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Telepractice parent-implemented training and coaching in a rural area in the UK: Impact on mothers and their children with autism

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ABSTRACT

Background: Parent-implemented interventions are reported to have positive outcomes for both children with autism and their parents. Online parent training and coaching have been increasingly used as an effective alternative or supplemental to traditional face-to-face services, especially after the start of the Covid-19 pandemic. The purpose of this study was to examine the extent to which parents of children with autism can implement a set of newly acquired strategies and the impact these had on their children's communication skills.
Method: Four mother–child dyads from a rural area in the UK participated in the study following a multiple-baseline design across strategies. Asynchronous training and synchronous coaching were provided, all online.
Results: The present study extended the results of the original US based study it replicated (Meadan et al., 2016). Mothers learned to use the targeted naturalistic teaching strategies they were trained and coached in (i.e., i-PiCS- internet-based Parent-implemented Communication Strategies) and their children's responsiveness and initiations of communication increased and were mostly maintained after the end of the study. Changes in the mothers' use of strategies were observed in many cases even after training only, and the strategy of time delay was linked to increases in the children's initiations of communication.
Conclusions: This replication study showed that i-PiCS is an appropriate intervention to use with mothers of children with autism in the UK and telepractice training and coaching can be a feasible and effective service delivery method.

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1. Introduction

There has been an exponential increase (787 %) in recorded incidences of Autism Spectrum Disorder (ASD) diagnoses in the UK in the last two decades (Russell et al., 2021) making it very likely for educational and health professionals to serve children with autism and their family at some point in their career. People with autism experience difficulties in social communication skills (American Psychological Association- APA, 2013), which have been reported to impact a number of other areas such as academic achievement, social success and quality of life (Meadan-Kaplansky et al., 2013). To enhance social-communication skills in children with autism, naturalistic communication strategies have been found to be particularly useful especially because these strategies can be embedded within everyday routines (Meadan et al., 2016).

1.1. Parent-implemented interventions and telepractice

As parents have unique knowledge and experience of their own child, they are likely to become better advocates for their child's needs (Prata et al., 2018). Parent-implemented interventions can ensure that ongoing opportunities for skill development and practice are provided during daily familiar routines in natural environments (McConachie & Diggle, 2007; Meadan et al., 2009, 2016). Hence, training and coaching parents as intervention mediators is cost-effective and ecologically valid (Brian et al., 2016; Ingersoll et al., 2017). A number of studies on parent-implemented interventions found positive outcomes for children's social communication (responsivity and initiations), complexity and spontaneous use of language, expressive language (Aldred et al., 2004; Brian et al., 2016; Ingersoll & Wainer, 2013; Lang et al., 2009; Meadan et al., 2009), adaptive behaviour and ASD diagnosis (Dawson et al., 2010), as well as reduction in challenging behaviour (Gerow et al., 2018). Positive outcomes such as maintaining low parental stress levels (Estes et al., 2014) and improving parent-child interaction (Aldred et al., 2004) have also been reported. In addition, a significant association between parents' fidelity in implementing an intervention and children's outcomes has been reported (Brian et al., 2016; Ingersoll & Wainer, 2013).

Telepractice is a promising service delivery approach which had been used widely in the health field, but to a limited extent in other disciplines including education up until the start of the Covid-19 pandemic. The main advantages of telepractice include reduced cost and time spent on travel as well as reduced intrusion into the family home (Chen & Liu, 2017). Online delivery methods to engage parents in training and coaching have been increasingly used in recent years as an alternative or supplemental to traditional face-to-face services with reported positive outcomes for both children and parents (Akemoglu et al., 2020; Ingersoll & Berger, 2015; Ingersoll et al., 2017; Sengupta et al., 2021). More specifically, Ingersoll and Berger (2015) and Ingersoll et al. (2017) found that the addition of an interactive coaching component may be a critical element of successful online parent training programs as opposed to fully asynchronous self-directed web-based parent mediated interventions.

1.2. The impact of the Covid-19 pandemic

During the global pandemic, parents of children with developmental disabilities were reported to be struggling more than ever (Aishworiya & Kang, 2021), especially families with younger children and greater severity of autism symptoms (Colizzi et al., 2020; Manning et al., 2021). Educational settings closed down, in some countries for several months, and mental health services have been disrupted in the vast majority of the countries worldwide (Layachi & Schuelka, 2022). Parent-implemented interventions gained more significance in light of the pandemic and the long hours children spent at home. Many parents of children with autism had to face additional challenges, including working from home or loss of employment, and many became overwhelmed with the demands of looking after their children without the daily support of specialists (Eshraghi et al., 2020). Telepractice services for individuals with autism developed during the pandemic although still emerging were in many cases found to be equivalent or better in quality to face to face services (Ellison et al., 2021).

1.3. Autism in rural areas

Children in rural areas are likely to have significantly more difficulty accessing services from professionals in their areas (Murphy & Ruble, 2012) and receive interventions of lower dosage due to increased travel time and cost (Mello et al., 2016). Although studies including rural families of children with autism are scarce (Guðmundsdóttir et al., 2019), it is reported that these families face multiple additional challenges such as low autism awareness, fewer support services, large caseloads and waiting lists, problems with recruitment and retention of professionals (Antezena et al., 2017; Hoogsteen & Woodgate, 2013; Murphy & Ruble, 2012; Preece & Lessner Lištiaková, 2021). Therefore, there is a pressing need for cost-effective solutions and alternative methods to interventions to support these children and families (Mello et al., 2016; Murphy & Ruble, 2012). Telepractice can be a promising alternative for reliable, affordable, and convenient intervention for underserved populations (Antezena et al., 2017).

1.4. The current study

This study is a replication of a study conducted by Meadan et al. (2016) in the US. The original study examined the effects of a training and coaching program, the Internet-Based Parent- Implemented Communication Strategies (i-PiCS), on parent implementation of a set of teaching strategies and on concomitant child communication skills. The study reported that when provided with telepractice training and coaching, mothers of children with autism can learn to implement naturalistic teaching strategies with fidelity

and this can have a positive impact on their children's communication skills. Given that there is need for more replication studies in educational research to shape education policy and practice (Makel & Plucker, 2014), the transferability of the findings of the above study to a rural population in the UK seemed appropriate to be tested. At the same time, the current research is one of the very few studies aiming to explore telepractice on parent implemented approaches during exceptionally challenging circumstances while maintaining high research rigour (Ferguson et al., 2022).

