of parents/carers also expressed that PACT had helped them with their own reading or language skills. Interviews did not reveal any additional negative impact themes.

Impact on parent confidence to support children's learning

Self-reported data about the parent's confidence in supporting their child's language learning specifically, and their child's learning overall was collected from both intervention and control parents in the baseline and post-intervention surveys. The pattern of responses is presented in Figure 8 and Figure 9 below. While almost all parents reported feeling confident or very confident to support their child's learning at both time points, the PACT intervention seems to have still impacted on parent confidence. For the intervention group, there is a higher percentage of parents reporting that they are '*very confident'* from baseline to post-test, while the percentage of control group parents reporting being '*very confident*' remains similar from baseline to post-test. This is evident in parents' confidence to support children's learning overall, as well as to support children's language learning with a more pronounced confidence increase for supporting language learning than learning overall. This indicates that the PACT programme did make a different to how confident parents felt.

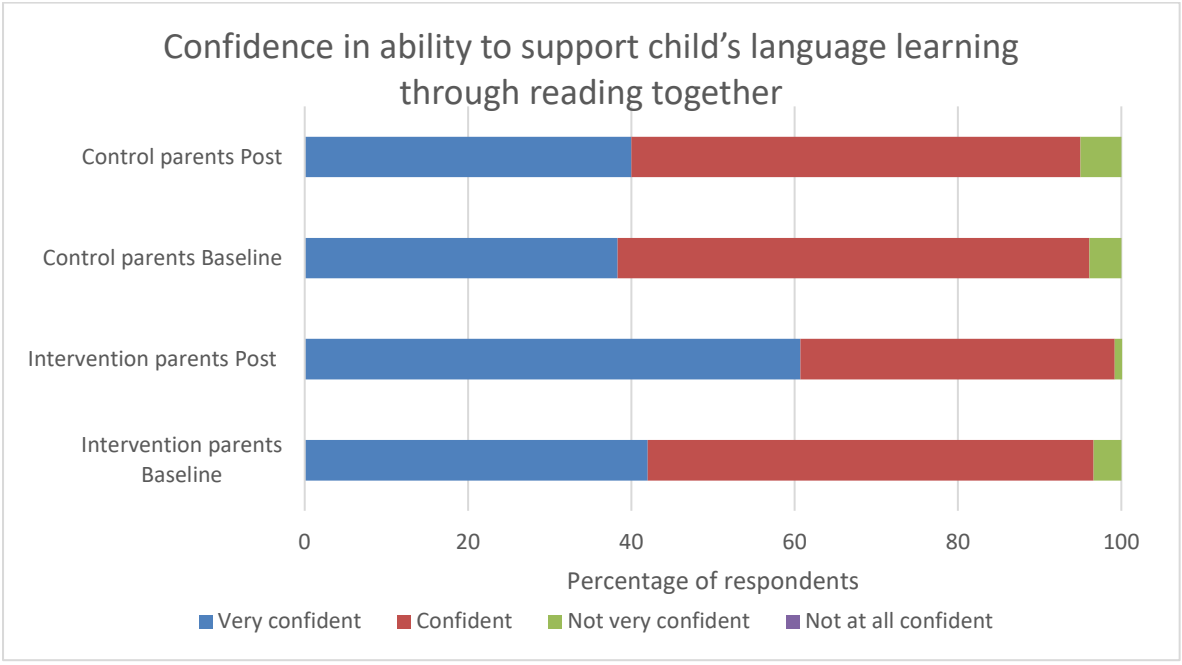

Figure 8. Parent baseline and post-intervention survey: "How confident do you feel in your ability to support your child's language learning through reading together and doing activities around books?" for intervention and control groups (Baseline Intervention parents, n=119; Baseline Control parents, n=128; Post Intervention parents, n=117; Post Control parents, n=120).

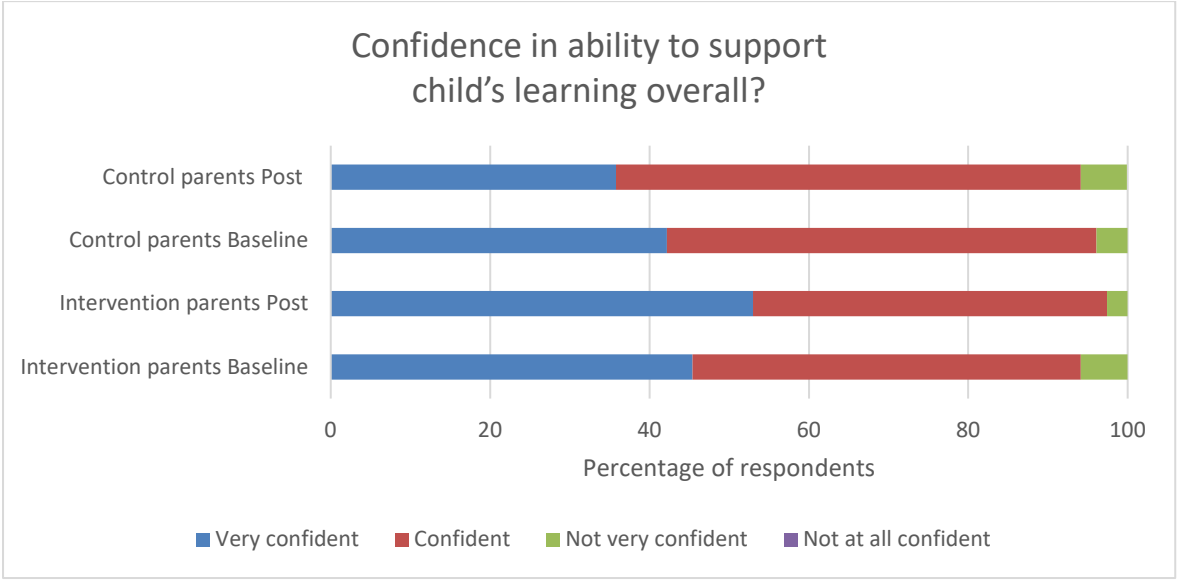

Figure 9. Parent baseline and post-intervention survey: "How confident do you feel in your ability to support your child's learning overall?" for intervention and control groups (Baseline Intervention parents, n=119; Baseline Control parents, n=128; Post Intervention parents, n=117; Post Control parents, n=120).

Impact of PACT on PACT Leads and Nurseries

PACT Leads were also asked about any impact PACT had had on them as PACT Leads or on their nursery (n=29). While there was not a clear dominant view of this impact, around a third of those responding felt that PACT Lead role had been time consuming particularly in chasing parents about engagement with PACT and recording progress. A few PACT Leads had found this stressful. However, more positively, some PACT Leads described how they found the PACT materials, strategies and activities useful for their own future practice in the nursery. Improvement to children's communication and language and improvements to children's love of reading at nursery were also mentioned by some respondents in response to this question. The range of other responses by fewer respondents included finding the project a positive experience, helping the nursery to support home learning, increased interaction with parents, reflecting on own practice, improved school readiness and increased communication between reception and nursery teachers.

"I love the resources and books...from a teaching perspective the materials are amazing. The parents haven't quite realised how amazing the resources are. I have felt that when we had safeguarding issues taking place that requesting PACT info was almost insensitive...so getting the balance and timing right, was hard."

(Post intervention PACT Lead survey)

Summary of perceived impact and quality of the programme

Families signed up to the PACT project hoping to improve their child's reading, general development, and school readiness. PACT Leads and parents were very positive about the PACT programme with parent's reporting their children's enjoyment of almost all sessions. The PACT materials were seen to be excellent, however some parents found the intensity of the programme too much to fit in with their busy lives. Parents and PACT Leads perceived that children's enjoyment of reading and books had improved as a result of taking part in the project and many parents also felt that their child's language skills had improved. Growing confidence and improvements to their child's behaviour and concentration were also reported by some intervention group parents and PACT Leads. Parents reported that PACT had also impacted on them as parents citing their enjoyment of increased one-to-one time with their child and of watching their child learning new things. They also felt that PACT had changed the way that they read books with their child incorporating PACT practices into other reading sessions. Parent confidence to support their child's learning, although high to begin with, also seemed to improve as a result of PACT.

Usual practice: programme differentiation and spill over (IPE: RQ3)

How does PACT differ from usual practice and control group activity?

In this section we describe usual practice in nurseries and at home. We use this to look at how PACT is different to usual practice and the context in which PACT is being delivered. We also look at whether there was any contamination in the control group and the activity these families were doing instead of PACT. The data used for this section was collected in the surveys from PACT Leads and parents both at baseline and post-intervention. Parent interview data is also used to understand how PACT was different to usual practice.

What is the usual practice with supporting home learning by nurseries?

In the baseline survey, the PACT Leads were asked about what their nursery currently did to provide advice, training or activities to help families support their child's development. Coding and frequency of responses are included in appendix G.13. More than half of PACT Leads described sharing information about the child and about nursery activities via an app. Around half of PACT Leads described providing parents with suggestions of activities that they could do with their child. These were often related to the theme or the work they had been doing in nursery and often had a language, communication or maths focus. Stay and play sessions, and parent workshops or meetings to cover different topics, were also common responses.

In terms of usual practice that may be similar to the PACT programme, ten PACT Leads described sending home story books on a weekly basis for shared reading but only a few mentioned additional activities that would be recommended alongside this. A few settings described providing weekly activities for families to complete but only one setting talked about providing daily activities. Five settings mentioned running weekly parent events with a story or communication focus where parents came into the setting with their child and attended a specific event. Rhyme of the week or word of the week, which was shared with parents, was also another practice mentioned by a small number of settings.

Nursery usual practice, specifically related to sending home books and associated activities was explored in the post-intervention PACT Lead survey question. The majority of PACT Leads said that their nursery did send books home to support families to read with their child at home (28/38, 73.7%) while 26.3% (10/38) did not send books home. For settings that sent books home, these were mostly sent home weekly (19/28, 67%), while a small number of settings sent books more often than once a week (4/28, 14.3%) see Table 22. Half of the nurseries sending books home, also said they provided additional resources/activities to support book reading (n=14, 50%), half saying they didn't (n=14, 50%).

Table 22. PACT Lead post-intervention survey: "How often are books sent home?" (Asked from only those PACT Leads who replied they send books home (n=28))

	#	%
More often than once a week	4	14.3%
Weekly	19	67.9%
Fortnightly	1	3.6%
Monthly	1	3.6%
Other	3	10.7%

Parents were also asked in the post-intervention survey about their experience of home learning activities and support provided for families by the nursery outside of PACT. Around two thirds (62.4%) of parents reported that the nursery sent home activities to complete at home. Slightly more control group families (78/120, 65%) reported that their nursery sent home activities to complete than the intervention families (70/117, 59.8%). This indicates that there could be some compensation bias present where PACT Leads offered additional activities for those not getting PACT or did not provide PACT families with the additional activities that were offered to the control families. However, this is a very small difference which could be the result of chance.

