Cover Sheet

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Association of turn-taking functions with joint attention in toddlers with autism

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Abstract

Nonverbal turn taking, defined as back-and-forth exchanges, may be used to convey instrumental or social intent. It has been theorized that social turn taking is foundational to joint attention and, as such, it has been incorporated as a component of early interventions for children with autism, who often have challenges in joint attention competency. The purpose of this study was to analyze the relationships between two turn-taking functions and joint attention as observed during interactions between 20 toddlers with autism who received intervention and their caregivers. It was hypothesized that socially driven turn taking would be positively related to joint attention, but instrumentally motivated turn taking would not. Video analysis revealed a positive relationship between social turn taking and joint attention, but not between instrumental turn taking and joint attention. While not causal, the findings support the promotion of social content in intervention and the concept that social turn taking may be a precursory competency to joint attention.

Lay abstract

Back-and-forth interaction, or turn taking, may support later joint attention, a more complex form of interaction, when promoted in interventions for young children with autism, especially depending on the child's intent when interacting. In the present study, we observed videos of 20 toddlers with autism engaging in turn taking with their caregivers during an intervention designed to support children's joint attention. We sought to identify when the children displayed turn taking socially and when they were using it for nonsocial purposes in the intervention videos. We also observed videos after the intervention was complete to identify when children used joint attention when interacting with their caregivers. After these observations, we used these video data to explore the relationship of social turn taking to joint attention, and the relationship of nonsocial turn taking to joint attention. We found a significant relationship between social turn taking and joint attention, but not between nonsocial turn taking and joint attention. These findings support the importance of considering social turn taking in interactions between young children with autism and their caregivers.

Keywords

autism spectrum disorders, family functioning and support, preschool children, social cognition and social behavior

Introduction

Autism is defined by core characteristics in social communication, such as difficulty in social reciprocity and relationship building, which occur at all diagnostic severity levels (American Psychiatric Association, 2013). Many children with autism have ongoing challenges with social communication, which may become evident in infancy and continue throughout the lifespan (Chawarska et al., 2013; Gillespie-Lynch et al., 2012; W. Jones & Klin, 2013). Social communication contributes to areas of development such as shared attention and an awareness of the perspectives of others (Bakeman & Adamson, 1984; Tomasello & Carpenter, 2007). Because of the importance of social communication in early development, promoting this competency in children with autism may be especially important. Early intervention for children with autism has often focused on promoting social communication at the nonverbal level, before verbal communication emerges,

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with the goal of supporting later outcomes at a young age (e.g. Murza et al., 2016).

Nonverbal communicative forms and functions

Young children use different forms of nonverbal communication, and it has been hypothesized that by using simpler forms, such as turn taking, children will progress to the more complex forms, such as joint attention (e.g. Lee & Schertz, 2020; Leekam & Ramsden, 2006; Schertz, Odom, et al., 2018). Depending on each communicative partner's intent, defined as the meaning an individual is trying to convey through a communicative act, nonverbal communication may serve instrumental or social functions, which can take both initiating and responding forms (Cochet & Byrne, 2016; Schertz, Call-Cummings, et al., 2018; Tomasello et al., 2007). Instrumental initiation is characterized by requesting an object or action from a communicative partner for the purpose of obtaining something from the request (e.g. Cochet & Byrne, 2016; Mundy et al., 1986; Schertz, Call-Cummings, et al., 2018). Instrumental initiation might appear, for example, when a child points to request a toy car. In this exchange, pointing serves a purpose of addressing the child's wants (i.e. obtaining the toy car) rather than sharing interest with a communicative partner. Social initiation, by contrast, is characterized by sharing interest in an object or event with a communicative partner (Cochet & Byrne, 2016; Schertz, Call-Cummings, et al., 2018). An example of social initiation might appear when a child points out a character in a book to allow a partner to share in the child's interest.

Instrumental, nonverbal responding is defined in the literature as responding to a communicative partner's request or following directions, such as following instructions or verbal prompts to complete tasks (Cochet & Byrne, 2016; Mundy et al., 1986; Schertz, Call-Cummings, et al., 2018). Instrumental responding may be observed, for example, when a caregiver asks their child to "pass the ball," followed by the child handing the ball to the caregiver. In this scenario, the child responds to a direct instruction given by the caregiver. Social responding may appear when a child is smiling and using eye gaze with their caregiver in response to social bids for attention, or in response to their caregiver's comment or interest sharing (e.g. Camaioni et al., 2004; Cochet & Byrne, 2016; Schertz, Call-Cummings, et al., 2018). An example of social responding might be observed when a caregiver rolls a toy bowling ball toward a set of plastic pins. The caregiver, having knocked down all the pins, cheers with excitement. The child responds by also cheering in excitement, clapping hands, and smiling at the caregiver. Distinguishing between how social and instrumental functions are manifest helps in determining the intent of an interaction.

