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A Technology-Enabled Adaptation of Face-to-Face Caregiver-Mediated JASPER Intervention: Preliminary Examination of Video Conferenced Caregiver Coaching

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Abstract

Family-centered practices that involve direct participation of caregivers as part of intervention is critical to effective early intervention. However, regularly scheduled, in person service delivery is not always possible in remote communities, prompting a need for adaptations to the delivery of services, such as the use of live video conferencing to coach caregivers in strategies to promote their children's development. In this study, caregivers and their children ages 2–9 with autism who were living in rural and remote Canadian communities were included. A concurrent multiple baseline design across participants was applied to examine the effects of live video conference caregiver coaching on children's time jointly engaged with caregivers and caregivers' intervention strategy implementation. Results indicated that all children demonstrated greater time jointly engaged and caregivers demonstrated greater use of strategies in comparison to baseline. The results of this study offer preliminary evidence of the effectiveness of real time video conference coaching for caregivers engaging their children with ASD in play.

Keywords: caregiver-mediated intervention, JASPER, rural and remote, autism, telehealth

Introduction

Family involvement is a critical component of early intervention services. Caregiver-mediated interventions aim to support families' adoption of strategies to optimize their children's learning. Caregiver coaching implies a partnership including several key strategies: (a) conversation and information sharing, (b) observation, (c) demonstration, (d) direct teaching, (e) joint interaction, (f) guided practice with feedback, (g) problem solving, and (h) child-focused approach (Rush & Shelden, 2011). Consistent with Division for Early Childhood (DEC) recommended practices for interaction, these strategies are often applied within naturalistic developmental behavioral interventions (NDBIs; Schreibman et al., 2015) to help grow the frequency and quality of caregivers' contingent responses to scaffold their children's behavior (DEC, 2014). These practices may be especially critical when children's communication is infrequent, unclear, or idiosyncratic (Doussard-Roosevelt,2003), often the case for young children with Autism Spectrum Disorder (ASD). Thus, coaching caregivers to notice, interpret and respond to children's cues is an important goal that to date has required frequent face-to-face contact with specialists that is often restricted to large urban centers. Technology including video conferencing can help bridge geographic gaps between providers and families living in rural and remote communities, however, the effectiveness of technology-enabled services is lesser understood.

Caregiver-Mediated NDBIs

Randomized trials of caregiver-mediated interventions delivered in clinic and low-resource home settings have demonstrated gains in outcomes for young children with ASD (e.g., Zwaigenbaum et

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al., 2015). Such intervention models often apply individualized coaching with real-time feedback provided to the caregiver who is interacting with their child (e.g., Brian et al., 2017; Wetherby et al., 2014). Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER) caregiver coaching intervention has demonstrated consistent effects in randomized trials leading to gains in social engagement, communication, and play skills for toddlers (e.g., Kasari, 2010; Kasari et al., 2015) and preschoolers (Kasari et al., 2014). Data from families with school-age children indicate that caregivers' most rapid learning occurred during coaching in comparison to observation and discussion (Shire et al., 2015). The critical influence of coaching is a significant consideration for the development of technology-enabled adaptations.

Technology-Enabled Intervention Delivery for Children With ASD

Live telehealth services involve real-time, two-way transmission between the provider and the recipient (Marcin et al., 2015). This method has been used to provide real time coaching for interventionists learning the JASPER intervention. This quasi-experimental comparison to interventionists receiving face-to-face instruction, found significant gains for interventionists' implementation and no significant differences in implementation or children's outcomes between remote and face-to-face training (Shire et al., 2020). Specific to caregiver implementation, a systematic review of 62 telehealth interventions studies reported that 95% of studies demonstrated significant gains for caregivers' knowledge and implementation outcomes primarily using video conferencing (Chi & Demiris, 2015). Further, review of applied behavior analytic (ABA) interventions also indicated gains but highlighted methodological limitations including limited experimental control, unstable baselines, and lack of blinded outcome raters (Ferguson et al., 2018). For families including children with ASD, mixed outcomes have been reported with intervention delivered using web-based methods including self-directed study (e.g., Ingersoll et al., 2017) and supported remote intervention (e.g., Ingersoll & Berger, 2015; Vismara et al., 2018). Telehealth interventions have also been conducted with families of children with Fragile X reporting increases in caregivers' strategies (McDuffie et al., 2016; Vismara, 2019) as well as children's prompted communication (McDuffie et al., 2016). Recent studies indicate increases for functional communication (Lindgren et al., 2020) and reductions in challenging behavior (Machalicek et al., 2016). The current study adds to this literature by (a) exploring a different intervention program adapted for remote delivery, (b) implementation of remote caregiver coaching by community interventionists, (c) serving rural and remote Canadian communities, and (d) measuring children's social engagement as a child level outcome.