The research questions which guided this study were:

1. Does parent telepractice training and coaching result in an increase in the fidelity of implementation and rate of use of the newly acquired strategies?
2. Are there corresponding changes between the parent-implemented intervention and their children's social-communication skills?
3. How do mothers rate the social validity of the goals, procedures, and outcomes of a fully online training and coaching intervention program (i.e., i-PiCS)?

2. Method

2.1. Recruitment

The study took place in Cumbria, a large mountainous county in North West England with 54 % of its residents living in rural areas while the equivalent average across England is only 18 % (Cumbria County Council, 2017). Cumbria's population is White British by 96.5 %, a percentage well above the national average of 79.8 % for England (Cumbria Observatory, 2020). One of the project's researchers (sixth author), who was located in Cumbria, facilitated the recruitment process. She initially approached local special schools, Early Years Specialist Advisory Teachers, Autism Specialist Advisory Teachers, as well as Speech and Language and Occupational Therapy professionals, providing them with an introduction to the project. These professionals made initial contact with families they thought would benefit from the study to explore their interest. Contact information of interested parents (i.e., first name and mobile number) were passed on to the first author, who contacted families with more detailed information on the project.

To participate in the study, children had to (a) be between 5 and 8 years old (early primary years and around the mean age of ASD diagnosis across the globe [60.48 months, van't Hof et al., 2021] when parent support needs are expected to have risen), (b) have received an independent ASD diagnosis, and (c) have been reported as having communication difficulties by an education or health professional in Cumbria. Parents had to commit to participate for a period of about 4 months. There was no need for the families to have access to technical resources as each family was provided with a 4 G Tablet (iPad mini) with a built-in SIM card and high speed internet for the duration of the study.

2.2. Participants

Five mother-child dyads started the study. However, one mother decided for personal reasons to withdraw after the first two coaching sessions and data of her family were withdrawn. All mothers were married and worked part time at the time of the study. All families were of White British origins. Children information is included in Table 1.

2.2.1. Ella
Prior to the commencement of the study, Ella was 6 years and 2 months with an ASD diagnosis and attended mainstream school. Her mother reported that Ella had quite a lot of words and tended to use two-three-word sentences and that she usually was able to communicate if she wanted something and responded to simple questions.

2.2.2. Connor
Connor was 5 years and 5 months with an ASD diagnosis and attended mainstream school. His mother reported that Connor had difficulties in his receptive language (e.g., "he understands some words of the sentence but often fails to understand the meaning of the sentence") whereas in terms of his expressive language, he had an extensive vocabulary but did not know how to use it to form sentences to communicate.

Table 1
Children participant data.

Child (Mother)*	Gender	Age**	Diagnosis***	Area of residence*****
Ella (Rose)	Female	6:2	ASD****	Town
Connor (Anna)	Male	5:5	ASD	Village
Rachel (Lucy)	Female	7:3	ASD + Down syndrome	Village
George (Sam)	Male	6:4	ASD	Village

Note. * All names are pseudonyms. ** Date of Birth obtained from mothers prior to the commencement of the study. The age represents years: months. *** Provided by the professionals with parental consent prior to the commencement of the study. **** Autism Spectrum Disorder. ***** Town: population between 10,000 and 100,000. Village: population below 10,000.

2.2.3. Rachel

Rachel was 7 years and 3 months with a dual ASD and Down syndrome diagnosis and attended mainstream school. Her family consisted of two children, Rachel being the eldest. Her mother reported that Rachel did not use spoken language to communicate but she took other people's hands to lead them to what she wanted and to express her needs.

2.2.4. George

George was 6 years and 4 months with an ASD diagnosis and attended special school. His family consisted of two children, George being the eldest. George's sister also has an ASD diagnosis. His mother reported that George could follow simple instructions, but sometimes only repeated questions posed to him. As far as his expressive communication is concerned, he took other people's hand to what he wanted and used occasional words.

None of the mothers with the exception of Lucy had received any training in special education prior to the start of the study. Lucy had been through some training (not coaching though) straight after the birth of her daughter and her diagnosis of Down syndrome.

2.3. Research design

A multiple-baseline design across strategies within each family was employed to examine the effects of the intervention on the mothers' application of the targeted naturalistic teaching strategies and their children's communication skills. In multiple-baseline designs, which are often used to evaluate the effectiveness of interventions (Levin & Ferron, 2021), the intervention starts at different time points for each strategy. Therefore, in this study each family served as its own control (i.e., four different multiple baseline studies). In line with the quality indicators of single case research (Horner et al., 2005), this design permitted three demonstrations of a basic effect within each family (i.e., across the three teaching strategies taught in the intervention, and replication across the four families).

2.4. The independent variable

The independent variable was a two-phased intervention, named i-PiCS; teleprastice training followed by coaching were offered to teach parents how to use four naturalistic teaching strategies (Meadan et al., 2016). These strategies were: (a) environmental arrangement (EA): setting up the environment to increase the likelihood that the child will communicate, a prerequisite to each of the following three other strategies, (b) modeling: using demonstrations to teach the child new words, phrases, signs or gestures, (c) mand-model: providing a verbal prompt in the form of a question (e.g., What do you want?), a choice (e.g., Do you want an apple or a banana?) or a mand (e.g., Tell me what you want or Say more please), and (d) time delay: encouraging children to initiate communication within a routine or regular activity where the child understands the expectations based on past patterns. The training in this study included short, self-paced asynchronous videos and graphic resources whereas the coaching, which followed training, consisted of a combination of synchronous observation, listening, reflection and feedback (Meadan et al., 2016).

2.5. Setting and materials

All sessions were conducted at the families' homes or occasionally in other locations of their choice (e.g., grandparents' home) over the Internet using Zoom, an online videoconferencing service. The decision was made to deliver training and coaching fully online to address the main difficulty in working with children with autism in rural areas, that of increased travel time and cost. A few weeks into the study the pandemic forced a nationwide lockdown and school closures which would have meant pause of the study or moving online anyway.

All families used 4 G tablets provided by the researchers for the duration of the project. Mothers used the tablets to watch the training videos, access the supportive materials, video record themselves interacting with their child, and send these videos to the researchers at three time points (i.e., baseline, post training, and full maintenance) as well as to connect via Zoom for the synchronous coaching sessions. Electronic materials, such as copies of training/coaching documents and videos of parent–child interactions, were shared between the family and the researchers using secure online file sharing services (i.e., BEAR DataShare). The training and coaching sessions were recorded using the Zoom video-recording function, saved on BEAR Research Data Store and encrypted external hard drives.