Where activities were being sent home, the most common frequency to receive home tasks from nursery was once a week (55.4% of responses) followed by once a month (14.2%) and less often than once a month (18.2%) (see Table 23 below).

Table 23. Parent post-intervention survey: "How often were activities sent home?" (n=148).

	Intervention	Control	Total
Every day	5 (7.1%)	4 (5.1%)	9 (6.1%)
Once a week	37 (52.9%)	45 (57.7%)	82 (55.4%)
Every two weeks	4 (5.7%)	5 (6.4%)	9 (6.1%)
Once a month	13 (18.6%)	8 (10.3%)	21 (14.2%)
Less often	11 (15.7%)	16 (20.5%)	27 (18.2%)

Three quarters of parents reported these activities taking up to twenty minutes with the most common response being 10-20 minutes (40.5% of responses). Fewer than 10% of respondents reported activities taking more than 30 minutes.

In a free-text field the intervention (n=63) and control parents (n=68) described the kinds of activities were sent home. Most common ones were a regular reading book; a practical activity suitable for the time of year (e.g., Christmas card); activities where you have to use pen; learning letters and numbers; and outdoor activities.

Parents in both groups were also asked in the post intervention survey whether they had received any advice or support from nursery to help them read with their child (Table 24) or support their child's learning in other ways (Table 25).

Table 24. Parent post-intervention survey: "Have you received advice of support from your nursery to help you read with your child?" n=237.

Advice or support from nursery to help read with child	Intervention group (n=117)	Control group (n=120)	Total (n=237)
Yes	43 (36.8%)	58 (48.3%)	101 (42.6%)
No	74 (63.2%)	62 (51.7%)	136 (57.4%)

Table 25. Parent post-intervention survey: "Have you received advice or support from your nursery to help you support your child's learning in other ways?" n=235.

Advice from nursery to help you support your child's learning in other ways?	Intervention group (n=117)	Control group (n=118)	Total (n=235)
Yes	46 (39.3%)	62 (52.5%)	108 (46.0%)
No	71 (60.7%)	56 (47.5%)	127 (54.0%)

A higher percentage of parents in the control group reported having had advice and support from nursery to help them read (48.3% control group vs 36.8% of intervention group) and to support children's learning in other ways (52.5% of control group vs 39.3% of intervention group) indicating that nurseries may have introduced some compensatory activities for those children not receiving PACT. Where parents elaborated on the support and advice they had been given to help their child read, the most commonly reported responses were being provided with books (sometimes as part of reading scheme, or library session) and being provided with information about how to support reading through email, leaflets or workshops. Phonics training or specific phonics activities were also reported by some families as were being given reading journals or diaries to complete.

Parents also commented on activities the nursery sends home in their interviews. A scheme called *Busy Bee,* in one nursery, encourages parents to read at home with their child for 10 minutes every day. Parents explained how they get a book with activities home every week. Sometimes the activity after reading the story can be inventing your own story. Another parent compared this homework to PACT.

> *"I would say it's similar to PACT, but you read the book and then it asks you questions, and you might get a colouring page related to the book and maybe little puppets that you could do a bit of a show with."*
>
> (1st Parent interview, EAL)

For support and advice not specifically related to reading, many parents reported being given suggestions of activities to complete at home, often in line with the topic or what the child was learning in nursery, most frequently including teaching numbers, phonics, supporting speech and practicing writing.

Other programmes being used by nurseries

The baseline survey asked settings to report any other programmes targeting early language or reading that they were also taking part in. Around half of settings (17/36) reported taking part in other programmes. The most frequently reported programme was Wellcomm (n=13) while a few nurseries were taking part in Early Talk Boost (n=4). Two nurseries mentioned SaLT, Language through listening, and Time to talk. Programmes that were reported by one nursery were: Blast, Chat challenge, Early Vocab, Communicate, Shine, Elklan, Phonics and Nursery narrative.

In the developer interview, the developer commented on how they felt that PACT was different to the usual nursery practice providing more resources and materials than they would be provided with by the nursery and setting the expectation of the intensity of the PACT routine which supports the findings above:

> *Developer 2: What's different about PACT is getting the parents fully involved. […] The amount of resources that they get […] goes beyond what they can provide usually for individual children in nursery to send home.*
>
> *[…]*
>
> *Developer 1: I guess even if nurseries are sending stuff home for families it might go in a bag that maybe doesn't get opened, or maybe gets opened and they go, "Oh, let's do this quickly for two minutes." Then it gets sent back with a, "Yes, we've done this." I guess I doubt there is much that parents, that nurseries would routinely send home that would be as in-depth or as […] consistent as PACT is.*
>
> (Developer interview)

What is the usual practice at home?

In the baseline and post intervention surveys, as part of the HLE measure, parents were asked to rate how frequently they did certain activities which support their child's learning. Table 26 below shows the percentage of participants who reported doing these activities frequently or very frequently spit for both the intervention and control groups.

Table 26. Home Learning Environment Usual Practice for intervention and control parents (summarised results)

		Baseline survey		Post-intervention survey	
		Control	Intervention	Control	Intervention
		(n = 127 - 128)	(n = 117 - 120)	(n = 119 - 120)	(n = 116 - 117)
How often does anyone at home read to your child?	At least once a day	91 (71%)	88 (73%)	71 (59%)	84 (72%)
	At least weekly	127 (99%)	113 (94%)	115 (96%)	115 (99%)
	Once a month or more	38 (30%)	30 (25%)	46 (39%)	42 (36%)

How often does anyone at home take your child to the library?	At least occasionally	56 (44%)	52 (44%)	61 (51%)	63 (54%)
How often does your child play with letters at home?	At least 5 times a week	30 (24%)	34 (29%)	42 (35%)	31 (27%)
	At least weekly	101 (80%)	85 (72%)	98 (82%)	91 (78%)
How often does someone at home help your child to learn the ABC or alphabet?	At least 5 times a week	53 (42%)	45 (38%)	54 (45%)	46 (40%)
	At least weekly	107 (84%)	101 (86%)	102 (85%)	100 (86%)
How often does someone at home try to teach your child numbers or counting?	At least 5 times a week	79 (62%)	69 (58%)	86 (72%)	71 (61%)
	At least weekly	121 (95%)	114 (96%)	115 (96%)	111 (96%)
How often does someone at home try to teach your child songs, poems, or nursery rhymes?	At least 5 times a week	88 (69%)	80 (68%)	80 (67%)	59 (51%)
	At least weekly	121 (95%)	107 (91%)	114 (95%)	104 (90%)
How often does your child paint or draw at home?	At least 5 times a week	60 (47%)	51 (43%)	64 (53%)	51 (44%)
	At least weekly	119 (93%)	113 (95%)	112 (93%)	107 (91%)

At baseline, for almost all families, someone at home read to the child at least once a week and, for the majority of participants (72%), someone read to the child at least once a day. At post-test the percentage of children who were being read to daily dropped for the control group but remained similar for the intervention group. This indicates a positive improvement for the intervention group.

The parent baseline and post-intervention usual practice survey also asked parents to report how long they would normally read with the child (if they did). The mean number of minutes reported by parents (for both intervention and control groups) was around 18 minutes, very similar to the expected length of a PACT session.

For the other items in the Home Learning Environment Index, most activities were not being done by the majority of parents at least five times a week, with the exception of someone trying to teach the child songs, poems or nursery which was being done by most participants at least five times a week by around two thirds of participants in the intervention and control group at baseline showing that the intensity of PACT is likely to be different to what parents were used to doing at home. However, most of the sample were engaging with home learning activities with their child at least weekly at baseline. Baseline and post-test were fairly similar for both groups across these items, however, there does seem to be a decline in how often the intervention group children were being taught songs, poems or nursery rhymes at post-test compared to the control group. There is also an increase in how often the control group participants played with letters at home compared to the intervention group. It is possible that the PACT activities displaced these other activities in intervention households e.g., singing songs with the child or reduced the time that families had for other activities. It may also be that the control group may have compensated for not having the PACT activities by introducing other formal learning activities such as playing with letters.

In the parent interviews, many parents described that they usually read books with their child even before taking part in PACT. However, their practice with reading books changed as a result of PACT. Reading before PACT was described by some parents as less in depth, often just reading aloud the story but not going any further. Some parents described that their children usual were read to as a group and so there was limited one-to-one time focused on groups and the books chosen weren't necessarily at the right level for the child.

> *"[before PACT] We read every night, but we read collectively, so I probably didn't read her age-appropriate stuff all the time."*
>
> (1st Parent interview, EAL)

Control group usual practice at home during the trial

As shown above in Table 26, control group usual practice at pre-test and post-test was fairly similar to that of the intervention group for the home learning environment items although fewer control group participants were being read to daily at post-test and control group participants were offering some language/literacy (non-book reading) -based home activities more frequently than the intervention group at post-test.

Table 27. Parent post-intervention survey (control group): "When looking at books with your child, what activities do you typically do?" (n=120).

	n	%
Reading the story out loud	115	95.8%
Talking about the pictures in the book	108	90.0%
Asking your child questions about the book – e.g., what do you think will happen next? who is this person?	89	74.2%
Following the words with a finger	78	65.0%
Describing what is happening in the book while reading	78	65.0%
Talking about what happened in the book after reading	65	54.2%
Giving your child praise or a reward for looking at the book with you	63	52.5%
Encouraging your child to ask questions about the book	45	37.5%
Playing games linked to the story	9	7.5%

In the post-intervention parent survey, the control group parents answered a question about which listed activities were they doing while reading books with their child (Table 27). Almost all of the control group parents reported talking about the pictures in the book (90.0%) and around three quarters of parents reported asking their child questions about the story (74.2%). More than half of the control group parents also described using strategies of describing what is happening in the book and talking about the book after reading it. Less frequent responses were encouraging their child to ask questions about the book (37.5%), although still done by a third of parents, and playing games linked to the story (7.5%). This indicates that although control group participants are not receiving the PACT intervention the majority of parents in the control group are using some dialogic strategies while engaging their children in reading stories similar to the PACT intervention.

Potential for spill-over effects or compensatory behaviour affecting the control group participants

Behaviour at home

As described above, there is some evidence from the parent survey that control group families reported more frequent use of formal learning activities not related to shared book reading which may be compensatory behaviour for not receiving the PACT materials. Control group children were also more likely to receive additional activities to complete at home from nurseries than intervention group parents. There is also some evidence that a small number of control group parents had seen (16.8% of survey respondents) and used (10.9% of survey respondents) the PACT materials indicating the potential for some level of contamination between the intervention and control group participants. Additional sensitivity analyses were conducted to investigate whether excluding children whose parents reported having access to the PACT materials impacted on the effect sizes of the impact evaluation outcomes: the removal of these participants made very minimal difference to the effect size found in the main analyses of almost all outcomes highlighting that direct contamination was unlikely to be impacting the conclusions of the impact evaluation.