Current Study

In partnership with the regional health authorities of Newfoundland and Labrador, Canada, the current study is a proof of concept adaptation of traditional face-to-face caregiver-mediated JASPER to a technology-enabled protocol where the coaching is provided through video conference. This adaptation is fitting with the service needs in the province where travel time and challenging terrain (e.g., bodies of water, snow/ice) are significant and costly barriers to service delivery. Therefore, we will explore if video conferenced JASPER caregiver coaching results in greater time jointly engaged for children and in caregivers' greater use of intervention strategies. We hypothesize an immediate change in level and gradual change in trend for both children and caregivers.

Methods

Participants

Interventionists were required to: (a) have reached fidelity in both JASPER clinician-child intervention and caregiver coaching, (b) be employed by the provincial health authorities, (c) serve families living outside of major urban centers, and (d) serve children age 2–9 years with ASD (diagnosed by a qualified professional) who qualified for government-funded provincial ABA services. The two interventionists were both Caucasian females, one earning a bachelor's degree in psychology and one, a Master's degree in Health Studies. Their intervention experience included discrete trial teaching, incidental teaching, and the Picture Exchange Communication System prior to JASPER training. Each interventionist served three families.

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All children participating in this study received autism diagnoses by developmental pediatricians who were working within the regional health authorities of the province. Prior to baseline, the Structured Play Assessment (SPA) and Early Social Communication Scales (ESCS) were delivered with each child to characterize their developmental level at baseline. These assessments are described in the measures section provided the data for the description of children's developmental level of play, requesting and joint attention below.

Elliot, a Caucasian male was 46 months of age and lived with his English-speaking mother and father. He was diagnosed with ASD at 26 months with direct home services with a child management specialist (CMS) starting at 36 months. His mother participated in the intervention and had an introduction to ABA. She had completed some college and was employed part time while his father had completed college and was not working at that time. During entry assessments, Elliot demonstrated 49 different play acts. His play was largely functional (building, familiar actions to self) but he also demonstrated three symbolic acts where he gave dolls life through sleeping and waking and pretended that blocks were water. He also combined single words with gestures (reach, point, and give) to request five times. He commented 27 times but did not demonstrate any joint attention gestures.

Isaac, a Caucasian male was 54 months of age. He was diagnosed with ASD at 34 months, with direct home services, speech language services and ABA starting after age 3. His mother participated in the intervention. The family chose not to report other demographic information. Isaac demonstrated 54 different play acts during entry assessments including a number of combination play acts (e.g., shapes in sorter, stacking materials). He also showed emerging pre-symbolic play skills by bringing a bottle to his mouth, extending a brush to a doll, and putting animals into a truck. He communicated using reaches and single words six times. He initiated joint attention 11 times including six comments but no gestures.

Peter, a Caucasian male was 94 months of age. He was diagnosed with ASD at 37 months with ABA services beginning shortly after followed by some speech language and occupational therapy services. He lived with his English-speaking mother, father, and older sibling. His mother participated in the intervention. She had a college degree and was employed full time in health care. Peter's father also had a college degree and was not working during the study. During entry assessments, Peter demonstrated 33 different play acts. His highest level was at the pre-symbolic level where he extended familiar actions to himself and to agents (e.g., utensil to doll). He also combined materials in conventional ways (e.g., blanket on the toy bed). He spontaneously used single words four times. He pointed to request and share. He demonstrated a total of 10 initiations of joint attention.

Charlie, a Caucasian male, was 36 months of age. He was diagnosed with ASD at 30 months and immediately, direct home, ABA, speech language and occupational therapy services began. He lived with his parents who had completed graduate degrees in education and spoke English. His mother taught full time and his father taught part time. Charlie's father engaged in the intervention. During entry assessments, Charlie demonstrated 31 play actions including several symbolic play acts (e.g., doll drinking from bottle, pretending a tissue was a blanket). He also demonstrated one-three word spontaneous requests and comments and pointed to request and to share. He initiated joint attention 48 times.

James, an Inuit male was 52 months of age. He was diagnosed with ASD at 38 months and ABA services followed as well as speech language and occupational therapies. He lived with his mother, father, and one older sibling. His mother completed a college degree in education and taught full time. She participated in the coaching sessions and had not received prior parent training. His father completed college and worked part time. The family's primary language was English, but also included Inuktitut at home and school. James showed limited play at entry with only five different simple play actions (e.g., rolling a ball). He used gaze and single words 19 times to initiate joint attention but no gestures. He reached, gave, or used words to request six times.

Levi, an Innu male was 3 years and 3 months of age, diagnosed with ASD at 37 months and receiving speech language therapy. He lived with his mother, father, and three older siblings. His parents had completed some high school and were employed part time (mother) and full time (father). The family's first language was Innu however, English was spoken with Levi. Levi's mother participated in the baseline sessions and had no prior parent training. Levi's entry assess-

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ment video was corrupted therefore skill totals are not available, However, during the portion that could be viewed, he engaged in combination play (e.g., stacking). He also built a Minecraft tower of blocks and put figures into a barn (presymbolic play). He demonstrated one symbolic act where he gave an animal life (pig runs away). He spoke in short phrases and both reached and pointed to request.