2.6. Procedures

The study consisted of the following phases during which data were collected for each family: baseline, post-training, coaching, maintenance with other coaching and full maintenance. During baseline the mothers were asked to video record themselves while interacting with their children in a natural way. Following baseline, the mothers went through the initial 3 training modules (i.e., introduction to i-PiCs, environmental arrangement and modeling) and then were asked to send more videos of them interacting with their children to the researchers. Data were not collected on environmental arrangement as this was the foundation strategy and coaching of the first to be assessed strategy (i.e., modeling) followed. Once each mother reached mastery for the first strategy while being coached, they were moved to the next strategy (i.e., mand-model first and time delay next). While mothers were trained and coached in the other two strategies, data were collected on their performance on modeling (i.e., maintenance with other coaching). Full maintenance data were collected from the mothers straight after the end of the study and a few months later (times varied for each

family). Video data were collected live (but coded at a later point) during the coaching and maintenance with other coaching phases whereas the mothers sent the researchers the videos to be coded for the remaining phases.

After each mother sent the researchers their baseline videos (i.e., three videos of 5–7 min length each) mothers were sent three of the five training videos (a) introduction to i-PiCS, (b) environmental arrangement and (c) modeling. Mothers were advised to watch the videos in this order, as many times as they wished, and once they felt ready, to send the researchers three post training videos. The four mothers reported that they watched each video a couple of times before recording their own videos.

After mothers were trained in each strategy, coaching followed. More precisely, they were coached in the use of the environmental arrangement strategy in combination with each of the other three strategies. Two doctoral students in special education with experience in working with children with disabilities and their families (third and fourth author) and the first author served as the coaches. Therefore, each mother-child dyad worked with two coaches, a doctoral student and a senior researcher, with the former being the first contact point for the families (i.e., primary coach). Mothers participated in sessions approximately once a week at times convenient to them. Therefore, there were variations depending on each family's availability and the duration of coaching sessions ranged between 20 and 60 min, whereas the duration of the overall i-PiCS study ranged for each family between 4 and 6 months.

2.7. Parent training

Parent training consisted of video modules developed for the US study (Meadan et al., 2016). These video modules presented each strategy with detailed step by step flowcharts, explained how it helps and showcased how it is used with several video examples to facilitate understanding. The duration of all modules ranged between 9 min 6 s and 14 min 14 s, with an average of 12 min 24 s (the total duration of the 5 training video modules was 62 min).

2.8. Parent coaching

The coaching sessions had three components: (a) a pre-observation part in which the mother and the coaches developed collaboratively an action plan about the targeted communication behaviour for the child and the routine the mother would follow during the observation, (b) observation of mother–child interaction for about 5–7 min without interruption, and (c) a post-observation part in which the mother and the coaches discussed the observation and the latter provided feedback on mothers' implementation of the targeted teaching strategy. Mothers were coached in three phases: (a) environmental arrangement+modeling, (b) environmental arrangement+mand-model, and (c) environmental arrangement+time delay. Each coaching phase continued until mothers used the target strategy at an established performance criterion level (i.e., high quality on >80 % of opportunities for three consecutive sessions). This performance criterion was not explicitly communicated to the mothers. After the performance criterion was reached for the modeling strategy, mothers were introduced to training and then coaching on the mand-model strategy, followed by first training and then coaching on time delay. Because each mother had to reach mastery for each strategy before they moved to the next strategy, the number of coaching sessions for each mother per strategy varied (from 3 to 11 sessions).

Once every three coaching sessions and at least once per phase, mothers also received video feedback (i.e., two short clips from previous session/s of around 30 s each were reviewed, as per Meadan et al.'s (2016) study). Video feedback was shared during the pre-observation part of the coaching session before developing the action plan. Prior to the video feedback, the primary coach had edited video segments of previous coaching sessions in which the mother was interacting with her child to highlight strengths and identify areas for improvement. The clips were short to ensure maximum engagement from the mother, they were played a few times on each occasion (i.e., 2 or 3 depending on the mothers' wish and the coaches' professional judgement) and were used to promote self-reflective discussion with the coaches. This is in line with other video coaching programs such as Video Interaction Guidance (Kennedy et al., 2011).

2.9. Fidelity of implementation of coaching

Fidelity of implementation for the coaching sessions was assessed on two levels. First, during every session the primary coach completed a fidelity checklist containing the steps they had to follow (e.g., specify resources needed for the routine, provide first supportive and then corrective feedback). Afterwards, another researcher watched at least 30 % of the sessions in each of the three coaching phases for each family and completed the same fidelity checklist. Inter-rater reliability for fidelity of implementation was 93 % across all coaching phases and dyads (Dyad 1 = 95 %, Dyad 2 = 87 %, Dyad 3 = 92 %, Dyad 4 = 97 %). An agreement was identified when both coders coded the same strategy and same level of fidelity (i.e., 4 =high, ≤3 =low).

2.10. Dependent variables

To answer the first two research questions two dependent variables were measured: (a) the quality and rate with which mothers implemented the naturalistic teaching strategies, and (b) children's social-communication skills. Three minutes of parent-child interactions were coded for each coaching session irrespective of the length of the full video. The videos of mothers interacting with their child sent to the researchers at baseline, post training, and full maintenance were also coded. Three consecutive minutes from each video of all phases were used (first and last couple of minutes per video segment were excluded from coding due to settling down time and to avoid participants' tiredness) and coded independently by the two primary coaches of each family. The i-PiCS coding manual, developed for the Meadan et al. study (2016), that detailed the parent and child behaviours to be coded, was used. This manual

included operational definitions for: (a) the naturalistic teaching strategies, (b) rating the quality of the teaching strategies as implemented by the parents (from 1 =low to 4 =high), and (c) the children's communicative behaviours (i.e., initiating and responding). Instances of children leaving interactions were coded only if they had communicative intent and the disruption of the interaction was shorter than 30 s. Instances of children engaging in challenging behaviour (e.g., putting themselves or their mothers at risk of physical harm or abuse) would have been excluded from the coding, but never occurred.

2.10.1. Parent quality and rate of strategy use

The fidelity with which mothers implemented i-PiCS was defined as the quality with which each of the three targeted evidence-based teaching strategies, (i.e., modeling, mand model, and time delay) was used. To measure fidelity, the percent of high-quality strategy use (i.e., 4) was calculated for each session by dividing occurrences of high-quality strategy use by the total frequency of strategy use. Also, the rate of strategy use per minute, including all quality/fidelity levels, was calculated.

