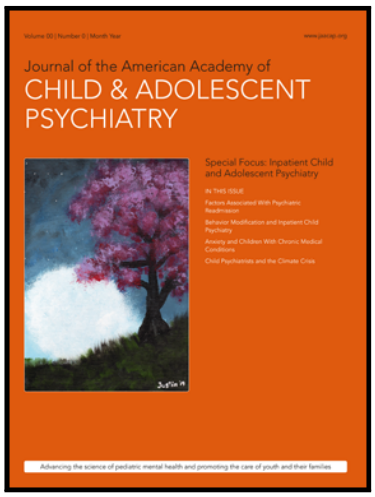

A Novel Group Parenting Intervention for Emotional and Behavioral Difficulties in Young Autistic Children: Autism Spectrum Treatment and Resilience (ASTAR): A Randomized Controlled Trial

Tony Charman PhD , Melanie Palmer PhD , Dominic Stringer MSc , Victoria Hallett PhD , Joanne Mueller DClinPsych , Renee Romeo PhD , Joanne Tarver PhD , Juan Paris Perez MSc , Lauren Breese DClinPsych , Megan Hollett BSc , Thomas Cawthorne MSc , Janet Boadu MSc , Fernando Salazar MRCPsych , Mark O'Leary FRCPCH , Bryony Beresford PhD , Martin Knapp PhD , Vicky Slonims PhD , Andrew Pickles PhD , Stephen Scott FRCPsych , Emily Simonoff FRCPsych

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A Novel Group Parenting Intervention for Emotional and Behavioral Difficulties in Young Autistic Children: Autism Spectrum Treatment and Resilience (ASTAR): A Randomized Controlled Trial

RH = Parent Intervention for Co-occurring Problems in Autism

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Supplemental Material

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Prof. Pickles, Mr. Stringer, Prof. Knapp, Dr. Romeo, and Ms. Boadu served as the statistical experts for this research.

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The independent members of the ASTAR TSC were: Prof. Alan Stein, FRCPsych, University of Oxford (Chair); Prof. Matthew Sydes, CStat, MRC Clinical Trials Unit at UCL, University College London (Member); Dr. Jacqueline Rodgers, PhD, University of Newcastle (Member); Bridget Gilchrist (Parent Representative); and Lindsay Stairs (Parent Representative). As the trial is a pilot

RCT, the TSC agreed that a subgroup of members consisting of Profs. Stein and Sydes would act as the Independent Data Monitoring Committee (IDMC) for ASTAR.

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ABSTRACT

Objective: To examine feasibility and preliminary efficacy of a group behavioural parenting intervention for emotional and behavioural problems (EBPs) in young autistic children.

Method: Feasibility pilot randomized controlled trial comparing a 12-week group behavioural parenting intervention (Predictive Parenting) to an attention control (Psychoeducation). Parents of sixty-two 4-8-year-old autistic children were randomized to Predictive Parenting (*n*=31) or Psychoeducation (*n*=31). Primary outcome: Blinded observational measure of child behaviours that challenge. Secondary outcomes: Observed child compliance and parenting behaviours; parent- and teacher-reported child EBPs; self-reported parenting practices, stress, self-efficacy and wellbeing. Cost-effectiveness was explored.

Results: Recruitment, retention, completion of measures, treatment fidelity and parental satisfaction were high for both interventions. There was no group difference in primary outcome: mean log of

rate 0.18 lower (*d*, 90% *CI*, -0.44 to 0.08) in Predictive Parenting. Differences in rates of child compliance (0.44, 90% *CI* 0.11 to 0.77), facilitative parenting (0.63, 90% *CI* 0.33 to 0.92) and parent-defined target symptom change (-0.59, 90% *CI* -0.17 to -1.00) favoured Predictive Parenting. No differences on other measures. Predictive Parenting was more expensive than Psychoeducation with low probability of being more cost-effective.

Conclusion: Feasibility was demonstrated. There was no evidence from this pilot trial that Predictive Parenting resulted in reductions in child EBPs beyond those seen following Psychoeducation, the effect size was small, and it was more expensive. However, it showed superiority for child compliance and facilitative parenting with moderate effect sizes. Future, definitive studies should evaluate whether augmented or extended intervention would lead to larger improvements.

Clinical trial registration information: Autism Spectrum Treatment and Resilience (ASTAR); https://www.isrctn.com/; ISRCTN91411078.

Key words: autism, emotional and behavioral problems, parenting, feasibility, randomized controlled trial

INTRODUCTION

Background

Autism is characterised by difficulties in reciprocal social communication and the presence of restricted and repetitive behaviours and sensory anomalies.[1] Psychiatric disorders frequently co-occur with autism at higher rates than the general population, with up to 80-90% of young autistic children displaying emotional or behavioural problems (EBPs).[2-4] Anxiety disorders, attention deficit/hyperactivity disorder (ADHD) and oppositional defiant disorder are most common and tend to persist over time.[5] These co-occurring difficulties are associated with greater parental stress and poorer well-being.[6]

Behavioural parenting interventions (BPIs) based on operant conditioning and social learning theories are well-established psychosocial approaches for improving behavioural problems in non-autistic children.[7] There is evidence for their effectiveness when delivered in both individual and group formats.[8,9] BPIs have been adapted for parents of young autistic children and there is emerging evidence for their efficacy.[10-12] Meta-analysis of randomized controlled trials (RCTs) of BPIs to reduce disruptive child behaviour found a moderate effect[13] and some evidence for improvements in child hyperactivity and parent stress.[14]

However, there are limitations in the extant literature. Only one RCT[13] involved anxiety management techniques even though anxiety disorders are the most common co-occurring psychiatric diagnoses in autistic children(2-4) and disruptive behaviours are often described by parents as an observable manifestation of anxiety.[15] Most trials have evaluated individual BPIs, although groups are more scalable and provide a support network for parents[8,16]; see Williams et al.[17] for a recent exception. Primary outcomes have been parent-reported measures of child EBPs, that are unblinded to intervention allocation for parent-mediated interventions and there is a need for blinded, objective measures of child outcomes. No trials in this area have estimated costs or explored cost-effectiveness.

Aims and objectives

We conducted a pilot RCT to evaluate the feasibility and preliminary efficacy and cost-effectiveness of a novel group-based BPI for young autistic children (Predictive Parenting), in comparison to an attention control (Psychoeducation), using a blinded observational measure of child behaviours that challenge (BTC) as the primary outcome.[18] Predictive Parenting consisted of 12 sessions with 6 to 8 parents/carers and two individual consultations. It provides strategies to manage both externalising behavioural problems and anxiety.[19] Separate groups were run for parents of minimally verbal (MV) and verbal (V) children to tailor content to the child's level of language and facilitate group cohesion. As universal interventions are warranted given the high prevalence of co-occurring EBPs we did not exclude children based on level of EBPs.

The aims of the study were to: (1) examine feasibility in terms of recruitment, retention, completion of research measures, fidelity of implementation of the intervention and parental satisfaction; (2) provide an indication of preliminary efficacy on the primary and secondary outcomes; and (3) provide preliminary estimates of the costs and cost-effectiveness of the intervention; to inform a larger trial.

METHOD

Trial design

Study registration: ISRCTN91411078. Ethical approval: NHS Camden and Kings Cross Research Ethics Committee (16/LO/1769). Parents/carers gave written informed consent. The study was a parallel two-group, two-site pilot RCT comparing Predictive Parenting to Psychoeducation. Parents of 62 children were randomized to Predictive Parenting (*n*=31) versus Psychoeducation (*n*=31). Since intervention group composition and content were adapted based on child verbal language (MV vs V), randomization was stratified by verbal ability as well as site. Randomization was conducted on blocks of 10-18 families on a ratio of 1:1, resulting in groups of 5-9 families in each condition for any block. Baseline measures were collected up to two months prior to the planned randomization date and post-intervention measures at approximately 18-24 weeks after randomization, once the 12-week intervention finished (see Figure 1 for CONSORT flow and timeline).

Participants

Inclusion criteria: Parent/carer of child aged between 4:0 and 8:11 years with a confirmed autism diagnosis; parent has sufficient spoken English to access the intervention; agreement to inform family doctor of involvement in the study.