Nursery practice

After the PACT Lead training, participants were asked whether they were familiar with the teaching strategies PACT uses to support parents in supporting language development (Table 28). All respondents were familiar with at least some of the strategies, while for most PACT Leads, all or most of the strategies were already familiar to them. It therefore seems unlikely that the PACT training would have particularly influenced the normal classroom practice of PACT Leads (and therefore that of the control group) given that they were already likely using these strategies.

Table 28. PACT Lead training survey: "The PACT programme is intended for parents to use best practice teaching strategies to support language development. Were these teaching strategies familiar to you?" (n=39)

	#	%
None of them were familiar to me	0	0.0%
Some of them were familiar to me	1	2.6%
Most of them were familiar to me	17	43.6%
All of them were familiar to me	21	53.8%

PACT Leads were asked in the post intervention survey whether they had changed their normal practice as a result of PACT. Most PACT Leads reported not changing their normal practice (34/38, 89.5%), however, three[17] (3/38, 7.9%) said they had changed their practice. Changes included a greater focus on teaching vocabulary (for two PACT Leads) and more repetition of stories so that children become experts (for one PACT Lead).

The post-intervention PACT Lead survey asked whether PACT Leads had done any extra activities in nursey or sent materials home specifically for the children who were not doing PACT (including the control group) (Table 29). Most PACT Leads (32/39, 84.2%) replied they did not offer anything extra for the children who were not in the intervention group. However, a small number of PACT Leads (n=6, 15.8%) said they were doing extra activities in the nursery for these children, and two nurseries said they were sending additional materials home (n=2, 5.3%). Where the PACT Leads described the additional activities in nurseries, they reported using language interventions such as WellComm and BLAST (2 settings), using similar materials to PACT (1 setting), specific support for children with speech and language needs (1 setting), and an activity using pictures to extend vocabulary (1 setting).

One PACT Lead explained that the additional material sent home was home book bags with puppets to encourage home reading. These findings of provision of additional support for some children not doing PACT may also support the fact that more control group parents reported activities being sent home, and the provision of advice to support learning than intervention group parents. This shows that for a small number of settings, PACT Leads may have been compensating for the lack of PACT through additional support and activities.

Table 29. PACT Lead post-intervention survey: "Have you done any extra activities in nursery or sent materials home specifically for the 3–4-year-old children not doing PACT?" (n=38) (they could choose more than one option)

	#	%
Yes, materials sent home	2	5.3%
Yes, activities in nursery	6	15.8%
No, nothing different to those doing PACT	32	84.2%

Summary of how PACT differs from usual practice and control group practice

Overall, PACT seems to be quite different to what nurseries offer as part of their usual practice. Although, many settings do send activities home to families to encourage their home learning (including sending home books) the frequency of these activities is considerably less often than the PACT programme. Books were often provided for families to borrow and read (mostly on a weekly basis) but rarely with accompanying activities. Parent advice and support provided by settings was varied but only a few settings offered specific workshops or meetings to support language instead providing support through sharing nursery learning and extending activities (often through an app), personalised support in parents evenings, meetings and informal conversations, and providing advice through websites, leaflets and other communications.

For the majority of children, parents in both intervention and control groups were already reading with their child on a daily basis before the PACT programme and almost all families were reading with their child at least once a week, with their reading sessions lasting around the same amount of time as a PACT session. Parents were generally offering other activities to support their child's learning but not doing these on such a regular basis as PACT. Parents doing PACT,

[17] Four PACT Leads reported that they had changed their practice, however, one then explained in follow-up to say they hadn't changed practice but liked aspects of the programme.

described that the way they read with their child changed as a result of the programme, however for those in the control groups many parents did describe using dialogic approaches when reading books with their child encouraging discussion (one of the aspects of PACT).

There was evidence of some compensatory approaches for the control group families both at the family level and at the nursery level. Control group families were doing more home learning activities (outside of shared book reading) at post-test than intervention families. In some cases, control group children were being offered additional activities in nurseries or through learning activities sent home to families. The control group was also minimally exposed to the PACT intervention with some participants reporting seeing and or using the PACT materials, but this contamination did not affect the results of the study.

RQ4. Contextual factors: How does the context of the PACT-3 trial affect understanding and interpretation of the evaluation data?

(1) How did Covid-19 affect the trial and delivery of PACT?

While there were no lockdowns or major impacts of Covid-19 on the delivery of the project, Covid-19 was perceived to have had some impact on the delivery of the trial.

At the family recruitment stage of the trial, PACT Leads reported not being confident about recruiting 10 families to project in the training survey (with only 41% of PACT Leads very confident or fairly confident about recruiting families to the project and 31% of PACT Leads only slightly confident or not at all confident about recruiting families to the project) with the Covid-19 context playing a part in this lack of confidence. Nurseries reported that Covid-19 had reduced the intake of the setting and so nurseries had fewer eligible children to sign up. Nurseries were also reporting that they had restricted contact with families (e.g., reduced home visits and face-to-face meetings) which meant less opportunity for the staff to get to know the families and discuss PACT. The use of digital tools instead of face-to-face meetings and the wearing of masks and social distancing at the gate, also had an impact on developing relationships with families. These themes emerged from the PACT Lead interviews (with 4/10 PACT Leads interviewed at time point 1 stating that Covid-19 had affected family's recruitment) and also in the reasons that settings withdrew from the project after not being able to recruit enough families to continue participation.

For the delivery stage of PACT, two thirds of PACT Leads reported in the post-intervention PACT Lead survey, that Covid-19 had impacted the way the project was run in their setting (n=29). For around a third of PACT Leads they were unable to run face-to-face support sessions for parents as the nursery was not allowing parents into the nursery. Covid-19 related absences (due to illness and isolation periods) for both nursery staff and children, also affected the delivery of the project. This was particularly an issue around the child assessment periods and for PACT Leads distributing the PACT packs and following up with families about progress. In the PACT Lead interviews, PACT Leads also reported that Covid-19 related illness also affected the delivery of the PACT programme at home with parents being ill and disrupting the PACT routine. One PACT Lead interviewed also felt that the Covid-19 restrictions made parents less likely to seek support from the PACT Lead while two PACT Leads felt that the online parent training did not engage parents with the programme and with the setting in the same way as the previous face-to-face training.

The trial design and delivery were not significantly disrupted by Covid-19 in this project. The issues with recruiting families described above, did mean that the trial went ahead with a smaller sample size than originally planned. However, the assessments, randomisation, IPE delivery and delivery of the programme went ahead as described in the protocol without disruption from Covid-19.

(2) How did previous delivery of PACT affect the delivery of PACT in this trial?

Out of the 43 nurseries that took part in PACT-3, twenty had previously taken part in PACT-2 and were involved in delivering the PACT programme. We explored whether previous PACT experience affected the way nurseries delivered PACT for a second time.

In the PACT Lead baseline survey, half of the respondents were from nurseries that had taken part in the PACT-2 study (n=18, 50%). These PACT leads were asked to compare the recruitment process of the two studies (Table 30).

Table 30. PACT Lead baseline survey: "How did your experience of recruiting families to the PACT-3 study compare to PACT-2?" (n=18).

	#	%
It was easier to recruit families to PACT-3	2	11.1%
It was just as easy/difficult to recruit families to PACT-3	5	27.8%
It was more difficult to recruit families to PACT-3	7	38.9%
I wasn't involved in recruiting families in PACT-2	4	22.2%

Of the PACT Leads that had been involved in recruitment for both trials, 7/14 (50%) felt it was more difficult to recruit families for this trial while 5/14 (35%) felt it was just as easy/difficult to recruit families to the trial. Two PACT Leads who said recruitment was easier this time said this was due to being more confident and that they managed to talk to parents who were already eager to read books and stories to their children. Those who said it was more difficult said they were unable to meet/speak to the parents in person due to COVID-19 restrictions providing further support for the findings above that Covid-19 impacted on recruitment of families to the trial.

In the post-intervention survey 15 PACT Leads who worked in settings that previously delivered PACT responded to how a question about how their previous experience of PACT had influenced their delivery of PACT during the current trial. The majority (11/15, 73%) stated that their previous involvement had not affected their delivery of PACT this time, while 4/15 (27%) said it affected their delivery. Three of the four who said previous experience had affected the delivery, went on to describe that they were more confident and knowledgeable to plan their own time and knew what they were recommending to parents.

From interviews with PACT Leads in settings that were also involved in PACT-2, some reported that the delivery of PACT felt easier the second time round. One PACT Lead reported being more relaxed with delivery and changing the more intensive support offered in PACT-2 to more informal catch-ups due to participants having lesser support needs. However, one PACT Lead also felt that parents were less engaged with PACT in PACT-3 and that families recruited were harder to engage with due to children also attending wrap-around care and not seeing parents at school. One PACT Lead also reported that they had less need for support from the developer team during PACT-3.

(3) How did the delivery of PACT during the trial affect usual delivery of PACT?

While PACT is not currently marketed and delivered outside of the trial context, we look here at how the trial and evaluation process impacted on what PACT would look like outside of this context.

In this project, it was necessary to fit the evaluation activities and the delivery of PACT into one academic year which needed to include baseline assessments, randomisation, 30-week delivery of the programme and post-testing. However, this restricted timeline limited the recruitment time for recruiting families to the project. Given that settings found recruiting families difficult, and that the Covid-19 context made it more difficult to have established relationships with parents, it may be that outside of a trial families would be recruited in a different manner with more time for nurseries to get to know families. Nurseries may also have targeted the programme at families they feel would benefit, rather than just trying to reach the recruitment numbers.

The developers agreed in their interview, that outside of a trial the timetable could be looser, and the 30-week-programme could continue further in the summer term without the post testing. This longer period for delivery of PACT may also remove the pressure that some families felt to "keep up" with PACT during the year and may make it easier to take breaks when needed. Outside of a trial, it is likely that the requirement to record progress through PACT would be removed or the burden lessened. However, this could impact on families completing less of the programme if they are not required to record their progress.

Outside of a trial, the burden on PACT Leads would be lessened somewhat, in particularly with the removal of the assessments and requirement of chasing families to complete their participation records. Both of these elements were felt to take up a significant period of time in the PACT Lead role. PACT Leads could also more freely promote and

discuss PACT in the nursery settings outside of a trial with control and intervention groups. This would give PACT Leads more freedom to invite parents into the setting or to host celebration events or coffee mornings for all parents.

(4) Additional language interventions during first year of school?

To look at whether taking part in PACT had reduced the need for intervention on children starting school, schools were asked to name any additional language interventions that children had received during their first year at school (Reception). For each child, it was recorded whether the child had received additional language intervention or not. The most common language interventions attached to children in Reception were: WellComm (23 pupils), Speech and Language Therapy (24) and NELI (22 pupils). Smaller numbers had taken part in LM Catch up (6), Early Talk Boost (3) and several Phonics interventions (9), with individual children assigned to Read Write Inc., Talkboost, Extra reading, Ginger Bear (Time to Talk), SHINE speech and language, Lingo sounds right and Reception Narrative.[18] Table 31 shows the number of children in each group who received additional language intervention during reception.