Nonverbal communicative functions have differential impacts on aspects of later development. Early, nonverbal communication with a social function is associated with positive cognitive, social, and language development (e.g. Charman, 2003; Cochet & Byrne, 2016; Mundy, 2016; Toth et al., 2006). However, use of the instrumental function has not been associated with later social communication outcomes (e.g. Camaioni et al., 2004; Charman, 2003; Cochet & Byrne, 2016; Harbison et al., 2017). For instance, Cochet and Byrne (2016) found that the use of social pointing for sharing interest was associated with later language outcomes, while use of instrumental pointing, for the purpose of requesting something from a communicative partner, did not result in similar outcomes. In addition, use of the social function has been linked with an understanding of a communicative partner's intent, while use of the instrumental function has not (Camaioni et al., 2004; Cochet & Byrne, 2016; Schertz, Call-Cummings, et al., 2018).

This differential impact of nonverbal communicative functions on later communication development may be especially important to consider for children with autism for whom the social function is often challenging. When compared to children with typical development and those with other disabilities, children with autism show difficulty in social communication not found among children in the other groups (e.g. Dawson et al., 2004; Mundy et al., 1990; Sigman et al., 1999; Werner & Dawson, 2005). These findings have important implications for children with autism because for them, the instrumental function has been found to be less challenging than the social function (e.g. Harbison et al., 2017; Mundy et al., 1986; Werner & Dawson, 2005). That is to say, children with autism may be more competent in communicating for instrumental than for social purposes. Promoting communication with a social rather than instrumental function may, therefore, have important intervention implications for young children with autism.

Joint attention

Joint attention, a form of triadic, social communication that starts to emerge at the nonverbal level and consists of initiating and responding forms, has been defined as visually coordinating attention between a communication partner and an object or event for the purpose of sharing information or interest about the object or event (Mundy, 2016). When initiating joint attention (IJA), children use gestures and eye gaze with their communicative partners to share social interest in an object or event (Mundy, 2016; Schertz, Odom, et al., 2018). When responding to joint attention (RJA), children follow gaze or pointing gestures of their communicative partners while receiving social bids for attention (e.g. eye gaze, pointing, or verbal cues) (Adamson et al., 2001; Mundy, 2016). Developmentally, joint attention is pivotal in supporting play, social interaction, and language (Adamson et al., 2009; Charman, 2003;

Whalen et al., 2006). Children's use of joint attention may vary depending on individual differences in cognition, language, and early use of eye gaze and gestures (e.g. Elison et al., 2013; Morales et al., 2005; Mundy & Gomes, 1998). On average, for children with typical development, joint attention begins to appear between 9 and 12 months old, and then consolidates by 18 months (Adamson et al., 2009; Charman, 2003).

For children with autism, difficulty with joint attention in early childhood is one of the first indicators of autism (Curcio, 1978; Mundy et al., 1986; Werner & Dawson, 2005). This unique challenge is demonstrated by numerous research findings that children with autism use joint attention less than children with typical development and children with other disabilities (Adamson et al., 2009; Dawson et al., 2004; Sigman et al., 1999; Wetherby et al., 2007). In addition, the social act of IJA may be more difficult for children with autism than is requesting, a form of instrumental initiation (Kasari et al., 1990; Stone et al., 1997). Because of this challenge, joint attention has been promoted in intervention for children with autism with positive outcomes in joint attention, social initiations, peer relationships, play, positive affect, and language (e.g. Freeman et al., 2015; E. A. Jones et al., 2006; Mundy et al., 1990; Schertz, Odom, et al., 2018; Sullivan et al., 2007; Whalen et al., 2006).

Turn taking: social versus instrumental

Before joint attention appears in development, young children may be seen engaging in another form of nonverbal communication known as turn taking, which can be defined as dyadic, back-and-forth exchanges between children and their communicative partners (Lee & Schertz, 2020; Schertz, Odom, et al., 2018). Turn taking may appear, for example, when a child pushes a toy car to their caregiver and then the caregiver pushes the car back and continues over several exchanges. Turn taking may help young children learn social reciprocity and may also influence their ability to share meaning with others (Dromi, 1993; Newson, 1977). For children with autism, however, turn taking can be challenging (C. H. Chiang et al., 2008; Clifford & Dissanayake, 2009). In comparison to children with typical development and children with other disabilities, children with autism have been observed to use fewer and briefer instances of turn taking in social interactions (e.g. C. H. Chiang et al., 2008; Leekam & Ramsden, 2006; Mundy et al., 1986).