Exclusion criteria: Current participation in another BPI; child has epileptic seizures more than weekly; parent or child has a severe hearing or visual impairment; active safeguarding concerns; current severe parental psychiatric disorder; participation in the initial feasibility study.[18]

Procedure

Children were referred via local autism diagnostic teams, education professionals, support groups or self-referral. After pre-screening for eligibility, informed consent was obtained, and baseline assessments conducted. There were separate research and clinical teams based in different buildings with separate supervision structures. Researchers involved in conducting the assessments were blind to intervention content and allocation and to reduce "training to task" therapists were blind to details of primary outcome.

Demographic information and child characterisation measures obtained at baseline are shown in Table 1. These included an observational measure (*Autism Diagnostic Observation Schedule – 2nd edition* [*ADOS–2*])[20] and parental report of autism severity (*Social Communication Questionnaire – Lifetime version* [*SCQ-L*])[21], and parental report of adaptive skills (*Adaptive Behaviour Assessment System – 3rd edition* [*ABAS–3*]).[22] ADOS–2 Module was used as the verbal ability stratification factor (MV=Module 1, defined as pre-verbal or using single words; V=Module 2 or 3, defined as phrase or fluent speech). Standard scores (*M*=10, *SD*=3) on the ABAS-3 Communication domain reflected this stratification factor: MV: 1.14 (0.44); V: 5.24 (2.36).

Interventions

Predictive Parenting

Predictive Parenting consisted of 12 weekly two-hour groups which extended parents' understanding of autism and co-occurring EBPs and included techniques to help parents anticipate, prevent and respond to disruptive behaviour and anxiety.[19] It was developed from the clinical observation that autistic children struggle with unpredictability and anticipating change and integrates well-established behavioural parenting strategies within an autism-specific framework. Predictive Parenting included three over-arching themes: learning to predict behaviour more effectively; making life for the child more predictable; and helping children cope with unpredictability. It also included content on promoting parental self-care and stress reduction (see Table S1, available online). Content was adapted based on child verbal ability. The group structure

included a mixture of presentations and didactic teaching with accompanying handouts and tools (eg, visual schedules, reward and emotion cards etc.), group coaching and practising techniques, and parents supporting each other with strategies and review of homework tasks. If sessions were missed, parents were supported to catch up either over the phone or in person. In addition, two 45-60-minute individual sessions were conducted – between sessions 2 and 4 and 10 and 12 – to support individualisation and generalisation of the strategies. The groups were held in local child and adolescent mental health services, libraries or schools.

Psychoeducation ('Seven Cs of ASD')

Psychoeducation also consisted of 12 weekly two-hour groups providing psychoeducation and social support, but no specific guidance on managing behaviour nor individual sessions. Content was adapted based on child verbal ability and delivered in the same community settings.

Intervention adherence

The therapists delivering the interventions were three doctoral-level clinical psychologists experienced working with autistic children, who led on the development of the intervention manuals. Sessions were led by two therapists and supported by a pre-doctoral psychology assistant or a learning disability nurse. The team was consistent for the duration of each programme (see Table S1, available online). A checklist was completed by therapists after each session, assessing intervention fidelity related to content (6 items Predictive Parenting; 7 items Psychoeducation) and group process (6 items), scored on a scale of 0-2 (0=not covered; 1=partially covered; 2=fully covered). Mean ratings are reported. Parents provided satisfaction ratings via a self-report questionnaire completed post-intervention. Questions (scored on a scale of 1-4, higher scores indicating greater satisfaction) asked about overall satisfaction with the intervention, the tailoring of content, and supportiveness, along with whether they would recommend it to a friend, and for Predictive Parenting the effectiveness of the intervention on child behaviour and emotions (see Table S2, available online). A global satisfaction score for both interventions was calculated by averaging the scores on the four items in common.

Measures

Feasibility

Feasibility was assessed in terms of recruitment, retention, completion of research measures, fidelity of implementation of the intervention and parental satisfaction.

Child outcomes

The primary outcome was the rate of child behaviours that challenge (BTC; eg, destructive behaviour, aggression towards self and others, frustrated vocalisations, non-compliance, avoidance and reassurance seeking). This was coded by researchers blind to intervention allocation from video-recordings of researcher-child and parent-child interactions during an observation developed for the trial (the *Observation Schedule for Children with Autism – Anxiety, Behaviour and Parenting* (*OSCA–ABP*[23]; see Supplement 1, available online, and list of tasks Table S3, available online). Two researcher-led and six parent-led tasks are completed during the 18-22 minute observation. Tasks aim to simulate everyday challenges that autistic children may face and find difficult. As the length of the observation varied, the rate of child BTC per minute was calculated. To establish inter-rater reliability, all baseline videos were coded by 2-3 researchers and 15 videos from post-intervention were double coded (total n = 77 videos resulting in 172 observations). The intraclass correlation coefficient (*ICC*) for rate of child BTC was .83 (95% *CI*, 0.72 to 0.94).

Secondary outcomes include the rate of child compliance, facilitative parenting behaviours (e.g. positive comments, clear commands, praise and supportive physical guidance), non-facilitative parenting behaviours (e.g. negative comments, unclear commands, no opportunity to comply and physical handling) and the proportion of facilitative parenting behaviour (compared to total of all facilitative and non-facilitative parenting behaviours) displayed during the OSCA–ABP (see Table S4, available online).

Other secondary outcomes: parent-reported child irritability and hyperactivity measured on the *Aberrant Behaviour Checklist* (*ABC*)[24]; parent-reported child non-compliance measured on the *Home Situations Questionnaire-Autism Spectrum Disorders* (*HSQ-ASD*)[25]; parent-reported

externalising and internalising behaviour measured on the *Assessment of Concerning Behaviours scale* (*ACB*) [26]; parent-reported child anxiety measured using the *Preschool Anxiety Scale – Revised* (*PASR*)[27]; researcher-rated change in one or two parent-defined target problems[28] and researcher-rated overall improvement in the child from baseline on the *Clinical Global Impression – Improvement* (*CGI-I*)(29); both of the latter rated at post-intervention only. Teacher-reported child irritability and hyperactivity measured on ABC[24] and externalising and internalising behaviour measured on the ACB[26] were also examined.

Parent outcomes

Parent outcomes measures were the Autism Parenting Stress Index (APSI)[30] to assess parenting stress; the Child Adjustment and Parent Efficacy Scale-Developmental Disability (CAPES-DD)[31] Parent Efficacy subscale to assess parenting self-efficacy; the Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS)[32] to measure parental wellbeing; and a short version of the Parenting Scale (PS)[33] to measure self-reported lax and overreactive parenting practices.

Economic pilot evaluation

Information on services used by children and parents was collected using a tailored Client Service Receipt Inventory (CSRI)[34] administered retrospectively at baseline and post-intervention covering previous 3-month periods. Service use data were multiplied by unit costs (2017-18 prices) obtained from publicly available sources[35] or calculated from pay-scales and working hours (see Table S5, available online). Medications prescribed for children were costed from the British National Formulary.[36] Unpaid parent and carer support were costed at unit cost of a homecare worker.

Questionnaires completed by therapists tracked time spent on intervention-related activities (direct contact, arranging and preparing for groups, other administration) and travel expenses. Costs of both groups combined time-use data, mean salaries and overheads using a micro-costing approach (see Table S6, available online).

Quality-adjusted life years (QALYs) were calculated from parent reports of *their own* health-related quality of life (EQ-5D-5L)[37] and societal weights[38], adjusting for time-elapse between data-points and linear interpolation.

Adverse events

Adverse events (AEs) were monitored and documented as they arose during intervention sessions and by the research team at post-intervention, regardless of relationship to study intervention or research procedures. Hospitalisation and bereavement in a family member residing in the home were considered severe adverse events (SAEs).

Statistical analyses

Descriptive statistics were used to demonstrate the feasibility of the study protocol. As detailed in Supplement 1, available online, we had estimated the study design as providing 79% power for a *d* of 0.6 (two-tailed alpha=.05). As a result of the range of baseline scores observed for the primary outcome, some very low, we analysed the log-rate of behaviour, for which power analysis suggested 80% power for a 15% reduction in rate, sufficient to be of clinical significance.