2.10.2. Child communication skills

Child's communication in the coded videos was defined as either responsivity (i.e., the child uses a communication behaviour to communicate due to the parent's use of a teaching strategy) or initiation (i.e., the child uses a communicative behaviour to begin a communication exchange with the parent as per the i-PiCS coding manual) (Meadan et al., 2016). To calculate the child's responsivity the number of times they responded to their parent was divided by the number of times they responded plus the number of times they failed to respond, multiplied by 100. The number of initiations per session was also measured.

2.11. Interobserver agreement (IOA)

The primary coach for each family (i.e., doctoral student in special education with experience in working with children with disabilities and their families) acted as the interrater coder for the other two families. The interrater coders had no contact with the two families whose videos they checked. The interrater coder independently coded at least 30 % of the sessions, randomly selected, in each phase of the study. The interrater coders were blind to the session order. IOA was calculated as agreements divided by agreements plus disagreements, multiplied by 100. An agreement was identified when both coders coded the same strategy or communication skill. Table 2 contains IOA data and ranges by family/dyad for each phase.

2.12. Ethics

This research was conducted according to the ethical guidelines of the British Educational Research Association (2018) and was approved by the University of Birmingham Research Ethics Committee (ERN_19–1312). All mothers gave written informed consent for themselves and their children before the commencement of the study. The children's young age and communication difficulties made it impossible for them to provide assent.

2.13. Social validity

Social validity data indicates "*the social significance of target behaviours, the appropriateness of procedures and the perceived importance of results*" (p. 360) with interviews and questionnaires being the most common methods used to collect these type of data (Armstrong

Table 2
Interobserver Agreement (IOA) by dyad and phase.

Dyads	Phase (n, % sessions coded)	Strategy (range) (%)	Communication (range) (%)	Overall (%)
Dyad 1	*Baseline (1, 33)*	67	86	77
	Post-training (3, 33)	81 (70–100)	78 (60–91)	80
	Coaching (6, 35)	97 (89–100)	93 (82–100)	95
	Maintenance (2, 33)	100	85 (83–86)	93
				86
Dyad 2	*Baseline (1, 33)*	33	90	62
	Post-training (3, 33)	83 (73–93)	89 (83–94)	86
	Coaching (6, 33)	94 (80–100)	94 (85–100)	94
	Maintenance (2, 33)	69 (60–78)	83 (80 86)	76
	Overall			**80**
Dyad 3	*Baseline (1, 33)*	100	80	90
	Post-training (3, 33)	87 (75–100)	91 (73–100)	89
	Coaching (5, 46)	100	84 (58–100)	92
	Maintenance (2, 33)	100	79 (78–80)	90
	Overall			**90**
Dyad 4	*Baseline (1, 33)*	100	100	100
	Post-training (3, 33)	95 (86–100)	95 (86 100)	95
	Coaching (4, 36)	95 (85–100)	95 (79–100)	95
	Maintenance (2, 33)	100	100	100
				98

et al., 1997). To answer the third research question on social validity, semi-structured interviews were conducted by the family coaches with each mother straight after the end of the intervention and 4–16 weeks later depending on the availability of the families. During these interviews, which lasted between 20 and 78 min (average duration= 48.5 min), issues such as mothers' experience of using i-PiCS and the impact of the intervention on the children's communication were explored. The interview transcripts were thematically analysed using NVivo 12 (2018) by the first and the third author independently. The analysis followed a mostly deductive approach as the emerging codes and subsequent themes resulted to a great extent from the questions posed to the mothers. Cohen's kappa for interviews was calculated 0.71 (0.78 for strategies and 0.65 for child's communication) indicating substantial agreement between the two coders (McHugh, 2012).

3. Results

Data as captured in the videos of all research phases are presented to answer the first two research questions. The authors used visual analysis within and across adjacent phases for changes in the level, trend, variability, and stability of data patterns while also considering immediacy of change and overlap of data points across phases and vertical analysis across tiers (target strategies) (Barton et al., 2018; Kratochwill et al., 2013). Each of the following four figures presents observational data for one family. The top three tiers of each figure present the mother's performance data in the multiple-baseline design across the three strategies they were trained and coached in. In these three tiers, the line graph represents the percent of fidelity 4 (i.e., the highest fidelity) strategy use in each session. The shaded bars represent the per minute rate that the mother used the strategy in each session, at any fidelity. Both the above two measures were included in the graphs to capture cases where a mother used a strategy at a high rate but with low fidelity or at a low rate but with high fidelity (Snodgrass et al., 2022). The goal of the i-PiCS intervention was to increase the quality with which the mothers used each strategy (high fidelity) and the rate. The bottom tier represents the child's communication; the line graph represents the percent of the opportunities (i.e., the mother's strategy use) to which the child responded and the shaded bars show the number of times the child initiated communication per coded session.

3.1. Dyad 1

Ella and Rose participated in 35 sessions. During the intervention Ella was primarily at home following the nationwide school closures due to the pandemic.
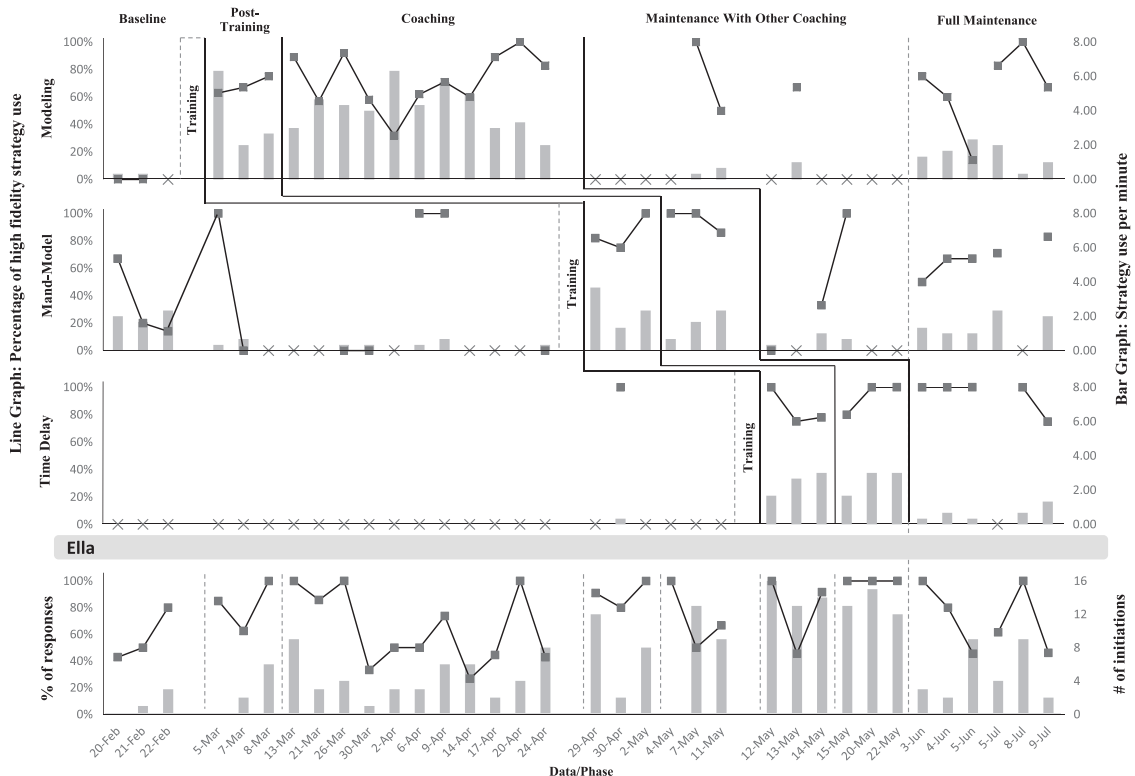