Table 31. Additional language interventions during first year of school (Reception) as reported by children's teachers at the delayed post-test.

Language intervention (in Reception)	Intervention group	Control group	Total
Language intervention	42 (23%)	39 (21%)	81 (22%)
No language intervention	135 (73%)	135 (73%)	270 (73%)
Missing data	8 (4%)	11 (6%)	19 (5%)
Total	185 (100%)	185 (100%)	370 (100%)

The pattern of additional language intervention was very similar across both groups with no obvious difference caused by taking part in PACT. Sensitivity analysis described in the Impact Evaluation section also found that whether the child had had additional language intervention during reception made no difference to the effectiveness of the programme results.

Cost evaluation results

This PACT programme was fully subsidised by the EEF. As the programme was not commercialised, a developer cost workshop—using EEF costing guidance—explored the costs to the developer of providing the programme to nurseries during the trial[19]. This took place at the beginning of the PACT-3 project and email communication with the developer team confirmed/adjusted the cost at the end of the programme. Based on the time estimates given by the developer team we have estimated the personnel cost using mid-band hourly estimates from pay scales of a Russell Group university for the staff roles involved. A table detailing the breakdown of the programme costs is included in Appendix G.6. The cost of the programme to a school would be £531 for the first year plus the costs of the PACT packs for families at £167 per set. For the second and third year of delivery it is assumed that PACT Lead training is not needed, settings already have a copy of the PACT materials for setting use, and that support to settings would be reduced. Costs per school for year 2 and year 3 would therefore be £290 each year plus the cost of PACT packs for families. For the cost per child cost, costs have been calculated assuming the 43 schools that were in the current trial and 5 children doing the intervention per year (as average number of participants doing the intervention per school in current trial is between 4 and 5). The programme cost covers the provision of online training to PACT Leads (1st year only) and parents (each

[18] Children may have taken part in multiple programmes, which is why the numbers don't create the total sum of 81.
[19] The same developer cost workshops looked at the costs for PACT-2 and PACT-3 and was conducted at the end of the PACT-2 intervention period and beginning of PACT-3 project. The developer team staffing was different for PACT-3 compared to PACT-2.

year), storing, collecting and delivering the PACT packs to schools throughout the programme, and providing ongoing support to schools.

The requirements of the PACT intervention from a school's perspective are listed below in Table 32. The time spent delivering the programme was collected from questions in the PACT Lead and Parent surveys.

Table 32. PACT requirements from school perspective

Category	Ingredients
Personnel for preparation, training, and delivery[20]	**Set-up phase (May to September 2021)** Time attending PACT Lead training, recruiting families, communication with developer team and preparation–to deliver PACT - 7.6 hours staff time per school (spread across 1-4 staff members)
	Getting started phase (October to December 2021) Time attending and/or delivering parent training, parent check-ups, support, delivering packs–administration - 2.43 days of staff time per school (spread across 1-3 staff members)
	Ongoing delivery of PACT (January to June 2022) Delivering packs, parent check-ups, administration, chasing parents with reduced engagement, supporting parents - 1.78 days per month (spread across 1-3 members of staff)
Training and programme costs	£531 per school for UoM provision of training, postage of PACT packs, and ongoing support for schools (assuming 47 settings with five PACT families per school)
	5 PACT packs per school at £167 per set
Facilities, equipment and materials	IT facilities (e.g., laptop or tablet with camera and mic) to facilitate online training
	Set-up phase: small number of settings required stamps and postage – up to £15 Ongoing delivery: small number of settings had printing/photocopying costs
Parent time to deliver PACT	Parent time to attend training, 1.5 hours
	Parent time to deliver PACT sessions: EXPECTED/IDEAL: 5 x 20 minutes x 30 weeks = 50 hours ACTUAL: 98.1 (mean number of sessions completed in the project) x 22 minutes (reported mean length of session) + 5.2 minutes (reported mean time to prepare for a session) = 44.5 hours

PACT Lead surveys and interviews indicated that there were very few additional costs for delivering PACT other than the personnel and programme costs. At the set-up phase, only four PACT Leads indicated additional expenses which included postage, printing/photocopying and stamps (up to a cost of £15). Only two PACT Leads indicated that there was any additional spending required beyond the set-up period and this was for printing the record forms when parents were unable to access the PACTApp. Only three schools reported that they had paid for any supply cover during the project with those settings paying for 6 hours each. As this cover was only required in 3 settings this has not been included in our assumptions of the cost of delivering PACT.

The majority of staff time for the PACT project was undertaken by the PACT Lead in the setting. There was not any requirement on who became the PACT lead for the project in terms of their role in the school, however, the majority of PACT Leads were teachers in the school or nursery (30), while two were members of senior leadership, and two were nursery leads. We have therefore assumed that teacher time is required for this role. Nineteen settings had a second member of staff involved during the set-up phase, while this reduced to 15 settings during the start-up phase and 11 settings during the main delivery phase. Of second staff members these were mainly other teachers or teaching assistants but did also include senior leadership, admin and nursery nurses. Very few settings had more than two members of staff involved: four at set-up phase, one during the start-up time, and one during the project. To calculate the staff time required for this project we have totalled the amount of time spent across all the staff on the project, and

[20] Staff time reported here is the mean figure of the time reported by PACT Leads for all staff members as collected in the baseline and post-intervention PACT Lead surveys.

conservatively assumed that this would be undertaken by 1 teacher as was done in the majority of settings. See Table 33 below for the staff time required for the different phases of the PACT delivery while Table 34 also details the material costs of delivering PACT and the cost per child assuming delivery over 3 years.

Table 33: Total time devoted by personnel for training, teacher cover, as well as for preparation and delivery

		Year 1 (or more if applicable)	
		Number of teachers [21]	**Mean number of hours** (range)
Training/setup phase including PACT Lead training and recruitment of children (May – September 2021)	PACT Lead (assumed teacher)	1	7.6 (4[22] -19)
Getting started phase including training parents and delivery and support of first PACT block (October – December 2021)	PACT Lead (assumed teacher)	1	19.44[23] (4 – 56)
Ongoing delivery for the rest of the programme (December to June 2022)	PACT Lead (assumed teacher)	1	113.03[24] (48 – 384)

Table 34. Material costs of delivering PACT

Item	Type of cost	Cost	Total cost over 3 years	Total cost per child per year over 3 years
Cost of PACT lead training, school materials, parent training and ongoing support during the first year of the programme	Start-up cost per school	£531	£531	(£531/3/5) = £35.40
Cost of ongoing support from developer team for subsequent years including parent training	Running cost per school	£290	(£290 x 2) = £580	(£580/3/5) = £38.67
PACT Packs	Running cost per child	£167	(£167*5 child *3 years) = £2,505	(£2505/5/3) = £167
Total			£3,616	(£3,616/3/5) = £241.07

See Table 35 for the cost of the implementation of the programme across three years of delivery including the cost per child per school year (£241.07). Due to no new staff being required to deliver the programme, very little supply cover being required across the settings in the project and many of the PACT delivery responsibilities overlapping significantly

[21] Assumed 1 teacher as majority of settings had one PACT Lead but this role could be spread across 2-4 other staff as was done in minority of settings
[22] Minimum of 4 hours assumed here as this is the PACT Lead training length. Where participants responded less than this this is likely to be an underestimate of time.
[23] Participants answered in days and have converted to hours assuming 8 hours per day
[24] Participants answered in days per month – calculations to convert into hours assume 8 hours per day and 6 months

with that normally required by staff in nursery, the hours spent by PACT Leads delivering the programme have not been translated into equivalent monetary costs.
As the programme is ultimately delivered by parent volunteers as part of their activities at home, the time required by parents to participate in the programme was also calculated (see Table 32 above). While the programme asks for parents to complete 30 PACT sessions at 20 minutes each (50 hours), the parent post-intervention survey asked parents for the time they spent on a PACT session and the time spent preparing for a PACT session. These were then used to estimate the actual amount of time spent by parents delivering the programme using the mean number of sessions completed by families across the programme which was 44.5 hours throughout the year per child. Parents were also unlikely to have any significant additional costs when delivering PACT with only occasional purchases of glue and stationery to support the programme.

Table 35: Cost of the implementation of the programme, per ingredient

Category	Cost Ingredient	*Start-up or Recurring?*	Nominal Values			
			£ Year 1	**£ Year 2**	**£ Year 3**	**Total**
Personnel for set-up phase	Teacher(s) in PACT Lead role[25]	Recurring (although may be reduced in subsequent years)	7.6 hours (not in addition to usual practice)	7.6 hours (not in addition to usual practice)	7.6 hours (not in addition to usual practice)	57.76 hours
Personnel for getting started phase	Teacher(s) in PACT Lead role	Recurring	19.44 hours (not in addition to usual practice)	19.44 hours (not in addition to usual practice)	19.44 hours (not in addition to usual practice)	58.32 hours
Personnel for ongoing delivery	Teacher(s) in PACT Lead role	Recurring	113.03 hours (not in addition to usual practice)	113.03 hours (not in addition to usual practice)	113.03 hours (not in addition to usual practice)	339.09 hours
Training and programme costs	Cost of PACT lead training, materials, parent training and support during the first year	Start-up cost	£531	-	-	£531
	Cost of support from developer team for subsequent years including parent training	Recurring	-	£290	£290	£580
Facilities, equipment and materials	PACT Packs	Recurring	£835	£835	£835	£2505
Cost per school per year		**Staff time**	**140.07 hours**	**140.07 hours**	**140.07 hours**	**420.21 hours**
		Programme costs	**£1366**	**£1125**	**£1125**	**£3616**
Number of children per school per year			**5**	**5**	**5**	**15**
Total cost per child-school-year						**£241.07**

[25] Teaching cover was generally not required for any aspect of PACT delivery, no new staff were employed to do this role and all staff were doing this as part of their role in school. Therefore, we have not translated the staff time into a cost.

Conclusion

Table 36. Key Conclusions

Key Conclusions
When assessed immediately after the intervention, children offered the PACT programme made, on average, no additional months' progress in overall language skills compared to children who did not receive the PACT programme. This result has a moderate to high security rating.
Assessments completed 11 months after intervention delivery showed children who received PACT made, on average, 1 additional months' progress in overall language skills compared to children who did not receive the programme. However, there is some uncertainty in this estimate and it may be that the true effect was no progress. The effect on language skills was higher for those with greater compliance to the PACT programme.
Children offered the PACT programme scored higher on measures of school readiness, expressive vocabulary, and one measure of receptive vocabulary than children who did not receive the PACT programme. Conversely, the results indicated a small negative impact on the child's home learning environment for children who participated in the PACT programme. No difference was found in spoken language information or grammar.
The PACT programme was delivered with a moderate to high degree of fidelity. On average, families completed around two thirds of the PACT sessions and reported delivering the sessions as prescribed. Engagement decreased throughout the 30-week programme and families reported finding it difficult to find time to fit in all programme sessions.
Families and nurseries were very positive about the programme and felt that it led to improvements in children's language and vocabulary, interest in books and that it led to parents and children spending more high-quality one-to-one time together.