Analyses followed the Statistical Analysis Plan (SAP) available at ISRCTN91411078, registered prior to data-lock and unblinding. All analyses were carried out partially blinded and using the intention-to-treat population. Bivariate linear mixed models (jointly modelling the baseline and post-intervention measures) were used within the generalised structural equation modelling framework in *Stata* (version 15.1) and estimated using maximum likelihood. Allocation group, time (baseline or post-intervention) and site were included as covariates; a random intercept for therapy group was included. In the light of possible effect differences the models were stratified by verbal ability (MV vs V) rather than dummy variable adjusted. The effect of allocation group at baseline was constrained to zero. Modelling this way yielded an ANCOVA estimate of the intervention's preliminary efficacy and allowed participants with non-missing baseline and/or post-intervention observations of the measure to be included. The analysis model outcome included interactions terms for verbal ability strata with treatment and also time providing verbal ability

stratum specific estimates of the treatment effect size, that were then pooled. Separate interpretation of the verbal ability stratum specific estimates was not pre-specified in the SAP and are included in Supplement 1 (Table S7, available online) as exploratory. Analysis models for the secondary outcomes did not include these interactions, and therefore estimated overall treatment effects directly.

Raw score and residual plots were examined for non-normality, those measures with skew being log-transformed. This was the case for all the OSCA–ABP outcomes. To retain a simple proportional interpretation of effects the constant added to avoid instances of logarithms of zero was chosen to be as small as possible while maintaining normality. For outcomes that were rated at post-intervention only (CGI-I and parent-defined target symptoms), the *mixed* command in Stata was used with the same covariates (trial arm, verbal ability and site), and a random intercept for therapy group.

For all outcomes except teacher reports, there was complete baseline data. For the teacher reports, there was a small amount of missing baseline data and an indicator of baseline missingness was additionally included as a covariate.[39] No investigation of predictors of post-intervention missingness was conducted as the proportion was small and for all outcomes (except teacher outcomes and those measured only at post-intervention) all participants were included in the model as a consequence of the bivariate modelling. Under an assumption of missing at random, estimates from the bivariate model will be unbiased. Standardised mean differences (*d*) use the pooled standard deviation across arms measured at baseline, except where there was no baseline measure, in which case the pooled standard deviation at post-intervention was used. Standardised mean differences are given on the log-scale for log-transformed outcomes. Throughout, we have reported 90% CIs as suggested by the DMC and described in the SAP to ensure that possible pilot effects are not missed; however, convention statistical significance was used ($p<.05$).

The primary economic pilot evaluation (cost-effectiveness analysis) compared incremental costs and outcomes over 12 weeks between trial arms from three perspectives: NHS and personal

social service (NHS/PSS); public sector (NHS/PSS, education and criminal justice services linked to the child's autism); and societal (public sector, out-of-pocket payments for autism-related services used by child, services used by other family members linked to child's autism, and unpaid care). Differences in mean costs, adjusted for baseline costs, verbal ability, baseline child BTC rate and site, were analysed using standard non-parametric bootstrapping (repeat re-sampling).[40] Preliminary cost-effectiveness was explored using the net-benefit approach with effectiveness measured on child BTC rates and parent QALYs. Cost-effectiveness acceptability curves were plotted. Sensitivity analyses investigated robustness given uncertainty around some parameters and assumptions.

RESULTS

Feasibility

Recruitment

The majority of the 191 referrals came from child development centres (*n*=80, 41.9%) or child and adolescent mental health services (*n*=55, 28.8%). Thirty-five (18.3%) families referred themselves for the trial after seeing information circulated by local support groups. The remaining 21 referrals (11.0%) were from specialist education provision. Of those who were contactable, just under half (*n*=70/169, 41.4%) consented to take part and of these 62 (88.6%) completed baseline assessments and were randomized.

- FIGURE 1; TABLE 1 HERE –

Completion of research measures, acceptability and retention

Completion of baseline assessment was high, with all families (100.0%) and greater than 90% of teachers completing assessments. High retention rates were achieved (90.3%-96.8%), with at least one outcome being available for all children (see Table S8, available online).

Intervention – Fidelity of implementation and parent satisfaction

Intervention adherence was good with mean (SD) attendance of 8.6 (3.3) and 8.4 (3.7) of 12 therapy sessions and 28 (90%) and 24 (78%) families still participating at the end of the final session in Predictive Parenting and Psychoeducation, respectively (see Figure 1 for reasons for withdrawal from therapy and SM for further information on attendance). Attendance in the individual Predictive Parenting sessions was high (*M*=1.68 sessions, range 0-2). Therapist-rated treatment fidelity was good with mean (SD) scores (out of 2) of 1.93 (0.19) and 1.92 (0.14) for content and 1.90 (0.15) and 1.94 (0.14) for process items for Predictive Parenting and Psychoeducation, respectively. Parental satisfaction was high; 91.3% and 81.8% 'very satisfied' and 8.7% and 13.6% 'satisfied' for Predictive Parenting (eight missing) and Psychoeducation (nine missing), respectively. The mean (*SD*) global satisfaction scores (out of 4) were 3.78 (0.29) and 3.76 (0.28) for Predictive Parenting and Psychoeducation. Parental reports of the effectiveness of Predictive Parenting on their child's behaviour (*M*=3.74, *SD*=0.45) and emotions (*M*=3.58, *SD*=0.51) was high.

Pilot Outcomes

Figure 2 shows the Cohen's *d* effect sizes for all outcomes. Figure 3 shows observed baseline and post-intervention OSCA–ABP scores. The model estimated relationship for the primary outcome of child BTC in Panel A, shows substantial declines in both groups, the additional change in Predictive Parenting compared to Psychoeducation was of modest size and non-significant (Cohen's *d*=0.18, 90% *CI* -0.44 to 0.08). A test of homogeneity of pilot treatment effect across verbal ability strata was non-significant (*p*=.149). There were group differences on the secondary observational measures in the relative rates of change in child compliance (Panel B *d*=0.44, 90% *CI* 0.11 to 0.77) and facilitative parenting (Panel D *d*=0.63, 90% *CI* 0.33 to 0.92) favouring Predictive Parenting, but no group difference for non-facilitative parenting (Panel C). There was an improvement in researcher-rated, parent-defined target problem measurement (*d*=-0.59, 90% *CI* -0.17 to -1.00) favouring Predictive Parenting. Groups did not differ on parent- or

teacher-reported child EBPs measures, nor on measures of parenting, parent stress, self-efficacy and wellbeing (see Figure 2 and Tables 2 and 3). Untransformed OSCA–ABP rates are in Table S9, available online.

- FIGURES 2, 3; TABLES 2, 3 HERE –

Exploratory, non-preregistered analyses by verbal ability strata suggested that there was a moderate difference for child BTC and child compliance in favour of Predictive Parenting among MV children and a large difference in favour of Psychoeducation for facilitative parenting among V children. However, tests of the significance of these differences across strata were, in all cases, non-significant (for details see Table S7, available online).

Adverse Events (AEs)

There were 47 AEs reported during the trial, of which 12 were SAEs. AEs were similar across arms: 15 families reporting 24 events (Predictive Parenting); 16 reporting 23 events (Psychoeducation). The number of SAEs was also similar across arms: 3 families reporting 4 events (Predictive Parenting); 5 families reporting 8 events (Psychoeducation), with all considered unrelated or unlikely to be related to intervention. No AEs occurred in more than 10% of the sample (details in Table S10, available online).

Pilot Cost-effectiveness

In terms of intervention costs only, Predictive Parenting was £135 per participant more costly than Psychoeducation (90%*CI* £74.67-£195.38) (Table 4). Without including intervention costs, NHS/PSS costs were £211 higher (90%*CI* £68.12-£392.82) for Predictive Parenting than Psychoeducation, and public sector costs £577 higher (90%*CI* £287.75-£918.39). There were no significant differences in societal costs (mean difference £481; 90% *CI* -£285.74-£1,581.96). QALY gains were not different between the interventions (mean difference -0.019; 90% *CI* -0.048 - 0.012).

