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# A Customised, Intensive Parent–Child Interaction Therapy for Children With Down Syndrome: Findings From a Real-World Pilot Effectiveness Study

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## ABSTRACT

**Background:** Coaching parents through parent–child interaction therapy (PCIT) is a key aspect of early communication intervention for children with Down syndrome. However, the evidence for its effect on child language outcomes is limited. Some research has indicated that more intensive, individualised interventions yield better outcomes; however, in Ireland many children receive less than the optimal dosage of intervention.

**Aims:** The aim of the study was to investigate the effectiveness of an intensive PCIT intervention in a real-world clinical context using a structured coaching protocol. We also aimed to explore SLT and parental views/experiences of the intervention.

**Methods and Procedures:** We piloted a PCIT intervention incorporating keyword signing (JEMT + Sign) with four parent–child dyads. A multiple baseline, individual case series design was used to measure the intervention effects based on (1) accuracy of parental strategies; (2) frequency of parental strategies and (3) child communication acts. Four parent–child dyads took part in a twice-weekly intervention delivered by two trained specialist speech and language therapists over 11 weeks, via a hybrid in-person and tele-practice model. Parental coaching followed a 'teach-model-coach-review' protocol. Researchers not involved in delivering the intervention coded parent behaviours and child communication acts at baseline, during the intervention and at follow-up. In addition, interviews were conducted to gather parent and practitioner views on the intervention.

**Outcomes and Results:** Using structured visual analysis supplemented with single-case statistics, we found that the intervention resulted in an increase in parental accuracy and for some, increased frequency of JEMT + Sign strategy use, although with individual variation. The children's language and communication improvements were also variable. Clinicians noted that the intervention suited the families involved, but may not be feasible for all families and found the structured coaching protocol of this intervention to be particularly helpful and effective. Parents valued the more intensive and individualised intervention, although they recognised that their existing relationship with the clinician and the flexibility of delivery were beneficial.

**Conclusions and Implications:** It was possible to implement this intensive intervention for children with Down syndrome in this Irish clinical setting. Parents and SLTs found the intervention to be valuable and reported that the hybrid nature of the delivery and clear coaching methods were helpful. Further research is needed to determine the longer-term effects and suitability of the intervention for a wider group of families and services.

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**WHAT THIS PAPER ADDS**

*What is already known about this subject*

- Individualised and intensive intervention has been found to be more effective for children with Down syndrome than more diluted services but is rarely available. This is particularly true of the Irish context where SLT services are under-resourced for children with disabilities. This study aimed to determine if it was possible to implement an intensive PCIT intervention for children with Down syndrome in Ireland and to determine whether it was effective and acceptable for the families and clinicians involved.

*What this study adds to the existing knowledge*

- JEMT + Sign has been shown to be effective for children with Down syndrome in the US when delivered under controlled research conditions, but has yet to be tested in 'real-world' clinical contexts. This study examined whether it could be implemented by trained clinicians in an Irish context, measured the effectiveness for parents and children and gathered the views of those taking part.

*What are the potential or actual clinical implications of this work?*

- Clinicians working in a specialised service for people with Down syndrome valued the intervention. They found it effective for families that they had an established and trusting relationship with and whom they knew had the capacity to engage with the demands required. They found the structured coaching protocol to be beneficial for wider aspects of their work. Parents learned the skills and could apply them to the required accuracy criteria. The children in general increased their language and/or communication skills, although this cannot yet directly be attributed to the intervention. Further research is necessary to determine if JEMT + Sign can be delivered in other contexts, the long-term effects of the intervention and whether it is effective for wider groups of families.

**Practitioner Points**

1. JEMT + Sign can be delivered in a hybrid model for some families of children with Down syndrome
2. The structured coaching protocol of JEMT + Sign helped SLTs to construct and deliver effective parent coaching.
3. JEMT + Sign may improve the language and/or communication of children with Down syndrome
4. JEMT + Sign is facilitated when clinicians and parents have an established and trusting relationship.

## 1 | Introduction

Best practice guidelines for preschool children with speech, language and communication needs highlight the importance of parents being coached in effective techniques for promoting early language and interaction (RCSLT 2005). This approach to intervention is known as parent–child interaction therapy (PCIT) and involves speech and language therapists (SLTs) coaching carers about the importance of responsivity and language input in everyday interactions to maximise their child's opportunities for communicative development. PCIT is a complex behavioural intervention that is based on the transactional model of development (Sameroff and Fiese 2000) which acknowledges the reciprocal effect of the child, caregiver and environment on a child's developmental outcome. It is supported by research demonstrating the impact of high-quality parental input and interaction on child language development (Anderson et al. 2021).

PCIT strategies are central to many early communication programmes such as those from the Hanen Centre in Canada (Spencer 2021) which focus on enhancing interaction and language in naturalistic settings. Enhanced Milieu Teaching (EMT) is another PCIT intervention that combines developmental strategies such as responding to the child's interests, turn taking and modelling with behavioural strategies such as prompting and waiting expectantly. Many studies involving EMT have come from the US, particularly the KidTalk laboratory at Vanderbilt University (Kaiser and Hampton 2017; Roberts et al. 2014) involving either clinician and/ or parent-delivered intervention. A systematic review and meta-analysis of high quality EMT intervention studies found it to be an effective approach to improve child language outcomes, even more so when delivered by parents, compared to clinicians (Kang et al. 2025). EMT differs from other PCIT interventions as the strategies are taught in a tiered fashion and parents learn the strategies incrementally, building from one tier to the next as they meet the required performance criteria. EMT has been combined with other interventions to meet the needs of different populations. For example, it has been combined with key word signing for children with Down syndrome and found to increase spoken vocabulary (Wright and Kaiser 2017). PCITs such as EMT are particularly important for young children with Down syndrome (Buckley and Le Prèvost 2002) as prerequisite skills that underly language and communication development may be delayed from an early age (D'Souza et al. 2017; Mason-Apps et al. 2018).

EMT has also been blended with an intervention that was first designed for autistic children called *Joint Attention, Symbolic Play and Emotional Regulation* (JASPER; Kasari et al. 2006). Combining EMT and JASPER is considered a useful PCIT approach for children with Down syndrome, as it builds on their strengths in social engagement and visual learning, while



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helping them to acquire the foundations of language through joint attention and symbolic play (Engelstad et al. 2024). This is important as children with Down syndrome have been found to have lower rates of engagement in object play than other children, including those with autism, perhaps as they tend to be fixated on attending to their social partner (D'Souza et al. 2017; Wright et al. 2013). They have also been noted to have difficulties in sustaining and responding to joint attention which limits exploration of their environment and how they process language input (Abbeduto et al. 2007; D'Souza et al. 2017; Fernández et al. 2024; Mason-Apps et al. 2018). Furthermore, although preverbal communication such as smiling and pointing follow the same developmental path as typically developing children, children with Down syndrome can be relatively passive in their communication and less attentive to parents in joint activities (Fernández et al. 2024; Soukup-Ascençao et al. 2016). Exacerbating these difficulties is the observation that there are fewer interactions between parents and children with Down syndrome than observed for typically developing children (Slonims and McConachie 2006) and that parents tend to be more directive and less sensitive to child communication (D'Souza et al. 2017). For example, parents of children with Down syndrome have been found to use simpler vocabulary, fewer words, less grammatically complex utterances, and a lower proportion of imitations when compared to parents of typically developing peers (Zampini et al. 2012). The effect of this relationship is bi-directional, as the passive interactional characteristics of children with Down syndrome affect parental input, with resulting implications for language learning experiences (O'Toole et al. 2018). Coaching parents of children with Down syndrome through PCIT on how to be responsive to their children with increased language input, imitation, and non-verbal communication is therefore an important part of early intervention (O'Toole et al. 2021; Walsh et al. 2024).

Systematic reviews of PCIT interventions for children with Down syndrome have consistently noted improvements in how parents communicated and interacted with their children following PCIT coaching (O'Toole et al. 2018; Seager et al. 2022). However, mixed outcomes have been found with respect to changes in child language. Some studies found no differences in language abilities between intervention and control groups (e.g., Girolametto et al. 1998; Kaiser and Roberts 2013), while others have reported improvements (e.g., Karaaslan and Mahoney 2013; Yoder et al. 2014). A potential reason for inconsistency in reported child language outcomes is that the interventions were not sufficiently intensive or individualised in content to address the strengths and needs of children with Down syndrome (O'Toole et al. 2018; Seager et al. 2022; Stojanovik et al. 2024). For example, Yoder et al. (2014) demonstrated that a higher dose frequency of PCIT (5×1-hour sessions per week) resulted in higher vocabulary in a randomised controlled trial of 76 preschool children with Down syndrome compared to a low-dose control group (1×1-hour session per week). Previous PCIT interventions may also not have been tailored to the strengths of children with Down syndrome in visuospatial processing (Abbeduto et al. 2007) and non-verbal/ gestural communication (Wright et al. 2013) by including key word signing (KWS). KWS promotes manual signing in combination with spoken words and has been found to improve expressive language in children with Down syndrome (Frizelle et al. 2023). Combining KWS with intensive PCIT interventions is therefore potentially useful to improve the language outcomes of children with Down syndrome. A study by Wright et al. (2013) combined JASPER and EMT (hereafter JEMT) with manual signs and spoken words to target the strengths and needs of children with Down syndrome. Four children aged 23–29 months at the beginning of the intervention were treated twice-weekly for 20 sessions by a clinician. All children increased their use of manual signs and gradually started to increase spoken words. A similar study by Wright and Kaiser (2017) included parent coaching in the intervention and found that the parents could implement the strategies successfully and that the children could improve their language over time.

Including parents in delivering early communication interventions makes it possible to increase the intensity of an intervention (Quinn et al. 2024) and combined with clinician-delivered intervention, has the potential to result in more effective child language outcomes (Kaiser and Hampton 2017). However, it may not be feasible for all families to engage in and attend an intervention that requires the high level of intensity of JEMT. One solution is to deliver the intervention using a hybrid model, combining the convenience of tele practice, with the benefits of in-person delivery (Quinn et al. 2024). In-person sessions allow the opportunity for clinicians to coach parents through modelling and physical guidance and to build relationships, while tele practice allows for more subtle coaching to help parents become more independent in their practice and facilitates attendance and engagement (Quinn et al. 2021; Engelstad et al. 2024). Two recent studies have used hybrid methods to deliver EMT (without JASPER) to children with language impairment, including Down syndrome, and their parents (Quinn et al. 2021, 2024). Both studies showed that the intervention was effective in teaching parents the EMT strategies and their skills were maintained for up to 6 weeks. There was also a gradual increase in the number of communication acts and words noted in the children (Quinn et al. 2024). Another benefit EMT is that clinicians follow a clearly defined and structured parent coaching protocol known as 'Teach-Model-Coach-Review' (Roberts et al. 2014; Wright and Kaiser 2017; outlined below) based on the principles of adult learning (Trivette et al. 2012). This provides clinicians with a clear format on how to coach parents with accompanying fidelity checklists which is important given that coaching is not often clearly distinguished from modelling or recognised as a discrete component of parent training in the literature (Kemp and Turnbull 2014).