Fig. 1. Dyad 1 performance* . * "x" means that there was no strategy use for that session.

3.1.1. Mother's behaviour

In baseline Rose used modeling rarely, mand model a few times and time delay only once. She scored 100 % high fidelity use for mand-model (three times) and time delay (once). After having received training, she increased the rate and quality of the three strategies (>80 % fidelity for all three strategies in one post training session) but with notable variability. When coaching was introduced, her percent of quality use for mand-model and time delay strategies remained steadily high whereas there was some considerable variability in the quality use of modeling (11 coaching sessions to master modeling). At maintenance while other strategies were being coached, Rose showed medium use of high fidelity for modeling and variable use of high fidelity for mand-model. At full maintenance, there was high fidelity use for time delay, medium use of high fidelity for mand model and variable high fidelity use for modeling. In sum, Rose showed variability in the mastery and use of the three strategies. It took her longer to master modeling and its high fidelity use at full maintenance was variable while she mastered both of the other 2 strategies in only 3 coaching sessions and showed medium to high fidelity use of them at full maintenance.

3.1.2. Child's behaviour

Visual analysis of the bottom tier in Fig. 1 shows that Ella showed high number of initiations as the intervention progressed, especially after her mother's training and coaching on time delay. Ella's responsiveness was more variable with some quite low percentages especially during Rose's coaching on modeling. This variability in Ella's responsiveness percentages is in sync with Rose's variability in the use of the modeling strategy.

3.2. Dyad 2

Connor and Anna participated in 33 sessions. During the intervention Connor was primarily at home following the nationwide school closures due to the pandemic.

3.2.1. Mother's behaviour

In baseline Anna did not use modeling at all; however, she used mand-model and time delay at medium rate (mand-model more often than time delay) and there were sessions in which she scored 100 % high fidelity use in both strategies. After having received training, she increased the rate she used all three strategies and the percent of high fidelity use but the latter with notable variability. When coaching was introduced, Anna's rate and percent of high fidelity strategy use increased substantially for all three strategies, although it took her longer to master high fidelity use for mand-model. Time delay was the strategy she mastered the fastest. At maintenance while other strategies were being coached, she used mand-model in more sessions than modeling and with higher fidelity.
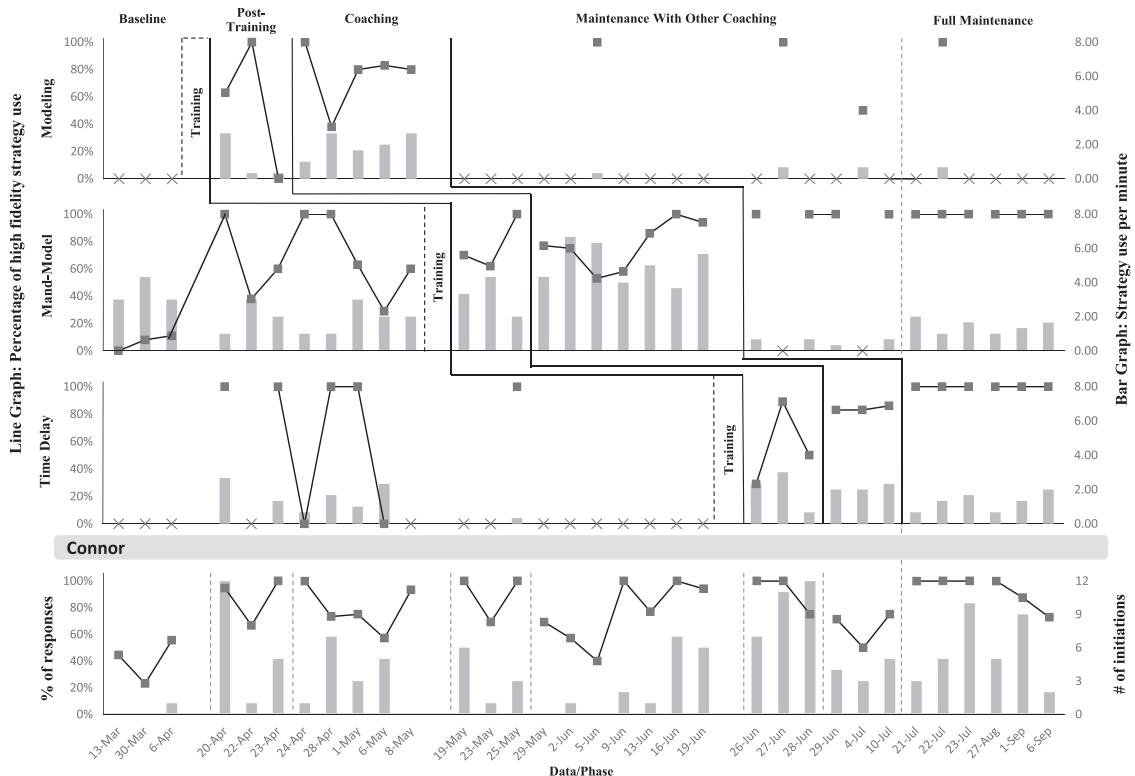

Fig. 2. Dyad 2 performance* . * "x" means that there was no strategy use for that session.

At full maintenance, she scored 100 % of high fidelity use for mand-model and time delay but she only used modeling in one session, with high fidelity but low rate. In sum, Anna's high fidelity strategy use increased and stabilised during the coaching phases and was also reported at full maintenance with the exception of modeling.