In interventions for children with autism, turn taking has been included as an embedded intervention component used to support various targeted outcomes, such as language, play, and joint attention (e.g. Alpert & Kaiser, 1992; Kemp et al., 2019; Rieth et al., 2014; Schertz, Odom, et al., 2018; Watkins et al., 2017), but turn-taking definitions vary across studies. Turn taking has been defined by some as having an instrumental function for achieving a nonsocial outcome, which may be observed when a child or communicative partner requests control of an object or desired activity, the child or communicative partner complies with that request, and this back-and-forth routine continues for more than one exchange (e.g. Kemp et al., 2019; Rieth et al., 2014; Therrien & Light, 2018). In a study by Therrien and Light (2018), for example, researchers trained children with autism to engage in instrumental turn taking (ITT) through explicit directions to take one turn and then wait for their peers to take a turn during story time. The researchers directed the children in this back-and-forth routine for approximately 10 exchanges instead of allowing them to freely initiate and respond to turn taking for their own volition. Others have defined turn taking as a social interaction in which a child engages in a back-and-forth exchange to share interest in an object, activity, or event rather than to request a particular partner action (Gengoux et al., 2019; Green et al., 2017; Schertz, Odom, et al., 2018). Green and colleagues (2017), for example, defined social turn taking (STT) as reciprocal, child-led exchanges that occur during parent–child free play. During intervention, parents were encouraged to be nondirective, attentive to their child's interests, and responsive to child initiations (Green et al., 2017). Although ITT and STT are both dyadic, back-and-forth exchanges, their purposes vary based on the desired goals and underlying communicative functions.

This definitional inconsistency reflects a need for targeted study of social and instrumental turn-taking functions in light of the potential developmental impact of STT, which may help children learn that communication partners have their own points of view and interests (Bruner, 1983; Harrist & Waugh, 2002; Newson, 1977). "Dyadic synchrony" can be defined as a mutual, coordinated, back-and-forth interaction between two communicative partners (Harrist & Waugh, 2002). STT as a free, dyadic, synchronous exchange may promote the development of other competencies, and lay the foundation for more complex, triadic interactions, such as joint attention (Harrist & Waugh, 2002; Hubley & Trevarthen, 1979; Schertz, Odom, et al., 2018). Because of its potential impact on later development, researchers have theorized that STT may lay the developmental foundation for joint attention in young children with autism when incorporated into intervention (Lee & Schertz, 2020; Schertz, Odom, et al., 2018).

Although promoting joint attention through turn taking in intervention for children with autism has been successfully demonstrated, studies on the relationship between turn taking and joint attention are limited. The authors of one study analyzed the correlation of turn taking to joint attention as observed in interactions between toddlers with autism and their caregivers (Lee & Schertz, 2020). While they identified a positive correlation between turn taking

and IJA, a relationship between turn taking and RJA was not found and turn taking was not differentiated by function (i.e. only STT was defined). In addition to the limited research on associations between socially defined turn taking and joint attention, studies have yet to investigate the differential influence of socially versus instrumentally motivated turn taking on joint attention competency for children with autism. Furthermore, the relationship between ITT and joint attention as observed in interactions between young children with autism and their caregivers has not been analyzed.

Purpose of the study

The purpose of this study was to analyze the strength and direction of the relationships between children's use of turn taking (social and instrumental) and joint attention as observed in interactions between caregivers and their toddlers with autism who received social communication intervention. In this preliminary exploration, we hypothesized that STT would be positively associated with both IJA and RJA, while ITT would not.

Method

Participants

Twenty toddlers with autism from the intervention group of the Joint Attention Mediated Learning (JAML) study (Schertz, Odom, et al., 2018) were included in the current study. Participants were recruited from service providers, including physicians, therapists, diagnosticians, and Part C providers, as well as from publications targeted to parent groups and a university research database (Schertz, Odom, et al., 2018). Child and caregiver characteristics are summarized in Table 1. To be eligible for JAML, children were required to meet the following criteria: be 30 months of age or younger at the start of intervention, meet the threshold for Autism Spectrum Disorder on the Autism Diagnostic Observation Schedule for Toddlers (ADOS-T; Lord et al., 2012), and exhibit challenges in joint attention as observed while playing for 10 min with caregivers. Children with a co-occurring diagnosis were excluded. Aside from their participation in JAML, child participants included in the present study received additional services during the intervention period. The type and average hours of these additional services received on a weekly basis are indicated in Table 1. A child's participation in additional services did not preclude them from participation in the study and did not have a significant moderating effect on child outcomes (Schertz, Odom, et al., 2018). Data on other caregiver training or guidance in interventions outside of JAML are not available.

Participant preintervention characteristics are also presented in Table 1. The Precursors of Joint Attention Measure (PJAM; Schertz, 2013), which is discussed later in further detail, was used to measure children's use of STT, IJA, and RJA before intervention was introduced. The PJAM scores reported in Table 1 are the average frequency of occurrences of these variables observed across three, 10-min videos taken at preintervention with a range of 0–180 occurrences. Because the instrumental turn-taking coding measure was developed for the present study and was not measured or analyzed in the intervention study, ITT was not assessed preintervention. However, preintervention characteristics for STT and joint attention were previously coded for the intervention study and available for inclusion in the present study. It should be noted that preintervention STT and joint attention were used for descriptive and not analytic purposes to demonstrate that children were displaying nearly no observable instances of STT and joint attention at preintervention.