In Ireland, speech and language therapy services for children with Down syndrome and intellectual disabilities are currently inadequate to support children's significant communication needs. For example, a survey of 590 families in 2021 indicated that 80% of children were offered fewer than 6 publicly available sessions a year, and the average waiting time was 1–2 years (Frizelle et al. 2022). Therefore, families often have to access semi-private, part-subsidised therapy through charities for people with Down syndrome. Moreover, a recent reconfiguration of services for children with disabilities in Ireland has shifted to a more consultative model where indirect interventions via PCITs are becoming the norm (O'Toole and O'Leary 2025). It is therefore important to employ an evidence-based intervention that is effective for both parents and children. This study aimed to pilot the effectiveness of an individualised, intensive intervention,



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JEMT + Sign, in an Irish context using a multiple baseline, single case series. This design was selected as children with Down syndrome are known to be heterogenous and it would allow us to show the individual responses to the intervention. We also asked SLTs and parents about the acceptability and feasibility of the intervention model, approach and goals as this will ultimately inform if and how the programme can be optimally adapted to the Irish context and impact on outcomes (Klaic et al. 2022; Klatte et al. 2019; O'Toole et al. 2021; Sekhon et al. 2017). Our research questions were as follows:

1. In what ways did the intervention change the *accuracy* of parental JEMT + Sign strategy use?
2. In what ways did the intervention change the *frequency* of parental JEMT + Sign strategy use?
3. In what ways did the intervention change child communication and language?
4. What were the views of clinicians and parents about the intervention?

## 2 | Methods

### 2.1 | Participants

Parent and child participants were recruited through Down Syndrome Ireland (DSI), a part-subsidised service providing multidisciplinary interventions and training programmes for individuals with Down syndrome and their families. The two intervening SLTs were asked to identify children on their caseload that met the inclusion criteria and whose parents were willing to take part. The researchers and clinicians met with the parents before starting the study to outline what was involved and answer any queries. In line with previous JEMT studies, children were included if they had a diagnosis of Down syndrome and:

a. were aged between 2 and 4 years;
b. had hearing and vision skills within normal limits or correct to be so;
c. had English as the primary language of the home.

We excluded children with a dual diagnosis of autism and/or a concomitant significant sensory difficulty (hearing or vision). Ethical approval for the study was granted by [removed for anonymisation].

We included four parent–child dyads (pseudonyms used below). All parents who took part in the intervention were mothers and identified as White-Irish ethnicity. Child participants were two boys and two girls. They had not spent more than three weeks in hospital in total and none had significant medical conditions. One child wore corrective glasses and one wore hearing aids. All children had attended intermittent speech and language therapy (individual sessions ranging from two x 6-week blocks to monthly sessions over 2-years) and other early intervention services including occupational therapy and physiotherapy. This were mostly delivered from the specialist Down syndrome service and not from public services. Kate had attended a PCIT intervention called LEEIP (O'Toole et al. 2023) and Susie had attended a Hanen programme (Spencer 2021) but no participants had been exposed to JEMT. None of the participants were receiving any other SLT intervention at the time of the study. All parents had taken part in introductory (family) Lámh training, the keyword sign system used in this intervention. One child (Ava) was 4 years 3 months while the others were aged between 2 and 2 ½ years at the outset of the intervention. All parents were University educated. For the period of intervention delivery, one mother was working full-time, one part-time, one was on carer's leave and one was a homemaker. Further background and demographic detail are contained in Table 1.

### 2.2 | Intervention Description

We used the Template for Intervention Description and Replication (TIDieR; Hoffmann et al. 2014; see Supporting Information 2) as a guide for describing the JEMT + Sign intervention in this paper.

### 2.3 | Intervention Materials and Procedures (What)

All relevant materials for delivering JEMT + Sign were provided to the clinicians, including workshop slides, example videos for training parents and an instruction manual with step-by-step instructions on how to implement the intervention and ensure fidelity (see below). An intervention manual was also provided to parents to give further background reading and information on the intervention. Although we modelled the intervention based on the Vanderbilt KidTalk programme and procedures used in Quinn et al. (2021, 2024), we modified the intervention from the studies in a number of ways. Firstly, we combined JASPER with EMT strategies in comparison to the Quinn studies that used EMT only. Secondly, we did not wait for parents to reach performance criterion before moving to the next tier. This was purely for practical reasons as the clinicians could only commit to the study for three months. This also meant that the intervention was relatively shorter than the original at just 22 sessions over two months instead of 24–28 over four months. Finally, we introduced key word (Lámh) signing instead of an AAC device which was an iPad and voice-output APP as used in previous studies.

JEMT + Sign strategies were introduced over five consecutive tiers (see Table 2 and Quinn et al. 2021, 2024 for further detail). The strategies associated with each tier were introduced over four sessions although baseline observations continued for the remaining strategies. Performance criterion for parental use of the strategies at each tier was monitored, although parents moved onto the next tier after two weeks (or 4 sessions) regardless of their performance. At the start of each new tier, parents took part in one individual online workshop for one-hour related to that tier. During the workshop, parents and clinicians reviewed the slides and intervention manual and watched videos of themselves or other parents implementing the relevant strategies. After this workshop, there were three intervention sessions per tier (two in person, one online) focusing on the strategies at that tier only. Therefore, each of the five modules were delivered over four



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**TABLE 1** | Background data for parent and child participants (parent pseudonyms are listed first).

| | Aoife and Cillian | Nora and Sarah | Kate and Bobby | Susie and Ava |
|---|---|---|---|---|
| Age at baseline | 2;0 years | 2;3 years | 2;7 years | 4;3 years |
| Child sex | Male | Female | Male | Female |
| Baseline SPL | Pre-symbolic | Pre-symbolic | Symbolic | Pre-symbolic |
| Baseline PLS-5 TLSS | 60 | 53 | 62 | 50 |
| Vineland Adaptive Behaviour Scale | 69 | 63 | 70 | 65 |
| Mother highest education | 3rd Level | 3rd Level | Post-graduate | 3rd Level |
| Father highest education | 3rd Level | 3rd Level | Post-graduate | 3rd Level |
| Mother's working status | Part time | Carer's leave | Full-time | Homemaker |
| Previous SLT | Some individual sessions | Some individual sessions | LEEIP | Hanen programme & some individual sessions |
| No. other children | 0 | 1 | 3 | 2 |
| Attendance at JEMT + Sign | 21/22 (7/10 in person) | 21/22 (9/10 in person) | 21/22 (10/10 in person) | 22/22 (7/10 in person) |

Abbreviations: SPL, symbolic play level; TLSS, total language standard score.

sessions and the two last sessions (one in person and one remote) in the final week reviewed all tiers (see Table 2).

At the start of the intervention, families filled in a questionnaire about their preferred routines and interactions at home. Throughout the intervention they selected one of these play and daily routines in which to practice implementing strategies and at all times clinicians worked in partnership, acknowledging the expertise that parents bring in order to support their child's communication. The coaching procedure for parents used during the intervention session followed a Teach-Model-Coach-Review (Roberts et al. 2014) format as follows:

- **Teach**: The SLT defined the JEMT + Sign strategy and explained the rationale to the caregivers, followed by a presentation either in video format (online) or role play (in person)
- **Model**: The SLT demonstrated the JEMT + Sign strategy with the child (in person) or through video examples (online). These video examples were either stock recordings as part of the intervention, or pre-prepared clips of the parents in the current study that demonstrated the target behaviour of the parent with the child. These ranged from 10 s to 2 min.
- **Coach**: The SLT observed and coached the parent (providing a suggestion or positive feedback on performance once per minute) during a play routine (10 min) and a home routine (5 min) as selected by the parent. Suggestions included reminding parents to use a specific strategy, word, activity or objects during their interaction (Quinn et al. 2021)
- **Review**: The SLT summarised the session by leading a reflection, encouraging the parent to review their strategy use and the child's response. They then problem solved how to use the strategy during the week at home.

## 2.4 | Interventionists and Intervention Delivery (Who and How)

The clinicians who delivered the intervention were two speech and language therapists (SLTs) working in Down syndrome Ireland. Both were highly experienced and specialised SLTs who had worked with children with Down syndrome for between 5 and 20 years. They were trained on other parent–child interaction therapy (PCIT) interventions including the Hanen programme and had delivered this and other PCITs to families of children with Down syndrome. Neither therapist had any experience with JEMT. Both were Lámh tutors and proficient in the use and teaching of this manual sign system.

The SLTs and first and last author were trained remotely on JEMT by a US-based clinician-researcher with extensive experience in delivering and researching JEMT interventions with this population. The first and last authors are both SLTs and researchers with extensive clinical and research experience in PCIT and children with Down syndrome. They completed fidelity checks and supported clinicians throughout the delivery of the intervention (outlined below), and supervised the researchers in collecting and analysing the outcome data. The interventions were delivered in a hybrid in person and remote/ tele practice matter.