Setting

The study took place in Newfoundland and Labrador, a province in Atlantic Canada. The overall prevalence of ASD in the province in 2015 was 1.8% or 1 in 57 youth age 5–17 years. Children are most frequently diagnosed at 4 years of age (Public Health Agency of Canada [PHAC], 2018) and public early intervention services are available up to age 9. Currently, there are about 420 children receiving autism intervention services in the province. Through collaboration with the JASPER intervention developer and research team, a team of interventionists across the province have been trained to fidelity and now both JASPER direct clinician-child services and caregiver- mediated intervention are offered as part of publicly available intervention services for children with autism. The two interventionists who led the current study were previously trained to first deliver JASPER directly with children through a 5-day introductory training followed by remote video review until reaching 90% implementation fidelity across two child cases. This was followed by a 3-day caregiver coaching training and remote video review of coaching sessions until the interventionist demonstrated 90% coaching implementation fidelity.

One interventionist was located in Labrador, a geographic area of nearly 300000 km^2 with a population of about 37,000 including three indigenous groups: Innu First Nation, Inuit, and Southern Inuit. The second interventionist was located in Eastern Newfoundland, an area of approximately 21,000 km^2 with a population of about 300,000. She served children approximately 115–340 km from her office. The interventionists connected with families using Microsoft Teams and GoToMeeting. Families chose to use personal devices including laptops ($n = 5$) and smart phones ($n = 1$). All families had access to a home internet connection. No family required access to hotspots or tablets which were available through the study.

The families were asked to select a small space where they could get face-to-face with their child with the toys in between them. Five families chose the living room and one chose the child's bedroom. Further, five families chose to play on the floor and one family chose a child size table with chairs. All intervention materials were selected from the home.

Experimental Design

A concurrent multiple baseline across participants design was used in each of the two sites. Due to scheduling and the length of baseline, it was not possible for all six families to begin baseline concurrently. Therefore, the two interventionists each managed three concurrent families separately. Within each site, the intervention starting order was randomized (e.g., shortest baseline, first to start intervention, second to start intervention, third to start intervention).

Measures

Descriptive Measures

Families completed a demographic form to describe the child (e.g., birthdate, diagnosis, etc.) and the child's intervention history including caregiver education. Further, two entry measures were administered to characterize the children's social communication and play skills: (a) Early Social Communication Skills (ESCS: Mundy et al., 2003) and (b) Structured Play Assessment (SPA: Adapted, Kasari et al., 2006).

The ESCS is a semi-structured play-based assessment designed to capture spontaneous initiations of joint attention and requesting. Across assessors from the health region, the ESCS was delivered with fidelity ($M = 81.64\%$, $SD = 6.54\%$). The SPA is a 15-minute assessment of children's spontaneous play. The child is presented with five toy sets and no prompting is permitted. The SPA was administered by clinicians from the local health region ($M = 95.54\%$, $SD = 4.64\%$). Both the ESCS and SPA were scored by reliable coders (graduate students) who were blinded to health region. The ESCS videos were coded for the frequency of verbal and nonverbal (gaze, gesture) initiations of joint attention and requesting and SPA video were examined for play acts by level (e.g., cup to doll's mouth, presymbolic play).

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Primary Outcome Measure: Caregiver-Child Interaction (CCX: Adapted From Kasari et al., 2010)

The dependent variables were coded from 10-minute CCX videos taken at the beginning of each baseline and intervention session. Each dyad was provided with two kits including materials spanning the developmental hierarchy of play levels. Kit A included two scarfs, instruments with two mallets, ring stacker, peg board, shape puzzle, dinosaurs, stacking cups, farm animals, barn, blocks, wooden food with knives and dishes, buildable block cars, and a small table and chairs set with dolls. Kit B included a pop-up toy, shape sorter, peg puzzle, stackable sandwich, tea set, 2 baby dolls with bottles, animals, stacking boxes and waffle block castle with two figures. Kit A was used for baseline CCX 1 and 2 followed by Kit B for CCX 3 and 4, switching after every 2 sessions. These materials were not used during intervention and families were asked not to use the toys outside of the CCX. The interventionist was instructed to provide no feedback. If the caregiver sought input, the interventionist would offer to discuss the topic during the coaching session. The interventionist recorded the CCX and sent it to the research team through a secure file transfer system.

Dependent Measures

The CCX videos were coded for the dependent variables: (a) children's joint engagement and (b) caregivers' strategy use. Graduate student coders were blinded to study phase, measure number, and health region.

Primary Dependent Measure: Children's Time Jointly Engaged

An engagement state was defined as five or more consecutive seconds in one of seven mutually exclusive engagement states: (a) unengaged- child does not attend to people or objects, (b) onlooking- child watches the adult act on the objects but does not participate, (c) person- child attends to the adult only and no objects (e.g., participating in songs or simple games like pat-a-cake), (d) object - child attends exclusively to objects to the exclusion of another person, (e) supported joint engaged- child demonstrates awareness of both the interaction partner and the shared activity (e.g., child imitates the adult's action, responds to the adult's language, initiate communication or play), and (f) coordinated joint engaged- child drives the interaction by coordinating the adult and the activity (e.g., child may direct the adult's actions, make eye contact, initiate joint attention gestures or spoken language). Time in supported and coordinated joint engagement was summed for "total time jointly engaged" as per previous studies (e.g., Shire et al., 2015).

