LSHSS

Clinical Focus

Communication Profile of a Minimally Verbal School-Age Autistic Child: A Case Study

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Purpose: The present clinical focus draws on an intrinsic case study to provide a thick description of the communication profile of John, a 9-year-old minimally verbal autistic student.
Method: Specifically, traditional behavioral assessments, classroom video observations, and semistructured interviews were used to gather information regarding John's communication profile and potential sensory–motor differences.
Results: Convergent evidence indicated that John's expressive profile was characterized by single words, emergent word combinations, some conventional gestures, and a low frequency of communicative initiations. Concomitant language comprehension challenges and poor intelligibility associated with motor speech impairment were also indicated. His sensory–motor profile was marked by fine motor impairment, relative strengths in gross motor abilities, and sensory differences across visual, hearing, and tactile modalities.
Conclusion: Direct implications for supporting minimally verbal autistic students like John include the need to (a) consider sensory–motor influences on social interaction and (b) support flexible use of multimodal communication resources, including augmentative and alternative communication.
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Despite the increased prevalence of autism research in recent years, minimally verbal individuals have been underrepresented in this literature (Kasari et al., 2010; Tager-Flusberg & Kasari, 2013). Approximately 20%–30% of individuals with an autism diagnosis do not develop spoken language as a reliable form of communication (Mawhood et al., 2000; Turner et al., 2006), and many more are substantially delayed in meeting prominent speech-language milestones (Tager-Flusberg et al., 2009). Despite this high prevalence of concomitant communication impairment, the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-5*) removed language impairment from the diagnostic criteria for autism in 2013, thereby leaving a gap in understanding the spoken language difficulties of many on the autism spectrum. In 2010, the National Institutes of Health held a multidisciplinary workshop to examine the state of the empirical knowledge base related to the minimally verbal autistic[1] population and to establish future research directions (Kasari et al., 2010). One of the key conclusions that emerged from this workshop was the need for further research into the behavioral profile of minimally verbal autistic individuals, including communication, sensory processing, and motor abilities.

Communication Profile of Minimally Verbal Autistic Students

The definition of the term "minimally verbal" encompasses a wide range of behaviors, including unusual vocalizations, limited speech sound approximations, few words, and fixed phrases that may be accessed only in specified contexts (cf. Grandin, 2000; Robledo et al., 2012;

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[1]Consistent with American Psychological Association's (2010) recommendations about language preferences (p. 72), we have chosen to use identity-first language for this clinical focus piece, which is preferred by many autistic individuals (e.g., Kapp et al., 2013; Kenny et al., 2016; Sinclair, 2013).

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Tager-Flusberg & Kasari, 2013); such definitions usually focus on expressive rather than receptive capabilities. Published communication profiles of minimally verbal autistic individuals are relatively limited, particularly as related to the multimodal communication practices of school-age students. The bulk of the autism literature tends to focus on younger children or those who are more highly verbal (Kwok et al., 2015; Tager-Flusberg & Kasari, 2013). For example, the term "minimally verbal" has been used primarily to describe preschool-age children who orally produce between three and 30 different words (Kasari et al., 2008; Norrelgen et al., 2014; Tager-Flusberg & Kasari, 2013; Yoder & Stone, 2006).

Tager-Flusberg et al. (2009) published a useful set of recommended benchmarks for language acquisition for autistic children, with a focus on spoken phonology, vocabulary, grammar, and pragmatics for each developmental stage up to 30 months of age. Key outcome indices included phonetic repertoires, variety in syllable shape, percent intelligibility, number of different vocabulary words, mean length of utterance, diversity of communicative functions, and frequency of communicative acts. In general, less specification has been noted in regard to language comprehension abilities in autistic youth, perhaps because they are more difficult to assess. However, a meta-analysis of 74 studies conducted by Kwok et al. (2015) indicated that autistic children demonstrate similar developmental trends in both language expression and comprehension, meaning that autistic children generally show the same pattern of comprehension exceeding production capabilities that is associated with neurotypical development (see also Gernsbacher et al., 2016).

In contrast to the frequent emphasis on speech, distributed models of communication explicitly highlight the multimodal nature of communicative competence. Such models emphasize that messages are always embedded within rich multimodal contexts that shape their meaning and include both verbal and nonverbal behaviors (DeThorne et al., 2014; Hengst, 2015). For many minimally verbal individuals, full access to multimodal communication includes augmentative and alternative communication (AAC; Beukelman & Mirenda, 2013; DeThorne et al., 2014, 2015; Fisher & Shogren, 2012; Hengst, 2015; Mirenda & Brown, 2009). Of particular interest, a study by Kasari et al. (2014) looked at the effect of integrating a speech-generating AAC device within the context of a blended intervention for a group of 61 minimally verbal autistic children ages 5–8 years. The children within the integrated speech-generating device condition produced an average of 21.6 more utterances/20-min language sample than the group without the integrated speech-generating AAC device (see also Almirall et al., 2016).

Distributed models of communication emphasize the importance of providing access to multiple communicative modalities, including, but not limited to, AAC. A case study by DeThorne et al. (2015) examined communicative competence through the classroom interactions of a preschool-aged autistic child, Aaron, who utilized a speech-generating device. Results illustrated the importance of flexible multimodality. Specifically, Aaron and his communication partners used a combination of vocalization, intonation, facial expression, gesture, posture, eye gaze, and objects, including AAC (see also Vidal, Robertson, & DeThorne, 2018). The study also highlighted the importance of presumed competence by communication partners and suggested that sensory–motor differences may impact communicative interactions.

Sensory–Motor Differences

The idea that sensory–motor differences may be contributing to the communication profiles of autistic individuals is not new. Movement disturbances have been explored as a fundamental aspect of autism as early as the 1970s (e.g., Bram et al., 1977; Damasio & Maurer, 1978). Since then, studies have associated autism with both gross and fine motor delays (Jasmin et al., 2009; Ming et al., 2007; Provost et al., 2007), motor coordination and planning issues (Ming et al., 2007; Mostofsky et al., 2006; Rodriguez, Wade et al., 2019; Vernazza-Martin et al., 2005; Wiemer et al., 2001), perceptual-motor integration difficulties (Müller et al., 2004; Vanvuchelen et al., 2007; Wiemer et al., 2001), hypotonia (Ming et al., 2007), and postural control issues (Kohen-Raz et al., 1992; Minshew et al., 2004). Despite such evidence, the extent to which motor differences might be contributing to the communication profiles of minimally verbal autistic children has remained relatively unexplored.