3.2.2. Child's behaviour

Visual inspection of the bottom tier of Fig. 2 shows that Connor's responsiveness increased after his mother was introduced to i-PiCS. This was mostly maintained with the exception of a couple of sessions when he reached $\leq$ 50 % responsiveness (5th June and 4th July). Towards the end of Anna's coaching on mand-model, Connor increased his initiations. Although these did not remain steadily high until the end of the study, since then Connor initiated at least twice in every coded session, which was not the case in the sessions before. Finally, during full maintenance, Connor's responsiveness and frequency of initiations remained well above his baseline levels.

3.3. Dyad 3

Rachel and Lucy participated in 31 sessions. During most of the intervention Rachel attended school as schools were back in operation with social distancing restrictions in place.

3.3.1. Mother's behaviour

In baseline Lucy did not use any modeling, used time delay in two sessions with 100 % high fidelity and mand-model many times but with low fidelity. After having received training, she increased the rate and fidelity of all three strategies. When coaching was introduced, she further increased the high fidelity use of all three strategies. At maintenance while other strategies were being coached, there was some use of modeling and mand-model with medium to high fidelity. At full maintenance, she continued using time delay with high fidelity, with the exception of one session, and at fairly high rate. Mand-model was also used with high fidelity but not that often whereas modeling was used at low rate and with variable fidelity levels. In sum, Lucy increased the rate and fidelity of all three strategies following the training and further increased their high fidelity use at coaching. At full maintenance, she appeared to use more and with high fidelity time delay followed by mand-model.

3.3.2. Child's behaviour

Visual inspection of the bottom tier in Fig. 3 shows that Rachel steadily increased her initiations after Lucy was trained in time delay. Her responsiveness to her mother was variable but overall improved also after Lucy was trained in time delay.
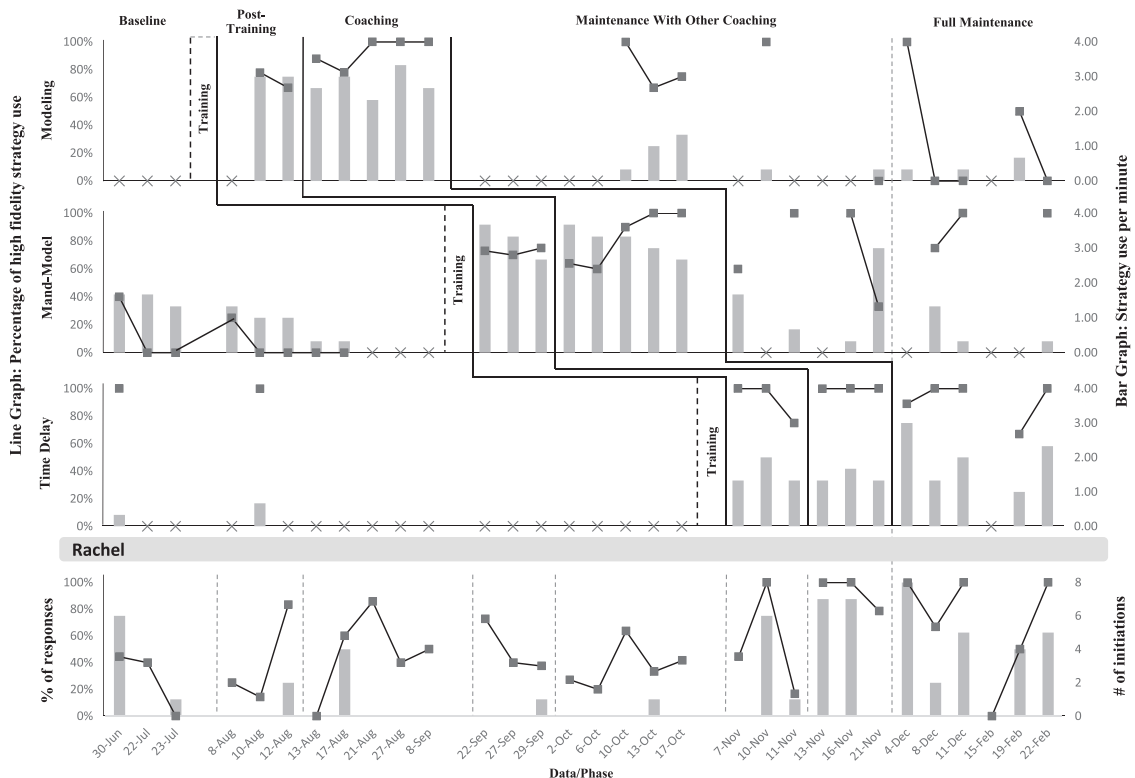

Fig. 3. Dyad 3 performance* . * "x" means that there was no strategy use for that session.

3.4. Dyad 4

George and Sam participated in 29 sessions. During most of the intervention George attended school as schools were back in operation with social distancing restrictions in place.

3.4.1. Mother's behaviour

In baseline Sam used all three strategies but with variable fidelity. After having received training, she increased the rate and high fidelity use of mand-model and time delay. She actually scored 100 % high fidelity for time delay in all three post training coded sessions. At coaching, she scored high fidelity for time delay and mand-model whereas there was some variability in high fidelity use of modeling. At maintenance while other strategies were being coached, modeling was used more than mand-model with variable fidelity for both. However, 100 % fidelity was achieved at certain sessions for both strategies. At full maintenance, she scored high fidelity for all three strategies straight after the end of the study but 16 weeks later, there was high fidelity use for modeling and varied high fidelity use for mand-model while time delay was not used at all. In sum, Sam used all three strategies mostly with high fidelity following coaching. High fidelity of mand-model and modeling were recorded at both phases of full maintenance, but time delay with high fidelity was only coded at the first phase of full maintenance.

3.4.2. Child's behaviour

Visual inspection of the bottom tier in Fig. 4 shows that the introduction of coaching for modeling and mand-model made George's responsiveness more consistent (>60 % responsiveness in all sessions). Responsiveness was coded at the same levels at full maintenance. His initiations were overall low throughout the study but they increased following Sam's training on time delay. However, George's initiations did not remain steadily high until the end of the study.