- TABLE 4 HERE –

When preliminary effectiveness was measured in terms of child BTC, the probability that Predictive Parenting would be viewed as cost-effective (from any study perspective) only exceeded

50% at willingness-to-pay values above £1,200 per point improvement in OSCA–ABP BTC rate (see Figure S1, available online). When measured in terms of parental QALY gains, the probability that Predictive Parenting would be viewed as cost-effective was very low, not exceeding 1% from any perspective, even at thresholds of £30,000 per QALY gain (see Figure S2, available online). Preliminary evidence suggests Psychoeducation is less expensive but possibly more cost-effective than Predictive Parenting. Sensitivity analyses explored different ways to measure unpaid care: reducing cost to zero and applying national minimum wage instead of homecare worker cost. Neither altered the pilot cost-effectiveness interpretation.

DISCUSSION

Feasibility of implementing this pilot RCT of the 12-week behavioural Predictive Parenting group intervention vs. an attention control Psychoeducation group was demonstrated. Recruitment into groups of 5-9 families stratified by child verbal ability was achievable but required a substantial number of referrals and drop out between referral and randomization was high. Of those who were involved, high rates of completion of measures by families indicated that once recruited parents remained engaged in the study. Similarly, teacher completion of questionnaires was good indicating that online collection of key outcomes in school settings was feasible within appropriate timeframes. Initial findings demonstrated the therapists could implement the interventions as planned to high fidelity and parental satisfaction was high.

However, in terms of preliminary efficacy, there were no group differences on the primary outcome, a blinded observational measure of child BTC, although in both groups post-intervention rates were lower than those at baseline. The reduction in observed child BTC in both groups is difficult to interpret in the absence of a TAU or waitlist control group. Reduction in child behavioural problems in both groups was also reported in Bearss *et al.*[10] who similarly employed an attention control design where the comparison group received psychoeducation, but these were greater for the BPI compared to psychoeducation (see also (41)). We do not know the natural trajectory of child BTC on the OSCA–ABP in children who received no intervention and how this

would compare to the reductions seen after parent-mediated interventions. There may be repetition effects from the observational presses and materials, the assessment location and research staff being more familiar to both the child and parent at post-intervention resulting in fewer child BTC.

The current feasibility pilot was only powered to detect moderate-to-large effects. However, the effect size on the child BTC primary outcome was small (*d*=-0.18) and nonsignificant but those for the secondary outcomes of child compliance and facilitative parenting were moderate (*d*=0.44 and 0.63, respectively) and significant. Larger, better-powered trials of individual therapist-delivered BPIs have found significant reductions in child EBPs[10,11]; with Bearss *et al*.[10] reporting a moderate effect size (*n*=180, *d*=-0.62) and Brookman-Frazeee *et al*.[11] reporting small effects (*n*=202, *d*=-0.19 and -0.28 across their two primary outcomes). However, these studies relied on unblinded parent report of primary outcomes. Both of these studies also had programmes that extended ~24 weeks; twice as long as the present intervention. In addition, baseline parent-reported ABC irritability and hyperactivity scores, and to a lesser extent HSQ-ASD scores, were higher in Bearss *et al*.[10] compared to our sample, possibly indicating greater scope to demonstrate change on these measures. We did not exclude children based on level of EBPs, offering the intervention universally to parents of all eligible children with an autism diagnosis given the high prevalence of co-occurring EBPs[2,3], but for some children baseline rates were low and for whom substantial absolute improvement would not be possible A pilot RCT of the Incredible Years® Autism Spectrum and Language Delays 12-week group BPI reported no differences in parent-reported EBPs compared to TAU[17] but a group-based format of the RUBI programme has reported encouraging (uncontrolled) feasibility data.[42]

Predictive Parenting did show superiority over Psychoeducation for the observational measures of child compliance and facilitative parenting. When looking at the baseline and post-intervention scores for both groups (Figure 3), this effect was due to a maintenance of rates on both measures in the Predictive Parenting group, whereas both child compliance and facilitative parenting declined from baseline to post-intervention for the Psychoeducation group. Again, in the

absence of a TAU group the interpretation of these group differences is not clear. It might be that Predictive Parenting has a 'protective effect' on both child and parent across time that is not apparent in those who received Psychoeducation and in whom both child compliance and facilitative parenting strategies reduced across the course of the trial. The other measure that showed superiority for Predictive Parenting was the researcher-rated change in parent-defined target symptoms that has previously shown large effect sizes in psychopharmacological trials[28] and is widely-used clinically[43] and is a meaningful outcomes for families. However, although the researchers were blind to group allocation, parents were not and we used a researcher rating of change in problems over time rather than rating the severity separately at each timepoint, limiting interpretation.

Although there were no group differences on the unblinded parent-report measures of child EBPs with most having small effect sizes, there was a broadly consistent pattern across measures favouring Predictive Parenting (Figure 2). The *SMD* for the HSQ-ASD subscales were ~0.20, and in both groups there were modest reductions in HSQ-ASD scores from baseline to post-intervention. Similarly, there were no group differences on parent self-report of parenting practices, but a similar pattern showed general favouring to Predictive Parenting. No differences were seen on blinded teacher-reported child EBPs. Change in child behaviour in the school setting following a time-limited BPI might not be expected over this time period and the timing of assessment of EBPs in the school context is an important design consideration for future RCTs.

In part due to including individual sessions, Predictive Parenting was more expensive to deliver than Psychoeducation, and was associated with higher NHS, social care and other public sector costs. However, the cost differences were not expected and should be examined in future studies. Predictive Parenting is probably less cost-effective than Psychoeducation in addressing child BTC and in generating parent QALY gains.

The present study has a number of strengths, including the autism-specific framework of Predictive Parenting that focused on managing both behaviour and anxiety; therapy and research

protocols were developed with input from parents of autistic children and autistic adults[18]; the comparison to an active attention control condition; the group format was designed to be scalable within the UK public health service context; and a blinded observational measure of primary and secondary child and parenting behaviours. However, it also has a number of limitations: It is a pilot RCT with a small sample size and hence modest power to detect group differences; the lack of an objective rating of intervention fidelity; the lack of a TAU group to track the natural trajectory of child and parent behaviours over time; and the fact that whilst the researchers who coded the observational measure were blind to intervention allocation they were not blind to timepoint.

Conclusions

This pilot RCT demonstrated good feasibility of the intervention and research procedures. However, it was not powered to detect small to moderate intervention effect sizes and, combined with the use of an active attention control condition and the absence of a TAU group, firm conclusions about the potential efficacy of the Predictive Parenting programme will require further research. Whilst there was some evidence for benefit on both child and parent secondary measures for Predictive Parenting with moderate effect sizes (d=0.44 and d=0.63, respectively for child compliance and facilitative parenting) there was no effect on the primary outcome – child BTC – which was small in size (d=0.18), although the 90% CIs included moderate effects (-0.44 to 0.08). Previous behavioural therapist- and parent-mediated interventions that have reduced EBPs in young autistic children have been conducted over longer periods, have been individualised, and have also pre-selected samples based on the presence or severity of child EBPs at baseline(10,11). We do not know if a more intensive or extended version of a group-based approach which may provide more time for parents to practice and consolidate the behavioural techniques they are learning would provide additional benefit; nor whether pre-selection based on severity of child EBPs would have led to larger improvements. The observational outcome measures, including the primary outcome child BTC, were positively skewed; indicating that some children showed low rates of these at baseline. Future larger, better-powered definitive efficacy studies are required to further evaluate

scalable BPIs such as Predictive Parenting; that if proven effective at reducing EBPs would bring considerable benefit to young autistic children and their families.

REFERENCES

(1) American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders: DSM-5. 5th ed. Arlington, VA: American Psychiatric Association; 2013.

(2) Salazar F, Baird G, Chandler S, Tseng E, O'Sullivan T, Howlin P, et al. Co-occurring psychiatric disorders in preschool and elementary school-aged children with autism spectrum disorder. J Autism Dev Disord 2015;40(9):1080-1093.

(3) Simonoff E, Pickles A, Charman T, Chandler S, Loucas T, Baird G. Psychiatric disorders in children with autism spectrum disorders: prevalence, comorbidity, and associated factors in a population-derived sample. J Am Acad Child Adolesc Psychiatry 2008 Aug;47(8):921-929.