## 2.5 | Intervention Setting (Where)

Only one SLT had capacity to complete the in-person interventions in the family's homes, (for dyads Aoife and Cillian, and Susie and Ava). The other clinician delivered the in-person interventions from the SLT clinic. The online sessions were conducted through Microsoft Teams on a desktop computer with



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**TABLE 2** | JEMT + Sign intervention components.

| Tier/module | Strategies | Key parent strategy | Performance criterion | Session |
|---|---|---|---|---|
| Setting a context for communication | • Sit face to face<br>• Follow the child's lead<br>• Respond to all communication<br>• Balance turns<br>• Imitate non-verbal actions (Mirror) and model (Map) language to these actions | *Matched Turns*: An adult verbal turn that follows the child's verbal or gestural turn and is contingent and related to the child's communication | >75% accuracy | 1–4 |
| Modelling language and play | • Choose interesting and engaging toys<br>• Teach target level play and language<br>• Mirroring and mapping | *Target Talk*: Adult models communication at the child's target language level using the child's mode of communication. | >50% accuracy | 5–8 |
| Routines and gestures | • Model point, show and give gestures (joint attention)<br>• Model target signs and words<br>• Create a routine | *Joint Attention*: Adult uses the strategies of point, show, or give to initiate a joint attention episode. | 1/minute | 9–12 |
| Expanding routines and communication | • Imitate and add<br>• Expanding communication with words and signs<br>• Environmental arrangements<br>• Modelling and expanding Routines | *Expanding language*: Adult repeats the child's spoken word, signed word, or gesture and adds one word. | >40% accuracy | 13–16 |
| Eliciting communication | • Time Delay and Prompting Strategies (Milieu teaching episodes)<br>• Open/ choice questions | *Time delay*: Adult uses a time delay (e.g., inadequate portions, nonverbal choice, assistance needed, waiting within routine and waiting with cue). *Prompting*: Parent uses following steps: offer choice, ask an open question and labelled the item which the child gestured. | >80% accuracy (*Time delay* expected 1-10 times per 10-minute interaction; *Prompting*, 1-5 times) | 17–20 |
| All components | All above strategies | All Strategies | n/a | 21–22 |



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webcams and parents interacted using their own tablets at home in a space of their choosing.

### 2.6 | Intervention Dosage (When and How Much)

There were 22 individual sessions in total: one 'workshop' per tier (5 in total) and three intervention sessions per tier (15 in total) with two final additional sessions focusing on all tiers. Intervention sessions and workshops lasted approximately 40–60 min. Attendance data for each parent–child dyad is contained in Table 1. Some sessions had to be cancelled due to other appointments or illnesses. If a session was cancelled, the SLT tried to follow the planned sequence, although at times in-person sessions were replaced with tele-practice so as not to have extensive gaps between sessions.

### 2.7 | Intervention Fidelity (How Well)

In order to determine if an intervention is delivered as intended, it is essential to measure fidelity (O'Toole et al. 2023). Therapist fidelity of intervention delivery was coded for accuracy on 20% ($n = 10$) of the intervention sessions. All sessions were recorded and then randomly selected for viewing, ensuring that both workshop, in person and online sessions were reviewed for each therapist. Two researchers (first and last author) reviewed the videos and coded these separately using JEMT + Sign fidelity checklists before discussing discrepancies and then agreeing on scores. The therapists were naïve to the sessions that were coded, but after each coding, met online with the researchers to receive feedback and discuss the session in order to improve fidelity for subsequent sessions. Therapist fidelity scores were an average of 74% ranging from 33.3% to 100%. Lower scores were related to child disengagement meaning the session had to be abandoned and the therapists could not deliver the intervention as intended.

### 2.8 | Outcome Measures

Baseline measures (with some repeated at follow up) are outlined below. The outcome assessors were two undergraduate, final-year SLT students. They were trained and supervised by the first and last author and supported by the US-based researcher/clinician on collecting and analysing the outcome measures. We used the following measures:

1. **The Pre-School Language Scale-5** (PLS-5; Zimmerman et al. 2011). This is a (UK) standardized assessment of language comprehension and expression designed for children between 0 and 7 years. As children did not always engage with the examiner, parent report in combination with observed elicited behaviours was used to achieve a raw score. Standard scores were then calculated for each child.
2. **Structured Language Sample**. A naturalistic language sample was collected during a 20-minute play interaction with the researcher, using a specific protocol to encourage play interactions with six play sets (full protocol available from Quinn et al. 2021).
3. **Structured Play Assessment** (SPA; Ungerer and Sigman 1981). The SPA uses a standardised set of toys to determine the child's highest level of play, across a number of sub-types (i.e., manipulative, combination, pre-symbolic, symbolic), and takes approximately 15–20 min.
4. **Child–Caregiver Interaction**. Carers interacted with their child during a 10-minute play routine, using toys of their choosing (such as their child's favourite toy) at all four baseline and follow-up sessions. Each session was recorded and coded by researchers for parental use of JEMT + Sign strategies and child communication acts.
5. **Vineland Adaptive Behaviour Scales-3rd ed** (Sparrow et al. 2016). This is a standardised assessment of adaptive behaviour in children with intellectual disabilities that looks as intellectual functioning across a range of domains such as communication, daily living skills, motor and socialisation. This test was used to profile the children at baseline and not as an outcome measure. The parent/caregiver form was administered remotely through Q-Global via an email link to the parents.

### 2.9 | Assessment Procedure

Four assessment sessions were conducted over two-weeks before, and one-month after the intervention by two SLT researchers who were trained on the assessment protocol. All assessment sessions comprised of one individual in-person session in the local SLT clinic and one online session over Microsoft Teams per week. The online sessions involved recording 10-min of child–caregiver interaction, asking relevant demographic information, completing the Vineland Scale and answering queries. The in-person sessions consisted of assessment administration (PLS-5, SPA and Language Sample) and recording 10 min of child-caregiver play. All sessions were recorded and the observational analysis was checked for fidelity by the first author (outlined below).

### 2.10 | Parent Outcomes

Parent outcomes in relation to strategy accuracy (precision) and frequency (dose) were measured during baseline, at each intervention session and during a short follow up (one month) period. *Accuracy* was calculated based on total correct strategy use ('hits') as a percentage of the incorrect strategy use ('misses') (total no. of hits/ hits+misses ×100%). *Frequency* was measured as the number of correct strategies ('hits') implemented over a 10-minute period. Accuracy was calculated for five strategies and frequency for all six strategies as joint attention was only measured by frequency. Performance criteria was established in previous research (see Table 2; Quinn et al. 2024) and different for each strategy. For frequency, parents were expected to use Time Delays between 1 and 10 times per 10-minute interaction and Prompting between 1 and 5 times (Roberts et al. 2014). The performance criterion for all strategies were measured as follows:

1. **Matched Turns (MT)**: number of adult utterances and signs that were matched to child utterances divided by number of matched turns plus the number that were not matched
2. **Target Talk (TT)**: number of intervals at child's target talk/sign level divided by number of intervals at target plus the number of unrelated targets



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3. **Joint Attention (JA)**: number of point, show and give instances per minute
4. **Expansions (EX)**: number of times the adult expanded a child communicative act through sign or speech divided by the number of expansions plus the number of times the adult failed to expand a communicative act
5. **Time Delay (TD)**: Number of episodes that included correctly executed time delay strategies divided by the number of correctly and incorrectly executed use
6. **Promoting (PR)**: number of correctly executed steps in prompting hierarchy (from least to most) divided by the number of correctly and incorrectly executed steps (see Table 2)

### 2.11 | Child Communication Outcomes

As with Quinn et al. (2021, 2024), the child communication skills were secondary and considered exploratory as this pilot study did not allow sufficient experimental control for these variables to be planned in the design. Changes in communication were examined using a simple before and after design. Communication behaviours were measured from three sources:

a. Observation of child–caregiver interaction (baseline, bi-weekly intervention and follow up sessions): Average frequency of (i) vocalisations, (ii) manual signs, (iii) spoken words, (iv) number of different words (signed or spoken).
b. PLS-5 (baseline and follow up): Auditory Comprehension, Expressive Communication and Total Language standard scores
c. Language sample (baseline and follow up): Number of manual signs and spoken words

### 2.12 | Qualitative Outcomes

The two SLTs and all of the parents were interviewed following implementation of JEMT + Sign to gather their views and experiences of the intervention. All interviews were semi-structured (see Supporting Information 1) and took place online for about 20–30 min by two additional student SLTs who were not involved with the assessment or intervention and had limited experience with PCIT, none of which involved JEMT +sign.

### 2.13 | Interobserver Agreement (IOA)

Prior to coding baseline data, two researchers were trained by the first author on parent and child behaviours. Training consisted of reviewing coding definitions and coding for all dependent variables using four practice videos. In depth analysis and discussion occurred post coding until agreement of over 80% was reached for accuracy and frequency and parental behaviours. Each week, one video was randomly selected for both coders to code separately to prevent observer drift. The coders discussed and further analysed cases where there were differences, and an average of both answers was inputted. The average IOA for parental behaviour was above 80% each week (range of 74–100%).

### 2.14 | Data Analysis

Two SLT student researchers measured child and parent behaviours during 10-min of child–caregiver interaction in baseline and follow up assessments. In addition, child and parent behaviours were coded for each bi-weekly session of the intervention during 10-min of the 'coach' section of JEMT+ Sign.

### 2.15 | Parent Outcomes

Structured Visual Analysis (SVA; Ledford et al. 2018) was used to analyse the effects of the intervention on parental *accuracy* and *frequency* of JEMT + Sign strategy use. Microsoft Excel was used to create graphs of parental strategy use and this was analysed through SVA to determine whether there was an increase in levels directly after a new tier was introduced (abrupt level change) and whether there was an accelerating (therapeutic) trend to the target performance criterion for that tier. As with Quinn et al. 2021), the intervention effect (functional relation) was decided by examining a) the average number of data points by looking at *level* (low, medium, or high); *trend* (accelerating/decelerating); *stability* and *overlap* of intervention data with baseline; b) reviewing how immediately the changes in frequency and accuracy occurred once the strategy was introduced and c) how consistent changes were across strategy use and parent–child dyads.

Statistical analysis was also modelled on Quinn et al. (2021, 2024) and took place secondary to visual analysis, using the quantitative metric of nonoverlap of all pairs (NAP) and log response ratio increasing (LRRi) to confirm the SVA analysis. According to Ledford et al. (2018), NAP represents a comparison of data points from baseline (A) to intervention (B) and were converted to parametric effect size using an interpretation by Petersen-Brown et al. (2012) to indicate whether there was no, small, medium or large effect from the intervention. The data from JEMT strategy use was inputted from baseline (A) to intervention (B) using an online effect-size calculator (SingleCaseES, Pustejovsky and Swan, 2018). LRRi was also calculated from the same platform to estimate the magnitude of the effects (LRRi; Pustejovsky, 2019) as they are deemed appropriate for behaviours measured as counts or percentages and can be converted into percentage change in the level of the outcome.