Pioneering work by Leary and Hill (1996) directly addressed the potential interaction/confound between social communication and motor disturbances. They highlight, for example, how perceived deficits in "spontaneous seeking to share enjoyment…interest or achievements" as noted in the *DSM* may be difficult to differentiate from extreme delays in responding to others (i.e., akinesia/dyskinesia or bradykinesia; p. 39). Based on results of an exploratory study of the motor characteristics of autistic individuals, they grouped symptoms of autism into those affecting (a) motor function; (b) volitional movements, including the initiation of communicative acts; and (c) overall behavior and activity (see also Donnellan et al., 2012).

In support of the potential impact of motor disturbances on the communication profiles of minimally verbal autistic children in particular, studies have demonstrated difficulties in oral-motor skills (e.g., Adams, 1998; Gernsbacher et al., 2008), including speech sound imitation (e.g., Bernard-Opitz et al., 1999; Hailpern et al., 2010), expressive spoken language (Kasari et al., 2013; Mawhood et al., 2000; Tager-Flusberg & Kasari, 2013; Turner et al., 2006), and unusual prosody (Donnellan et al., 2012; McCann & Peppé, 2003; Paul et al., 2005; Robledo et al., 2012). Of interest, Page and Boucher (1998) studied the motor skills of 33 autistic students, ages 5–16 years, most considered to be "nonverbal." The authors found that nearly 80% of all participants had at least one area of marked motor impairment, with oromotor and manual impairment being more prevalent than gross motor difficulties. Difficulties with initiation, evidenced through groping behavior and slow

initiations, were noted in approximately a third of the participants, a finding that seems to align with some common features of childhood apraxia of speech (Fog-Paulsen, 2013; Iuzzini-Seigel & Murray, 2017; Ozanne, 2005; Page & Boucher, 1998; Shriberg et al., 2011; Tierney et al., 2015). Findings from Page and Boucher also indicated that the more pervasive the students' motor impairment, the more substantial the language impairment (see also Seal & Bonvillian, 1997).

More recently, Licari et al. (2020) conducted a large-scale study (n = 2,084) of motor difficulties in autistic children under 5 years of age. They found that 79% of participants scored in the low or moderately low range for motor skill. Correlations between motor and other domains, such as communication and social skills, were significant. Overall results led the authors to conclude that, "despite mounting evidence, generalized motor difficulties within the ASD phenotype remains overlooked during standard diagnostic practice…" likely due in part to the fact that generalized motor difficulties are outside the traditional social-cognitive conceptualization of autism (p. 6; see also Jaswal & Akhtar, 2018). In short, it is very difficult to draw meaningful conclusions regarding communication and social reciprocity, without directly considering the potential impact of motor differences.

In addition to motor challenges, sensory differences of autistic individuals have been described from the early days of the diagnosis (Kanner, 1943), but they have received increasing attention in the last 3 decades (Cesaroni & Garber, 1991; Courchesne, 1997; Donnellan et al., 2012; Grandin, 2000; Jones et al., 2003; Kientz & Dunn, 1997; Paul et al., 2007; Tomchek & Dunn, 2007). The *DSM-5* lists "hyper- or hypo-reactivity to sensory input" as an example of the restricted, repetitive patterns of behavior used to diagnose autism (American Psychological Association, 2013, p. 50). Sensory differences in autistic individuals have an incidence of 30%–80% and are characterized by processing and modulation challenges (Baranek et al., 2005; Dawson & Watling, 2000). Particularly for sensory processing disorders, impairments have been described primarily in hearing, visual, and tactile modalities (Baranek et al., 1997; Kientz & Dunn, 1997; Paul et al., 2007; Sinclair, 2010; Tomchek & Dunn, 2007; Watling et al., 2001).

Studies that include first-person perspectives from autistic individuals have described fluctuation between different sensory issues depending on the context (Burke, 2005; Costa & Lampreia, 2012; Donnellan et al., 2012; O'Neill & Jones, 1997). For example, Grandin and Scariano (1986) described how the same stimuli (noise) can be unnoticed when an activity of interest is conducted (e.g., spinning a coin) and can be overwhelming in a different context (i.e., social interaction). Another example taken from the study by Robledo et al. (2012) highlighted the case of Geneva, a 57-year-old woman who preferred to be interviewed over the phone because she was able to think and communicate better when her body was supported in a recliner or a bathtub (p. 7). She reported that these environments supported her both physically and emotionally. Such examples highlight the need for a better understanding of sensory–motor profiles of autistic individuals in order to support everyday functions, including communication. In addition, the variable and highly contextualized nature of the sensory–motor experiences reported by autistic individuals can be difficult to capture in traditional experimental studies that depend on standardized environments across numerous individuals.

In summary, relatively limited literature has focused on describing the multimodal communication profiles of minimally verbal autistic children, particularly as related to sensory–motor differences. A recent review by Hengst et al. (2015) highlighted the need for "thick" participant representations as an important means to bridge research and practice within the discipline of communication sciences and disorders. They defined thick representations as "those that include contextualized, dynamic, and interpretive accounts, often including more personalized representations of people and their social worlds" (p. 839), a pursuit well suited to case study research. Accordingly, the purpose of the present clinical focus piece was to provide a thick description of the multimodal communication profile of a minimally verbal school-age autistic student, including sensory–motor differences.

Method

Qualitative Approach and Research Paradigm

Situated with a pragmatist research paradigm (Creswell & Clark, 2007), the present intrinsic case study is derived from a larger mixed-method research project designed to examine and support the peer interactions of John, a minimally verbal autistic student using a distributed model of communication (Vidal, 2018). Specifically, this clinical focus article draws on data obtained from behavioral assessments of communication and sensory–motor function, semistructured interviews from familiar communication partners, and video-recorded classroom observations across a period of 3.5 months.

Researcher Characteristics and Reflexivity

The authors are three speech-language pathologists and academics, who together represent the discipline of communication sciences and disorders across three different countries: Chile, Sweden, and the United States. Relevant areas of expertise include mixed methodology, child language, autism, AAC, and motor speech disorders. The authors worked collaboratively on the assessment protocol, drawing on prior research practices (e.g., DeThorne et al., 2015) and experiences from a multidisciplinary diagnostic team at the Karolinska Institute, co-directed by the second author (A. M.). All authors share an interest in studying the potential role of motor differences in autism using a distributed model of communication. The investigative team also included 10 undergraduate research assistants who were studying speech and hearing science at the University of Illinois at Urbana–Champaign; they assisted with data

collection and analyses. One of the research assistants continued to assist on this project after she transitioned to graduate school in speech-language pathology at Western Michigan University.