3.4.3. Data across dyads

Visual inspection of the above four figures reveals key patterns but also differences amongst mother-child dyads in terms of i-PiCS strategy use and children's communication. Inspection of the data shows that all mothers scored at least once 100 % fidelity for a strategy use at baseline. More precisely, Anna scored a few times 100 % fidelity use for both mand-model and time delay at baseline. Additionally, all four mothers increased the rate and high fidelity use of the three strategies following training and before coaching. After coaching was introduced, the time it took each mother to master a strategy varied, especially for two of the three taught strategies (i.e., modeling and mand-model). Overall, it took the mothers three to 11 coaching sessions to master each strategy. All four mothers mastered time delay in only three coaching sessions and seemed to have fewer high-fidelity scores for modeling. Rose found modeling
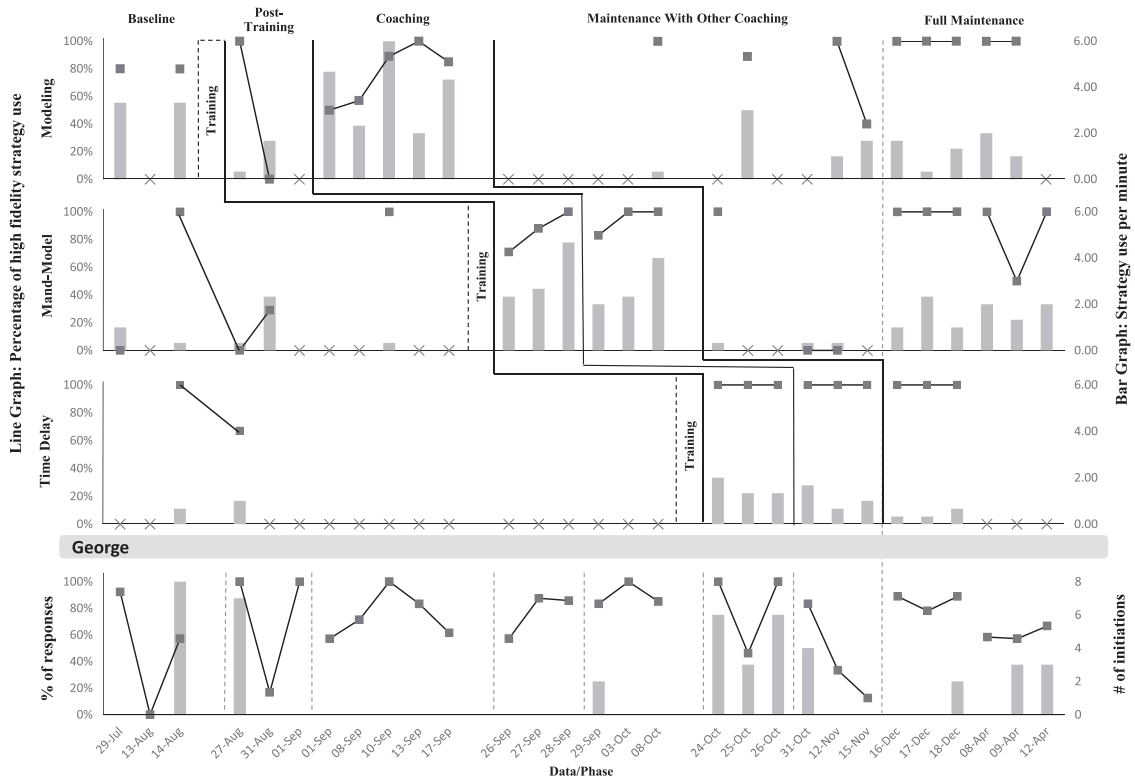

Fig. 4. Dyad 4 performance* . * "x" means that there was no strategy use for that session.

the most difficult strategy to master (it took her 11 coaching sessions) while Anna and Lucy did not use modeling a lot at full maintenance. Data on children's communication demonstrated that there was a variation in the number of initiations per child (i.e., more initiations were coded for Ella and Connor and fewer initiations were coded for Rachel and George), but all children increased their initiations following their mothers' training in time delay.

3.4.4. Social validity

All four mothers indicated high satisfaction with the goals, procedures, and outcomes of the i-PiCS program. At the end of the project, Anna said that "I wish we could start all over again. I enjoyed it so much." Overall, they reported that they had learned new skills to use when they interacted with their children, and that the implementation resulted in positive changes in their children's communication skills. All four mothers reported an increase in the complexity of their children's communication while Rose, Anna and Sam also saw an increase in the frequency of their children's initiations. Lucy reported that Rachel "became less passive and more persistent in communicating her needs and preferences." All mothers also reported that they felt more confident in their parenting skills and empowered by the knowledge they acquired. Anna specifically mentioned how important it is to have some evidence-based strategies in place as when raising a child with autism it often feels that "everything is so out of your control." Finally, all mothers felt comfortable teaching others (e.g., spouse, grandparents, school staff) how to use the strategies as well as recommending i-PiCS to other parents.

4. Discussion

The present i-PiCS study, the first to be conducted in the UK, extends the results of the original study it replicated (Meadan et al., 2016). As the mothers who participated in the US study a few years ago, the mothers of the sample in the UK learned to implement the targeted naturalistic teaching strategies with high fidelity when they were provided first with asynchronous online training and then with synchronous coaching over teleconferencing. The UK based study demonstrated a functional relation between the intervention, both training and coaching, and the mothers' use of the targeted strategies; there were instances where only training was sufficient for changes in their behaviour, but mothers needed both training and coaching in order to master the use of the strategies. Children's responsiveness and initiations of communication were increased and mostly maintained after the end of the study.

Although both fathers and mothers were approached during recruitment, all parents who signed up for the project were mothers (4 who participated and 1 who withdrew early on in the study). This is not uncommon as the vast majority of parent-implemented interventions for children with autism employ largely mother participants (Akemoglu et al., 2020; Schultz et al., 2011).

The current study showed that the four mothers used the learned i-PiCS strategies to different extents. Modeling was the most difficult to master strategy by two of the mothers. This could have been the case because modeling was the first of the strategies the mothers were trained and coached in and the foundation where the other two strategies built upon. Mand-model was fairly easily mastered whereas time delay was linked to increases in the children's initiations of communication. The impact of strategies such as time delay and modeling as parts of broader intervention models for children with autism has long been researched with positive results on early social communication skills (Hwang & Hughes, 2000; Kossyvaki et al., 2016). The strategy of mand-model has also been used to teach social communication skills in children with autism (Aktas & Ciftci-Tekinarslan, 2018; Mancil, 2009).

The mothers' implementation of the i-PiCS strategies was correlated with some positive changes in their children's communication skills. Three of the four children increased their initiations and their responsiveness, skills which were maintained to a certain extent at full maintenance. These findings are consistent with those of other studies, beyond the original i-PiCS study (Meadan et al., 2016), both empirical (Ferguson et al., 2022; Garnett et al., 2022; Sengupta et al., 2021) and reviews (Akemoglu et al., 2020), supporting that online parent training and coaching can be effective to enhancing children's communication. More precisely, this study found that all children increased their initiations after their mothers were trained in the time delay strategy. This is also in line with other studies which have reported that time delay is likely to increase communicative initiations (Mohammadzaheri et al., 2022).