Secondary Dependent Measure: Caregivers' JASPER Strategy Use

Caregivers were held to the same expectations as JASPER interventionists. Strategy use was rated for quality and quantity using a 32-item fidelity form covering the seven strategy subscales: (a) setting up the environment, (b) imitation and modeling, (c) establishing routines, (d) expanding routines, (e) programming for joint attention and requesting, (f) language, and (g) supporting engagement and regulation. Each item was rated from 0–5 where 0 represented no strategy use, 3 represented mixed quality implementation, and 5 represented consistent, appropriate, high quality strategy use. The total number of points scored were divided by the total possible points to achieve a percentage score for total JASPER strategy use. Clinicians are expected to reach 90% total JASPER strategy use to achieve fidelity. Caregivers' strategy use is rated with the same tool and scoring standards. Prior data indicate that caregiver strategy use of at least 75% is associated with children's gains in spontaneous language (Shire et al., 2018).

Interrater Reliability

Twenty percent of the CCX across children and phases were independently double coded. Reliability scores for engagement states included: unengaged (.911), person (.871), object (.993), supported joint engagement child initiated (.846), and coordinated joint engagement child initiated (.859). ICCs for caregivers' strategy use across seven strategy subscales ranged from $\alpha =$ .855–.986.

Procedure

Initial Contact: Technology Setup

The week prior to baseline, the interventionists called their respective families in order to setup the video conferencing application, test the viewing angle and connection quality, and confirm the schedule. The calls lasted 15–30 minutes.

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Baseline

Play and social communication assessments were conducted by an independent assessor prior to baseline session 1. The duration of the baseline was fixed at 6, 9 and 12 measurements with two measures taken each week to match the intervention session schedule. With each of the two sites, three child-caregiver dyads were randomized to intervention start order. Due to the increased wait time for families with the longest baseline, randomization to start order was considered the ethical approach. The interventionist met each family twice a week to record the a 10-minute caregiver-child interaction (CCX: see measures section for more information).

Intervention

Families received the caregiver-mediated JASPER intervention (Kasari et al., 2010). JASPER is a play-based comprehensive social communication intervention that targets children's spontaneous initiations to communicate (to comment and request) and play by fostering the child's social engagement in play routines. Following a manualized protocol, core concepts (e.g., engagement, play levels) are introduced first to caregivers, followed by 1–2 strategies per session (see Table 1). This model has been tested through face-to-face home and clinic coaching in randomized trials demonstrating gains for children's social communication and engagement (e.g., Kasari et al., 2015).

In this study, the protocol was adapted to include only three home visits (session 1, 12 and 24) with all other coaching sessions delivered through video conference. Families were allocated 24 coaching sessions over 12 weeks (2 sessions per week). Each session (live or remote) began with a CCX where no instruction was provided to the caregiver, followed by 30-minutes of coaching. Families were given a binder of strategy handouts at the initial home session. Each handout focused on a concept (e.g., play levels) or strategy (e.g., expanding language) that was used as a visual aid during a 3–5-minute discussion. The interventionist then provided verbal support to help the caregiver to gather and arrange the session materials that are matched to the child's developmental level from a list emailed the day prior. All materials were selected from those available in family's home. This support for toy selection was individualized and faded over time to become brief review of the caregivers' independent setup. The child was then brought over and the interventionist provided live feedback to help the caregiver practice the strategies with their child.

Follow-up

Four families completed one additional CCX at 3-month follow-up.

Procedural Integrity

Session Schedule

The study took place over the summer months thus, vacation time occurred for interventionists and families. The interventionist supporting Charlie and James took two weeks of vacation during intervention. A colleague who supervised caregiver-mediated JASPER stepped in to substitute. To prepare, she was provided with children's goals and observed a coaching session before conducting sessions 20–23 for Charlie and sessions 23–24 for James. In addition, Charlie's family completed sessions 21–24 while on vacation.

Missing Data

Whenever possible, missed sessions were rescheduled within the calendar week. Charlie's family completed 21 sessions. One session was cancelled by the interventionist and two were cancelled by the family due to travel. James' family completed 23 sessions, Elliot completed 22, and Isaac completed 23. Peter completed 10 sessions before exiting early. Levi exited after baseline session 3. One CCX recording during intervention was missed for each of Charlie, James, Elliot, and Peter and one session recording was lost for James.

JASPER Coaching Fidelity

Both interventionists had established JASPER clinician-child fidelity and caregiver-coaching fidelity. JASPER coaching fidelity was rated for a random 20% of all sessions. Coaching fidelity included 13 items rated from 0 (no implementation) to 5 (high quality, consistent). The items address the accuracy, quality, and individualization of the material (e.g., building rapport, pacing content, applying an appropriate level of support). Interventionist 1 scored an average 98.61%% (SD = 1.64%) coaching fidelity and interventionist 2 scored an average 93.67% (SD = 5.97%).