(4) Lai MC, Kassee C, Besney R, Bonato S, Hull L, Mandy W, et al. Prevalence of co-occurring mental health diagnoses in the autism population: a systematic review and meta-analysis. Lancet Psychiatry 2019 Oct;6(10):819-829.

(5) Simonoff E, Jones C R, Baird G, Pickles A, Happe F, Charman T. The persistence and stability of psychiatric problems in adolescents with autism spectrum disorders. J Child Psychol Psychiatry 2013;54(2):186-194.

(6) Yorke I, White P, Weston A, Rafla M, Charman T, Simonoff E. the association between emotional and behavioral problems in children with autism spectrum disorder and psychological distress in their parents: a systematic review and meta-analysis. J Autism Dev Disord 2018 10/01;48(10):3393-3415.

(7) Patterson GR. Coercive Family Process. Eugene, OR: Castalia; 1982.

(8) Barlow J, Bergman H, Kornor H, Wei Y, Bennett C. Group-based parent training programmes for improving emotional and behavioural adjustment in young children (CD003680). 2016. Available from: https://www.cochrane.org/CD003680/BEHAV_group-based-parent-training-programmes-improving-emotional-and-behavioural-adjustment-young-children

(9) National Institute for Health and Clinical Excellence. Antisocial behaviour and conduct disorders in children and young people: recognition and management (CG158). 2013. Available from: https://www.nice.org.uk/guidance/CG158

(10) Bearss K, Johnson C, Smith T, Lecavalier L, Swiezy N, Aman M, et al. Effect of parent training vs parent education on behavioral problems in children with autism spectrum disorder: a randomized clinical trial. JAMA 2015 Apr;313(15):1524-1533.

(11) Brookman-Frazee L, Roesch S, Chlebowski C, Baker-Ericzen M, Ganger W. Effectiveness of training therapists to deliver an individualized mental health intervention for children with ASD in publicly funded mental health services: a cluster randomized clinical trial. JAMA Psychiatry 2019 Jun 1;76(6):574-583.

(12) Tellegen CL, Sanders MR. A randomized controlled trial evaluating a brief parenting program with children with autism spectrum disorders. J Consult Clin Psychol 2014 Dec;82(6):1193-1200.

(13) Postorino V, Sharp WG, McCracken CE, Bearss K, Burrell TL, Evans AN, et al. A systematic review and meta-analysis of parent training for disruptive behavior in children with autism spectrum disorder. Clin Child Fam Psychol Rev 2017 Jun;20(4):391-402.

(14) Tarver JH, Palmer ML, Webb S, Scott SBC, Slonims V, Simonoff E, et al. Child and parent outcomes following parent interventions for child emotional and behavioral problems in autism spectrum disorders (ASD): a systematic review and meta-analysis. Autism 2019 Feb;23(7):1630-1644.

(15) Bearss K, Taylor CA, Aman MG, Whittemore R, Lecavalier L, Miller J, et al. Using qualitative methods to guide scale development for anxiety in youth with autism spectrum disorder. Autism 2015 Sep;20(6):663-672.

(16) Whittingham K, Sofronoff K, Sheffield J, Sanders MR. Stepping Stones Triple P: an RCT of a parenting program with parents of a child diagnosed with an autism spectrum disorder. J Abnorm Child Psychol 2009 May;37(4):469-480.

(17) Williams ME, Hastings RP, Hutchings J. The Incredible Years Autism Spectrum and Language Delays parent program: a pragmatic, feasibility randomized controlled trial. Autism Res 2020;10.1002/aur.2265.

(18) Palmer M, Tarver J, Paris Perez J, Cawthorne T, Romeo R, Stringer D, et al. A novel group parenting intervention to reduce emotional and behavioural difficulties in young autistic children: Protocol for the Autism Spectrum Treatment and Resilience (ASTAR) pilot randomised controlled trial. BMJ Open 2019;9(e029959).

(19) Hallett V, Mueller J, Breese L, Hollett M, Pickles A, Slonims V, et al. Introducing 'Predictive Parenting': a new group parenting intervention targeting emotional and behavioral difficulties in children with autism spectrum disorder. J Autism Dev Disord 2020.

(20) Lord C, Rutter M, DiLavore PC, et al. Autism Diagnostic Observation Schedule (2nd ed.). Torrance, CA: Western Psychological Services 2012.

(21) Rutter M, Bailey A, Lord C. Social Communication Questionnaire. Los Angeles, CA: Western Psychological Services 2003.

(22) Harrison P, Oakland T. Adaptive Behavior Assessment System (ABAS-3) (3rd ed.) Los Angeles, CA: Western Psychological Services 2015.

(23) Palmer M, Paris Perez J, Tarver J, Cawthorne Thomas, Frayne M, Webb S, et al. Development of the Observation Schedule for Children with Autism – Anxiety, Behaviour and Parenting (OSCA–ABP): A new measure of child and parenting behavior for use with young autistic children. J Autism Dev Disord 2020.

(24) Aman MG. Aberrant Behavior Checklist. In: Volkmar FR, editor. Encyclopedia of Autism Spectrum Disorders New York, NY: Springer New York; 2013. p. 10-17.

(25) Chowdhury M, Aman MG, Lecavalier L, Smith T, Johnson C, Swiezy N, et al. Factor structure and psychometric properties of the revised Home Situations Questionnaire for autism spectrum

disorder: The Home Situations Questionnaire-Autism Spectrum Disorder. Autism 2015 Jul;54(3):281-291.

(26) Tarver J, Vitoratou S, Mastroianni M, Heaney N, Bennett E, Gibbons F et al. Development and psychometric properties of a new questionnaire to assess mental health and concerning behaviors in children and young people with autism spectrum disorder (ASD): The Assessment of Concerning Behavior (ACB) Scale. J Autism Dev Disord 2020.

(27) Edwards SL, Rapee RM, Kennedy SJ, Spence SH. The assessment of anxiety symptoms in preschool-aged children: the revised Preschool Anxiety Scale. J Clin Child Adolesc Psychol 2010;39(3):400-409.

(28) Arnold LE, Vitiello B, McDougle C, Scahill L, Shah B, Gonzalez NM, et al. Parent-defined target symptoms respond to risperidone in RUPP autism study: customer approach to clinical trials. J Am Acad Child Adolesc Psychiatry 2003 Dec;42(12):1443-1450.

(29) Guy W. ECDEU Assessment Manual for Psychopharmacology: Publication ADM 76-338. 1976. Available from: http://inhn.org/fileadmin/archives_new/Ban/Ban_-_ECDEU_Manual.pdf

(30) Silva LM, Schalock M. Autism Parenting Stress Index: initial psychometric evidence. J Autism Dev Disord 2012 Apr;42(4):566-574.

(31) Emser TS, Mazzucchelli TG, Christiansen H, Sanders MR. Child Adjustment and Parent Efficacy Scale-Developmental Disability (CAPES-DD): First psychometric evaluation of a new child and parenting assessment tool for children with a developmental disability. Res Dev Disabil 2016 Jun-Jul;53-54:158-177.

(32) NHS Health Scotland, University of Warwick and University of Edinburgh. Short Warwick Edinburgh Mental Well-Being Scale (SWEMWBS). 2008. Available from: https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/development/swemwbs/

(33) Arnold DS, O'Leary SG, Wolff LS, Acker MM. The Parenting Scale: A measure of dysfunctional parenting in discipline situations. Psychol Assess 1993;5(2):137-144.

(34) Beecham J, Knapp M. Costing psychiatric interventions. In: Thornicroft G, editor. Measuring Mental Health Needs. 2nd ed. London: Royal College of Psychiatrists; 2001. p. 200-224.

(35) Curtis L, Burns A. Unit Costs of Health and Social Care 2018. Personal Social Services Research Unit, University of Kent, Canterbury. Available from: https://kar.kent.ac.uk/70995/1/Unit%20Costs%202018%20-%20FINAL%20with%20bookmarks%20and%20covers%20%282%29.pdf

(366) The Royal Pharmaceutical Society. MedicinesComplete. 2020. Available from: https://www.rpharms.com/publications/medicinescomplete

(37) EuroQol Group. EuroQol--a new facility for the measurement of health-related quality of life. Health Policy 1990 Dec;16(3):199-208.