The Case: John

The primary participant of this study was John,[2] a student aged 9;8 (years;months) who lived with his parents and brother. John's family identified as Hebrew, immigrating to the United States from India 6 years prior. Although, John's mother stated that they used Hebrew at home, she reported that she spoke to John solely in English because they had always lived in countries where English was the primary language. John was selected as the primary participant of this study using a combination of purposive and convenience sampling. John's family participated in a previous study conducted by the second and third authors who examined the co-occurrence of childhood apraxia of speech and autism (still ongoing). During this process, John's mother agreed to be contacted about additional study opportunities. Accordingly, John was recruited for the present case study given that his communication profile was not well represented in the literature on autism and the fact that his mother reported a need for support in peer interactions. This study received institutional review board approval from the University of Illinois at Urbana–Champaign, which included consent and assent procedures for all participants.

At the time of this study, John was homeschooled in the mornings by his mother, who was a formally trained psychologist. She reported using the time to focus on math and literacy. At the start of the study, John received both applied behavioral analysis (ABA) and speech therapy at home. He attended a Midwestern public elementary school in the afternoons, and his primary placement was a special education "life skills" classroom. In terms of related services at school, John's paraprofessional reported that John received social work, occupational therapy, and speech-language pathology services outside the classroom (i.e., pull-out model). At the beginning of the study, John participated 20–45 min per day in the third-grade general education classes, which alternated daily across art, music, and physical education.

Developmental History

John's mother reported that he reached all developmental milestones until 14 months of age when his behavior abruptly changed. Specifically, she wrote in an e-mail to the third author (L. D.) that John's first symptom was crying "day and night." She also shared that "he stopped sleeping at night" and added: "He was chewing extensively on everything, on his hand and the pacifier, and crying. (He) stopped eating the foods that he ate before (…); my son stopped laughing." In addition, she mentioned that John started to "obsessively" watch commercials and stopped paying attention to others.

John's mother expressed that she was concerned about John at this point; however, professionals that she visited in India told her that it was part of "his painful teeth," presumably tooth eruption, and it was part of normal development. When John was 18 months old, she decided to take him for an evaluation in Israel with a multidisciplinary team after seeing that "John stopped walking on the shiny floor," and instead, he started to run and spin. It was during this evaluation that John received a diagnosis of autism.

After his autism diagnosis, John's mother mentioned that John continued crying and having difficulty sleeping. She also shared that a critical moment in shaping her perception of John's behavior came when his grandmother gave him a "pain killer," which appeared to ease his discomfort. This led her to stop viewing his behavior as "annoying" or "just sensory" as it had been presented to her by others. She reflected, "What does it mean, just sensory? Pain is also sensory." From this situation, John's mother looked for additional causes that might explain John's symptomatology, which led her to suspect pediatric acute-onset neuropsychiatric syndrome associated with streptococcal infections (Mazzone et al., 2012; T. K. Murphy et al., 2014; Shriberg et al., 2011; Swedo et al., 1998). This is a condition associated with neuropsychiatric symptoms such as anxiety, motoric hyperactivity, unusual movements, and sensory challenges (see also M. L. Murphy & Pichichero, 2002; Swedo et al., 1998, 2004). John's mother also reported that, while in the United States, John was diagnosed with apraxia by a developmental pediatrician at a local hospital. It was unclear whether the given apraxia diagnosis was general or specific to speech.

John's mother emphasized in her interviews that receiving services for John had been challenging. While she lived in India, she mostly received parent consultation. John started to receive direct support once he and his family arrived in the United States, which was in 2013, 5 years prior to the initiation of this study. Services included speech-language pathology, occupational therapy, and ABA. ABA intervention was implemented for 4 years before being discontinued by John's mother in the midst of this study. She reported that it was not useful. John's mother shared that she had suggested to the last ABA therapist that she should focus on teaching John to type because "John loves typing," but the therapist reportedly responded, "No, he doesn't in my assessment…he cannot type." John's mother shared that John's mood and behavior improved dramatically after stopping ABA. John's mother expressed frustration with the tendency of professionals to underestimate John's capabilities and reported that she had been told he was "unteachable." As evidence of his capabilities, John's mother shared an anecdote of how John remembered a specific walk route they had taken only once to look at Christmas decorations, highlighting that this clearly demonstrated learning. Because of difficulties finding appropriate supports for John, John's mother shared that she had

[2]Pseudonyms were selected by the study participants.

come to view herself as his main teacher/therapist and the "case manager of the household."

John's Interests and Abilities

During interviews, classmates and adult participants noted that John liked physical activities, such as jumping, playing ball, and running around. Specifically, when the primary examiner (V. V.) asked John if he liked to jump during his initial interview, he nodded and said, "yes." He also said yes when asked if he liked school and art class. John's paraprofessional reported that John liked to paint, work with clay, and feel the texture of materials. The primary examiner (V. V.) observed John frequently seeking out the sink within the art classroom, and his paraprofessional noted that John liked to play with the hairdryer in one particular bathroom. When asked about his strengths, John's mother mentioned that John is "very smart," and he has "very good potential."

Data Collection

Initial Behavioral Assessments

John's communication profile was explored over a period of prolonged engagement through observational tools, parent report measures completed by John's mother, and teacher report measures completed by John's paraprofessional at school. The assessment battery drew on measures and practices recommended by Kasari et al. (2013) for minimally verbal autistic students as well as input from a multidisciplinary diagnostic team at the Karolinska University Hospital, co-directed by the second author (A. M.). The parent report measures included the MacArthur–Bates Communicative Development Inventories (CDI): Words (Fenson et al., 2006), the Intelligibility in Context Scale (ICS; McLeod et al., 2012), the Nordic Orofacial Test–Screening (NOT-S) interview (Bakke et al., 2007), and the Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07; Wilson et al., 2009). The school report measures included the Sensory Processing Measure (SPM; Parham et al., 2010) and the Vineland Adaptive Behavior Scales–Third Edition (Vineland-III), teacher form (Sparrow et al., 2016). In addition, we drew on speech-language assessment data collected 1 year earlier during John's participation in the prior project from the same lab. Results from this prior speech-language assessment included the Social Communication Questionnaire (Rutter et al., 2003) completed by John's mother and a 25-min speech sample obtained from parent–child interaction during free-play in a sensory room (i.e., swinging and jumping on a trampoline) and book reading activities. During the parent–child interaction, John and his mother were encouraged to play as they would usually interact (see Figure 1 for a summary of data collection process).