Impact evaluation and IPE integration

Evidence to support the logic model

Similar to the previous PACT-2 evaluation, the results here indicate that there is evidence to support most of the delivery elements of the PACT logic model but limited evidence to support the expected outcome elements. An updated logic model is included in Figure 10 which shows the extent to which different elements of the logic model were supported by the evaluation data and the support for each element will be discussed below. Numbers in square brackets refer to that aspect of the revised logic model in Figure 10.

While recruiting school nursery settings to the project ([1] in Figure 10) was not problematic, settings struggled with the recruitment of the required number of families to the project [3]. Following the PACT Lead training, many PACT Leads were not confident about recruiting families to the project and a number of settings subsequently had to withdraw from the trial due to not being able to recruit sufficient numbers of families. The Covid-19 context was seen as being a challenge here, as recruitment was during a period when nurseries were unable to do home visits or invite families into the nursery setting and therefore were not able to establish relationships with families before they started in nursery. Socially distanced drop-offs and mask wearing also continued the difficulty of establishing relationships with families once the children started nursery. Fewer children were recruited to the trial than originally planned and it may be that those who were recruited to the project were those families already most engaged in their children's learning. Of the sample recruited, around 60% of households included someone with a higher education degree, and around a third of the sample already had more than a hundred children's books in their household, potentially indicating the reading with their child was already highly valued by these families.

For the delivery elements, training for nursery staff and for parents was delivered as intended [2] [5], was well attended by participants who considered it to be appropriate and useful; PACT Leads and parents felt confident to deliver the programme following the training [4] [6]. The change to the online training for this trial was not seen as detrimental by participants and PACT Leads who had attended both types of training felt that the online training was as appropriate and effective as the previous in person training in PACT-2. However, there were some parents that did not attend the live version of the training and were sent a recording of the training. There was limited evidence around whether these parents engaged with the training.

Families felt that the level of support provided by the nurseries was appropriate and that they knew how to get help if they needed it [8]. However, the context of the delivery towards the end of the Covid-19 restrictions led to challenges. Some nurseries were not able to invite families into the setting for support early in the project, and social distancing and mask wearing in some settings at the beginning of the project made it harder for PACT Leads to build relationships with families and to check in on progress. However, families did not report this as an issue. PACT Leads felt that the support from the developer team was good and appropriate throughout the project [7]. PACT Leads were able to get quick responses from the developer team when needed and knew how to access support when required.

Families received the PACT materials from the nurseries as expected [9]. The delivery of the PACT sessions in the home [10] was similar to that seen in the first and second PACT trials with an average of around two thirds of possible PACT sessions completed. While almost all families started out engaging well with the PACT programme, engagement decreased linearly throughout the length of the programme with fewer than half of the families that started the programme still engaging by the final PACT pack. Families reported finding it difficult to fit in the five PACT sessions each week over the duration of the programme and some families, particularly when both parents were working, found it difficult to find a suitable time to complete PACT around nursery and other family routines. When families were delivering PACT sessions, they mostly described doing all of the activities for each session and following the programme with high fidelity. There was minimal reporting of adaptations made to the delivery of PACT; some families reported changing the order of books to suit their child's interest and adapting activities to suit their child's ability. However, the biggest adaptation was to the delivery schedule of the programme, with more than half of families occasionally needing to do more than one PACT session in a day (and 20% of families having to do this regularly) in order to keep on top of the PACT schedule. This may indicate that the frequency schedule of the programme is currently too much for families to engage with.

For the expected outcomes predicted by the logic model there is limited and sometime conflicting evidence- outcomes supposedly measuring the same vocabulary construct showing different results and the IPE findings not agreeing with the IE findings. The impact evaluation findings found no statistically significant findings of impact of any of the primary or secondary outcome measures.

Looking at the impact of the programme on language and communication outcomes [11] there was no evidence of improvement for the PACT group compared to the control group for the primary outcome of overall language skill immediately after the programme, however there was some evidence of a small impact of the programme on overall language skills 11 months later (effect size 0.09, confidence intervals -0.14, 0.33) although this was still not statistically significant. The CACE analysis found that the effect size increased for those that did more sessions of PACT, however immediately after the intervention effect sizes remained negligible (0.05) even when looking at the sample that completed more than 80% of the sessions. Eleven months after the intervention period however, the effect size for those that completed more sessions of PACT increased to more notable effect sizes with an effect size of 0.33 for those that comply with more than 90% of sessions. Seeing greater effects at delayed post-testing, 11 months after completion of the intervention, may indicate a 'sleeper effect' where the effects of the intervention are not immediately apparent, but grow over time. It may be that PACT prepares children better for school and that children who have done PACT are more receptive to the teaching at school. The logic model expects this to some extent in that there is expected to be interaction between children's language skills and school readiness as well as concentration and self-regulation which can promote early literacy skills. However, even the larger effect sizes found a delayed post-testing are not statistically significant cautious interpretation should be made.

For the secondary language outcomes investigating specific language domains, there was improvement on receptive language as measured by the BPVS (effect size 0.11, confidence intervals -0.14, 0.36) immediately after the programme but this was conflicted by finding no improvement on the similar LanguageScreen receptive vocabulary subscale (effect size -0.05, confidence intervals -0.29, 0.19). There was also no evidence of improvement on receptive vocabulary eleven months later except for the EYPP subgroup. There was some evidence of a positive effect on expressive vocabulary as measured by the LanguageScreen expressive vocabulary subscale (effect size 0.1, confidence intervals -0.15, 0.34) and the CELF expressive vocabulary measure (effect size 0.03, confidence intervals -0.22, 0.29) at immediate post-test and for the LanguageScreen expressive vocabulary measure this was maintained eleven months later. For the other language assessments (APT, LanguageScreen Sentence Repetition subscale and LanguageScreen listening comprehension subscales), there was no evidence of improvement with some outcomes showing small negative effects. Again, these effects are not statistically significant and should be interpreted with caution.

While the logic model didn't specify greater improvements to any specific domains of language skill, the PACT programme does have an explicit focus on vocabulary development as part of the activities each day and improvements to vocabulary would be expected from this (PACT 1 found an effect size on the BPVS receptive vocabulary measure of 0.24 and on expressive vocabulary of 0.10, while PACT 2 found very small but positive effects of PACT on both expressive and receptive vocabulary (0.04 and 0.08)) . However, the full programme of activities was expected to have broader impact on language skills than just vocabulary and the data from this trial does not find these effects. In the IPE, both parents and PACT Leads reported positive impact of the PACT programme on language outcomes mentioning improvements to the child's vocabulary (partially supported by the impact data), speech and communication and storytelling.

There was minimal evidence for improvements to the home learning environment and to parent/child relationships from the evaluation [12]. The impact evaluation found a small negative impact of the PACT programme on the home learning environment secondary outcome (effect size -0.07, confidence interval -0.35, 0.21) for intervention families compared to control families at the end of the programme. In the IPE, parents in the intervention group reported

having higher level of confidence to support their child's learning at the end of the programme compared to parents in the control group (although both groups were confident at baseline) [14]. Parents reported that PACT had increased the amount or quality of the one-to-one time their child received and that they had enjoyed spending more time with their child one-to-one and watching their child learn new things [13]. Around two thirds of parents in the PACT group reported that they had changed the way that they read with their child as a result of PACT mostly increasing the amount of interaction that they have with their child [15]. The IPE results therefore support the improved parent/child relationships outcome from the logic model resulting for the time spent together doing PACT, alongside the increased provision of focused learning opportunities PACT provided and greater parental confidence as a result of the training and doing the PACT programme. It may be that as a result of doing PACT, parents had reduced time to do the range of activities captured by the Home Learning Environment Index questionnaire. There is some evidence to support this from the specific questions in the post-test HLE that the intervention group participants declined in the frequency of teaching songs, poems and nursery rhymes and playing with letters in comparison to the control group participants. PACT may not promote the home learning environment overall (as measured by the HLE) but does support it regarding shared reading (which was higher at post-test for the intervention group than that control group).

There was some evidence that PACT improved children's school readiness [17]. The impact evaluation found that children in the PACT group had improved in school readiness across the four subscales of the BESSI questionnaire which included behavioural adjustment (effect size 0.14, confidence interval -0.13, 0.40), Language and Cognition (effect size 0.11 confidence interval -0.15, 0.37), Daily Living Skills (effect size 0.13, confidence interval -0.12, 0.38), and Family Support (effect size 0.12, confidence interval -0.16, 0.40) (although these results were not statistically significant and should therefore be treated cautiously). The IPE also found some support for PACT improving aspects of school readiness from a parent perspective. Parents reported seeing an impact on their child's ability to learn including improved confidence of the child and improved concentration and behaviour. Many families also reported that their child had an increased enjoyment of books and reading as a result of the project.

There was some evidence that PACT improved aspects of early literacy skills , when measured 11 months after the intervention although statistical analysis did not show any significant effects.. In particular, there was evidence that PACT improved children's early word reading for regular words (effect size 0.12, confidence interval -0.17, 0.41) compared to exception words (effect size 0.06, confidence interval -0.02, 0.32) similar in pattern to PACT 1. There was a also a small effect on letter sound knowledge (effect size 0.05, -0.25, 0.36) [18 However, there was a negative effect of the intervention on the sound deletion task (effect size -0.11, -0.35, 0.14). This may indicate that PACT can improve aspects of early literacy relating to text (i.e., the letters and word reading) however this doesn't lead to increases in phonologic manipulation as measured by the sound deletion task which did not contain any text cues.

As described above, the PACT logic model was mainly supported in terms of the programme inputs and outputs (i.e., delivery) of the programme. However, this delivery has not clearly resulted in the intended outcomes – especially as measured by the project's primary and secondary outcome impact measures particularly in the period immediately following the intervention. However, it is unclear whether revisions should be made to the logic model or whether it may be that better targeting of the intervention is required or that different types of settings should be recruited. Further discussion of these issues is included below.