Measures

STT, IJA, and RJA were measured using the PJAM coding manual (Schertz, 2013), whereas the criteria for ITT were developed for the present study. All variables were measured using an observational coding system, as described in the coding procedures below. Additional examples of each coding measure are presented in Table 2. In the present study, turn taking is operationally defined as back-and-forth exchanges that may or may not include objects, imitation, vocalizations, or motor play (e.g. during peek-a-boo), and that consisted of at least two child actions for a full turn-taking routine. If a caregiver initiated turn taking, the child must have responded more than once to the caregiver. If the child initiated turn taking, they must have repeated their actions at least once following a caregiver's response. The following coding criteria were used to identify when children initiated or responded to observable instances of turn taking and whether their actions occurred for social or instrumental purposes.

STT

STT is defined in this study as a dyadic, reciprocal, interaction between a child and their caregiver for socially driven purposes (Schertz, Odom, et al., 2018). STT might appear, for example, when a caregiver and child roll a ball back-and-forth, during which time the child is laughing and smiling while engaging with the caregiver. STT was coded when a child actively responded to or initiated a back-and-forth, repetitive, and predictable exchange with their caregiver showing playful intent. A full STT routine consisted of at least two child actions across two consecutive, 10-s intervals. STT was continuously coded in each interval that a child action occurred. If a child did not complete a full routine within two consecutive intervals, STT was not coded. The child's response did not have to be an imitation of but was related to the caregiver's action. Instances of STT may have occurred, for example, during

Table 1. Preintervention characteristics.

Participant characteristics	Observation group ($n = 20$)
Age in months: *M (SD)*	24.95 (4.12)
Gender (% male)	75
Ethnicity (%)	
Asian	5
Black or African American	25
White	60
Other (including multiethnic)	10
ADOS-T severity score: *M (SD)*	16.90 (5.50)
Social affect	14.05 (3.86)
Repetitive restrictive behavior	3.35 (1.66)
PJAM scores: *M* (*SD*)	
Social turn taking	1.7 (2.99)
Responding to joint attention	2.1 (2.73)
Initiating joint attention	3.05 (3.35)
Mullen Scales of Early Learning (*T*-scores)	
Early learning composite	84.10 (1.31)
Receptive language	20.00 (0)
Expressive language	21.35 (0.58)
Other service hours received weekly: *M* (*SD*)	
General early intervention	6.90 (7.86)
Speech and language therapy	0.76 (0.41)
Occupational therapy	0.50 (0.39)
Physical therapy	0.11 (0.25)
Other services not otherwise specified	0.03 (0.09)
Parent education (%)	
No high-school diploma or GED	15
High-school diploma or GED	5
Some college but no degree	30
Associate degree	5
Bachelor's degree	30
Graduate degree	15
House income range (%)	
Less than US$23,050	35
Between US$23,051 and US$49,999	35
Between US$50,000 and US$74,999	10
Over US$75,000	20

ADOS-T: Autism Diagnostic Observational System-Toddler version; PJAM: Precursors of Joint Attention Measure.
PJAM scores are the average frequency of variable occurrences observed across three, 10-min videos taken at preintervention.

imitation of the caregiver's actions or in a game of teasing. STT was not coded if the caregiver used verbal prompts, such as "roll the ball back," if the child responded to tickling, if the child exhibited open defiance, or if the child acted without consideration of the caregiver's actions. Conversations between the child and caregiver, such as if the caregiver asked a question and the child responded verbally, were excluded; however, vocalizations were not excluded if the nature of the turn-taking exchange met other coding criteria.

ITT

ITT is defined in this study as nonsocial, back-and-forth interactions between a child and caregiver characterized by following directions or requesting for completing a task or activity. ITT might appear, for example, when a caregiver and their child roll a ball back-and-forth, during which time the caregiver directs the child to roll the ball back saying, "I roll the ball, now you roll the ball," and the child responds to these directions, rather than engaging on their own volition. A full ITT routine was measured using the same coding as described in the STT measure. ITT was coded when a child responded to a caregiver's verbal or physical prompt (e.g. "You turn the page, then I turn the page" or tapping an object to indicate a turn), responded with a verbal or physical imitation (e.g. participating in repetitive songs), answered a caregiver's task-oriented question, and/or repeated actions without consideration of the caregiver's actions. ITT was not coded if the child showed anticipation, active participation, and/or playful intent during verbal or physical imitation exchanges with their caregiver. ITT was also coded when the child requested an action from the caregiver, such as passing a ball for the purpose of obtaining the object.

IJA

Joint attention is defined in this study as triadic, visually coordinated attention among a child, their caregiver, and an object, activity, or event of social interest in either initiating or responding forms (Mundy, 2016; Schertz, Odom, et al., 2018). The definition of joint attention in the present study excludes an instrumental function. IJA was coded when a child exchanged looks with a caregiver while drawing their attention to an object of social interest and while displaying positive affect (Schertz, 2013). Children may draw attention through eye gaze, pointing, or showing. Positive affect helped determine children's mutual social interest with their caregiver, and may include smiling, giggling, or facial excitement. IJA might appear, for example, when a child hears a clock chime, looks at their caregiver's face while smiling, and then looks back at the clock. IJA was not coded if the child was drawing the caregiver's attention to request a desired object or action.