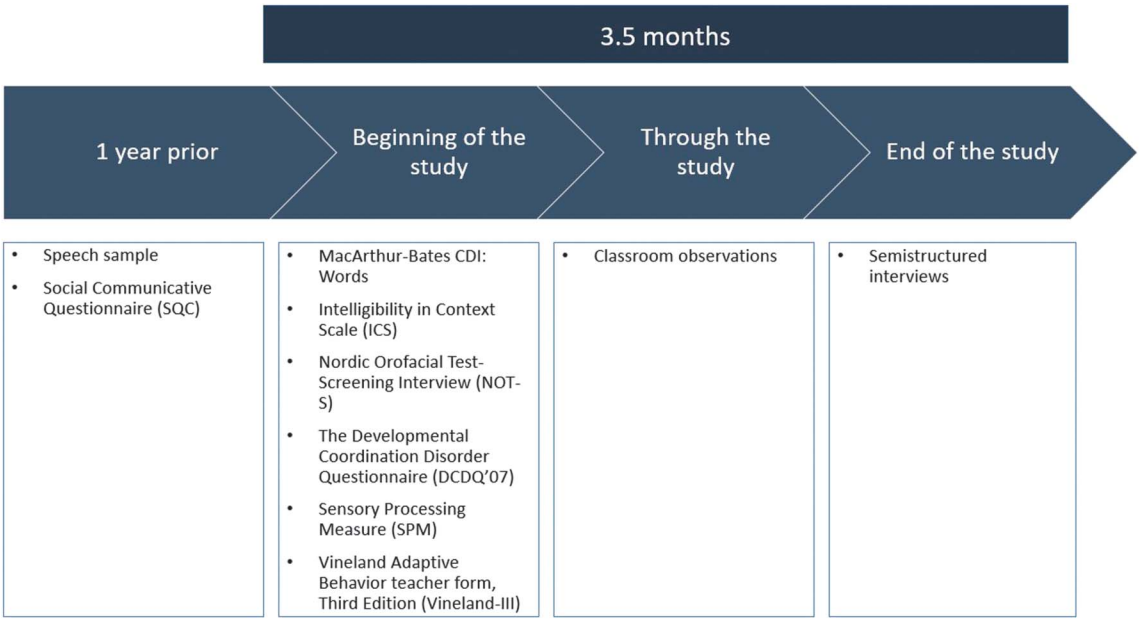
Although an original transcript of John's speech sample was completed 1 year prior when the sample was first collected, the third author and a graduate research assistant both individually reviewed the original transcript together with the raw video footage to create a time-stamped document that provided a phonetic transcription of all John's speechlike utterances. A speechlike utterance was defined as any utterance with at least one recognizable phoneme paired with at least one other communicative behavior by either John or his communicative partner (e.g., eye gaze, shift in proximity, aligned posture). Each speechlike utterance was designated as imitative if (a) it occurred within 3 s after spoken by someone else and included at least one of the same phonemes or (b) occurred within 3 s of a direct command to say a word. In addition, each speechlike utterance was assigned a discourse structure of initiation or response, consistent with coding presented in the study by Wetherby et al. (1988). Any discrepancies between the two transcriptions and associated coding were resolved through a final consensus pass between the research assistant and the third author while reviewing the original video footage together. Consistent with benchmarks highlighted in the study by Tager-Flusberg et al. (2009), the speech sample was used to derive John's speech sound repertoire, including the diversity of his syllable shapes. Prior to the consensus pass, point-by-point agreement between the independent transcribers for the outcomes of interest were 80% for vowel repertoire, 71% for consonant repertoire, 60% for syllabus shape repertoire, and 100% for discourse functions. The lower reliability of the phonetic indices reflects the inherent difficulty of completing this analysis for minimally verbal children and supported the importance of the final consensus pass to enhance validity.

Semistructured Interviews

Semistructured ethnographic interviews (Westby et al., 2003) were conducted at the beginning and at the end of the study to gain insights regarding John's communication profile and the nature of peer interactions. For the purpose of this study, peer interaction was defined as a reciprocal interaction between the child on the autism spectrum and one or more of his neurotypical peers (Howes et al., 1988). The semistructured interviews were conducted with John, three adults who provided weekly care or instruction (John's mother, John's paraprofessional, and the art teacher), and two of John's third-grade general education peers from art class (Ethan and María).

Interviews of the adult participants ranged from 26 to 40 min and were conducted in person or over the phone. Interview questions focused on John's communication profile, his general development, and the nature and frequency of his peer interactions. Adult participants had the opportunity to review their interview transcripts for clarification or correction. Only one participant offered feedback, which was a single word revision. Interviewed children were selected based on the head teacher recommendations and in concordance with two criteria: (a) demonstrated consistent attendance and (b) receptivity to interactions with John. According to these criteria, two peers were selected, Maria and Ethan. Child interviews ranged from 4 to 21 min and took place at the children's school. Child interviews focused on participant interests and patterns of peer interactions with one another.

Figure 1. Summary of data collection process. CDI = Communicative Development Inventories.



All interviews were video-recorded via camcorder, except for the interviews from John's mother, which were audio-recorded only based on her preference. Interviews were transcribed in Microsoft Word using line-by-line methods in the case of adult participants and sequential methods (Hengst, 2003) for child participants. This sequential method, though more laborious, captures more contextual information, which is particularly helpful for interpreting meaning in children with limited verbal capabilities. The method visually displays the time course of the interactions and codes for salient gestures, paralinguistic features, eye gaze, and use of AAC devices (see Supplemental Material S1). Interview data were used to provide descriptive background information and to help triangulate key findings.

Classroom Observations

The first author (V. V.) and a supporting research assistant conducted videotaped classroom observations during art class once to twice per week, for approximately 15–30 min each, and for a total of 20 sessions. Consistent with practices for building credibility within qualitative research (Guba & Lincoln, 1985), the first author also completed analytic memos after each classroom observation and weekly lab meeting in order to document reflective insights, salient examples, and emerging questions.

Guided by the analytical memos and team discussions, video recordings were iteratively discussed throughout the process of data collection to select salient examples of John's peer interactions. Examples were narrated into Microsoft Word by one member of the research team using microanalysis procedures (Ratcliff, 2003), and then that narration was reviewed in conjunction with the video by one of the authors (V. V. or L. D.). For the purpose of illustrating the nature of John's communication profile within the context of classroom interactions, we have selected two narrated examples.

Results

Expressive Communication

Converging evidence across behavioral assessments (see Table 1), classroom observations, and participant interviews indicated that John's spoken communication consisted predominantly of single word productions. Specifically, the 25-min speech sample yielded 27 speechlike utterances, the bulk of which appeared to be single words (e.g., *ball*) or two-word combinations (e.g., *a bath*); however, limited intelligibility made it difficult to segment individual words with certainty. Of the 27 utterances, 12 were recognizable as direct imitations. For example, John repeated "push" when John's mother asked, "Shall I push?" and repeated the word "ten" after she finished counting to 10. All but one of John's utterances from the speech sample (26/27, 96%) were coded as responses, either to a direct question (e.g., "What do you want to play with?), a verbal prompt (e.g., "Can you say I?"), or a cloze procedure (e.g., "A boy standing on a chair and grabbing for…"). John's one recorded initiation from the speech sample was a spontaneous request for water that occurred at the end of the sample during book reading. Specifically, John shifted his gaze toward the shelves where cups were located, touched his mom, and uttered "buhwuhduh."