(38) Devlin NJ, Shah KK, Feng Y, Mulhern B, van Hout B. Valuing health-related quality of life: An EQ-5D-5L value set for England. Health Econ 2018 Jan;27(1):7-22.

(39) White IR, Thompson SG. Adjusting for partially missing baseline measurements in randomized trials. Stat Med 2005 Apr;24(7):993-1007.

(40) Efron B., Tibshirani R. J. *An introduction to the bootstrap*. New York: Chapman Hall; 1993.

(41) Bradshaw J, Bearss K, McCracken C, Smith T, Johnson C, Lecavalier L, et al. Parent education for young children with autism and disruptive behavior: response to active control treatment. J Clin Child Adolesc Psychol 2018 12/21;47:S445-S455.

(42) Burrell TL, Postorino V, Scahill L, Rea HM, Gillespie S, Evans AN, et al. Feasibility of group parent training for children with autism spectrum disorder and disruptive behavior: a demonstration pilot. J Autism Dev Disord 2020.

(43) Odom SL, Cox AW, Brock ME. Implementation Science, Professional Development, and Autism Spectrum Disorders. Except Child 2013;79(3):233-251.

Table 1. Characteristics of the Sample by Intervention Arm and Overall

Sample characteristics	Predictive parenting (*N*=31)		Psychoeducation (*N*=31)		Total (*N*=62)	
	n	*%*	*n*	*%*	*n*	*%*
Child sex (Male)	25	80.6	25	80.6	50	80.6
Site						
Croydon	16	51.6	16	51.6	32	51.6
Bromley	15	48.4	15	48.4	30	48.4
Child verbal ability						
Minimally verbal (ADOS–2 Module 1)	16	51.6	17	54.8	33	53.2
Verbal (ADOS–2 Module 2 or above)	15	48.4	14	45.2	29	46.8
Child ethnicity[a]						
White	16	51.6	17	54.8	33	53.2
Black/Black British	7	22.6	3	9.7	10	16.1
Asian/Asian British	4	12.9	4	12.9	8	12.9
Mixed/Multiple ethnicities	4	12.9	6	19.4	10	16.1
Did not wish to answer	0	0.0	1	3.2	1	1.6
Parental education						
No formal qualification	2	6.5	5	16.1	7	11.3
General Certificate of Secondary Education (GCSEs), General Certificate of Education Advanced Level (A levels), or equivalent	3	9.7	10	32.3	13	21.0
Vocational qualifications (NVQ, City and Guilds or equivalent)	6	19.4	4	12.9	10	16.1
University degree	20	64.5	12	38.7	32	51.6
Parent/carer						
Mother	28	90.3	29	93.6	57	91.9
Father	3	9.7	0	0.0	3	4.9
Grandmother	0	0.0	2	6.5	2	3.2
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Child age (mean years)	6.52	(1.22)	6.81	(1.06)	6.67	(1.15)
Autism severity						
ADOS–2 CSS total	7.29	(2.36)	7.71	(1.40)	7.50	(1.93)
Parent-reported SCQ-L total	25.13	(6.58)	21.74	(6.63)	23.44	(6.77)
Adaptive functioning						
ABAS–3 General Adaptive Composite (GAC) standard score	61.90	(12.98)	62.45	(12.63)	62.18	(12.70)

Note: [a]White = English/Welsh/Scottish/Northern Irish/Irish/British/Other White ethnicity, Black/Black British = African/Caribbean/Other Black ethnicity, Asian/Asian British = Indian/Pakistani/Bangladeshi/Chinese/Other Asian ethnicity, Mixed/Multiple ethnicities = White and Black Caribbean/White and Black African/White and Asian/Other Mixed ethnicity.

Table 2. Baseline and post-Intervention Scores for the Blinded Primary and Secondary Outcomes

Outcome measure	Baseline				Post-intervention				*d* (90 % CI)	*p*
	Predictive parenting		Psychoeducation		Predictive parenting		Psychoeducation			
	M	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)		
Primary observational outcome[a]										
Log OSCA–ABP child behaviours that challenge rate per minute	0.52	(0.94)	0.36	(0.86)	0.06	(0.76)	0.13	(0.82)	-0.18 (-0.44, 0.08)	.243
Secondary observational outcomes[a]										
Log OSCA–ABP child compliance rate per minute	0.49	(0.40)	0.49	(0.32)	0.46	(0.32)	0.32	(0.31)	0.44 (0.10, 0.77)	.030
Log OSCA–ABP facilitative parenting rate per minute	0.79	(0.57)	0.73	(0.63)	0.86	(0.54)	0.48	(0.67)	0.63 (0.33, 0.92)	<.001
Log OSCA–ABP non-facilitative parenting rate per minute	0.89	(0.60)	0.89	(0.58)	0.72	(0.74)	0.73	(0.69)	0.09 (-0.17, 0.35)	.557
Log OSCA–ABP facilitative parenting proportion	0.43	(0.10)	0.42	(0.08)	0.47	(0.12)	0.42	(0.11)	0.44 (0.04, 0.84)	.073
Teacher-reported secondary outcomes – child emotional and behavioural problems[b]										
ABC irritability total	7.43	(8.71)	7.47	(10.29)	8.89	(10.48)	9.00	(9.30)	0.05 (0.31, -	.729

									0.20)	
ABC hyperactivity total	13.79	(10.43)	16.07	(12.45)	13.32	(13.21)	15.80	(12.15)	-0.04 (0.24, -0.31)	.820
ACB externalising total	14.46	(9.10)	17.20	(11.93)	15.89	(11.34)	16.77	(9.95)	0.15 (0.42, -0.12)	.369
ACB internalising total	13.46	(8.01)	14.73	(9.56)	14.70	(10.80)	15.03	(10.51)	0.09 (0.43, -0.26)	.676

Note: Observation Schedule for Children with Autism – Anxiety, Behaviour and Parenting (OSCA–ABP) rates are per minute and have been log transformed for analysis. The log transformations are reported here.

[a]*N*=31 and *N*=29 at baseline and post-intervention respectively for Predictive Parenting. For Psychoeducation, *N*=31 and *N*=28 for baseline and post-intervention respectively.

[b]*N*=28 at baseline and post-intervention respectively for Predictive Parenting. For Psychoeducation, *N*=30 for baseline and post-intervention.

[c]Cohen's *d* is reported on the log scale for log-transformed variables. These values show the magnitude of the effect of Predictive Parenting in comparison to Psychoeducation.

Table 3. Baseline and post-intervention for the unblinded secondary outcomes

Outcome measure	Baseline				Post-intervention				Cohen's *d* (90% CI)	*p*-value
	Predictive Parenting (*N*=31)		Psychoeducation (*N*=31)		Predictive Parenting (*N*=30)		Psychoeducation (*N*=30)			
	M	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)		
Parent-reported secondary outcomes – child emotional and behavioural problems										
ABC irritability total	18.13	(11.02)	14.39	(9.90)	15.3	(9.08)	12.71	(8.94)	-0.07 (-0.29, 0.16)	.630
ABC hyperactivity total	24.45	(13.73)	21.88	(12.87)	22.63	(12.34)	19.93	(11.3)	-0.01 (-0.24, 0.22)	.929
HSQ-ASD non-compliance severity	3.98	(2.04)	2.76	(1.77)	2.69	(1.65)	2.33	(1.53)	-0.27 (-0.58, 0.03)	.143
HSQ-ASD demand specific non-compliance severity	3.59	(2.20)	2.58	(1.86)	2.38	(1.45)	2.18	(1.6)	-0.28 (-0.58, 0.03)	.124
HSQ-ASD socially inflexible non-compliance severity	4.37	(2.36)	2.93	(1.93)	3.01	(2.11)	2.48	(1.59)	-0.21 (-0.51, 0.10)	.264
ACB externalising total	23.81	(12.88)	21.65	(11.20)	23.27	(11.6)	20.21	(10.69)	0.09 (-0.19, 0.36)	.617
ACB internalising total	22.84	(13.28)	22.1	(14.36)	21.2	(10.41)	20.39	(10.91)	-0.09 (-0.34, 0.16)	.562
PASR anxiety total	40.81	(22.92)	46.1	(22.89)	36.27	(20.69)	40.29	(22.56)	-0.06 (-0.28, 0.17)	.679
Improvement in parent-defined target symptoms[a,b,c]	-	-	-	-	4.09	(0.98)	4.64	(0.84)	-0.59 (-1.00, -0.17)	.020
CGI improvement[a]	-	-	-	-	3.33	(1.12)	3.72	(1.22)	-0.33 (-0.74, 0.09)	.198
Parent-reported secondary outcomes – parent outcomes										