### 2.16 | Qualitative Analysis

The SLT and parent interviews were transcribed and uploaded to NVivo (Version 12) and analysed using reflexive thematic analysis guided by Braun and Clarke (2021). The two students transcribed all the interviews and then took an inductive approach by openly coding the participants' statements. They did this separately for all transcripts before meeting to discuss and refine codes and then generating themes and subthemes based on patterns from the interviews. They then met with the last author to discuss and refine these themes and agree on their core meaning. A number of themes and subthemes at this stage were merged where overlap occurred in order to develop more mutually exclusive themes. The themes were then defined by all researchers, linking back to the interview data and named before producing this report.



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## 3 | Results

The results will be presented in relation to the specified research questions.

**RQ1**: In what ways did the intervention change the accuracy of parental JEMT + Sign strategy use?

The left side of Figures 1–4 shows the *accuracy* of parental JEMT + Sign strategy use over the 22 sessions (the right side reflects the *frequency* results for RQ2).

As can be seen, there is some within-condition (baseline, intervention, follow-up) variability across strategies, although this did not affect the ability to determine level changes. The scores for all dyads in the baseline condition were relatively variable on all strategies, apart from *Prompting* which was consistently low across all participants. All strategies were below the performance criteria at baseline. Once the intervention was introduced (as per red line on y axis), there was an increase in the level of that strategy for all dyads, although with much variability across sessions and participants. During the intervention, all parents reached the target performance criteria (broken green line on the x axis) on 4/5 strategies with one parent (Aoife) falling slightly below the 80% accuracy criterion on *Matched Turns* and two carers (Aoife and Nora) falling below the 80% criterion for *Prompting* although showing improvements towards the end of this tier. During the brief (4-week) follow up period we noted that *Target Talk, Expansions* and *Joint Attention* stayed at the target criterion level as did *Matched Turns* (apart from Aoife who dipped to 68% accuracy). Only two parents (Nora and Kate) maintained the performance criterion for *Time Delay* and only one parent, Nora, for *Prompting* at follow up. There was also some covariation observed across tiers. For example, as soon as *Matched Turns* was introduced, there was a co-occurring increase on the accuracy of *Target Talk* and a marginal accuracy increase for *Expansions*. Parent performance was similar across in-person and online intervention delivery.

Structured visual analysis (SVA) indicated a relative consistency in behaviour changes across conditions. This consistency was replicated across tiers and dyads and led us to determine that there was a functional relationship (intervention effect) for the accuracy of JEMT + Sign strategy use for all parents. To support SVA, we calculated NAP estimates (Table 3) including standard error and 95% confidence intervals as well as description of the effect size. NAP estimates ranged from no or small to large effects. All participants had the smallest estimates for *Time Delay* (range from 0.38-0.80) followed by *Prompting* (0.57 to 0.82) and *Expansions* (0.73 to 0.86), where only Kate showed a large effect (0.99). *Target Talk* ranged from 0.92 to 1.00 and *Matched Turns* showed the largest effect (1.00), although was still small for Nora and Sarah (0.80). Overall, the effects were found to be small for most dyads, apart from Kate and Bobby where there was a large effect for accuracy on the Matched Turns, Target Talk and Expansion strategies. Similar mixed effect sizes were noted for LRRi values which ranged from -0.5 to 4.19. Finally, the estimates of percentage change also varied across participants from a decrease to a large increase as follows: Aoife and Cillian (62% to 435%); Nora and Sarah (−5% to +6513%); Susie and Ava (21% to 162%) and Kate and Bobby (−13% to +2052%). All parents showed a consistent and relatively large change on the *Expansion* strategy and three (Aoife, Nora and Kate) had the lowest level of change for *Time Delay*. It was not possible to calculate change for Susie and Ava on *Prompting*, as use of this strategy was consistently low in the baseline which affect LRRi estimates (Quinn et al. 2021).

**RQ2**: In what ways did the intervention change the frequency of parental JEMT + Sign strategy use?

The right hand column of Figures 1–4 above show the *frequency* of parental use of JEMT + Sign strategies as measured by the number of times in which the parent used each strategy correctly. All four parents had a relatively low and stable baseline for *Prompting*, followed by *Expansions* and *Time Delay*, but overall performance was variable. *Joint Attention* had the highest frequency level from the beginning of the intervention, and remained so for Nora and Sarah but increased to the performance criterion (once per minute) for Aoife and Cillian, Kate and Bobby, and Susie and Ava following introduction of the strategy. For Aoife and Cillian, although performance was highly variable, there was an immediate change observed for 4/6 strategies once they were introduced (apart from *Joint Attention* and *Prompting*) with an overall accelerating trend for all strategies. For Nora and Sarah, performance at baseline was variable and this continued during the intervention although a moderate level increase was observed for *Matched Turns* and *Target Talk*. These participants did demonstrate an accelerating trend in frequency across all strategies, although this was not maintained at follow up. For Kate and Bobby, an accelerating trend was observed for all strategies apart from *Time Delay* at baseline and this continued during the intervention for all strategies apart from *Prompting*. Performance for this dyad at follow up was somewhat variable, although in general continued to increase. Finally, for Susie and Ava, an immediate, if somewhat variable, increase was noted following the introduction of all strategies, apart from *Matched Turns*, with some deceleration noted during follow up. All four dyads met the criteria of using *Time Delays* between 1 and 10 times per child–caregiver interaction and *Prompting* 1–5 times once Tier 5 was introduced.

SVA indicated that out of 20 potential demonstrations of effect, 17 were realised (this was across 4/5 tiers for three participants, and 5/5 for Kate and Bobby in Table 4). Although we determined a functional relationship between the intervention and frequency of all parent strategy use, based on consistency of changes and replication across tiers and participants, these changes showed predominantly no or small effects. All NAP estimates for *Matched Turns* ranged from none (0.46) to small effects (0.86); for *Target Talk* effects were small (0.86-0.92); for *Joint Attention* the range was again from no (0.36) to small effects (0.89); *Expansions* ranged from small (0.71) to medium effects (0.95); for *Time Delay* from no (0.36) to medium effects (0.95) and *Prompting* from no (0.50) to small effects (0.84). LRRi estimates showed similar variability and ranged from −1.25 to 2.65 with a percent increase from −71% to



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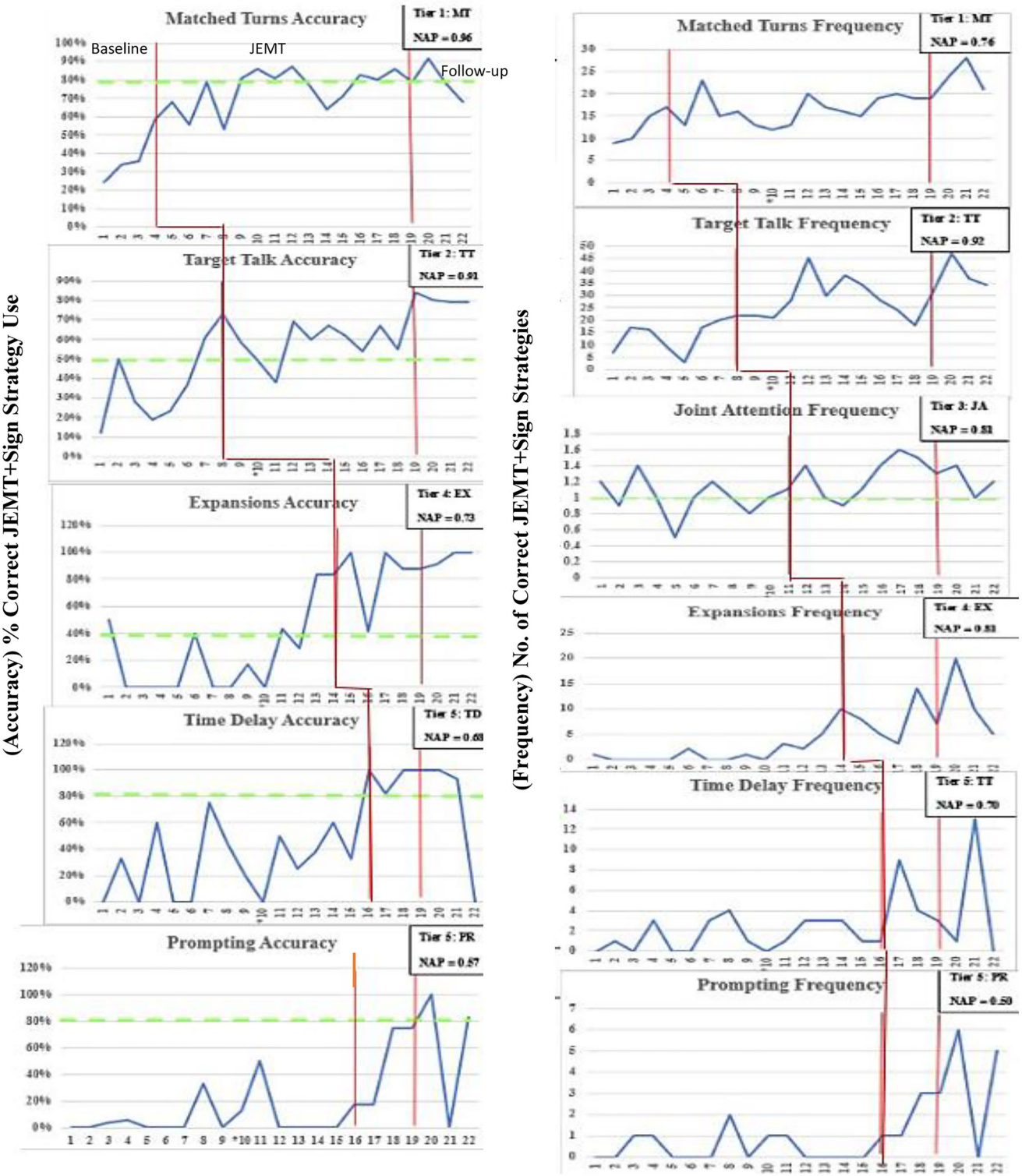



**FIGURE 1** | Aoife and Cillian's accuracy (left) and frequency (right) of JEMT+Sign strategy use. *Note:* The first continues red line on *y*-axis = baseline depending on when the specific skill was introduced and the second red line = follow up; Broken green on *x*-axis = performance criterion per strategy; * = early discontinued sessions; NAP = nonoverlap of all pairs.