The present study reported two noteworthy differences compared to the findings of the original study (Meadan et al., 2016). Firstly, all mothers of the UK based study showed higher fidelity strategy use following training compared to mothers of Meadan et al.'. s study who increased fidelity use mainly after they were introduced to coaching. Secondly, all mothers in the UK based study scored at least twice 100 % fidelity strategy use at baseline (Rose= 4 times, Anna= 8 times, Lucy= twice and Sam= 3 times). A number of reasons might account for these differences. The average age of the children who participated in this replication study (around 6 years old) were double the average age of the children in the original study (around 3 years old). Therefore, the mothers in the UK based study were more experienced in having a child with autism. Additionally, the children in the replication study had more developed communications skills at the start of iPiCS; three out of four were verbal whereas in the original study two of the three participating children were non verbal and the third had very limited language. Interacting with verbal children is likely to have increased the number of questions mothers in the UK sample asked during baseline, as well as the models they provided their children. Parents might be more prone to model language for their children rather than gestures and other non verbal behaviours as language development is one of the top intervention priorities of parents of children with autism (Ghanadzade et al., 2018). No cultural issues were observed or raised by the mothers in the UK, which can explain the above differences.

Finally, providing training and coaching to parents of children with autism from rural areas is not only ethically desirable and sound but also more pressing than ever nowadays that the impact of the pandemic was added to the challenges these families face. Telepractice became a well perceived essential resource for people with autism and their families during the pandemic (Baweja et al., 2022). In this study, three out of the four participating families came from small villages (<1000 inhabitants) and one of them lived far away (>1 h) from a town or city. For families of children with autism who live in small places and far away from towns and cities the

option of telepractice seems the ideal alternative.

4.1. Limitations

There are several limitations to the study. Having coded longer than 3-minute segments of mother-child interactions might have increased the robustness of the study but it was impossible to do so for 4 families due to time and budget limitations. Also, due to time and funding limitations, it was not possible to run the social validity interviews with a team member who had no prior contact with the families and this might have resulted in some response bias. The coding used for children data were not sensitive enough to capture more subtle changes; measuring methods and functions of children's communication (e.g., Kossyvaki et al., 2012; Kossyvaki et al., 2016), although considerably more time consuming, might have led to more remarkable changes. Another limitation of this study has to do with the variability of the time of the of second phase of full maintenance for each family (i.e., ranged from 4–16 weeks after the completion of the first phase/ end of the intervention). Although the second phase of full maintenance was initially planned for 4–6 weeks after the end of the first phase, the ongoing enforced lockdowns, school closures/adaptations and pressures/insecurities on families' lives and mothers' jobs resulted in delays in the second phase for two of the four families. Interestingly both these families were the ones who completed the study during less strict lockdowns but after a while into the pandemic (June and July 2020 onwards). The authors have no reasons to believe that the variability of the time of the second phase of full maintenance has influenced the internal validity of this study. Although it was beyond the scope of this study to measure the impact of the pandemic on the families, all mothers have reported during the coaching sessions changes in their usual schedule with their children (e.g., two of them reported that they had more time to spend with their children or invest in their own training while the other two faced work-related pressures as the pandemic progressed irrespective of the timing into the pandemic they participated in the study). Finally, there was no opportunity in the study to demonstrate experimental control related to changes in children's behaviour.

4.2. Implications for research

In line with previous studies (e.g., Akemoglu et al., 2020) future research is critically needed to further examine the effects of telepractice training and coaching on parent-implemented interventions. The need to conduct further research to develop online parent training and coaching with high fidelity is more pressing than ever now because of the pandemic (Eshraghi et al., 2020; Fogler et al., 2020; Liu et al., 2021; Sengupta et al., 2021). Given that this feasibility study showed that i-PiCS can be successfully implemented in the UK, next steps should be in two main directions: (a) follow the example of the US study and train service providers to deliver the intervention with greater number of parents including fathers as well, and (b) use the i-PiCS training and coaching protocol with educational and health professionals. Following the example of Ferguson et al. (2022), further i–PiCS research on non-English speaking populations (Meadan et al., 2020) or countries (Inbar-Furst et al., 2021), where parents of children with autism have limited access to similar services and not as many opportunities to participate in research, should be a priority.

4.3. Conclusions and implications for practice

This study showed that i-PiCS has the potential to be an effective tool to increase parents' skills and their children's social-communication. By setting up the environment in a way which promotes communication and applying evidence-based strategies such as modeling, mand-model and time delay, adults can support children with autism to enhance their communicative responses and initiations. There is no reason to believe that such an initiative cannot extend to school staff and other educational professionals' training and coaching with wider implications for the education of children and young people with autism and other Special Educational Needs. This is very significant in the light of the pandemic during which many of the existing therapies for children with autism had to either be discontinued or shifted online where feasible (Amaral & De Vries, 2020). Additionally, given that it is very likely that we will face similar situations in the future (Morents et al., 2020, cited in Baweja et al., 2022), it is prudent to go forward with a certain level of preparedness. It is also believed by many that we are entering a new era where hybrid online and face to face training and coaching is likely to be the norm for cost and time efficiency. Finally, online training and coaching for parents and educational professionals can be extremely beneficial in rural areas in the UK and abroad where travelling can be challenging especially during winter.

CRediT authorship contribution statement

Lila Kossyvaki: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Visualization, Supervision, Project administration, Funding acquisition. **Hedda Meadan:** Conceptualization, Methodology, Formal analysis, Resources, Writing – original draft, Visualization, Supervision, Funding acquisition. **Laura Cristescu:** Investigation, Formal analysis, Writing – review & editing. **Hadeel Alharbi:** Investigation, Formal analysis, Writing – review & editing. **Michelle Sands:** Resources, Writing – review & editing, Supervision. **Danielle Tuite:** Investigation Writing – review & editing.

Declaration of Competing Interest

None of the authors of the manuscript "*Telepractice parent-implemented training and coaching in a rural area in the UK: Impact on mothers and their children with autis*" submitted for consideration by RASD (i.e., Dr Lila Kossyvaki, Prof Hedda Meadan, Ms Laura

Cristescu, Dr Hadeel Alharbi, Dr Michelle Sands, and Ms Danielle Tuite) are aware of any conflict of interest. I, Lila Kossyvaki, as the corresponding author of this manuscript confirm that the document has been read and approved prior to submission by all the above-named authors.

Acknowledgements

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