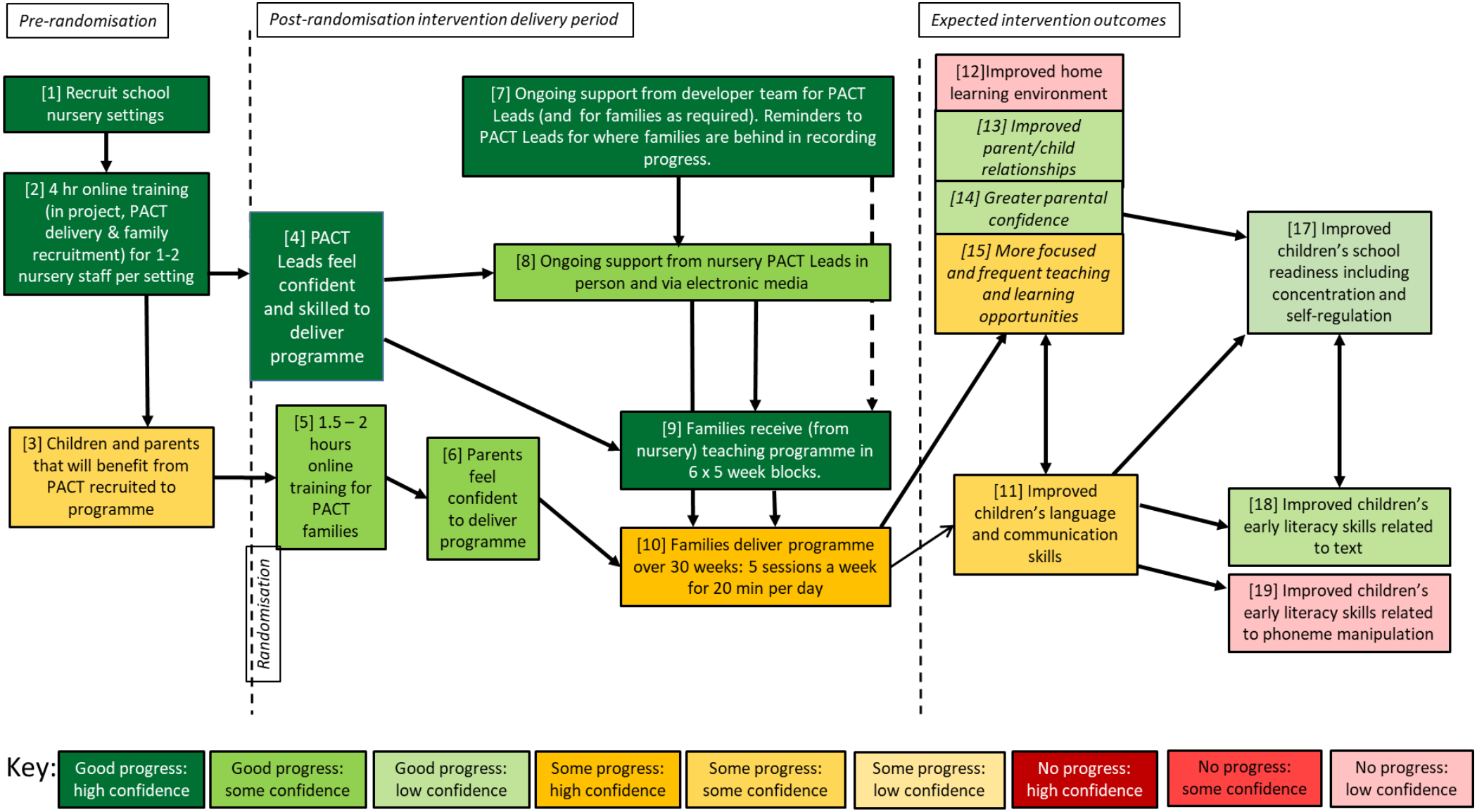

Figure 10. Updated PACT Logic Model

Interpretation

The impact evaluation did not find that taking part in PACT impacted on overall language skills when measured immediately following the intervention although there was a small (but non-significant) effect of the programme eleven months after the intervention. In looking at different domains of language skills there were small but positive effects of the programme on both measures of expressive vocabulary and on one of the two measures of receptive vocabulary (although also not statistically significant) although this was only maintained eleven months later for one measure of expressive vocabulary. The two measures of receptive vocabulary (BPVS and LanguageScreen RV) showed contradictory findings with BPVS show a small impact of the intervention and LS RV showing a very small negative effect. The BPVS measure is delivered face-to-face by a visiting researcher and is a longer measure while the LS RV subscale is a short measure. It may be that the short LS subscale was not as sensitive as the longer BPVS measure here or that since neither outcome was statistically significant, it may indicate that this positive finding for the BPVS occurred by chance. Neither measure showed impact at the eleven-month delayed post-test. The findings for the language outcomes have a high level of security as attrition was low for the primary outcome and for the language secondary outcomes. The IPE results indicated that participants in the PACT programme felt that PACT had improved language outcomes for children however, this data was self-reported and improvements to children's skills may have been due to natural child development over the course of the programme.

The impact evaluation also found no statistical evidence of improvements to school readiness however, the results were positive for the intervention group who showed around two months progress on all school readiness BESSI subscales compared to the control group. This is different to the previous PACT-2 trial which did not find any effect on school readiness when it was measured towards the end of Reception year at school. The previous trial likely suffered from ceiling effects due to the timing of the measure. In this trial the BESSI measure was used at the end of nursery when it was more valid to use. However, again, the lack of statistical significance on this measure here means that this positive result may still be due to chance. Improvements to children's ability to learn, confidence, concentration and behaviour were all reported by parents and PACT Leads as impacts of the PACT programme in the IPE providing further support for these findings.

As discussed above in the logic model section, the impact evaluation found a small negative impact on the Home Learning Environment outcome measure which was not supported by the IPE findings. The IPE findings found that parents involved in PACT reported changed practice in how they read with their children, improved confidence in supporting their child's learning and increased one-to-one time with children. It seems likely that PACT may specifically improve the home learning environment related to reading story books and promoting language, however the time taken for PACT may have displaced some of the other activities measures in the Home Learning Environment Index and therefore led to lower scores on this measure for the intervention group in comparison to the control group.

The impact evaluation found no statistical evidence of improvements to children's early literacy skills eleven months after the intervention, although there was a positive impact of 2 months progress on the early word reading regular word subscale and a positive impact equivalent to 1 month progress on the letter-sound knowledge scale. However, this was contradicted by a negative finding for the sound-deletion test. While these results are in a similar direction to those found in the PACT-1 trial, which found significant impact on letter-sound knowledge and regular word reading, the magnitude of the effect sizes are much lower in this trial compared to the PACT-1 trial.

For the small group of children who were eligible for EYPP, the PACT programme appears to have a small negative impact on the primary language skills outcome (effect size -0.04) at immediate post-testing and no effect eleven months after the programme. At immediate post-testing there are also contradictory effects across the different LS subscales secondary outcomes (with negative effect sizes on the receptive and expressive LanguageScreen subscales, no effect on the listening comprehension subscale and a small positive effect on the sentence repetition subscales). However, the face-to-face researcher-delivered secondary outcome language measures showed a more positive effect for the EYPP group on the BPVS receptive vocabulary measure, the CELF expressive vocabulary measure and the APT Grammar measure compared to the sample as a whole. At delayed post-testing, there appears to be a positive effect for the EYPP group on receptive vocabulary measures (equivalent to two to five months progress) which is not present in the sample, and a negative impact on the LanguageScreen sentence repetition measure compared to the sample as a whole. Other outcomes were similar to those for the full group. However, these results should be interpreted very cautiously as they are based on a small subgroup of participants which was underpowered to look for an effect in this group.

The trial was designed to be delivered as an efficacy trial with the intervention delivered under ideal conditions and there were limited disruptions to this. The IPE found that overall PACT was delivered as expected with all elements of the programme delivered reasonably well. There was a similar level of engagement (measured through number of sessions completed) with the PACT programme as in the previous PACT-1 and PACT-2 trials, however for all trials the mean level of engagement with the programme in terms of percentage of PACT sessions completed was between 58 and 65% and engagement with the programme throughout the programme could be improved, in particular towards the latter stages of the programme.

The IPE also found that there was evidence of compensatory activities going on for some children in the control group. A few nurseries provided additional support specifically to non-PACT children which included activities in nurseries as well as sending activities home for parents to do. Some control group parents also reported having seen the PACT materials and 11% of control group parents also said they had used the PACT materials with their children. Although these compensatory activities did not affect the majority of the control group it may have lessened any impact seen in the trial.

While the results of this evaluation are similar to those of the disrupted PACT-2 trial, which found no impact of the programme on language outcomes as measured by LanguageScreen at delayed post-test, they are not in line with the original PACT-1 trial, which found that PACT improved a range of language outcomes for participating children as well as early literacy skills. The evaluation design of the first PACT trial was different using a cross-over design with an active motor skills programme control group instead of the business-as-usual control group. One hypothesis could be that the regular active control group activity in PACT-1 displaced some of the beneficial usual practice (e.g., shared book reading) in those families which might have led to seeing a larger effect for the intervention group in that trial. It may also be that due to the active control intervention there was less time or need for compensatory activities (of which there seems some evidence for in this trial). Another explanation could be that the recruitment of children's centre's instead of school nurseries in the PACT-1 trial led to the trialling of the PACT programme with a notably different sample with different characteristics to the families taking part in PACT-2 and PACT-3. For the PACT-3 sample a higher percentage of families has a higher education degree (57%) compared to in the PACT-1 sample (24%) (however some caution should be applied as for PACT-3 this was the highest qualification in the household rather than the responding adult). This idea of recruiting through children's centres resulting in a different sample was also emphasised by the developer in the developer interview:

> *"I think the families who engage with those settings are very different. I mean if I think about the children's centres, families were volunteering themselves to engage with the children's centre. There is already that level of, "I'm a committed parent who is seeking out opportunities for support" whereas with your nursery, I mean you are basically taking your child for childcare aren't you, essentially."*
>
> (Developer Interview)

Children's centres also serve a different purpose to school nurseries, existing to engage and help support families rather than to just look after children and provide education. Nurseries wouldn't normally have family engagement as a focus of their activities and may be less well placed to deliver them. It may also be that families who attended the children's centre were in more need of the PACT programme and were doing less of these activities before PACT. There is some evidence from this trial to support this theory in that participating families already had a good number of children's books in the household with 61% of the sample having more than 50 children's books in the house (compared to the PACT-1 trial where 38% of sample had more than 50 children's books). The majority of families in the PACT-3 trial also already read to their child at least once a day already showing that they already valued shared book reading. Parents in the control group in this trial also reported using dialogic reading strategies with their children despite not receiving PACT. Anecdotal evidence from PACT Leads during the IPE also flagged as a potential issue that the parents that signed up to take part in the project were those already engaged in their children's learning.

An alternative explanation for why this study did not replicate the PACT-1 results could be that different outcome measures were used in the PACT-1 trial to those used in this trial and these measures may not have been sensitive to the PACT programme. This trial sometimes found some conflicting results between the LanguageScreen subscales of receptive and expressive vocabulary and the researcher-delivered measures of these language domains which could lend some evidence to this theory. However, none of the outcome measures used in this trial found statistically significant effects so it seems unlikely that this explanation holds.

A further possible explanation of why this trial (and the PACT-2 trial) did not find PACT impacted on outcomes could be due to the policy context and timing of the trial. Since the PACT-1 trial, there have been reforms to the Early Years Foundation stage which may have changed the teaching practice in early years classrooms as well as specific post-covid policy focus and awareness on improving language in early years at nursery and on entry to school. It may be that there is less of a need for the PACT programme now as nurseries are now delivering more language supporting activities and children and parents who need support are already receiving additional support. This context shift may be contributing to the lack of impact found in this trial but it seems unlikely this is the whole picture.