RJA

RJA was coded when a caregiver attempted to draw a child's attention to an object, such as by pointing, commenting, or showing to share social interest and the child responded by looking between the object and caregiver's face while displaying positive affect (Schertz, 2013). An RJA overture might appear, for example, when a caregiver knocks down a block tower while saying "uh oh," and the child looks between the fallen blocks and the caregiver's

Table 2. Description of measures with examples.

Measures	Description of measures	Example
Social turn taking	A child and caregiver engage in back-and-forth routines that involve sharing interest or social perspective taking by either communicative partner for at least two related, child actions.	A child picks up a dragonfly toy and puts it on their father's head. The father makes a "buzzing" sound and shakes the toy off of his head to make it fall to the floor. The child picks up the toy and places it on their father's head again, and the father shakes it off while "buzzing." The child smiles and the routine continues on and on.
Instrumental turn taking	A child and a caregiver interact in back-and-forth routines that involve requesting and/or following directions by either communicative partner for at least two related, child actions.	A child places a wooden block on the floor to make a miniature fortress. Their mother joins in by stacking another block. She then directs her child where to put the next block, so as not to knock the fortress down. The child follows their mother's instructions and stacks a block where their mother tells them to place it. They continue in this routine until several blocks have been stacked.
Initiating joint attention	A child exchanges looks between a caregiver's face and an object to draw the caregiver's attention to the object for sharing interest.	A child finds a picture of their family, which includes a new kitten that the family adopted. The child is very excited to see the new kitten in the picture and wants to share their excitement with mom, so the child, smiling widely, exchanges looks between the picture and mom while pointing to the kitten.
Responding to joint attention	A caregiver draws a child's attention to an object and the child looks between the caregiver's face and the object for the purpose of sharing in the caregiver's interest.	A father and child are playing with a toy train on the floor. As the father is moving the train, he makes a "choo-choo" sound. The child exchanges looks between the toy train and father's face. The child giggles and watches as their father moves the toy train across the floor.

face while laughing. If the caregiver drew the child's attention for the purpose of requesting something of the child, then RJA was not coded.

Procedures

Since data were derived from child performance based on participation in the JAML intervention, pertinent details from that study are discussed in the following sections. How data were collected, coded, and measured for the present study are also described.

JAML intervention description

The purpose of the JAML intervention was to enhance preverbal social communication through caregiver mediation in natural, home settings and in everyday routines, and, therefore, the intervention environment was not controlled or restricted. Rather than trained in specific procedures, caregivers received conceptual guidance by an Intervention Coordinator (IC) to promote child learning in three, sequential phases: Focusing on Faces (FF), Turn Taking (TT), and Joint Attention (JA). These phases were implemented through caregivers' promotion of five mediated learning principles (focusing, organizing and planning, giving meaning, encouraging, and expanding), which were adapted from Klein (2003) by Schertz, Odom, et al. (2018) to encourage caregiver's active engagement in their child's learning. In this way, caregiver learning was mediated to support their promotion of child engagement as they translated learned concepts to everyday interactions. Therefore, because activities were parent-centered and not prescribed, they varied across participants.

Intervention sessions occurred across a span of 32 weeks. Throughout intervention, the ICs visited participants' homes weekly. They collected 10-min videos of caregivers interacting with their children and reviewed the recordings with the caregivers for reflection and conceptual guidance on use of the mediated learning principles related to the current intervention phase. Between weekly sessions, caregivers were asked to engage with their children in daily, planned 30-min sessions, as well as in regular daily routines to support their children's engagement relative to current targeted outcomes (i.e. focusing on faces, turn taking, and joint attention). ICs did not directly intervene with the children. The ICs also collected 10-min video data pre- and post-intervention. All children in the present study received the full intervention protocol.

Current study data collection

The original intervention study was conducted at three sites across the United States; however, data from a single, Midwestern site were used for the present study because the primary researcher only had access to this site's full data set. This data set originally consisted of videos of 23 participants; however, only 20 were included in the present study because data from two participants were required for video coder training, and one participant had an incomplete number of videos post-intervention. A total of 120 videos (six for each of the 20 participants) were collected from the JAML study. Of the six videos per participant,

three were from the TT intervention phase for STT and ITT analysis and three were from post-intervention for RJA and IJA analysis. The decision to analyze videos from the TT phase of intervention was made because at that time turn taking would have been optimally promoted and joint attention had yet to be introduced. Post-intervention videos, taken within 2 weeks following intervention completion, were selected because children would have, theoretically, begun replacing turn taking with joint attention, showing fewer instances of turn taking than they would during the TT phase of intervention. In addition, turn taking tends to decrease when joint attention competency is observed (Schertz et al., 2013; Schertz, Odom, et al., 2018). For the TT-phase videos, participants had three to eight videos available due to variations in participants' rate of progress in this phase of intervention. For participants with more than three videos, the last three were chosen. The mean duration of time between the TT-phase videos and the post-intervention videos was 23.6 weeks across the 20 participants. Each participant only had three videos from post-intervention, so all three post-intervention videos per child were included in the present study.

