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Beyond Paralinguistic Responsiveness: How Does a Pre-Schooler Address His Gestural Communication?

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Abstract

This study ethnographically portrayed the pre-schooler's gestures responsiveness with his existing autism spectrum disorder (ASD) and speech delay. It naturally accomplished the insightful qualitative analysis and interpretation observation and videotape recordings to address Levi's daily communication that became a single case study. Levi's paralinguistic responsiveness measured some portrayable emotions and behaviours including responses, requests, and complaints that empirically conveyed his egocentrics, obliviousness, self-consciousness, self-reliance, and reticence rhythms. The findings recalled the eduistic language annotator (ELAN) results of depicting the annotations on chronological transcriptions, generic, and media synchronization modes, from which partially showed Levi's emotions and behaviours as indicated his gesturally paralinguistic responsiveness. This fact addressed how a pre-schooler with his ASD and speech delay emotionally and behaviourally derives the responses, requests, and complaints as major nonverbal language communications. This study recommends other comparably quantitative and qualitative instruments that they are subject to consider the neuroscience and psychometric assessments of having accomplished research variances, particularly on the fields of paralinguistic attribution.

Keywords: *Circumstantial interaction; gestural communication; paralinguistics; pre-schooler with ASD; speech delay*

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INTRODUCTION

Children's speech delay and language development disorder cases can continually destruct their communication patterns and intentions in the future. The delay and disorder can be functionally found at the frequent mild and impact from a lack of parenting's stimulation or inappropriate cares, and non-functional condition that appears from receptive spoken and social communication disorders. As the consequences of children's spoken language development, Shriberg (2019; de Brouwer, 2018) points out that these cases heavily carry on the anatomical and physiological functions growth through its nervous system, audio-visual organs, attentional abilities, and external stimuli. Children's growth and development monitoring along with their early detection of risk factors due to the speech functions, are consequently critical major actions in their speech disorder prevention, reduction, and amendment (Zepeda-Mendoza et al., 2019).

Children of three to years old with speech delay and language development disorders are mostly found to some initial symptom of psychiatric, neurological, or behavioral problems (Division of Birth Defects, 2018). They are predictable to be at high risk of behavioral, social, and academic difficulties. Hence, early stages of identifying and interfering these cases can be the solution to improve the stimulated children when they are less than seven years old (Saeed, Abdulaziz, & AL-Daboon, 2018). Their social communication disorder potentially produce inattention, hyperactivity, and impulsivity, which positively correlate with the social cognition and communication impairment symptoms, such as social awareness, cognition, communication, and motivation (Chen et al., 2020).

Having experience with her son's speech delay, Levi's mother firstly talked to her female friend, who previously survived with a speech delay in her childhood before Levi was sent to children development care clinic of DEA DIA development care in Sleman, Indonesia when he was 2.7 years old. Levi's parents realized that this became a late decision to consult with the experts for his sensory integration and behavioral therapy appointments. The experts exercised him with a principle diagnostic protocol and discussed the results with us on the second week of February 2024. Following experts' recommendation, Levi was then scheduled to attend the series of those two therapies. Four sensory integration sessions were handled on the fourth week of February, third and fourth weeks of March, and fourth week of April 2024. Meanwhile, the behavioural therapies were scheduled on third and fourth weeks of February either, first week of March, and April 2024.

Further, Levi's social communication disorder experientially relied on some difficulties functions towards his ability to convey verbal communication in social language situations, communication style adaptation in various contexts, and flexibilities. Levi had difficulties in vocabulary and phonology production concisely. He struggled to indicatively use his gestural paralinguistics in day-to-day communication purposes along with his mother and I. So far, Levi's recent position impacted his ability obstacles to socialize and maintain friendships at school as a pre-schooler, served himself in group exertions, and understood social dynamics. On the other situation, Levi's sensory processing disorders relying to the sniffily particular food's flavours and mushy textures. Levi usually denied to blow harmonica, although blowing out the candles was fine to him.

Physical stimulation of his lips, tongue, jaws, and cheeks still became the prioritized activities, besides acknowledging his paediatric neurology issues with the paediatricians during his therapy sessions either. Levi also afforded to babble significant messages including shouting when conveying his complaints and disappointments with his mother and sister, in order to adjustably become another progress in daily communication.