APSI parenting stress total	24.52	(9.49)	21.74	(10.20)	21.33	(9.96)	19.79	(7.75)	-0.02 (-0.32, 0.27)	.901
CAPES-DD parental self-efficacy total	99.61	(33.92)	108.06	(29.24)	120.17	(30.59)	120.61	(24.35)	0.07 (-0.28, 0.43)	.744
SWEMWBS positive wellbeing total	21.13	(5.75)	23.94	(4.34)	21.8	(6.09)	25.21	(3.39)	-0.30 (-0.69, 0.08)	.198
PS mean	3.08	(0.72)	2.82	(0.90)	2.57	(0.75)	2.67	(0.84)	-0.31 (-0.61, -0.01)	.091
PS laxness mean	3.07	(0.83)	2.97	(1.15)	2.64	(0.85)	2.77	(1.08)	-0.16 (-0.48, 0.15)	.397
PS overreactivity mean	2.90	(1.02)	2.50	(0.98)	2.37	(0.98)	2.34	(0.88)	-0.21 (-0.50, 0.07)	.217

Note. [a]These variables are improvement ratings and recorded at post-intervention only. [b]Mean of two ratings. [c]Categorised as an: Externalising problem (56.4%), Internalising problem (19.7%) or Other (23.9%).

Table 4. Costs and outcomes between baseline and 12-week follow-up for Predictive Parenting and Psychoeducation

Costs (£, 2017-18 prices) and outcomes	**Predictive Parenting (*N*=29) Mean (*SD*)**	**Psychoeducation (*N*=28) Mean (*SD*)**	**Difference (90% *CI*)[d]**
Intervention Costs	431.27 (159.61)	295.81 (129.65)	135.27 (74.67 to 195.38)
NHS/PSS (child)[a]			
NHS/PSS	383.21 (552.76)	153.52 (192.79)	210.80 (68.12 to 392.82)
Total NHS/PSS costs (incl. Intervention costs)	789.77 (567.96)	434.48 (231.66)	347.04 (186.55 to 539.17)
Public sector (child)[b]			
Public sector costs	1,028.51 (951.25)	432.27 (281.18)	576.57 (286.75 to 918.39)
Total public sector costs (incl. Intervention)	1,393.42 (1,008.07)	700.19 (318.69)	668.88 (372.88 to 1,015.79)
Societal (child and parent)[c]			
Societal costs	2,845.16 (2,223.14)	2,015.99 (2,702.37)	364.01 (-402.97 to 1,512.99)
Total societal costs (incl. Intervention)	3,092.87 (2,315.62)	2,181.74 (2,689.04)	480.84 (-285.74 to 1,581.96)
Outcomes:			
OSCA-ABP rate per minute at 12 weeks	1.13 (0.80)	1.33 (1.18)	-0.310 (-0.664 to 0.076)
Utility values (EQ5D-5L) at 12 weeks	0.782 (0.210)	0.878 (0.123)	-0.064 (-0.117 to 0.007)
QALY gain (baseline to 12 weeks)	0.385 (0.107)	0.427 (0.102)	-0.019 (-0.048 to 0.012)

Note: [a]NHS/PSS perspective (health and social care services used by the child).
[b]Public sector perspective (NHS/PSS, education and criminal justice services) linked to the child's autism.
[c]Societal perspective (NHS/PSS services, education and criminal justice ser/vices used by the child, services used by other family members that are linked to the child's autism and unpaid care).
[d]Adjusted for baseline costs, trial arm, ADOS module (verbal vs minimally-verbal), baseline OSCA-ABP and site (Bromley or Croydon)