It is difficult to interpret why this PACT evaluation did not find clear evidence to support the logic model and the findings from the PACT-1 trial. The most likely explanation seems the difference in samples recruited from children's centres and those from school nurseries i.e., with families more well-educated and already engaged in supporting their child's education. Difficulties with recruitment may have also led to only the most engaged and motivated parents signing up to the project. Further research into the characteristics of the families take up the offer of PACT and their circumstances would be needed to investigate in further research to see whether this is a feasible explanation.

Limitations and lessons learned

This evaluation ran smoothly, especially in comparison to the Covid-19 impacted previous PACT-2 study. However, there were a few instances where there are limitations in how the project ran and how the results are interpreted.

The recruitment of families to the project was a challenge for nursery settings meaning that the project did not manage to recruit the targeted number of families. The recruitment was particularly challenging due to the timing of the project which was designed to fit in the baseline assessment, the 30 weeks of PACT programme and the post-testing within the school year. This mean that nurseries were asked to recruit families in the July before the programme began and at the beginning of September. At this time many of the children were new to the settings and nurseries had not had the chance to get to know the families or children – this lack of relationship building was exacerbated by the Covid-19 policies in place in schools at the beginning of the project. The PACT programme was therefore offered to all families in the setting and not necessarily targeted at those who could most benefit from it. Families who were already more engaged with the nursery may have been more likely to sign-up and this may have limited the ability to see the impact of such a programme.

The evidence of some compensatory behaviour and of some control group parents having had access to the PACT materials may indicate that randomisation at the individual child level was not the most appropriate design for this study. Randomisation at the level of the nursery would limit any exposure of the control group to the PACT materials and be less likely to introduce compensatory behaviour at the nursery level for the control group children. A future trial may want to consider altering the design.

In order to include a number of outcome measures that had previously been shown to be impacted the PACT programme, as well as to manage the risk that Covid-19 restrictions may limit the delivery of face-to-face assessments, this study had a large number of secondary language outcomes including in two cases, different measures of the same construct (expressive and receptive vocabulary). Where the results of these secondary outcomes have not been similar (in one case showing a negative effect of the programme on one measure and a positive effect of the programme on another measure) it is difficult to interpret these results and decide which measure is a true indication of the impact of the programme. However, given that none of the effects of the secondary outcomes were statistically significant this is probably less on an issue indicating the effects seen may have been due to chance. Future research should focus on the most promising outcome measures to investigate further whether these effects are replicated.

As discussed above, the use of the HLE survey may not have been an appropriate measure of the expected change to the home learning as a result of the PACT programme. Some evidence from this evaluation indicates that the changes to the home learning environment were in the quality and quantity of the shared book reading activity at home, while the HLE captures a broader range of activity in less detail. A more targeted measure of the home learning environment related to shared book reading and language development activities may have been more likely to find an improvement as a result of PACT.

As with many research trials, there is the potential for the IPE data to be biased towards parents that were more engaged with the programme. Attempts were made to mitigate for this for example, using survey and interview incentives, shortening surveys from those delivered in PACT-2 and targeting interview invitations to specific families representing a range of different characteristics. However, the survey response rate was still less than 70% of the sample, meaning that we have not been able to draw on IPE data from 30% of the sample. This should be borne in mind when interpreting the findings, although surveys were completed by similar percentages of intervention and control group parents making it unlikely that only those more motivated by the PACT programme completed the survey.

This study was based in mostly urban settings in the north-west region of England and was delivered to families through school nurseries. It is therefore difficult to generalise these findings outside of this region and of this sample of families.

Future research and publications

Due to this study not replicating the findings of PACT-1, additional research should be carried out to look at whether the PACT programme may be effective with different samples (e.g., PVI nurseries) or delivered through alternative providers (e.g., health visitors). As participants were not engaged with the programme for the full thirty weeks, research that looks into a shorter PACT programme but allows settings more time to target recruitment may also support the programme to target those families most at need.

Future publications in academic journals, written jointly with the developer team, are planned to report on the impact evaluation results of the PACT-2 and PACT-3 trials as well as the lessons that can be learned from the implementation of home shared-reading programmes.

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Appendix A: EEF cost rating

Cost rating	Description
£ £ £ £ £	*Very low:* less than £80 per pupil per year.
£ £ £ £ £	*Low:* up to about £200 per pupil per year.
£ £ £ £ £	*Moderate:* up to about £700 per pupil per year.
£ £ £ £ £	*High:* up to £1,200 per pupil per year.
£ £ £ £ £	*Very high:* over £1,200 per pupil per year.

Appendix B: Security classification of trial findings

OUTCOME: *Language Skills Latent Variable*

Rating	Criteria for rating			Initial score		Adjust		Final score
	Design	**MDES**	**Attrition**					
5		<= 0.2	0-10% (9%)					
4	Design for comparison that considers some type of selection on unobservable characteristics (e.g. RDD, Diff-in-Diffs, Matched Diff-in-Diffs)	0.21 - 0.29 (0.21-0.22)	11-20%	4				
3	Design for comparison that considers selection on all relevant observable confounders (e.g. Matching or Regression Analysis with variables descriptive of the selection mechanism)	0.30 - 0.39	21-30%			Adjustment for threats to internal validity **1**		3
2	Design for comparison that considers selection only on some relevant confounders	0.40 - 0.49	31-40%					
1	Design for comparison that does not consider selection on any relevant confounders	0.50 - 0.59	41-50%					
0	No comparator	>=0.6	>50%					

Threats to validity	Risk rating	Comments
Threat 1: Confounding	Low	Some imbalance in observables but primary outcome imbalance is low, and pre-tests accounted for in analyses.
Threat 2: Concurrent Interventions	Moderate	Some evidence of compensatory activities in the control group (teachers sending additional activities to non-PACT families) but this was not controlled for analytically.
Threat 3: Experimental effects	Moderate	Evidence of around 11% of PACT families receiving PACT materials. Sensitivity analysis showed that removing these participants made minimal difference to the study's main outcome.
Threat 4: Implementation fidelity	Low	Training delivered with fidelity but compliance among parents waned over time. IPE is detailed and comprehensive.
Threat 5: Missing Data	Low	Relatively low missing data and FIML used.
Threat 6: Measurement of Outcomes	Moderate	Outcome measures described in detail and justified based on intended outcomes and prior trials.
Threat 7: Selective reporting	Low	Protocol/trial pre-registered and available.

Appendix C: Changes since the previous evaluation

	Feature	PACT-2 changes from Burgoyne *et al.* (2018b) study PACT-1 (non-EEF funded)	PACT-3 changes from Covid-affected PACT-2 trial
Intervention	Intervention content	There were updates to the programme content from PACT-1 to PACT 2. This included changes to some of the story books (and resources to go with them due to availability of books as well as updates to how the resources were presented to make them look more professional and engaging. Introduction of PACTApp to record progress through the intervention.	The PACT home reading programme is identical to the PACT-2 study. Some additional resources were created to support delivery and recruitment including: • PACT video to support recruitment. • PACT demonstration videos for parents/carers to access.
	Delivery model	The study has been moved from 22 children centres to nurseries (47 in the first EEF trial, 43 in the second). In PACT-1, parents received a £10 gift voucher on completion of each 10-week block of the programme at celebration events. In EEF trials all families (intervention and control) were given £10 for each assessment their child went through (pre-test, post-test and delayed post-test)	Delivery of PACT Lead and parent/carer training changed from face-to-face training to live online or video delivery because of University Ethics' Covid-19 restriction on face-to-face contacts.
	Intervention duration	No change – 30 weeks.	No changes – 30 weeks (which was delayed by Covid-19 in PACT-2 trial).
Evaluation	Eligibility criteria	Change from delivery through Children's Centres to delivery through state-maintained nurseries.	Nurseries – should be administratively part of a school rather than standalone settings – to reduce attrition at delayed post-test. Additional eligibility criteria that families, who took part in PACT-2 study cannot sign up with their younger siblings.
	Level of randomisation	No changes. – individual randomisation within settings	No changes – individual randomisation within settings
	Outcomes and baseline	Originally planned same language and early literacy outcome measures however, covid-19 restrictions meant no immediate post-test was possible and delayed post-test changed to Language Screen latent variable. Baseline measures remained the same.	Primary outcome changed to Language Screen from the previous combination of CELF, APT and BPVS due to the risk of Covid-19 restrictions limiting face-to-face assessments. LanguageScreen is delivered by nursery staff using an app and can therefore be delivered even if face-to-face visits are not possible. LanguageScreen was also used as the baseline assessment for nurseries.

			Secondary outcomes of CELF Expressive Vocabulary, BPVS and APT added to post-testing when it was more likely these would be able to go ahead. The timing of the BESSI school readiness (secondary outcome) measure was changed to be delivered at the end of nursery instead of first year of school. YARC early literacy measures and APT, BPVS and CELF-EV added to delayed post-testing (11 months after completion of the intervention)
	Control condition	Change from motor skills programme to 'business as usual' with book bundle incentive at end of intervention period.	No changes – 'business as usual' with book bundle incentive at end of intervention period.

Appendix D: Effect size estimation

Appendix table 1: Analysis for immediate post-test measures reflecting adjusted mean difference between groups, effect size using conditional and unconditional variances, for both the usual MLM model in pre-test only as covariate, and for the model with pre-test and 'pre-test completeness' stratification variable used for randomisation as covariate.