Table 1. Summary of assessments description and results.

Measure	Description	Results	Interpretation
Communication			
CDI: Words (updated)	Standardized inventories of expressive and receptive vocabulary (parent report)	180/396 (words receptively) 80/396 (words expressively)	18 months old age equivalent 17 months old age equivalent
Social Communication Questionnaire (previous study)	Screening tool for ASD (parent report)	30	Over 15 months is indicative of autism
Speech-Language Sample (previous study)	Mother–child interactions during free-play activities (i.e., swinging and jumping on a trampoline) and book reading	9 vowels: /ɪ,ɛ,ə,ʌ,u,ʊ,o,æ,i/ 14 consonants: /p,b,t,d,k,g,m,n,w,j,h,f,s,ʃ/ 27 speechlike utterances Inconsistent errors in articulation, unusual prosody, coordination issues	Limited phonetic repertoire, 18–30 months age equivalent (Tager-Flusberg et al., 2009) Limited expressive vocabulary (12–24 months) Consistent with motor speech disorder
Sensory–motor profile			
Intelligibility in Context Scale	>5-point Likert scale to assess children speech intelligibility (parent report)	1.85/5	Low intelligibility (< 2 *SD*s) compared to both TD children and children with speech disorders
Nordic Orofacial Test–Screening	Sensory function, breathing, oral habits, chewing and swallowing, drooling, and dryness of mouth (parent report)	Used qualitatively	Reduced sensitivity in oral cavity; motor difficulties associated with chewing
Developmental Coordination Disorder Questionnaire	Clinical screening to identify coordination challenges (parent report)		Indication of developmental coordination disorder (DCD) or suspected DCD
Control during movement		13/30	
Fine motor/handwriting		4/20	
General coordination		14/25	
Total		31/75	
Sensory–motor profile			
Sensory Processing Measure	4-point Likert scale to assess praxis, social participation, and the five sensory systems (teacher report)		
Social participation		37 (77T)	Definite dysfunction
Vision		15 (67T)	Some problems
Hearing		21 (77T)	Definite dysfunction
Touch		16 (70T)	Some problems
Body awareness		14 (65T)	Some problems
Balance and motion		14 (58T)	Typical development range
Planning and ideas		26 (67T)	Definite dysfunction
Total sensory systems		113 (76T)	Some problems
Overall assessment			
Vineland Adaptive Behavior Scales–Third Edition	Student functioning across parameters of daily life (teacher report)		
Receptive	Student functioning across parameters of daily life (teacher report)	8	< 3 years old
Expressive		1	< 3 years old
Written		6	< 3 years old
Personal		4	5;0 (years;months)
Numeric		2	< 3 years old
School community		2	< 3 years old
Interp. relationship		7	< 3 years old
Play and leisure		2	< 3 years old
Coping skills		1	< 3 years old
Gross motor		16	9;10 + (years;months)
Fine motor		1	< 3 years old

Note. CDI = MacArthur–Bates Communicative Development Inventories; ASD = autism spectrum disorder; TD = typically developing.

In specific regard to speech, John's intelligibility was low. His speech intelligibility as assessed through the ICS (McLeod et al., 2012) leads to an overall score of 1.85/5.00, which indicated poor intelligibility of his speech by others. From the speech sample taken a year prior to this study when John was 8 years old, his phonetic repertoire included nine vowels /ɪ,ɛ,ə,ʌ,u,ʊ,o,æ,i/ and 14 consonants /p,b,t,d,k,g,m,n,w,j,h,f,s,ʃ/. Rhotic vowels, diphthongs, interdentals, affricates, and lateral consonants were not observed, nor were word-initial or word-final consonant

clusters. The syllable shape of his 27 speechlike utterances from the speech sample was predominately consonant–vowel (CV; $n = 7$), but also included V ($n = 2$), VC ($n = 1$), VCV ($n = 1$), CVC ($n = 5$), VCVC ($n = 2$), CVCV ($n = 4$), CVCVC ($n = 3$), and CVCVCV ($n = 2$). Based on milestones for speech development provided by Tager-Flusberg et al. (2009), John's phonetic repertoire and syllable use were generally consistent with 18–30 months of age. Of interest, vocalizations noted during the speech-language sample also included audible mouth movements (i.e., sucking, kissing, tongue smacking sounds), humming, laughs, and vocalizations of unclear significance. Some of John's productions were observed as inconsistent across the sample; for example, the word "push" was pronounced /pus/, /pʊs/, and /pʊʃ/ at different points in the transcript. Finally, unusual prosody was frequently noted, such as use of a high pitch and a tendency to vocalize during inhalation. Although John's small number of spontaneous speech productions, poor intelligibility, and limited engagement with direct standardized assessments made the nature of his motor speech impairment difficult to specify, some findings appeared consistent with classic features of childhood apraxia of speech (e.g., inconsistent productions, unusual prosody, vowel errors, distorted production).

In regard to language, John's mother reported that John could spontaneously produce 80 of the 396 words listed on the CDI (Fenson et al., 2006), which corresponded roughly to the mean for 18-month-old boys within the test's normative data. Similarly, the Vineland-III (Sparrow et al., 2016) expressive language score corresponded to an age equivalent of "less than 3 years old." In addition to spoken language, John was beginning to use the app LAMP Words for Life via a tablet as an AAC device. During their initial interviews, John's paraprofessional and John's mother reported that John could not yet use his tablet without direct prompting. John's mother elaborated, "We are trying to prompt him in every situation that requires communication," including when reading and when in therapy. The first author (V. V.) observed John using emergent word combinations via his AAC device during the first and second support phases during art class. For example, she observed him selecting the combination "I want a break" when he wanted to leave the classroom. Also, she observed him once selecting "I feel…" and then searching the emotions page on his tablet after she asked him if he was tired. John was also observed requesting in the classroom through a combination of words, vocalizations, signs, and nonverbal communication. For example, he approximated the word "bathroom" together with a sign in order to request a break.