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**TABLE 3** | Non overlap indices and parametric effects sizes for accuracy of JEMT + Sign strategies.

| Dyad | JEMT strategy | NAP | SE | 95% CI | Non-overlap | LRRi | SE | 95% CI | % Increase | Actual/ potential | Functional relation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aoife and Cillian | MT | 0.96 | 0.04 | [0.65–1.00] | Medium | 0.66 | 0.19 | [0.29–1.04] | 94% | 4/4 (Tiers) | Yes |
| | TT | 0.91 | 0.07 | [0.59–0.98] | Small | 0.66 | 0.31 | [0.05–1.27] | 94% | | |
| | EX | 0.73 | 0.14 | [0.41–0.91] | Small | 0.80 | 1.03 | [−1.21–2.81] | 123% | | |
| | TD | 0.68 | 0.16 | [0.36–0.88] | Small | 0.48 | 0.66 | [−0.81–1.77] | 62% | | |
| | PT | 0.57 | 0.14 | [0.28–0.82] | Small | 1.68 | 0.73 | [0.24–3.11] | 435% | | |
| Nora and Sarah | MT | 0.80 | 0.14 | [0.47–0.94] | Small | 0.16 | 0.09 | [-0.02–0.34] | 17% | 4/4 (Tiers) | Yes |
| | TT | 1.00 | 0.02 | [1.00–1.00] | Large | 0.77 | 0.06 | [0.65–0.90] | 117% | | |
| | EX | 0.78 | 0.10 | [0.45–0.93 | Small | 4.19 | 0.55 | [3.11–5.27] | 6513% | | |
| | TD | 0.50 | 0.13 | [0.23–0.77] | No effect | −0.05 | 0.30 | [0.64–0.53] | −5% | | |
| | PT | 0.57 | 0.14 | [0/28–0.82] | Small | 1.91 | 0.68 | [0.57–3.25] | 574% | | |
| Susie and Ava | MT | 0.95 | 0.05 | [0.65–0.99] | Medium | 0.38 | 0.11 | [0.16–0.60] | 46% | 4/4 (Tiers) | Yes |
| | TT | 0.92 | 0.06 | [0.61–0.99 | Small | 0.86 | 0.19 | [0.48–1.24] | 136% | | |
| | EX | 0.86 | 0.08 | [0.54–0.97] | Small | 0.96 | 1.01 | [−1.02–2.94] | 162% | | |
| | TD | 0.80 | 0.11 | [0.48–0.94] | Small | 0.80 | 0.67 | [0.52–2.12] | 123% | | |
| | PT | 0.84 | 0.07 | [0.52–0.96] | Small | — | — | — | — | | |
| Kate and Bobby | MT | 1.00 | 0.02 | [1.00– 1.00] | Large | 0.19 | 0.07 | [0.06–0.32] | 21% | 4/4 (Tiers) | Yes |
| | TT | 1.00 | 0.02 | [1.00–1.00] | Large | 0.58 | 0.08 | [0.43–0.73] | 78% | | |
| | EX | 0.99 | 0.01 | [0.69–1.00] | Large | 1.48 | 0.36 | [0.76–2.19] | 337% | | |
| | TD | 0.38 | 0.13 | [0.15–0.68] | Small | −0.14 | 0.28 | [−0.69–0.41] | −13% | | |
| | PT | 0.82 | 0.09 | [0.49–0.95] | Small | 3.07 | 1.03 | [1.05–5.09] | 2052% | | |

*Note:* Significant estimate as 95% confidence interval does not include zero. Criterion for NAP estimates for no effect, small effect, and large effect were based on Petersen-Brown et al. (2012).

Abbreviations: CI, confidence interval; NAP, non-overlap of all pairs (Parker & Vannest, 2009); SE, standard error. No effect = <0.50, Small = 0.51 - 0.92, Medium = 0.93 - 0.96, Large = >0.96.—= Not able to calculate.



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**TABLE 4** | Non overlap indices and parametric effects sizes for frequency of JEMT + Sign strategies.

| Dyad | JEMT strategy | NAP | SE | 95% CI | Non-overlap | LRRi | SE | 95% CI | % Increase | Actual/ potential | Functional relation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aoife & Cillian | MT | 0.88 | 0.07 | [0.55–0.97] | Small | 2.49 | 1.03 | [0.47–4.50] | 1191% | 4/5 (Tiers) | Yes |
| | TT | 0.79 | 0.14 | [0.47–0.94] | Small | 0.67 | 0.78 | [−0.86–2.20] | 95 | | |
| | EX | 0.84 | 0.07 | [0.52–0.96] | Small | — | — | — | — | | |
| | TD | 0.76 | 0.16 | [0.43–0.92] | Small | 0.25 | 0.16 | [−0.07–0.56] | 28% | | |
| | PT | 0.92 | 0.07 | [0.60–0.99] | Small | 0.70 | 0.23 | [0.25–1.15] | 101% | | |
| Nora and Sarah | MT | 0.79 | 0.10 | 0.94 | Small | 1.72 | 1.04 | [−0.31–3.75] | 457% | 4/5 (Tiers) | Yes |
| | TT | 0.48 | 0.14 | [0.22–0.76] | No effect | 0.00 | 0.17 | [−0.33–0.33] | 0% | | |
| | EX | 0.62 | 0.14 | [0.31–0.84] | Small | 0.29 | 0.19 | [−0.09–0.67] | 33% | | |
| | TD | 0.36 | 0.20 | [0.14–0.67] | No effect | −0.17 | 0.16 | [−0.48–0.13] | −0.16% | | |
| | PT | 0.71 | 0.09 | [0.39–0.90] | Small | — | — | — | — | | |
| Susie and Ava | MT | 0.11 | 0.07 | [0.02–0.43] | No effect | −1.08 | 0.40 | [−1.86--0.30] | −66% | 4/5 (Tiers) | Yes |
| | TT | 0.52 | 0.15 | [0.24–0.78] | Small | 0.37 | 0.70 | [−1.01-1.75] | 44% | | |
| | EX | 0.86 | 0.08 | [0.54–0.97] | Small | 0.51 | 0.15 | [0.23-0.80] | 67% | | |
| | TD | 0.91 | 0.07 | [0.59–0.98] | Small | 1.35 | 0.23 | [0.91-1.80] | 287% | | |
| | PT | 0.89 | 0.09 | [0.57–0.98] | Small | 0.51 | 0.21 | [0.11-0.92] | 67% | | |
| Kate and Bobby | MT | 0.46 | 0.18 | [0.20–0.74] | No effect | −0.05 | 0.11 | [−0.27-0.17] | −5% | 5/5 (Tiers) | Yes |
| | TT | 0.88 | 0.08 | [0.56–0.98] | Small | 0.62 | 0.20 | [0.24–1.01] | 86% | | |
| | EX | 0.85 | 0.11 | [0.52–0.96] | Small | 0.35 | 0.12 | [0.12– 0.58] | 42% | | |
| | TD | 0.95 | 0.05 | [0.63–0.99] | Medium | 2.65 | 0.40 | [1.87–3.44] | 1322% | | |
| | PT | 0.04 | 0.04 | [0.00–0.35] | No effect | −1.25 | 0.32 | [−1.87–0.63] | −71% | | |

*Note:* Significant estimate as 95% confidence interval does not include zero. Criterion for NAP estimates for no effect, small effect, and large effect were based on Petersen-Brown et al. (2012).
No effect = <0.50, Small = 0.51 - 0.92, Medium = 0.93 - 0.96, Large = >0.96. NaN = Not a number.
Abbreviations: CI, confidence interval; NAP, non-overlap of all pairs (Parker and Vannest, 2009); SE, standard error.



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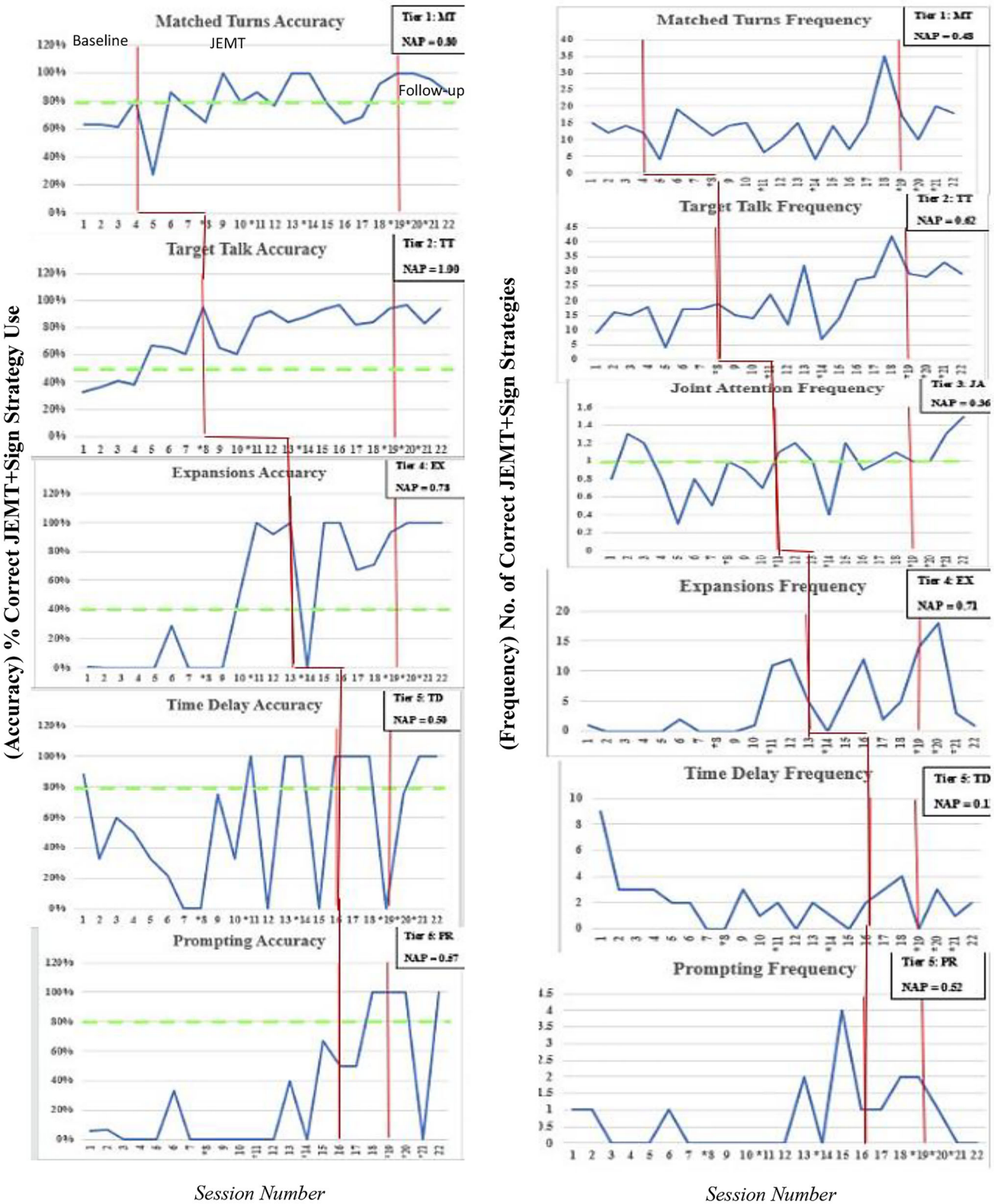



**FIGURE 2** | Nora and Sarah accuracy (left) and frequency (right) of JEMT+Sign strategy use.

1322% The effects observed for frequency measures were therefore smaller than for accuracy as noted in Table 3.