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Table 1
JASPER Caregiver-Mediated Teaching Sequence

Topic	Details
Engagement States and Play Levels	Conceptual introduction to developmental sequence of play levels (simple through symbolic) and hierarchy of engagement states (unengaged through joint engagement). Share the child's mastered and target skills based on assessment data.
Environment	Strategies to set up the physical play space, body orientation, positioning of materials, developmentally appropriate toy choices, and setting up the choices in the environment.
Noticing and Responding to Communication	Identifying the ways the child is communicating and practicing responding to the child's nonverbal and verbal communication.
Imitation and Modeling	Immediately and consistently responding to the child's productive play acts through imitation and providing support as needed through modeling.
Establishing Routines	Establishing the first step (base) of the routine and adding more steps that are matched to the child's mastered and target play levels
Social Communication	Strategies to support children's spontaneous communication including appropriate space to communicate, imitation and expansion of children's communication, modeling nonverbal and verbal communication at the child's developmental level.
Expanding Routines	Timely provision of materials to support the child's expansions. Responding to and scaffolding the child's expansions to link in new steps that add to the story/ direction of the routine. Selecting expansions that are developmentally appropriate.
Programming Social Communication	Creating opportunities for the child to communicate using their target joint attention or requesting skill.
Supporting Engagement and Regulation	Identifying potential roadblocks and planning strategies to address them.
Practice and Generalization	Addition opportunities to practice the program of strategies with feedback. Identify ways to use key strategies (e.g., responding to and expanding children's communication) in other daily activities.

Social Validity

Four caregivers attended one 90-minute focus group via Skype for Business led by the province's caregiver-mediated JASPER trainer. She was selected because in her role as a trainer she had a rich knowledge of the intervention, however, she was not otherwise directly involved with the families, assessment or intervention conducted on this study. She was provided with a list of main questions with examples of probes and follow up questions. The main questions focused on the families' experience with the technology, comparing to face-to-face, dose/frequency, benefits, and challenges. The session was recorded and transcribed. The transcript was coded by two independent coders and then discussed for consensus on codes and emerging themes.

Results

Visual analysis of graphical data for level, trend, and variability was conducted for both dependent variables. Tau-U, a quantitative approach applied to single case data to estimate the effect size was applied (Parker et al., 2011). Tau-U acknowledges baseline data trends, thus allowing for analysis of between phase differences and within phase trends, a unique advantage over other overlapping data tools (Lee & Cherney, 2018). Tau-U was estimated using an online calculator (Pustejovsky & Swan, 2018).

Children's Joint Engagement

Figures 1 and 2 displays children's joint engagement in site 1 and site 2 respectively. Each

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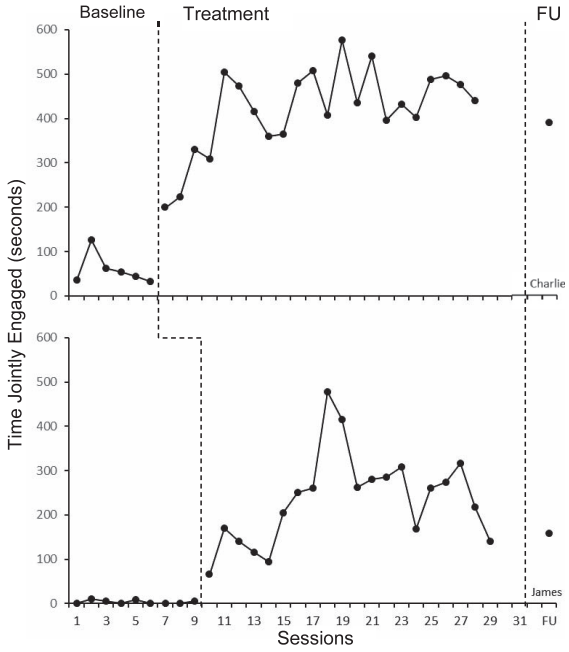
Figure 1
Children's Joint Engagement – Site 1



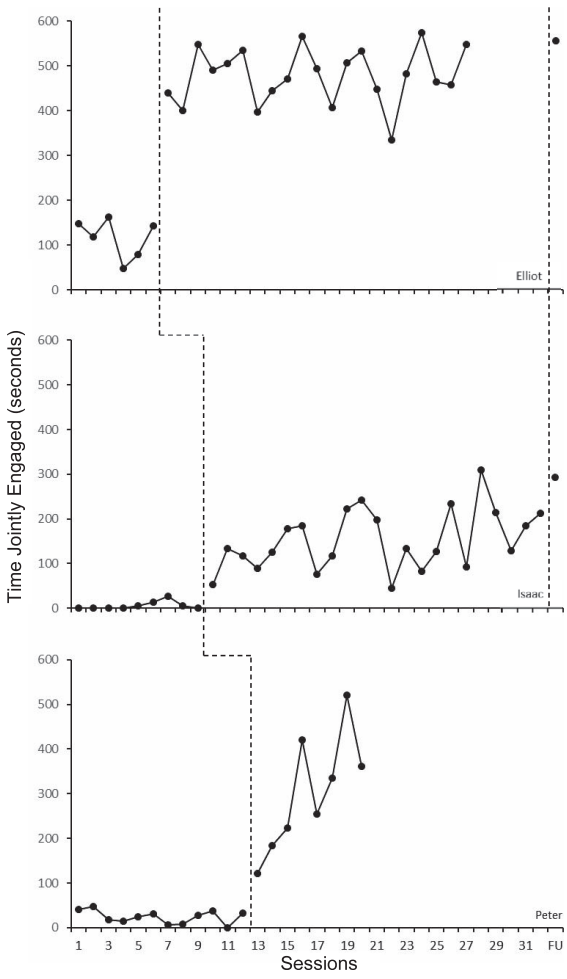
participant displayed stable baseline data. All dyads show variable peaks and valleys in intervention with an overall increasing trend. Levi exited during baseline and is not represented in the figures.