John's mother, John's paraprofessional, and some of John's peers described during their initial interviews that they communicated with John mainly through vocalizations, words, and gestures. John's paraprofessional mentioned that John "can sign for bathroom, nod yes, and shake his head no." When the first author (V. V.) asked John's peer, Ethan, specifically how he communicates with John, Ethan said: "You (..) have to ask him a couple times and then eventually he'll say yes or no (…) it is pretty easy (…) he makes like a squeak kind of noise, and then, you can kind of tell like it's meant to sound like hi or something like that." When the first author asked another peer, María, how she knows when John is not okay, she said: "Well, when he is not okay, he like screams a lot, and, um, he goes like (she plugs her ears with both hands) cause it's like loud." The first author also asked Maria how she knows when John is happy, and she stated, "Um, well, when he's really not screaming and when he's, um, cooperating with the people (…) like when he's talking to people, when he's being kind to people." Based on observations and peer interviews, John's peers in art class did not seem familiar with his use of AAC. During his initial interview, the first author asked Ethan about whether he used the tablet to communicate with John. Ethan responded: "I don't really know what like the iPad does. I know that it's a thing that they teach those special needs kids to use the iPad. Like if you're mute and you can't talk. Like you could like apparently click on the thing that you want to do."

Comprehensive Language Impairment and Other Cognitive Challenges

Language comprehension was difficult to assess, particularly as distinct from auditory processing and attention to speech. John's mother reported that John had attentional difficulties, and the art teacher mentioned that John had difficulties sitting and listening for long periods of time. During the assessment sessions, his interviews, and even the implemented support during art class, there were several times when the examiner (V. V.) was not able to elicit a clear response from John. Sometimes, nonverbal cues such as staring into space suggested that John's attention was directed elsewhere. During the final interview, John's mother reported that she suspected that he might be experiencing seizures, but she was having a hard time attaining relevant medical examinations.

Based on results from the CDI (Fenson et al., 2006), John's receptive vocabulary was substantially limited, with his mother reporting that he understood 180 words from the total list of 396. This score corresponded approximately to the mean for 17-month-old boys reported in the measure's normative data. Similarly, the Vineland-III (Sparrow et al., 2016) results corresponded to an age equivalent of less than 3 years old (see Table 1). During the speech-language sample, interviews, and classroom observations, the primary examiner (V. V.) observed John responding to simple questions and initiations. For example, John appeared to approximate *ball* when John's mother asked him during the speech sample what he wanted to play. When the first author (V. V.) asked John during his initial interview whether he liked school, he said "yes," and when the first author asked him whether he liked to draw, he said /hm/ and shook his head left and right (i.e., no). Also, during both the initial and final interviews, the first author asked John who his friends were, and he consistently named the

same classmates from the life skills classroom via his AAC device. In addition, John would also respond to the first author's greetings by waving his hand or giving a high five.

Sensory–Motor Differences

In addition to speech-language impairment, relatively pervasive impairments were identified in John's fine motor and praxis skills (i.e., ideation and motor planning) paired with heightened reactivity and sensory seeking in relation to some sensory stimuli (see Table 1). Specific to oral-motor skills, John's mother reported via the NOT-S (Bakke et al., 2007) that John used to swallow large bites of food without chewing and used to take 30 min or more to eat a main meal. John's mother reported on the DCDQ'07 (Wilson et al., 2009) that John had difficulties with control during gross motor movements; fine motor skills, including handwriting; and general coordination. DCDQ'07 (Wilson et al., 2009) results were consistent with difficulties in motor planning found in the SPM (Parham et al., 2010), and in turn, both results were consistent with an apraxia diagnosis. John's motor impairments seemed relatively specific to fine motor, rather than gross motor, activities. For example, his gross motor score on the Vineland was above age expectations, whereas his fine motor abilities on the same measure were notably impaired. From a sensory–motor perspective, these results were consistent with difficulties in coordinating and dissociating small muscle groups.

In regard to his sensory profile, the SPM (Parham et al., 2010) demonstrated overreactivity and sensory seeking behaviors in hearing, visual, and tactile sensory systems. For example, John's paraprofessional reported that John demonstrated "distress at loud sounds" and "complains about classroom light" (i.e., overreactiveness). Consistently, María reported that John had a hard time tolerating noisy environments. In addition to such sensitivity, John's paraprofessional reported via the SPM that John demonstrated sensory-seeking activities, such as "makes noises, hums, sings, or yells during quiet class time" and "spins or flicks objects in front of eyes" (i.e., sensory seeking). Regarding his tactile sensory profile, John's paraprofessional reported through the SPM that John showed distress when someone accidentally touched him (i.e., overreactiveness), although he frequently sought out touching peers during class (i.e., seeking). Based also on the SPM, John's paraprofessional reported that John looked for objects with temperature differences (cold or hot) such as windows (i.e., seeking).

The combined profile of seeking sensory input while also demonstrating overreactivity was also supported by NOT-S (Bakke et al., 2007) results, where John's mother reported that John sought sensory stimulation through biting and sucking his hands and objects daily. The primary examiner (V. V.) observed John biting a chewy tube or his hands, especially during what appeared to be stressful situations. John's mother also reported that John showed overreactivity to some food textures. Related to this, the SPM (Parham et al., 2010) results revealed overreactivity to "tastes and odors of different food." Regarding proprioception, John demonstrated a sensory-seeking profile. According to John's paraprofessional's report via the SPM, John tended to "run, hop, or bounce instead of walk." Also, he used to chew and put different objects and materials in his mouth. During the final interview, John's mother mentioned that these sensory challenges affect other activities. She stated specifically, "He's actually very smart and I know you don't see this so much at school because he's sensory overwhelmed." In accordance with this, María, one of John's peers, shared in her interview that "He (John) can do a lot of things he doesn't really show he can do."

Illustrative Examples

For the purpose of illustrating the nature of John's communication profile within the context of everyday interactions, we have selected two salient examples for narrated microanalyses: one from classroom observations and the other from a book reading activity with his mother that was conducted as part of the initial speech sample. This first example comes from the 14th observational session of peer interactions during art class activities (minutes 5:12–11:59) in which students were assigned to draw animals during art class (see Figure 2). In addition to John, the example includes the first author (V. V.), the paraprofessional, and three of John's peers (María, Ethan, and one incidental peer referred to here as "Gold").