**RQ3**: In what ways did the intervention change child communication and language?

We observed strong individual differences across the children's communication and language from the continuous observational and before and after measures. First, we review their overall communication outcomes from our observational measures averaged across baseline, intervention and follow up conditions (see Figure 5). As we did not have sufficient experimental control to



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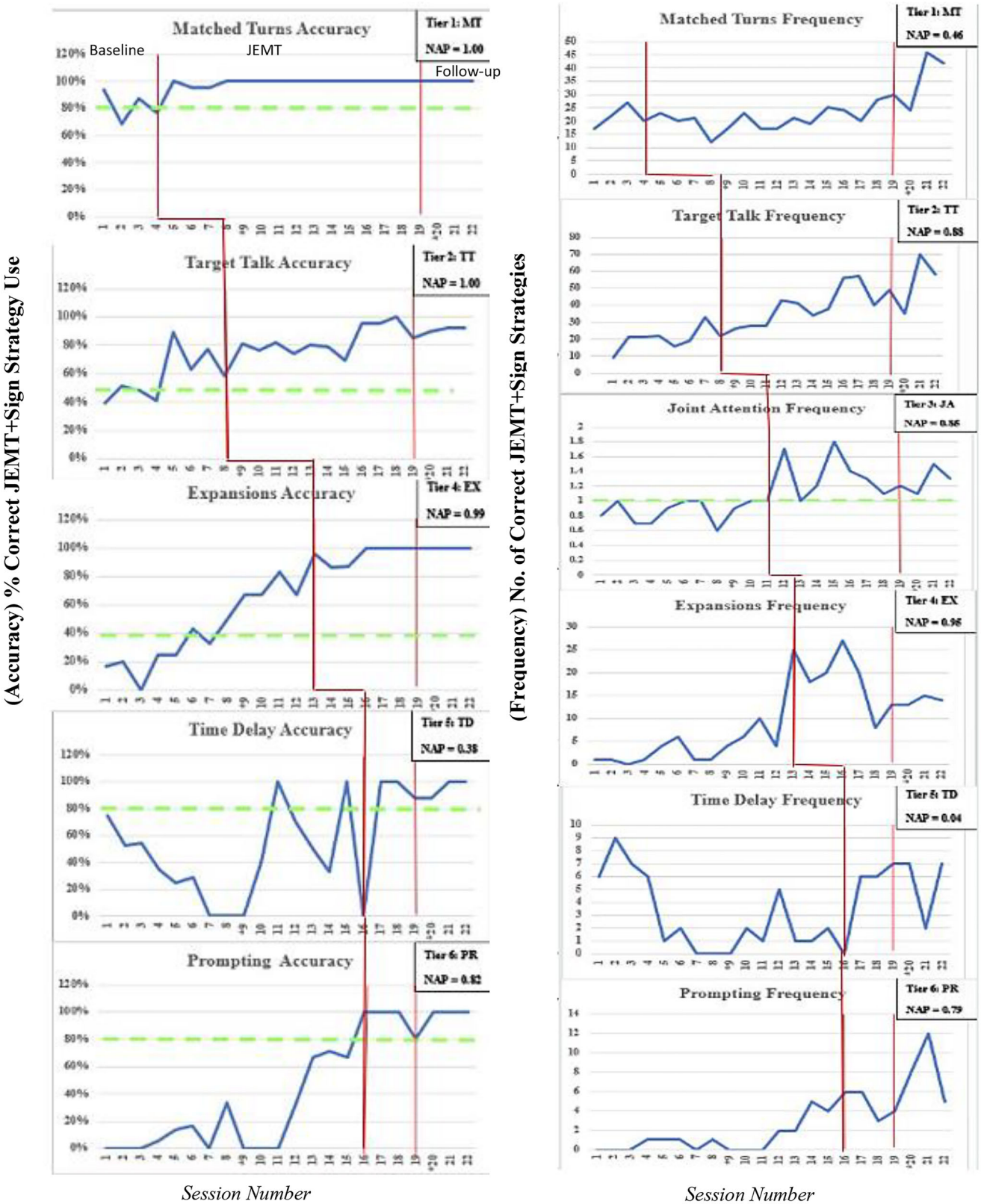



**FIGURE 3** | Kate and Bobby's accuracy (left) and frequency (right) of JEMT+Sign strategy use.

investigate whether any change was linked to the intervention, we did not carry out any inferential statistics to investigate the significance of any change.

For Cillian and Sarah, vocalisations decreased somewhat during the intervention, with a corresponding small increase in the use of signs and words. Overall, Cillian's communication continued



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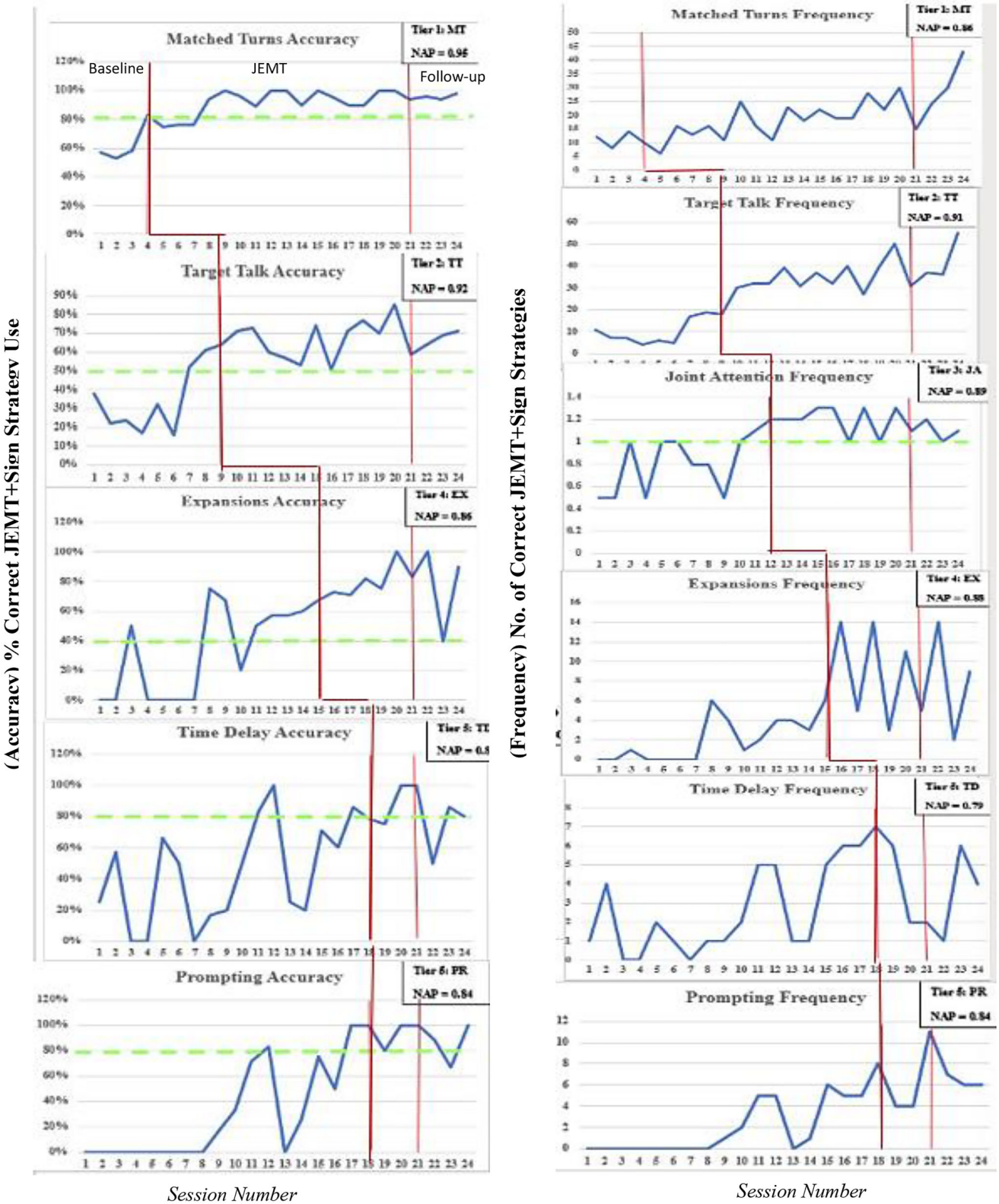



**FIGURE 4** | Susie and Ava's accuracy (left) and frequency (right) of JEMT+Sign strategy use.

to increase at follow up, while Sarah's plateaued. For Bobby, all communication outcomes decreased somewhat during the intervention, but by follow up there was an increase, which could indicate that it took time to consolidate his skills as his mother increased her use of the JEMT + Sign strategies. Finally for Ava, we see a relative increase in all communication during the intervention which continued at follow up.