Video coding and reliability

Video coding was conducted by two trained coders, described below. A partial-interval observation coding system (Yoder & Symons, 2010) was used to capture instances of STT and ITT, in every 10-s interval of each 10-min video from the TT phase. IJA and RJA were coded in the same manner, but from post-intervention videos. Video-splitting software was used to divide continuous videos into 10-s intervals, which allowed the two coders to indicate where they had agreement or disagreement. Under this coding system, occurrence of a variable was indicated by a "1," which was used only once per interval even if observed multiple times during that interval. A non-occurrence was indicated by a "0." This coding method was used to calculate the frequency of how often each variable occurred within the 60, 10-s intervals of each 10-min video. The total number of variable occurrences in each video was summed. After the three videos per participant were coded, the total number of occurrences was summed across the set of three videos from the TT phase and post-intervention, respectively.

The research investigator acted as the secondary coder and trained the primary coder, who was a doctoral student in special education. The primary coder was trained using sample videos and by following the coding criteria in the PJAM and the ITT measure. The coders were trained to 85% agreement and agreement was monitored throughout the study. After training, the primary coder observed all participant videos and the secondary coder observed 25% of the videos to assess interobserver percentage agreement, which was determined by dividing interval agreement by the sum of agreement and disagreement, multiplied by 100. In addition to percentage agreement, Cohen's (1968) Kappa coefficient, which considers agreement between interraters happening by chance, was calculated for this study. The two coders reached substantial to almost perfect levels of Cohen's Kappa for the four variables. The mean and ranges for percentage agreement and Kappa for the four variables are shown in Table 3.

Table 3. Video coding reliability.

Variable	Agreement (%)	Range (%)	Cohen's Kappa	Kappa range
ITT	93.47	76–100	0.65	0–1.0
STT	95.22	71–100	0.84	0–1.0
IJA	99.15	95–100	0.92	0–1.0
RJA	98.31	88–100	0.73	0–1.0

ITT: instrumental turn taking; STT: social turn taking; IJA: initiating joint attention; RJA: responding to joint attention.
The possible range is between 0 and 180 intervals in which variables were observed across three videos during the TT phase and three videos during post-intervention.

Community involvement

For the original intervention study, the families and their children with autism were recruited from community agencies that provide early intervention services and some received other services in addition to the JAML intervention. However, the present study is a secondary analysis of preexisting data and community members were not directly involved in this study.

Results

Spearman's (1904) rank-order correlation coefficient (r_s) was chosen for this study because it is a nonparametric measure that is robust to outliers, is used for interval-scaled data, and captures increasing or decreasing nonlinear trends (Altman & Krzywinski, 2015; Schober et al., 2018). Pearson's product-moment correlation coefficient (Pearson, 1896) was considered, but because the data violated Pearson's assumption of normality and because of outliers in the sample, this method of analysis was deemed not suitable for this study. The data, which are interval-scaled, met Spearman's assumption of monotonic relationships. Prior to calculating the correlation coefficient using Spearman's r_s, scatter plots were graphed (Figure 1), which depicted the strength and direction of the relationship between and trends of the variables (Hauke & Kossowski, 2011).

Normality was determined for each variable using a *t*-distribution conducted at alpha = 0.01, one-tailed with a critical value of $t(19)$ at alpha = 0.01, 2.54. The results indicated that IJA and RJA distribution was not

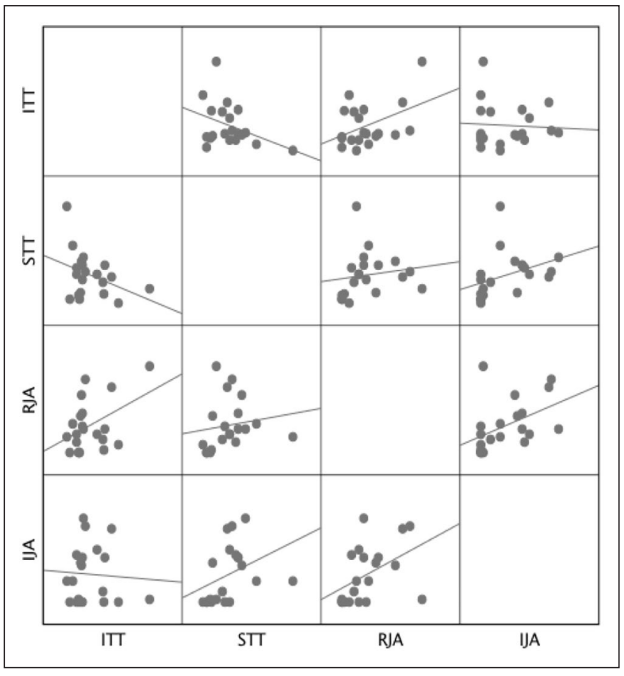

Figure 1. Scatter plots of monotonic relationships.
Note. This figure represents the trends of the four variables.