Charlie demonstrated an average of 59.33 seconds (range 33–127) jointly engaged during baseline. Once intervention began, a change in level was observed to 199 seconds jointly engaged during CCX 7. Over 22 intervention sessions, an increasing trend was observed where Charlie demonstrated an average of 420.86 seconds (range 199–577) jointly engaged and 391 seconds at follow-up. The Tau-U estimate of effect size was 1.

James demonstrated very limited joint engagement during baseline averaging 3.44 seconds (range 0–10). A change in level was observed when intervention began at session 10 with 66 seconds jointly engaged. Over 20 intervention sessions, James was jointly engaged for an average of 240.47 seconds (range 66–477) and 158 seconds at follow-up. The Tau-U estimate of effect size was 1.

Elliot averaged 116.17 seconds (range 48–162) during 6 baseline CCX. Engagement was lowest in baseline CCX 4 and 5 (48 and 79 seconds) rising to 143 seconds in CCX 6. However, this value was still lower than the child's initial baseline CCX. A large change in level was observed when intervention began to 426 seconds jointly engaged and remained high throughout intervention averaging 459.38 seconds (range 334–574), increasing to 555 seconds at follow-up. The Tau-U estimate of effect size was 1.

Figure 2
Children's Joint Engagement – Site 2



Isaac showed very limited time jointly engaged in 9 baseline sessions averaging only 5.78 seconds (range 0–27). Over 22 intervention sessions, average time jointly engaged was 152.09 seconds (range 45–310) and reached 292 seconds at follow-up. An increasing trend in engagement was observed, however, engagement was variable when the intensity of dysregulation (crying, scripted songs, and repetitive actions) occurred. The Tau-U estimate of effect size was 0.94.

Peter was in baseline for 12 sessions and averaged 23.83 seconds jointly engaged (range 0–48). A shift in level and then increasing trend in joint engagement was observed over 10 sessions in

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intervention with an average of 302.38 seconds (range 121–520). The Tau-U estimate of effect size was 1.

Caregivers' Strategy Implementation

Figures 3 and 4 display caregivers' JASPER strategy use during play with their children for sites 1 and 2 respectively.

Charlie's father demonstrated an average of 47.20% strategy use during baseline (range 40–57.78%). Over 21 intervention sessions, strategy use averaged 76.19% (range 42.58%–92.41%). An immediate change in level (to 65%) was followed by an increasing trend. Variability in implementation up to 20% was noted during intervention. However, only one intervention data point overlapped with baseline scores. The Tau-U estimate of effect size was .98.

James' mother demonstrated an average of 36.18% strategy use during baseline (range 26.67%–44.14%) with a slight increasing trend. A gradual increasing trend was observed in the intervention phase with an average of 62.90% over 23 sessions (range 44.44%–80.00%). The Tau-U estimate of effect size was .95.

Elliot's mother's average JASPER strategy use was 39.23% during the baseline phase (range 34.67%–46.21%). A significant change in level to 81.33% implementation was observed at the start of the intervention phase. Average strategy use over 22 intervention sessions was 73.76% (range 60.00%–82.76%). With no scores overlapping between phases, the Tau-U estimate of effect size was 1.

Isaac's mother showed an average of 32.49% for JASPER strategy use (range 25.00%–40.71%). A small change in level to 56.43% and gradual increasing trend in strategy use were observed during intervention. Average strategy use over 23 intervention sessions was 67.06% (range 47.33%–78.67%). With no scores overlapping between phases, the Tau-U estimate of effect size was .98.