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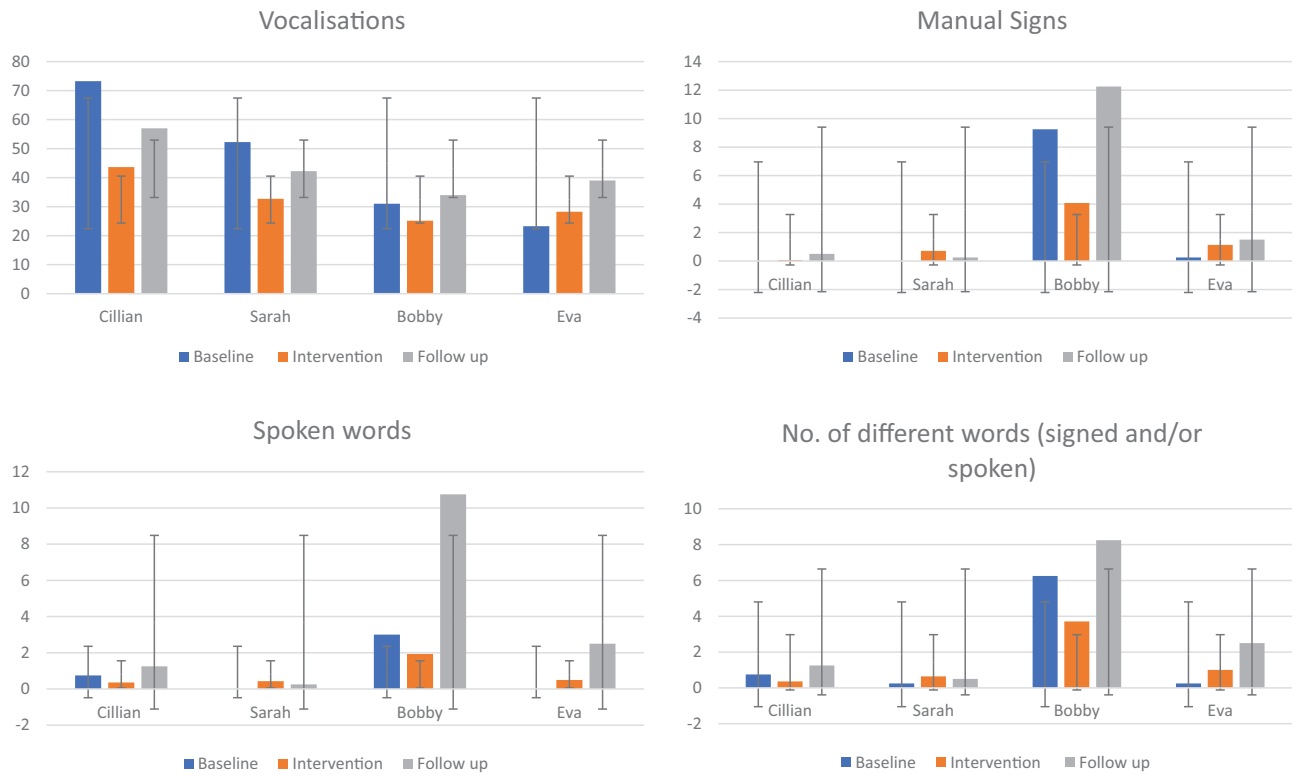



**FIGURE 5** | Child communication outcomes (including Standard Deviation error bars); average performance across baseline ($n = 4$), intervention ($n = 14$) and follow-up ($n = 4$) conditions.

We then calculated their change in language and communication scores from baseline to follow up assessments on the PLS-5 and structured language sample in Table 5.

The standard scores on the PLS-5 are reported here, which have a mean of 100 and a standard deviation of 15. As can be seen, Cillian, Sarah and Ava increased their standard scores across all subtests, although for Bobby his score decreased for auditory comprehension with no change across other scores. This was interesting to note as he made the greatest changes on the observational measures, while the other children did not make as many gains on observational measures. For the language sample, Cillian was observed to increase the number of signs and words used, no change was observed for Sarah or Ava, and the number of spoken words for Ava decreased. Bobby's post-intervention scores were not calculated as the final session for the language sample was cancelled. As previously noted, all of the child language and communication outcomes are exploratory at this point and cannot be directly linked to the intervention.

**RQ4**: What were the views of parents and clinician about the intervention?

Table 6 summarises the main themes and subthemes from the parents and clinician interviews.

The first theme related to the *feasibility* of the intervention where both facilitators and barriers were identified by parents. The SLTs identified that their familiarity with families and their capacity to take part was a facilitator as they knew which families would be able to engage with the intense nature of the intervention. They explained that they '*knew what families it might work for [due to] knowing the family dynamics*' (SLT2). For parents, one mother mentioned how having one online session per week '*made it easier*' (P1) as it reduced travel time to the clinic. Another parent recognised that they '*wouldn't have been able to do it*' (P4) without JEMT being carried out through home visits. All parents agreed that having JEMT carried out over eleven weeks positively impacted the feasibility as it was '*for a defined period*' (P2) and they felt that it was '*doable*' (P4).

Barriers indicated by the SLTs were the time it took both to record and edit videos to use in parent coaching and for measuring fidelity. One SLT was unable to complete home-based intervention due to an already busy work schedule which was a barrier. Both SLTs questioned whether it would be feasible to carry out JEMT + Sign in the wider Irish public health service. As they worked in a semi-private service specific to the needs of people with Down syndrome, they recognised that they had '*more leeway*' (SLT1) to deliver the intervention. Parents also stated that the time commitment was a barrier, particularly for those who had more than one child. For example, one parent said that JEMT '*worked*' as they only had one child but considered that '*it might be different for other parents that have four or five kids*' (P1). Work commitments were also identified as a barrier. One parent felt that they were '*lucky*' that their work was '*semi-flexible*', and this allowed them to take '*time out during the week*' for this intervention (P2). Another parent was on leave from work at the time of intervention and admits that she '*wouldn't have been able to do this*' (P3) if she had returned to work.



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**TABLE 5** | Post-intervention assessment results and change from pretest.

| Measures | Cillian | | Sarah | | Bobby | | Ava | |
|---|---|---|---|---|---|---|---|---|
| | Post-intervention | Change from pretest | Post-intervention | Change from pretest | Post-intervention | Change from pretest | Post-intervention | Change from pretest |
| PLS-5 | | | | | | | | |
| AC[SS] | 69 | +5 | 55 | +5 | 50 | −6 | 69 | +15 |
| EC[SS] | 71 | +6 | 67 | +3 | 50 | no change | 82 | +11 |
| TL[SS] | 68 | +6 | 58 | +5 | 50 | no change | 74 | +14 |
| Language sample | | | | | | | | |
| Manual sign | 7 | +2 | 0 | no change | not calculated | | 0 | no change |
| Words | 13 | +12 | 0 | no change | not calculated | | 1 | −5 |

Abbreviations: AC, auditory comprehension; EC, expressive communication; TL, total language; SS, standard score

The next theme related to the *impact* of the intervention. All participants observed changes in themselves and the children. The SLTs felt that the parents became '*more involved*' and '*really empowered*' (SLT2) and realised that '*their voice was important*' (SLT1). Parents reported having greater confidence in using the strategies, such as '*mirror and mapping*' (P4) and '*offering choices*' (P3). Parents recognised that they became more '*patient*' (P1) following JEMT + Sign and now acknowledge their child '*making the effort*' (P1) to communicate. One parent recognised how they now give their child '*the opportunity to speak*' (P4). A realisation of the importance of '*getting down to (the child's) level*' (P1) was also stated. Furthermore, parents generally felt that the changes they saw during JEMT have transferred into '*everyday life*' (P2). Both SLTs perceived a change in the children who took part and saw '*huge progress*' (SLT1) in different aspects of the children's communicative abilities including '*joint attention… play skills… use of sign… use of words*' (SLT2). Parents perceived several changes in their child's communication such as the use of signs and increased intentional communication. For example, one child now initiates an interaction with her parent by giving her '*things to play*' (P3). Another parent spoke about an improvement in their child's ability to '*engage and communicate*' (P2) and as a result, the child '*isn't frustrated*'. Finally, the SLTs described a change in themselves as clinicians and acknowledged a '*spill over to other clients*', specifically with the use of '*parent coaching techniques*' (SLT1).

The third theme related to the factors that influenced the success of the intervention. The SLTs noted that engagement was a key aspect of success as evidenced by a '*very high attendance rate*' (SLT2) by all participants. Parents also said that the intensity of two sessions a week was beneficial; '*…the fact that I was getting two sessions a week…that was gold*' (P3). Parents felt '*really immersed*' and admitted to '*practicing all the time*' (P3). The individualised nature of JEMT + Sign was also key to the success as parents said that '*there's nothing that can take from the one-on-one intervention*' (P2). Although parents recognised that '*groups are great settings*' (P2), the '*one-on-one focused*' nature of JEMT + Sign specific to their child's needs was deemed to be of '*big benefit*' (P2). Parents praised the feedback that was given to them by their SLTs throughout JEMT. They believed that this enhanced their learning of strategies as '*you wouldn't know if you're doing it right or not unless someone tells you*' (P4). Finally, the established relationship between the family and the SLT was raised as being integral to the success of the intervention. For parents this meant that they '*felt very comfortable*' with the clinician meaning that they could express themselves '*if…struggling with one piece*' (P3) of the intervention.

## 4 | Discussion

This pilot study shows positive preliminary results for the implementation of a hybrid JEMT + Sign intervention delivered in a real-world clinical context. Our analysis showed that parents can learn the strategies to the required performance criterion. In addition, the intervention increased their accuracy, and frequency of strategy use, albeit the latter to a lesser extent. For children, there were some increases noted in their communication and in the use of spoken and signed words, although these cannot be definitively attributed to the intervention. Despite overall positive



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**TABLE 6** | Themes from the clinician and parent interviews with illustrative quotes.

| Theme | Subtheme | Illustrative quote (participant code) |
|---|---|---|
| *Feasibility* | Facilitators | '*We had… specifically picked who it might work for because of us knowing the family dynamics and… the parents who may be able to … attend for all of those sessions*' (SLT2). |
| | Barriers | '*If I was going to the child's home, it definitely would have taken up a half a day and it just wouldn't have been viable*' (SLT2).<br>'*I'm not sure everybody could make the commitment to it… I'm lucky that my work is semi-flexible in terms of being able to do something like that… it's not even just the work time out during the working week, but… it's also the implementing the strategies and… making sure you get the time to practice before the next session and stuff like that*' (P2). |
| *Impact* | Changes in parent, child and SLT | '*I think what was really nice was just seeing a change in the parent becoming really empowered… I found that they became really confident in how to use the strategies… which is great because we know a lot of those strategies are what's needed*' (SLT2).<br>'*I was then able to take that parent coaching piece and use that with more of my other clients. So that had like a wider impact*' (SLT1)<br>'*I really saw a difference in [child]. I really thought he came on hugely throughout the program. We saw… some improvement in terms of [his] ability to engage and communicate*' (P2).<br>'*Yeah, definitely made me kind of sit back and notice more as in watching what she's doing, seeing what she's like… And I definitely give her more of an opportunity to say something*' (P4). |
| *Success factors* | Engagement | '*I think their engagement was really good. They had all of their sessions, There was really good buy in*' (SLT1). |
| | Intensity | '*I would say the intensity of it… is absolutely brilliant and like it's very different from other parent child interactions… It wasn't just a group setting where then you're moving on to the next topic without them really having grasped the first one*' (SLT1).<br>'*There's probably no comparison from the point of view of the amount of speech and language that was offered… Like the fact that I was getting two sessions a week… and then the fact that it was so intense as well… We were really immersed in it*' (P3). |
| | Relationship | '*I thought it was very beneficial and I thought [SLT] was excellent and she put a lot of time and effort into it and I think that came across and clear and I suppose [child] gets on very well with [SLT2]. So maybe… that makes… the process a little bit easier*' (P2). |

trends in our findings, it is important to note that there was considerable variability in the performance of parents and their children, with outcomes ranging from no or small, to large effects. The parents and clinicians involved found the intervention to be effective, and noted a change in their own and the children's behaviour. This was facilitated through a pre-established trusting relationship between clinicians and families, having the flexibility to deliver the intervention through a hybrid model and the support of the wider organisation to facilitate this delivery.