Table 4. Descriptive statistics for ITT, STT, IJA, and RJA ($N = 20$): number of 10-s intervals.

Variable	*M*	*SD*	Range	Skewness		Kurtosis	
				Statistics	*SE*	Statistics	*SE*
ITT	27	20.60	3–88	1.53	0.51	2.74	0.99
STT	21.50	17.22	0–74	1.45	0.51	3.43	0.99
RJA	10.45	9.69	0–33	1.04	0.51	0.27	0.99
IJA	10.60	10.93	0–32	0.62	0.51	−0.88	0.99

ITT: instrumental turn taking; STT: social turn taking; RJA: responding to joint attention; IJA: initiating joint attention.
Note. The possible range is between 0 and 180 intervals in which variables were observed across three videos for each participant.

significantly skewed, but kurtosis was significant (skew = 0.62, $t(19) = 1.21$, $p > 0.01$; kurtosis = 0.27, $t(19) = 0.27$, $p < 0.01$) for IJA and (skew = 1.04, $t(19) = 2.04$, $p > 0.01$; kurtosis = 0.27, $t(19) = 0.27$, $p < 0.01$) for RJA. ITT and STT distribution skewed significantly from normal (skew = 1.53, $t(19) = 2.98$, $p < 0.01$; kurtosis = 2.74, $t(19) = 3.46$, $p < 0.01$) for ITT and (skew = 1.45, $t(19) = 2.84$, $p < 0.01$; kurtosis = 3.43, $t(19) = 3.46$, $p < 0.01$) for STT. Descriptive statistics for the four variables are presented in Table 4.

A one-tailed test was used to analyze the directional (i.e. positive) relationships hypothesized in this study. Correlational analysis identified moderate correlations, as defined by Schober and colleagues (2018), between STT and the joint attention variables. Specifically, a significant positive relationship was found between STT and RJA, $r_s(18) = 0.481$, $p < 0.05$, one-tailed, and between STT and IJA, $r_s(18) = 0.622$, $p < 0.00$, one-tailed. The coefficient of determination (R^2) was used to measure the level of variability shared by variables and revealed that STT shared 23.13% of variance with RJA and 38.68% of variance with IJA. A significant relationship was not identified between ITT and RJA, $r_s(18) = 0.337$, $p = 0.07$, one-tailed, or between ITT and IJA, $r_s(18) = 0.161$, $p = 0.24$. The results of the correlational analysis are presented in Table 5.

Table 5. Intercorrelations for ITT, STT with RJA and IJA.

Variable	ITT		STT	
	rho	*p*	*rho*	*p*
RJA	0.33	0.07	0.48*	0.01
IJA	0.16	0.24	0.62**	0.00

ITT: instrumental turn taking; STT: social turn taking; RJA: responding to joint attention; IJA: initiating joint attention.
*$p < 0.05$, one-tailed. **$p < 0.01$, one-tailed.

Discussion

Young children with autism often display challenges in joint attention, a competency that has been promoted in some early intervention research that includes a turn-taking component (e.g. Isaksen & Holth, 2009; Rocha et al., 2007). However, the relationship of turn taking, differentiated by function, to joint attention, has not been investigated in research on early intervention for children with autism. This preliminary study explored the association between two turn-taking functions and joint attention as observed in young children with autism when interacting with their caregivers. In full support of our hypotheses, the correlational analysis revealed that STT has a significant positive relationship with both initiating and responding forms of joint attention, while no such relationship was identified between ITT and the joint attention variables. STT was found to correlate more strongly with IJA than with RJA.

Implications

Previously, researchers identified a significant relationship between STT and IJA as observed in interactions between young children with autism and their caregivers (Lee & Schertz, 2020), a finding that was supported by the present study. However, the authors of the earlier study did not find a relationship between STT and RJA. In addition, they excluded instrumentally motivated turn-taking exchanges, defining turn taking as social. Furthermore, their findings were derived from post-intervention data, a period in which turn taking tends to decrease as joint attention

develops (Schertz et al., 2013; Schertz, Odom, et al., 2018). In the current study, turn taking was observed during the phase of intervention in which it was being promoted prior to introducing joint attention. The joint attention variables were observed post-intervention when children were expected to have developmentally progressed to joint attention. Different data collection points between the two studies may explain why a relationship was identified between STT and RJA in the present study but was not identified in Lee and Schertz (2020). Since, to our knowledge, the present study is the only reported research to identify a relationship between STT and RJA as observed between young children with autism and their caregivers, further exploration is needed to support this tentative finding.