Peter's mother demonstrated an average of 38.85% strategy use during the baseline phase (range 30.00%–47.10%). Demonstrating the greatest change in level, Peter's mother reached 75.33%

Figure 3
Caregivers' Strategy Use – Site 1

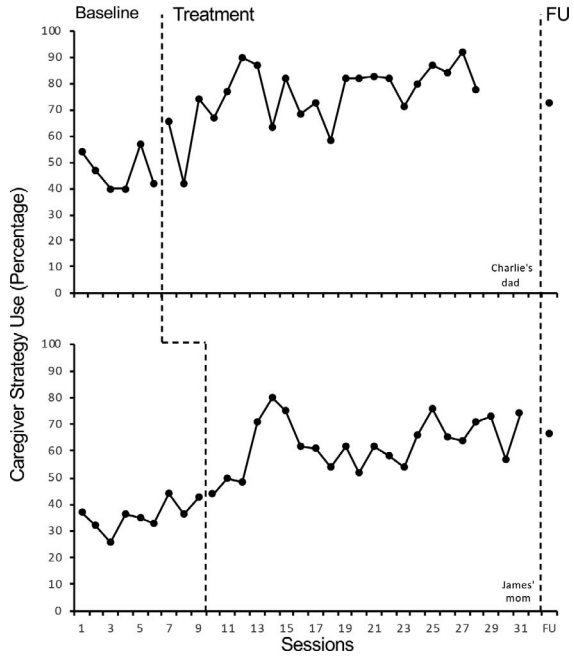
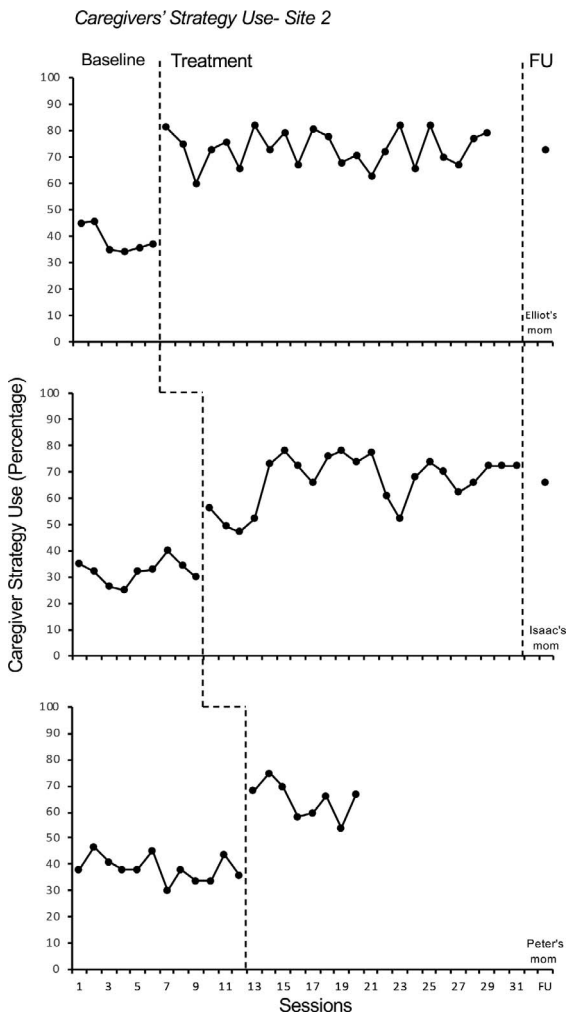


Figure 4
Caregivers Strategy Use – Site 2



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after intervention began, averaging 65.09% strategy use over 10 intervention sessions (range 54.38%–75.33%). The Tau-U estimate of effect size was 1.

Social Validity: Focus Groups

Several themes emerged from the group discussion: similarities to face-to-face, advantages, challenges, and facilitators of success. Families perceived remote and face-to-face support as similarly effective for their learning. Families described the advantage of engaging in their home (when city visits take 2–3 days of travel) and the flexibility of the remote format. They also described challenges related to learning new technology, the time commitment, the setup of materials, and managing multiple children. Some of these challenges were mitigated by a close rapport with the interventionist, the clinician's skill set that facilitated caregiver learning, and sufficient session pacing to build on prior learning.

Discussion

Although the JASPER caregiver-mediated intervention model using face-to-face coaching has been tested in randomized trials, remote technology-enabled coaching has not. This proof of concept study provides preliminary evidence for the use of video conferencing technology to provide real time coaching for caregivers engaging their children with ASD in play. With the support of highly skilled community interventionists, approximately 20 remote coaching sessions led 5 children to demonstrate greater time jointly engaged and their caregivers to demonstrate greater use of JASPER strategies during intervention and follow-up in comparison to baseline.

Caregivers' Strategy Use

Across the five caregivers, strategy use grew throughout the intervention phase. By exit, four caregivers were scoring some sessions at 75%+, a level of implementation that has previously been linked to changes in children's spontaneous spoken language (Shire et al., 2018). Further, these results are consistent with prior JASPER studies providing face-to-face coaching of a similar dose with school-age children with minimal spoken language ($M = 70\%$; Shire et al., 2015). With scores around 70%, caregivers successfully apply the intervention mechanics (e.g., imitation, establishing a routine, responding to communication). However, support is still required to apply higher-level strategies including expanding play and programming targeted opportunities for social communication, a challenge noted in previous trials with caregivers as well as practitioners (e.g., Shire et al. 2017).