### 4.1 | Parent Outcomes

The findings from this study are in line with previous studies from the US that used similar versions of the intervention. Quinn et al. (2021, 2024) employed a hybrid model with a group of children with disabilities, including Down syndrome and found that carers met the performance criteria for all EMT strategies during the intervention. Both studies observed an intervention effect between EMT and the accuracy and frequency of parental use of strategies. They also found that based on SVA, the effects for accuracy were more consistent than for frequency data and observed significant variability across parents and children. Our findings are also in keeping with Windsor (2015) who implemented JEMT with two young children with Down syndrome aged 18–22 months and their parents and found parents could effectively implement most strategies. Windsor also found variability among the parents and that the final strategy of *Prompting* was the most complex for parents to perform. In addition, carers in the current study met criterion for each strategy regardless of whether the session was delivered online or in-person, consistent with previous findings (Quinn et al. 2021; Wright and Kaiser 2017). This preliminary evidence contributes to the evidence base in support of hybrid therapeutic delivery models as seen in McDuffie et al. (2013, 2016). This study indicates that tele-intervention greatly facilitated the caregivers' availability and accessibility to engage in the bi-weekly programme. In terms of maintenance, Quinn et al. (2021) found that the carers continued to use EMT strategies six weeks after the intervention. In the current study, parents continued to use the six JEMT strategies four weeks after intervention and remained generally above the criterion cut off for each strategy.

Unlike the Quinn studies in the US which observed statistically significant and stronger effects for accuracy and frequency of parental use of JEMT strategies, the current study yielded more variable and weaker effects. One possible reason for this difference could be the difference in dose frequency between the Quinn studies (which involved 24–28 intervention sessions over 4 months) compared to the current study (22 sessions over 2 ½ months). The shorter time period may not have given carers sufficient time to consolidate their skills and some have argued



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that better outcomes are observed for higher dosages of between 20 and 58 sessions (Meadan and Daczewitz 2015; Roberts and Richmond 2015; Roberts et al. 2014; Windsor 2015; Wright et al. 2013) particularly for children with Down syndrome. This of course has to be balanced with the acceptability of a longer intervention given that parents found the shorter time to be 'feasible' and as it is much more intensive than any service currently offered to families in Ireland (O'Toole and O'Leary 2025). Another reason for the stronger effects for JEMT from the US could have been that the clinicians were more experienced in delivering EMT and had the support of research assistants and the Kidtalk Vanderbilt laboratory for training and analysis. The clinicians in our study, although very experienced, were new at delivering the intervention and in their interviews noted that their understanding of the intervention improved by the end and that they would implement it differently if they were to do it again.

### 4.2 | Child Outcomes

Although the impact of the intervention on child communication and language was exploratory, we did see some increases on both observational and standardised measures, albeit with considerable individual variation. Most notably, the greatest difference demonstrated was in the number of different words and/or signs used and increase in spoken words. These increases could have been related to the intense nature of the intervention where families were receiving twice-weekly input from the SLT and parents reported they were practicing regularly at home outside of these sessions. It appears to be the case that a high input dose of intervention results in better outcomes for children with Down syndrome, as observed in a recent study on language through music (Frizelle et al. 2024). Wright et al. (2013) and Windsor (2015) also found gradual increases in use of spoken words, although less so in children younger than 2 years. All of the children in the current study were aged over 24 months which might have resulted in greater improvements. Similar studies have noted that older children tend to have greater increases in language outcome (Quinn et al. 2021; Roberts and Kaiser 2012). For example, Quinn et al. (2021) noted a change in the children's communication within one month of their parents learning a strategy to criterion. Quinn et al. (2024) noted that children gradually increased their communication and words during the follow up phase, as in the current study, which was argued to be relate to increased parental proficiency and competence in using the strategies, resulting in a cumulative impact of the intervention over time. Finally, although three out of four children in the current study showed improvement on standardised scores but not clinical observation measures, one child has the opposite outcome. This highlights the importance of collecting outcome data from a variety of sources. Further research and methodological control is needed to provide evidence that changes in the children are due to the effects of the intervention.

### 4.3 | Experiences of JEMT + Sign

Our final research question addressed the clinician and parental views and experiences of taking part. Regarding feasibility, the SLTs' understanding of the family context and capacity to take part was perceived as a core component to increase parental engagement in therapy. Klatte et al. (2019) and Klaic et al. (2022) both noted that the SLT's ability to understand and judge parental capacity for engagement with PCIT interventions is a key part of intervention success. The flexibility of the online and home-based sessions were instrumental in making the intervention feasible and accessible as it reduced practical barriers like travel and childcare that are involved in accessing interventions (Amsbary 2019; Guglani et al. 2023). O'Toole et al. (2021) synthesised parental views on engagement with PCIT interventions and noted that technology may provide practical benefits to enable some families to engage with the intervention. At the same time, this paper also highlighted challenges regarding the therapeutic alliance between parents and clinicians in online delivery when compared to face-to-face intervention. This points to the importance of a hybrid model of service delivery to combine the advantages of both in person and online methods. Furthermore, although the intervention was intense, as it was for a defined period of 11 weeks, parents considered it to be achievable and there was a high attendance rate. Parents also valued the individual and direct nature of the intervention and felt that the success was linked to the trusting and comfortable relationship with the clinician. O'Toole et al. (2021) also highlighted that individual sessions and home visits are valued as a more personalised approach for families and that a trusting relationship is key to the success of PCITs.

One of the biggest advantages of this intervention was the structured approach to coaching parents which is often ambiguous in early intervention (Kemp and Turnbull 2014). Clinicians were provided with a fidelity checklist with a clear protocol on how to complete the coaching sessions and explicit instructions on how and how often to provide coaching and feedback through 'Teach Model Coach Review'. These fidelity checklists were provided for both in person and remote delivery of the intervention, the latter arguably more challenging to implement (Quinn et al. 2021). The clinicians noted that they were able to generalise their coaching skills to interventions with other families. Furthermore, many PCITs are unclear on how to coach parents and do not always include or differentiate the 'model' aspect where clinicians work directly with the child to demonstrate to parents how to implement a strategy. Modelling was identified as an important aspect of coaching in a qualitative evidence synthesis of parental experiences of PCIT interventions as 'parents prefer to see strategies modelled by the clinician with their child before they practice them' (O'Toole et al. 2021, 3170). The SLTs in the current study found that the intervention increased parental strategy use following the intervention, resulting in parental empowerment. Our findings resonate with those of Klatte et al. (2019) in which SLTs also observed a change in parental empowerment after participating in PCITs. Similarly, parents noted changes in themselves and their children which motivated them to continue with the intervention. Moreover, the high dosage of bi-weekly interventions over 11 weeks was considered by parents and clinicians to have resulted in success and contrasts significantly with the five sessions per year on average offered to children with Down syndrome in Ireland (Frizelle et al. 2021). At the same time, the SLTs acknowledged that not all families would have the capacity to take part and that not all services (particularly public services) would have the resources and flexibility to deliver such an intensive intervention.



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## 5 | Limitations and Future Directions

There were several limitations to this study. Firstly, there was a very small and selective sample size which limits the generalisability of our findings. All mothers had high levels of education and were either not working at the time of the intervention, or had flexible working to enable them to take part. The four-week follow up period was relatively short, especially as it is known that changes in children with Down syndrome's language skills can take longer to consolidate than changes in parents. This highlights the importance of a longer follow up period to assess the impact of the intervention in this group (Roberts et al. 2019). The research design meant that the coders were not blinded to the intervention and no control measures were included. Future studies should consider different designs including more controlled feasibility studies looking at different adaptations such as dosage levels as well as more diverse participants and interventionists before scaling up to a randomised controlled trial. Further studies should also include a cost effectiveness measure. Finally, we noted that one child (Bobby) had the highest level of play skills at baseline and was observed to make the greatest communication gains from the intervention. Yoder et al. (2014) also noted that children with better object play skills had better outcomes in a similar PCIT intervention. It would therefore be worth exploring whether there are prerequisite child development skills such as object play that impact success.

## 6 | Conclusion

Parents play a fundamental role in child language development (Woods and Brown 2011). JEMT + Sign addresses previous gaps in PCIT within the Down syndrome population in both its intensity as well as how it is tailored to the strengths and needs of children with Down syndrome (Wright et al. 2013; Windsor 2015). This study found that it was possible to teach parents interaction and language promoting strategies and that parents and clinicians considered it to be a very valuable intervention. Not only did they find it to be feasible and acceptable to implement, they noted changes in their own behaviours and that of the children and valued the intensive nature of the programme. The clinicians found the coaching procedures to be very useful for training parents. The intervention differs significantly from current dosage and administration models of PCIT programs in the Irish clinical context and so further research is needed to determine whether similar outcomes could be observed in other context, particularly given how the intensity of intervention services have deteriorated under a recent reconfiguration of children's disability services in Ireland (O'Toole and O'Leary, in 2025).


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### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

Data is not publicly available due to confidentiality. Further anonymised data can be made available on request to the corresponding author.

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## Supporting Information

Additional supporting information can be found online in the Supporting Information section.

**Supplemental Materials 1**: Semi-Structured Interview Guide.

**Supplementary Material 2**: TIDieR checklist.



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