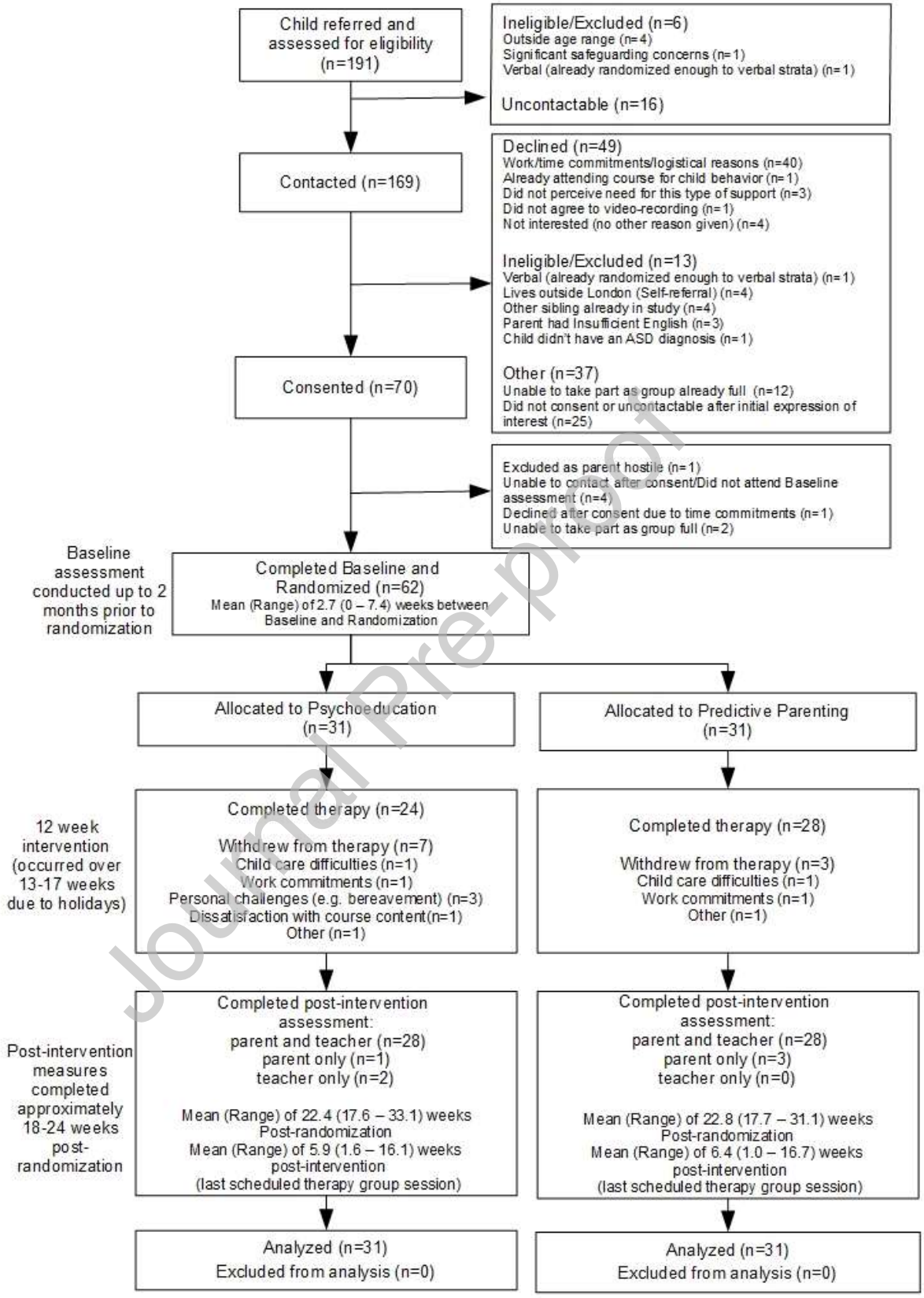

Figure 1. CONSORT Diagram

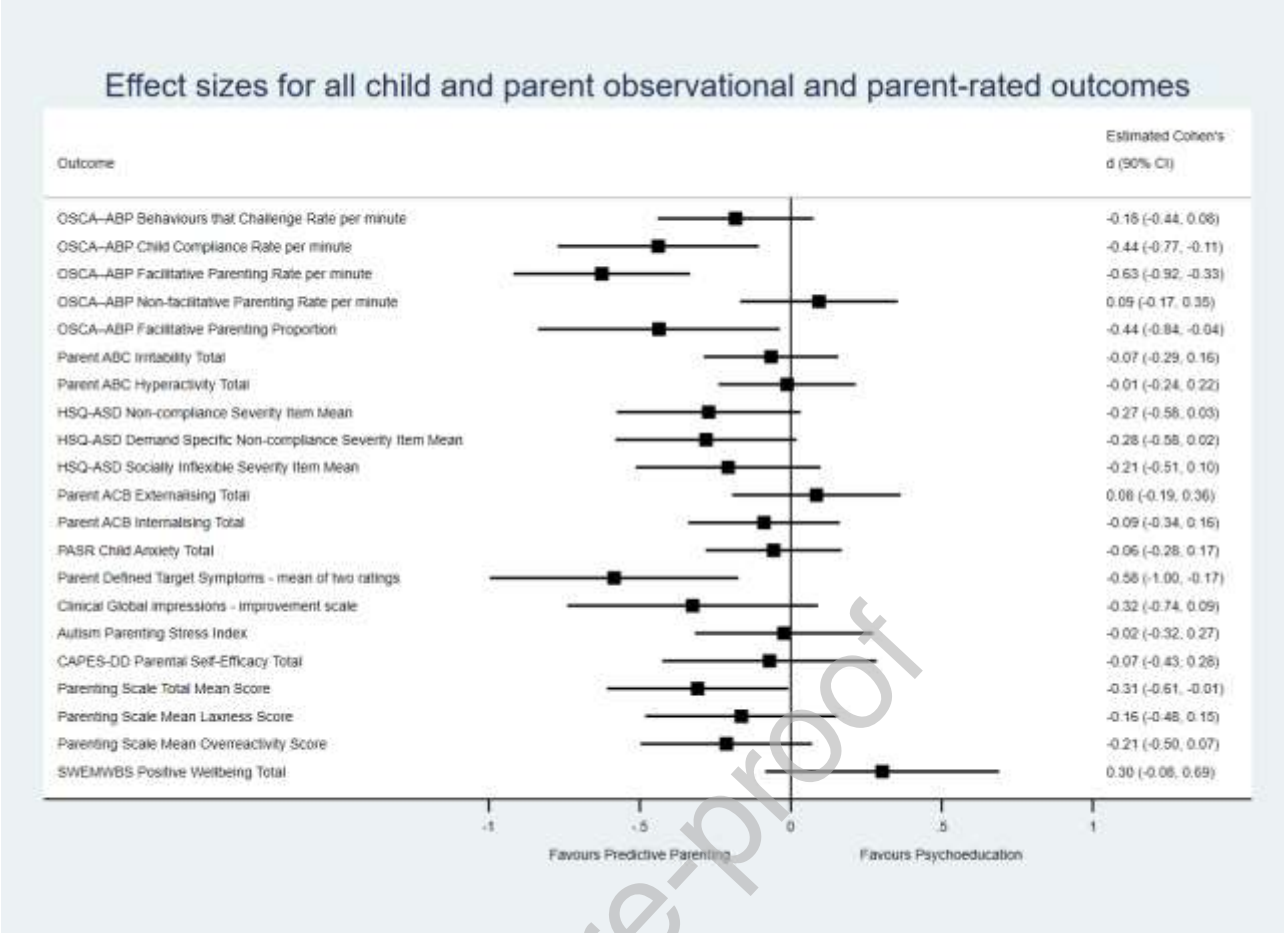

Figure 2. Effect Sizes for All Child and Parent Observational and Parent-Rated Outcomes

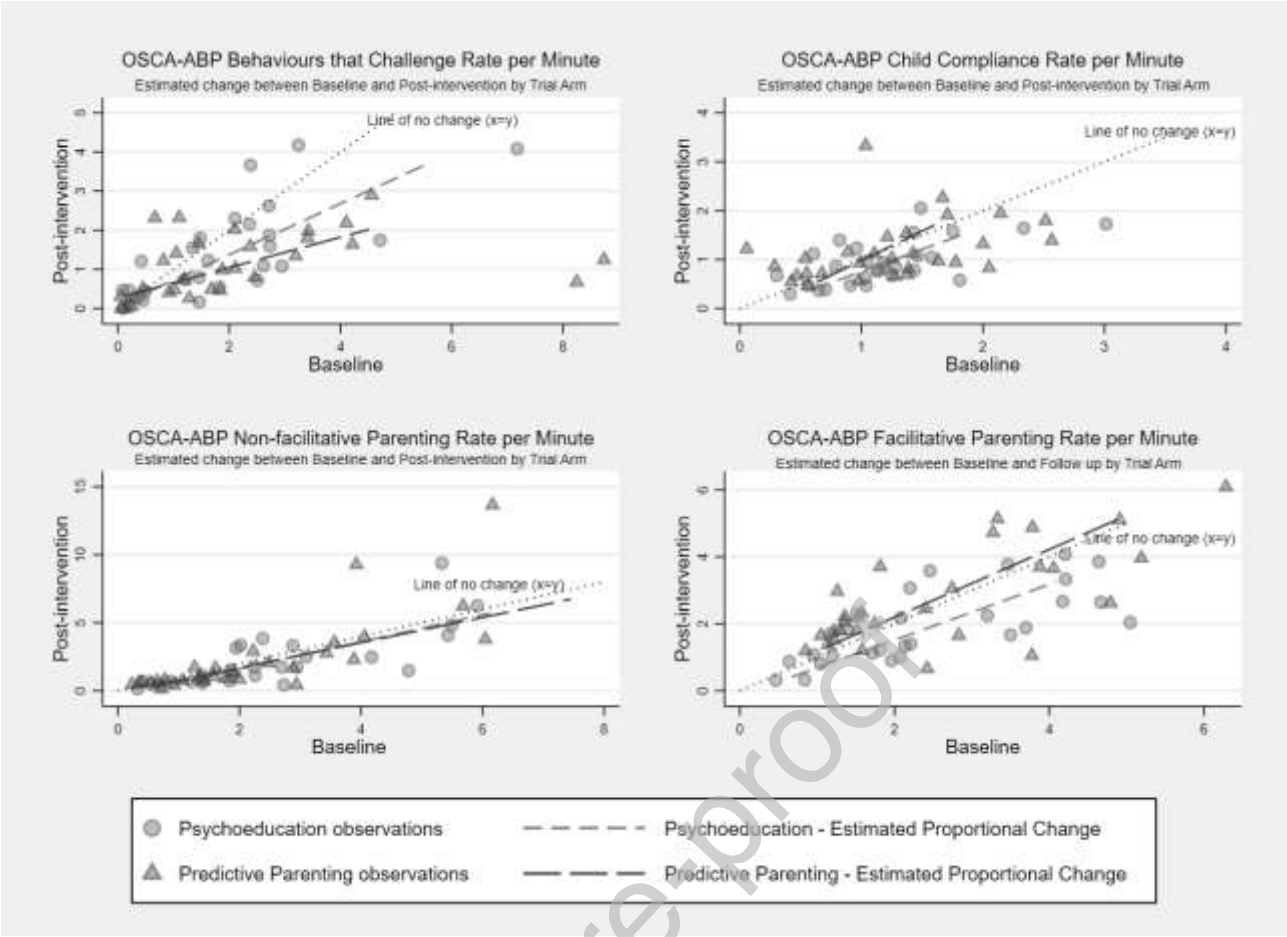

Figure 3. Baseline-to-Post-Intervention Plots for Primary and Secondary Blinded Observational Child and Parent Outcomes

Note: For each figure, scores on the Observation Schedule for Children with Autism – Anxiety, Behaviour and Parenting (OSCA-ABP) variable at baseline are plotted along the x-axis and scores at post-intervention on the y-axis. Each triangle represents a participant in Predictive Parenting and each circle represents a participant in Psychoeducation. The dotted grey line shows the line of no change and the blue dashed line shows the estimated proportional change for Predictive Parenting, and the red line is the equivalent for Psychoeducation. For example, in the Behaviours that Challenge (BTC) Figure (top left), both lines show a reduction in BTC, but the proportional change for predictive parenting is larger than for psychoeducation as it is further away from the line of no change.