Although moderate correlations were found between the joint attention variables and STT, a stronger correlation was identified between STT and IJA than between STT and RJA. A possible explanation for this finding is that the voluntary initiative aspect of STT, which is required to keep the exchange going, may better prepare children for IJA than RJA, since the latter requires partner initiation (Lee & Schertz, 2020). However, RJA has been found to be less challenging for some children with autism than is the initiating form (e.g. Mundy et al., 1994; Schertz & Odom, 2007), so this finding was somewhat unanticipated. Other developmental factors, such as basic cognitive processes related to memory and attention, language, and use of eye gaze (e.g. Elison et al., 2013; Morales et al., 2005; Mundy & Gomes, 1998; Walton & Ingersoll, 2013), may have contributed to individual differences in use of STT and each form of joint attention. In addition, because intervention environments and activities were not restricted in the original intervention study, these factors could also contribute to the variance found in the present study. Exploring why STT has a stronger correlation to IJA than RJA is an area for future research and other influencing factors should be considered.

The findings of the present study support the idea that, when included as a component of intervention, socially driven turn taking—a simple form of dyadic engagement—is foundational to the more complex, triadic competency of joint attention. Although numerous studies have demonstrated the impact of joint attention on later developmental outcomes, current research has yet to solidly identify nonverbal communicative forms that may be precursors to joint attention. Existing early intervention research for young children with autism addresses the importance of joint attention for various areas of development (e.g. Charman, 2003; Mundy, 2016), and other studies have incorporated a social turn-taking component to promote joint attention (e.g. Greenspan & Wieder, 2006; Schertz, Odom, et al., 2018). The findings of the present study support the concept behind interventions, such as JAML (Schertz, Odom, et al., 2018), that promote joint attention through STT. To examine this theory further, future research should test for causality between the two competencies, such as through single-case design studies that differentially examine effects of STT and ITT interventions on joint attention in young children with autism.

While turn taking is often incorporated in interventions for children with autism, there remains inconsistency in how it is defined across interventions. Some interventions have focused on increasing children's turn-taking actions, but do not clearly promote turn taking in its social function (e.g. Kemp et al., 2019; Therrien & Light, 2018; Wang, 2017). In Kemp and colleagues (2019), for example, peers coached children with autism to use turn-taking exchanges to increase their ability to follow their peer's directions and to make requests; however, the instrumentally defined turn-taking outcome did not indicate that the children benefited from meaningful social interaction. The results of the current study support the idea that STT and ITT are distinguishable. Classifying turn-taking definitions by function can guide researchers, practitioners, and caregivers to consider child intent when incorporating turn taking into social communication interventions. To distinguish between STT and ITT, researchers and practitioners may follow the definitions presented in this study and in other research on communicative functions that provide key, observable indicators of child intent (e.g. Cochet & Byrne, 2016; Schertz, Call-Cummings, et al., 2018).

Furthermore, our findings suggest that STT may be better at supporting children's social development than ITT when used in intervention, further emphasizing the need for differentiating turn taking by function. This finding is especially important for children with autism, who may require more support in use of the social than the instrumental function. Interventions, such as JAML (Schertz, Odom, et al., 2018) and Floortime (Greenspan & Wieder, 2006), that promote STT, do so through the child's active engagement in their own learning, through family involvement, and in environments and routines that are natural to the child. This intervention content that aligns with recommended childhood practices that are developmentally appropriate for young children (Division for Early Childhood, 2014). To support children's use of STT in intervention, researchers and practitioners can encourage non-prescribed, child-led, dyadic interactions that are free-play-based and elicit children's positive affect when engaging with communicative partners. Incorporating these recommendations in interventions for young children with autism may optimally promote their later social development.

Limitations

Although this study is a preliminary investigation, it may be limited by the sample size. In the future, a larger sample size could confirm the tentative findings of the present

study and doing so could enhance study rigor (VanVoorhis & Morgan, 2007). The study results are limited by the sample population, who were mostly homogeneous in their language scores and had moderate-to-severe autism assessed at preintervention, so the findings may not be attributed to all children with autism. Future studies with a more diverse sample could support our findings. In addition, as discussed previously, individual developmental differences that could influence children's engagement in social communication competencies were not analyzed in this study and are an area of future exploration that extend beyond the scope of the current study. While secondary data analysis is a common and accepted research method (e.g. H. M. Chiang et al., 2012; Saunders et al., 2015) and can be advantageous in helping to identify new solutions to current issues, it is not without drawbacks (Cheng & Phillips, 2014). A potential limitation of using secondary data, such as the preexisting JAML videos utilized in the present study, is that it was obtained from a study that was not designed to address the hypotheses proposed in our secondary analysis (Cheng & Phillips, 2014). Finally, because this is the first study to differentiate turn taking by function, additional research is needed to validate the use of instrumental turn-taking coding criteria.

Conclusion

The present study distinguished between ITT and STT and analyzed their relationship to RJA and IJA in interactions between 20 toddlers with autism and their caregivers. The results indicate a positive association between instances of STT and both RJA and IJA, but not between ITT and either form of joint attention. This finding supports the theory that STT is foundational to joint attention competency. An implication of these findings is that the intent behind communicative interaction should be considered in interventions for young children with autism to best promote social communication outcomes. Further study through causal evidence is needed to substantiate STT as a precursory competency to joint attention.

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