JASPER places a high demand on caregivers to closely monitor and then respond to children's communication and play skills. With session-by-session data, the natural variability of these fluid interactions can be observed. Consistent strategy implementation can be hard to achieve when children demonstrate high levels of restricted and repetitive behaviors (e.g., repetitive singing, rigid play, rejecting expansions), are highly active (e.g., wandering, turning) or dysregulated (e.g., crying, throwing toys). During these times, it is understandably more challenging to establish a clear play routine and to maintain an active role through imitation. Caregivers had variable success applying visual supports, reducing verbal instruction, and modeling developmentally appropriate play acts to help the child regulate and re-engage.

Although some days were challenging, overall, children demonstrated gains in time jointly engaged, ranging from 2.5 minutes to nearly 7 minutes over baseline scores. However, children in the current study exhibited greater gains in engagement than prior studies (e.g., Shire et al., 2015). This may be due to the more heterogenous community sample included in this study. Although two children had very limited spoken language and play skills, similar to a prior study of minimally verbal school age children (Shire et al., 2015), children with word combinations and higher level pre-symbolic and symbolic play skills were also included. Therefore, tuning caregivers in to their children's existing communication and shifting participation to imitation rather than narration drove immediate increases in joint engagement.

Arranging the Play Environment

During face-to-face JASPER coaching, management of the play environment is a critical coaching tool. The interventionist helps the caregiver to choose developmentally appropriate materials and then provides timely access to those materials throughout the session. This allows the caregiver to focus on responding to their child's behavior through consistent imitation and language expan-

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sions rather than manipulate materials. Shifting to a remote environment, the team learned that the time required to prepare the environment and plan routines with verbal instruction was significant and required throughout intervention. This setup time did decrease over time shifting from verbally directing the setup (e.g., for the farm routine you will need the barn, 20 blocks, 8 Velcro food pieces, 6 animals, etc.) to reminders and open-ended guidance (e.g., let's try the farm routine again and add one new routine of your choice). Planning to provide this dedicated setup time can help prime the caregiver for the steps they will take when the child enters allowing the interventionist to coach on strategies rather than materials management once the child is present.

To further assist in reducing the amount of live feedback required, the interventionists took additional time to explain specialized language. For example, "model" refers to showing the child a way to use the toy. By taking time to ensure the caregiver understood how the term was applied with the child, the interventionists could coach using key words such as "model" rather than explaining this means to demonstrate in the moment. In future, including video and additional handouts may provide more visual tools to display strategies such as the pacing of an action which are difficult to verbally explain.

Clinical Implications and Lessons Learned

Unlike prior caregiver-mediated JASPER trials, attrition was greater in this study with one family exiting during baseline and another family exiting treatment after 10 sessions. This may be due to several factors. First, both families who exited early received the longest baseline phase (12 sessions). In group trials, families typically begin intervention within a couple of weeks from consent. This unusually long lead up to intervention may have impacted buy-in. Second, scheduling was a significant challenge. Levi's family often traveled for multiple weeks to attend cultural events, thus drops from intervention had previously occurred. Further, the target caregivers were working outside the home including shift work. These demands combined with a history of low frequency therapist-mediated rather than caregiver-mediated services, made it difficult for families to commit to consistent sessions. Breaking the 12-week commitment into phases to offer planned breaks or shifting to weekly 60-minute sessions (versus 30-minutes twice weekly) once the caregiver has established the skills to sustain longer sessions are two possible methods the interventionists suggested to facilitate engagement.

The intervention protocol included three home visits however, the interventionists reported that three visits may not be necessary. The interventionists agreed that the initial home visit was critical to help the family identify and setup the physical space, find developmentally appropriate toys (often toys considered too young had been put into storage) and build rapport with the family. However, both clinicians felt they were progressing with remote coaching, such that visits 2 and 3 could have occurred remotely. When the intervention is conducted in clinical practice, this initial session could also include assessment of the child's skills to also reduce the need for an additional assessment visit. This modification could further reduce costs.

This study was conducted as one component of a larger multi-year collaboration between JASPER researchers and the provincial health authority. As such, this study took place within a service system that had already completed considerable work to train a growing group of clinicians across the province's multiple health regions to deliver both direct clinician-child JASPER intervention and caregiver-mediated JASPER. In addition, five clinicians had also undergone additional training to become local JASPER supervisors of both the clinician-child and caregiver-mediated models. This training model will be further described alongside the results of randomized trial (blinded, in progress). However, it is important to recognize that the ability to move to a remote coaching model was possible due to strong foundation of both JASPER intervention and caregiver coaching that was already present in the province.

Several questions remain regarding the clinical implementation of remote JASPER coaching. This study included children with a range of strengths and needs. Although two children often showed periods of dysregulation, no child demonstrated aggressive or unsafe challenging behavior. For children who show a greater need for regulation supports at baseline, additional targeted strategies may be needed prior to or concurrent to the start of JASPER coaching. Second, in past caregiver-mediated JASPER trials, both play and home routines (e.g., books, household chores, etc.) have

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been tested. Future examination of remote coaching may include home routines to provide more options for family participation.

Conclusions

This proof of concept study provides preliminary evidence for the use of video conferencing to provide JASPER coaching to caregivers. Randomized effectiveness trials are needed to understand if these gains in children's engagement and caregivers' strategy use at levels similar to face-to-face coaching will generalize beyond these cases.

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