Furthermore, some derivable sensory processing disorders led to Levi's daily sensory information process and integration difficulties with his tactile—being sensitive to the typical textures of muds

and sticky liquids conditionally, vestibular—aligning coordination, intolerably social interactions with strangers and spatial awareness difficulties with his friends at school, proprioception—anticipating physical movement when running and falling down, visual—being attractive to the scarlet colours shown in cartoons and songs and pictural patterns, such as toys and puzzles, and gustatory—being reactive to certain foods and drinks flavours avoidance. Regarding Levi's social communication and sensory processing disorders, Baksh et al. (2020) has pointed out that the intrinsic social norm convention positively corresponds with reading the mind in the eyes through the social recognition aspects and a preschooler with the autism spectrum disorder (ASD). This was appropriately acknowledged with the offended and reacted social norm, although he tends to show his egocentric inquiries or responses regardfully upon his restraints, contextual interaction broadly within certain ways. However, more significant mutability through sensory processing patterns, exceptional sensory patterns frequency, and sensitivity closeness in the most conventional design may affect motor coordination barriers in response to sensory processing variableness and social elements (Delgado-Lobete et al., 2020). On the other had, the hypo-reactivity to sensory stimulation among the ASD survivors involve a low neurological threshold, with all sensory modalities—visual, auditory, tactile, olfactory, taste, vestibular, and proprioceptive (Ranford et al., 2020; Adam et al., 2015) and requires strategies to adapt their daily life behaviors (Dellapiazza et al., 2020).

This study empirically supports Levi's gesturally paralinguistic responsiveness to support his nonverbal communication. It is well-known so far that gesture facilitates non-verbal interactions among its users (Sparrow, Lind, & van Steenbrugge, 2020) through eye contacts, proxemics, and hand movements engagement (Sampietro, 2019) intentionally. To be functional matters of multimodal paralinguistic exercises, gesture improves any interpretable multimodality, highlights processing mechanisms among the users, and recompenses expressive actions (de Beer et al., 2020). Gesture triggers various exegeses, aspirations, and denotations based on particular relationships (Simones, 2019), establishes reflex hand movements during nonverbal initiation, encircles intentions range, and prepares simultaneous occurrence. It supports precise information, helps message formation cognitively, covers learning and memory, mirrors basic ideas, and assumes users' perspectives (Clough & Duff, 2020), as well as produces smiles and large smiles, moves open-hands and self-oriented actions, and heads tilts that manages non-verbal communication within notices closeness (Potdevin, Clavel, & Sabouret, 2020).

Gesture operationally supports non-content-carrying which is used to strengthen and or balance speech accentuation and matter (Sumekto et al., 2021; Kong et al., 2015), as long as the symbolic gesture that is coded as a single signal to create a unique communication system (Bernardis & Gentilucci, 2005), well-defined, stimulating numerous interpretations and knowledgeably understanding the meanings. The lexical retrievals, encoded syntactics, and cohesive relationships, interactive and recursive processes extracting long-term recollection into understandable language form concepts (Michel et al., 2019), where they pitch voices and prolong definite syllables with pronunciation, and recognize body movements (Naderi & Yazdi, 2018) for emphasizing Levi's nonverbal intentions and feelings accordingly. The gestural variability accordingly enhances feelings of satisfaction and happiness (Mills et al., 2020), besides channelling frustrated energy and detachment, forming a factual interface with normalization and daily expressions (Vidal, 2019). This gestural variability highlights gesture adaptability and multifunctionality conveying diverse experience and extending mono-mode of communication beyond (Hartman & Paradis, 2020).

In paralinguistic responsiveness, gesture drives nonverbal communication functionality and non-lexical cues due to encoding, transmitting, and decoding sounds, gazes, body languages, rhythms,