Outcomes	Parameters	Effect size (ES) for model with pre-test, Confidence intervals	Effect size (ES) for model with pre-test + stratification variable, confidence intervals
T2 LS latent variable	Adjusted mean difference	0.08 (-0.33, 0.49)	0.08 (-0.33, 0.49)
	ES_conditional*	0.05 (-0.20, 0.29)	0.05 (-0.20, 0.29)
	ES_unconditional**	0.03 (-0.23, 0.28)	0.03 (-0.23, 0.28)
T2 HLE	Adjusted mean difference	-0.67 (-2.61, 1.27)	-0.67 (-2.61, 1.27)
	ES_conditional*	-0.10 (-0.40, 0.21)	-0.10 (-0.40, 0.21)
	ES_unconditional**	-0.07 (-0.35, 0.21)	-0.07 (-0.35, 0.21)
T2 CELF EV	Adjusted mean difference	0.23 (-0.81, 1.28)	0.23 (-0.81, 1.29)
	ES_conditional*	0.05 (-0.16, 0.25)	0.04 (-0.16, 0.25)
	ES_unconditional**	0.03 (-0.22, 0.29)	0.03 (-0.22, 0.29)
T2 BPVS	Adjusted mean difference	1.92 (-1.18, 5.07)	1.92 (-1.18, 5.08)
	ES_conditional*	0.15 (-0.1, 0.41)	0.15 (-0.1, 0.41)
	ES_unconditional**	0.11 (-0.14, 0.36)	0.11 (-0.14, 0.36)
T2 APT Information	Adjusted mean difference	-0.03 (-1.18, 1.17)	-0.03 (-1.18, 1.17)
	ES_conditional*	-0.01 (-0.25, 0.23)	-0.01 (-0.25, 0.23)
	ES_unconditional**	-0.01 (-0.26, 0.25)	0.00 (-0.26, 0.25)
T2 APT Grammar	Adjusted mean difference	0.05 (-1.22, 1.34)	0.06 (-1.21, 1.34)
	ES_conditional*	0.01 (-0.24, 0.26)	0.01 (-0.24, 0.26)
	ES_unconditional**	0.01 (-0.24, 0.25)	0.01 (-0.24, 0.25)
BESSI BA	Adjusted mean difference	-0.39 (-1.17, 0.40)	-0.39 (-1.17, 0.39)
	ES_conditional*	-0.14 (-0.42, 0.14)	-0.14 (-0.42, 0.14)
	ES_unconditional**	-0.14 (-0.40, 0.13)	-0.14 (-0.40, 0.13)
BESSI LC	Adjusted mean difference	-0.13 (-0.35, 0.09)	-0.12 (-0.34, 0.09)
	ES_conditional*	-0.12 (-0.33, 0.09)	-0.12 (-0.33, 0.09)
	ES_unconditional**	-0.11 (-0.37, 0.15)	-0.11 (-0.37, 0.16)
BESSI DLS	Adjusted mean difference	-0.15 (-0.4, 0.09)	-0.15 (-0.4, 0.1)
	ES_conditional*	-0.14 (-0.36, 0.09)	-0.14 (-0.36, 0.09)
	ES_unconditional**	-0.13 (-0.38, 0.12)	-0.13 (-0.38, 0.12)
BESSI FS	Adjusted mean difference	-0.15 (-0.44, 0.15)	-0.15 (-0.44, 0.15)
	ES_conditional*	-0.12 (-0.38, 0.13)	-0.12 (-0.38, 0.13)
	ES_unconditional**	-0.12 (-0.4, 0.16)	-0.12 (-0.4, 0.16)
BESSI Total	Adjusted mean difference	-0.77 (-1.9, 0.37)	-0.77 (-1.9, 0.37)
	ES_conditional*	-0.16 (-0.41, 0.08)	-0.16 (-0.41, 0.08)
	ES_unconditional**	-0.15 (-0.43, 0.13)	-0.15 (-0.43, 0.13)
T2 LS EV	Adjusted mean difference	0.40 (-0.16, 0.97)	0.41 (-0.15, 0.97)
	ES_conditional*	0.15 (-0.06, 0.35)	0.15 (-0.06, 0.35)
	ES_unconditional**	0.10 (-0.15, 0.34)	0.10 (-0.15, 0.35)
T2 LS RV	Adjusted mean difference	-0.17 (-0.79, 0.45)	-0.17 (-0.79, 0.45)

	ES_conditional*	-0.06 (-0.29, 0.17)	-0.06 (-0.30, 0.17)
	ES_unconditional**	-0.05 (-0.29, 0.19)	-0.05 (-0.29, 0.19)
T2 LS LC	Adjusted mean difference	-0.12 (-0.87, 0.62)	-0.12 (-0.82, 0.54)
	ES_conditional*	-0.04 (-0.29, 0.21)	-0.04 (-0.29, 0.21)
	ES_unconditional**	-0.03 (-0.29, 0.23)	-0.03 (-.029, 0.23)
T2 LS SR	Adjusted mean difference	-0.02 (-0.65, 0.61)	-0.02 (-0.65, 0.61)
	ES_conditional*	-0.01 (-0.24, 0.22)	-0.01 (-0.24, 0.22)
	ES_unconditional**	-0.01 (-0.28, 0.26)	-0.01 (-0.28, 0.26)

**Unconditional model is included in the report as the main analyses

*Conditional model is done as sensitivity analysis

Appendix table 2: Analysis for delayed post-test measures reflecting adjusted mean difference between groups, effect size using conditional and unconditional variances, for both the usual MLM model in pre-test only as covariate, and for the model with pre-test and 'pre-test completeness' stratification variable used for randomisation as covariate.

Outcomes	Parameters	Effect size (ES) for model with pre-test, Confidence intervals	Effect size (ES) for model with pre-test + stratification variable, confidence intervals
Delayed post-test latent LS variable (T3)	Adjusted mean difference	0.24 (-0.13, 0.61)	0.24 (-0.14, 0.61)
	ES_conditional*	0.14 (-0.08, 0.36)	0.14 (-0.08, 0.35)
	ES_unconditional**	0.09 (-0.14, 0.33)	0.09 (-0.14, 0.33)
T3 CELF EV	Adjusted mean difference	-0.13 (-1.13, 0.86)	-0.15 (-1.14,0.85)
	ES_conditional*	-0.04 (-0.25, 0.17)	-0.04 (-0.25, 0.17)
	ES_unconditional**	-0.03 (-0.27, 0.22)	-0.03 (-0.27, 0.22)
T3 BPVS	Adjusted mean difference	-0.54 (-2.83, 1.75)	-0.54 (-2.84, 1.75)
	ES_conditional*	-0.04 (-0.26, 0.17)	-0.04 (-0.26, 0.17)
	ES_unconditional**	-0.03 (-0.30, 0.24)	-0.03 (-0.30, 0.24)
T3 APT Information	Adjusted mean difference	0.26 (-0.74, 1.26)	0.26 (-0.75, 1.26)
	ES_conditional*	0.05 (-0.19, 0.29)	0.06 (-0.17, 0.28)
	ES_unconditional**	0.04 (-0.19, 0.28)	0.05 (-0.19, 0.29)
T3 APT Grammar	Adjusted mean difference	-0.71 (-1.76, 0.34)	-0.74 (-1.79, 0.31)
	ES_conditional*	-0.15 (-0.38, 0.08)	-0.16 (-0.39, 0.07)
	ES_unconditional**	-0.13 (-0.37, 0.11)	-0.14 (-0.38, 0.10)
YARC LSK	Adjusted mean difference	0.18 (-0.30, 0.65)	0.18 (-0.29, 0.65)
	ES_conditional*	0.06 (-0.15, 0.26)	0.06 (-0.15, 0.26)
	ES_unconditional**	0.05 (-0.25, 0.36)	0.05 (-0.25, 0.36)
YARC EWR Regular	Adjusted mean difference	0.51 (-0.26, 1.28)	0.52 (-0.25, 1.28)
	ES_conditional*	0.14 (-0.06, 0.34)	0.14 (-0.06, 0.34)
	ES_unconditional**	0.12 (-0.17, 0.41)	0.12 (-0.17,0.41)
YARC EWR Exception	Adjusted mean difference	0.26 (-0.52, 1.05)	0.27 (-0.52, 1.06)
	ES_conditional*	0.07 (-0.17, 0.30)	0.08 (-0.12, 0.29)
	ES_unconditional**	0.06 (-0.20, 0.32)	0.08 (-0.18, 0.34)
YARC SD	Adjusted mean difference	-0.26 (-0.75, 0.24)	-0.24 (-0.74, 0.25)
	ES_conditional*	-0.12 (-0.35, 0.11)	-0.11 (-0.34, 0.12)
	ES_unconditional**	-0.11 (-0.35, 0.14)	-0.10 (-0.35, 0.15)
T3 LS EV	Adjusted mean difference	0.36 (-0.22, 0.93)	0.35 (0.22, 0.92)
	ES_conditional*	0.13 (-0.08, 0.35)	0.13 (-0.09, 0.35)
	ES_unconditional**	0.10 (-0.15, 0.35)	0.10 (-0.16, 0.35)
T3 LS RV	Adjusted mean difference	-0.02 (-0.54, 0.51)	-0.01 (-0.54, 0.51)
	ES_conditional*	-0.06 (-0.32, 0.20)	-0.06 (-0.32, 0.21)
	ES_unconditional**	-0.05 (-0.28, 0.18)	-0.05 (-0.28, 0.18)
T3 LS LC	Adjusted mean difference	0.17 (-0.47, 0.82)	0.16 (-0.48, 0.81)
	ES_conditional*	0.05 (-0.17, 0.27)	0.05 (-0.17, 0.27)
	ES_unconditional**	0.05 (-0.18, 0.28)	0.05 (-0.19, 0.28)
T3 LS SR	Adjusted mean difference	0.26 (-0.26, 0.78)	0.26 (-0.27, 0.78)
	ES_conditional*	0.12 (-0.09, 0.34)	0.12 (-0.09, 0.34)
	ES_unconditional**	0.10 (-0.15, 0.36)	0.10 (-0.15, 0.36)

**Unconditional model is included in the report as the main analyses

*Conditional model is done as sensitivity analysis

Further appendices:

A further document of technical appendices is available separately which includes the following:

Appendix E: Recruitment documents

- E.1 Memorandum of Understanding (MoU)
- E.2 Participation Agreement Form (PAF)
- E.3 Information Sheet for Schools
- E.4 Information Sheet to Parents
- E.5 Privacy Notice for PACT Leads
- E.6 Privacy Notice for Parents
- E.7. Three-way Data Sharing Agreement between the developer team, evaluation team and schools recruited at the start of the project
- E.8. Three-way Data Sharing Agreement for schools joining the project only for post-testing/delayed post-testing

Appendix F: Research Tools

- F.1. PACT Lead Post Training Survey
- F.2. PACT Lead Baseline Survey
- F.3. PACT Lead Post Intervention Survey
- F.4. PACT Parent Baseline Survey
- F.5. PACT Intervention Parent Post Intervention Survey
- F.6. PACT Control Parent Post Intervention Survey
- F.7. First PACT Lead Interview Information Sheet and Schedule
- F.8. Second PACT Lead Interview Information Sheet and Questions
- F.9. First Parent Interview Information Sheet and Questions
- F.10. Second Parent Interview Information Sheet and Questions
- F.11. PACT Developer Interview Information Sheet and Questions
- F.12. PACT Lead Training Observation Sheet
- F.13. Parent Training Observation Sheet
- F.14. Assessor Quality Assurance Framework

Appendix G: Statistical Appendices

- G.1 Randomisation and analysis code
- G.2 Complier Average Causal Effect Results
- G.3 Creation of latent variables
- G.4 Distribution of outcome variables
- G.5 R Analysis code

- G.6 Developer cost of programme
- G.7 Correlation tables between outcomes
- G.8 PACT Training attendance and training survey responses
- G.9 Process for comparing PACTApp/Record form data with survey data
- G.10 Parent report of nursery support for families
- G.11 The PACT Lead Role
- G.12 Parent reasons for taking part in the programme
- G.13 Nursery usual practice with supporting home learning at baseline
- G.14 Effect size for EYPP subgroup analysis
- G.15 Sensitivity analysis effect sizes

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