Looking for Elise

> John is standing up on one side of the table, vocalizing unclearly, nodding/shaking his head, extending his arms toward the front, and looking toward the back of the room. The first author (V. V.) is trying to figure out what he wants, and John's paraprofessional approaches the table to help. Gold and María are also looking at John when María smiles at the classmate next to her and says, "He's saying something to you." John is still vocalizing and nodding. The first author asks John's peers, "What do you think guys?" María points toward a different table and offers, "Maybe he might be looking at the paint colors right there." The

Figure 2. *Looking for Elise* example.

first author asks John if he wants to paint. John stops vocalizing for a second, looks down briefly, and then returns to vocalizing, nodding, and looking in the same direction as he had been. Ethan enters the conversation by adding, "It kind of sounds like he's saying 'ball.'" John yells, continues to vocalize, and raises his hands. The first author improvises a ball for him by crumpling up a piece of paper. John leaves the table, moving toward John's paraprofessional and vocalizing. John's paraprofessional interprets that John wants a break and explains to him that we will take a break later. John comes back to the table and sits quietly. The first author prompts John to play ball with Ethan. Ethan throws the ball and John catches it, but instead of throwing it back, he throws the ball on the table and smiles. John stands up and looks toward John's paraprofessional while biting on his own hand. John's paraprofessional asks, "Do you want me to say something with your talker?" John's paraprofessional grabs the AAC device and passes it to John. The first author adds, "Do you want to see your friend in the iPad?" John's paraprofessional points to Gold and asks John, "Who is that one?" John selects "Gold" via his AAC device. John's paraprofessional and the first author are prompting John to say names of his friends with his iPad. Gold comes to watch what's happening and starts touching the AAC device. Ethan comes over to watch too. John and Gold start exploring the iPad together. John uses his AAC device to say, "Elise." It seems perhaps that John has been asking for Elise the whole time. The first author asks Elise to come to the table to say hi to John. Elise comes and greets John, and then she asks him whether she could return back to her table to which John shakes his head no.

This extended series of classroom interactions highlights multiple aspects of John's communication profile, specifically his limited use of speech, intelligibility issues, unclear language comprehension abilities, persistent multimodal expression of communicative intent, relative gross motor strengths, and use of biting as a potential sensory outlet for frustration. Although John does not use a single recognizable word within this 6-min sequence of multiparticipant interaction, he demonstrates persistent communicative intent through vocalization, gesture, eye gaze, and eventually AAC use. For example, Ethan makes an attempt to interpret John's vocalization when he states, "It kind of sounds like he's saying ball," but multiple modalities play a critical role in shaping the communication interaction. Although John does not appear engaged in the fine motor drawing activity, he takes fairly readily to the gross motor activity of tossing the ball back and forth. One can observe evidence of John's situated language comprehension, such as when John stops vocalizing and looks down at the table for a brief moment when asked if he wants to paint, or when John shakes his head no when Elise asks him if she can return back to her table. On the topic of multimodality, it is interesting to note that, even though access to AAC ultimately helped tip this series of interactions toward communicative success, John's paraprofessional introduced the AAC device only after repeated unsuccessful attempts to interpret John's communicative attempts. Consequently, introduction of the AAC device appeared as an attempt at diversion rather than an alternative means of clarifying John's message. Specifically, once John started biting his hand, John's paraprofessional introduced the AAC device by asking, "Do you want me to say something with your talker?" and then proceeded to look at friends on the iPad. In summary, this first microanalysis highlights the difficulties that John may have in making his communicative intent understood, particularly without supported access to flexible multimodal interactions.

This second example was taken from John's speech sample conducted in a university speech-language clinic (minutes 24:42–25:26) approximately 1 year prior to the classroom observations. Specifically, John and his mother were left alone in a small therapy room to look at books as part of a standardized speech sample collection procedure (see Figure 3).

Want Water

John sits at a round table in a small therapy room, and his mother stands beside him. John looks up from the book and over toward the shelves. He maintains this gaze while uttering "buhwuhduh" and simultaneously touching his mother's wrist. John then quickly glances toward his mother's face and touches her leg. John's mother asks, "You want water?" John shakes his head side-to-side and simultaneously says, "wuh." His mother asks, "Yeah?" John responds by vocalizing "eh" and makes a downward motion with his head, like a nod. His mother replies, "Ok" and turns toward the shelves where his cups are stored saying, "I'll get you water." John takes a couple steps toward her but then sits

Figure 3. *Want Water* Example.

back down once she has retrieved the two cups. With a smile on his face, John returns to flipping pages in a book. His mother presents two cups, asking "You want an orange cup or the pink cup?" Without looking up, John selects a different book, and his mother narrates, "You want to see another book, ok. You can do it on your own now." John brings a book into his lap and then looks up to the cups his mother is still holding. Seven seconds after his mother initially offered the drinks, John turns his gaze from the books to the cups. His mother presents the cups again saying, "Which one? This one?" He chooses the pink cup and takes several drinks.

Similar to the prior example, this series of interactions illustrates how John leverages multimodal expressions of communicative intent with his mother, who is a very familiar interactant. John's aligned use of eye gaze, vocalization, and physical contact supported his request for water. His mother seemed to recognize the request immediately, even though the speech sounds were not precise, and the two engaged in at least three turns to solidify the request. It is interesting to note that, to an unfamiliar partner, John's communicative gestures may appear less clear. For example, his initial side-to-side head shake in response to her question, "Want water?" resembled a conventional negative response, but his mother sought additional clarification by asking, "yeah?" At this point, John nods in an affirmative gesture, and his mother responds accordingly. Although one cannot state definitely what John's intention was, his communication appeared intentional and his ultimate response to getting the water appeared favorable (i.e., smiling, picking the cup, and drinking the water). Furthermore, John's poor intelligibility and the dissociation between his first response (negative) and his ultimate affirmative response suggest a potential disconnection between motor movement and intent. This observation is consistent with the formal assessment results that indicated challenges in motor planning.

Discussion

The present clinical focus piece uses a case study to provide a thick description of the communication profile, including sensory–motor challenges of John, a minimally verbal school-age autistic child with an additional diagnosis of apraxia. In summary, convergent evidence across initial behavioral assessments, semistructured interviews, and classroom observations indicated that John's expressive communication profile is characterized by single words, emergent word combinations, some conventional gestures, concomitant language comprehension challenges, and poor intelligibility associated with motor speech impairment. His sensory–motor profile was marked by fine motor impairment, relative strengths in gross motor abilities, and sensory differences across visual, hearing, and tactile modalities.

At least three key details from the findings, triangulated across data sources, supported the likely role of sensory–motor differences in John's communication profile. First, and perhaps most obvious, is the evidence of sensory–motor challenges that emerged from the behavioral assessments and classroom observations. Of particular interest is the support for motor coordination difficulties and the discrepancy between fine and gross motor activity, a finding consistent with prior literature (e.g., Licari et al., 2020; Page & Boucher, 1998; Tierney et al., 2015). A second form of support for sensory–motor challenges as significant in John's communication profile is the several indices of motor speech impairment observed via the behavioral assessment (i.e., ICS), the speech sample, and classroom observations. Many of the findings were consistent with childhood apraxia of speech: low speech intelligibility, unusual prosody, vowel errors, and inconsistent production of speech sounds in the absence of any neuromuscular deficits (American Speech-Language-Hearing Association, 2007). The third and final detail is the predominance of responses relative to initiations in John's speech sample. Specifically, 96% of John's speechlike utterances when interacting with his mom were coded as responses.

While some might view the limited rate of communicative initiations as support for social communication deficits, low rates of initiation have also been attributed to difficulties with volitional coordination of complex motor acts (cf. Donnellan et al., 2012; Jaswal & Akhtar, 2018; Leary & Hill, 1996; Mari et al., 2003; Page & Boucher, 1998). The instances of communicative intent highlighted through the narrated microanalyses suggest that John is motivated to communicate with others and that he is able to demonstrate communicative intent through coordination of multiple communicative resources (e.g., eye gaze, vocalization, gesture). The point here is not to say that John's social communicative is neurotypical but rather that an absence of communicative intent cannot be used to explain his limited use of speech to initiate interactions. The interpretation that sensory–motor differences may play a significant role in John's communication profile is broadly consistent with prior findings of motor praxis and difficulties with motor initiation observed in some autistic children (e.g., Adams, 1998; Donnellan et al., 2012; Gernsbacher et al., 2008; Leary & Hill, 1996; Page & Boucher, 1998; Robledo et al., 2012; Tierney et al., 2015). When taken in conjunction with such prior research, the findings from the present case study offer at least two key implications for clinical practice: the need to (a) consider sensory–motor influences on the interactions of minimally verbal autistic students and (b) support flexible multimodal interactions across communication partners, including use of AAC when applicable.

Consider Sensory–Motor Influences on Interaction

The complexity of John's case underscores the highly interpretable nature of communication and the potential high stakes of such resulting interpretations. For example, in John's case, it was often difficult to disentangle the

influence of factors such as attention, motivation, linguistic competence, and potential seizure activity on observed behaviors. Both the *Looking for Elise* and *Want Water* examples illustrated how challenging it could be for communicative partners to interpret John's behavior and how easily misinterpretations could occur, especially if sensory–motor differences are not taken into consideration. Of particular relevance here is the extent to which John's limited initiations may be misinterpreted as limits in cognitive–linguistic competence or a lack of interest in social interaction (see Donnellan et al., 2012; Jaswal & Akhtar, 2018). For example, John's mother expressed frustration with the tendency of professionals to underestimate John's capabilities, such as the ABA therapist who insisted that John was unable to type. During his final interview, John's paraprofessional explicitly mentioned some instances during art class in which John's capabilities surprised him. For example, when the first author (V. V.) showed the paraprofessional a video of John playing ball with peers, he said, "what stands out to me here is he's actually taking turns with the kids," which is different to what he usually does during social work sessions where he throws the ball off. Such findings highlight the value of working through communication disruptions and presuming communicative intent (cf. DeThorne et al., 2015).

Given the complexity of such cases and the high stakes of related interpretations, supporting clinicians are encouraged to help ensure minimally verbal autistic students receive thorough sensory–motor assessments and collaborative support from qualified colleagues, particularly in occupational therapy. In addition, clinicians are encouraged to recognize their critical role in helping communicative partners (i.e., caregivers, teachers, peers) understand how such sensory–motor challenges may be impacting an autistic students' interactions. In particular regard to peer interaction, Vidal, Ernat, and DeThorne (2018) recommended clinicians use "behavioral interpretation" as a means to explain unexpected or unusual behaviors across peers. In the *Looking for Elise* example, the first author is encouraging this process when she asks of John's peers, "What do you guys think?" As a result, John's communicative partners work together for nearly 6 min to interpret John's communicative intent, which was contingent on assuming such intent was there in the first place. Accordingly, clinicians can play a critical role in helping communicative partners understand that students such as John may require more time to coordinate their motor movements and may benefit from alternative modes of communication, such as AAC.

Support Flexible Multimodal Interactions

Distributed models of communication emphasize the inherently multimodal nature of all interactions (DeThorne et al., 2014; Hengst, 2015), a fact that often becomes more transparent through individuals like John who are minimally verbal. Initial interviews with multiple participants highlighted the multimodal nature of communication with John, emphasizing the role of gestures and nonspeech vocalizations in addition to speech and AAC. In the *Looking for Elise* example, we observed John utilizing vocalizations, gestures, and his AAC device to communicate that he wanted Elise at his table. Not surprisingly, speech often becomes an area of explicit intervention for minimally verbal students. While supporting speech is a worthwhile endeavor, focusing on any single modality at the exclusion of others can severely restrict the interactions of minimally verbal students like John, thereby unintentionally impeding the overall goal of successful communication.

In addition to highlighting the importance of allowing individuals to flexibly utilize multimodal resources, John's case also demonstrated some of the potential difficulties in integrating AAC in everyday interactions, especially for communication partners who may be unfamiliar with the device or how best to use it. For example, based on observations and peer interviews, John's peers and paraprofessional did not seem well versed in how to integrate AAC within the interaction. Despite the current-day prevalence of electronic tablets, when Ethan was asked if he used the tablet to communicate with John, he reported not knowing what the iPad does and referred to it as a thing "those special needs kids use." Similarly, the paraprofessional had not received any training on AAC use, and in the *Looking for Elise* example, he seemed to use it more as a diversion than an opportunity to clarify the communicative misunderstanding. Such examples add to other literature that has emphasized the need to provide some form of training to communicative partners who are supporting an individual's AAC use (e.g., DeThorne et al., 2014; Kent-Walsh & McNaughton, 2005).

In conclusion, the present clinical focus article represents one of the first case studies to provide a thick description of the communication profile, including sensory–motor differences, of a minimally verbal child with diagnoses of both autism and apraxia. In combination with prior literature, such data help highlight the potential role of sensory–motor differences in communication practices and emphasize the need to support flexible multimodal interactions. Teasing apart motoric versus social-communicative differences is inherently difficult. Consistent with descriptive case study research (Stake, 1995), this investigation was not designed to determine causal influences between sensory–motor and communication skills and cannot rule out alternative interpretations such as the contribution of cognitive, linguistic, and/or social communication deficits. However, given the current predominance of attributing the communication differences of autistic students to social communication/theory of mind deficits, we feel there is merit in casting an alternative lens to these data, particularly given evidence that John shows clear communicative intent and multiple indicators of motor impairment and apraxia of speech. Future studies using experimental methodologies are better positioned to examine causal contributions. Instead, this study helps contribute to the paucity of literature that considers the role of sensory–motor differences on the communication profiles of minimally verbal

autistic students and highlights the complexities of social interaction and related support needs of students like John within everyday contexts.

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