paces, and facial expressions (Cánovas et al., 2020; Gupta, Audhkhasi, & Narayanan, 2016). It addresses meanings both speech presence and absence of co-occurrence. This nonverbal communication uniquely utilizes movements and configurations to convey meanings (Trujillo et al., 2019) and to connect the systematic spoken language and nonverbal relationships. The distinct co-occurrence emphasizes structurally- and co-vernacular gesture that was measurable to connect the signal parts of communication (Cánovas et al., 2020). Hence, gesture diversely shows relevance with meaningful symbols, spatial cognition to convey nonverbal language (Kwon et al., 2018; Kita, 2009) towards genuine human-to-human interactions. In some contexts, gesturally paralinguistic responsiveness can be more effective since the expressions pragmatically apply for biometrics, personal identification and recognition, and verification—confirmation and denial purposes (Nugrahaningsih & Porta, 2019). It symbolizes conventional hand movements for identifying nonverbal communication management. The symbol constitutes positive or negative social advice and links users' emotional expressions (Wood et al., 2018) as naturalistic behaviours (Caridakis et al., 2013) to identify and recognize it with the cognitive, social, and emotional situation (Behera et al., 2020). However, gesture may lessen exceptions relating to strong roles upon directions, substance oversight, authentic resemblance, and acceptable signs (Wu et al., 2018), whilst the co-speech gesture enrols users' assistance and conceals difficulties (Wessel-Tolvig & Paggio, 2016).

Gestural production potentially signifies users' self-oriented cognitive functions (Lin, 2020), gains social interactions, behavioural uniqueness (Kwon et al., 2018), collective actuation, acceleration, dominion, fluency, infinite boundary, and natural interaction parameters as gesture expressivity (Caridakis et al., 2013; Pichel, 2016). The productive and incorporated paralinguistic responsiveness utilize nonverbal communication and maximize integrated informativity of the multimodal signals (Cánovas et al., 2020) to understand the adopted gesture (Wu et al., 2018), to modulate gesture across ages (So & Wong, 2017), and to affect cognitive skills in activation, manipulation, packaging, and spatial-motoric information for thinking and nonverbal exploration (Kita, Alibali, & Chu, 2017). They stimulate numerous interpretations, knowledge, meaningful comprehension (Sumekto et al., 2021), basic communication skills from generative to responsive responses (Sumekto, 2022), and phonetic accommodation that have provided additional insights into speech intelligibility and highlighted the effects of partial language processes (Winn, 2020).

Evidences from previously gestural responsiveness and a pre-schooler with autisms spectrum disorder studies had strengthened nonverbal communication existence, in both educational settings and users' daily disclosures. Accordingly, Sumekto (2022*) reported that children's hospitality and respectfulness to others were empirically revealed when they afforded the capability of spreading, promising, demanding, commanding, requesting, complaining, and announcing hints towards the significance of children's learning and interaction* found in the gesturally paralinguistic responsiveness. In this context, Prosperi et al. (2019) supported that children's gestures activate an efficiently verbal behavior to convey any physical discomforts, for instance by screaming, sighing and or grumbling, and howling and or blubbering. Experiential gestures also revealed evidence when male student's left fingers and female student's lips were proportionally set up and gained meaningful in students' oral presentation (Sumekto et al., 2024). Tracing adult experience, Sumekto and Setyawati (2020) addressed that gestural attribution showed positive influences towards undergraduate students' writing class initiation, from which it constituted lecturer's teaching vigorousness.

Further, Küpper et al. (2020) identified the adaptable portions of five behavioural attributions [sensitivity and specificity accuracy, unusual eye contacts, facial expressions heading to others, gestures, and overtures quality] to hand closure with the factual and full autism diagnostics. Therefore, to strengthen these adaptable portions, Soma et al. (2023) highlighted the psychotherapy's

silence treatment that assisted children with ASD in order to control their emotional experience within any promotional processes. Children with sensory processing disorder were detected in between 5% to 15% with its comorbidity, whereas 80% to 90% of ASD cases were on conditionally fragile consequences (Galiana-Simal et al., 2020). Somehow, the above case impacted to children' representing structural verbal communication ability scales verifying unsuitable induction upon their nonverbally pragmatic abilities, social interests, and interactions (Ahmmed & Mukherjee, 2021). Conclusively, language impairment development, attention deficiencies, and delinquent behavior-calls among children with ASD had been evolved by gaining effective therapies towards auditory sensory process enhancement (Berken, Miller, & Moncrieff, 2020).

This study ethnographically aims at portraying a pre-schooler's gesturally paralinguistic responsiveness with his speech delay through the insightful qualitative analysis and interpretation. Hence, this present study raises the question of how does the gesturally paralinguistic responsiveness portray a pre-schooler with speech delay in terms of emotionally and behaviourally nonverbal language development contribution as a part of communication pattern. Therefore, the better anticipation and understanding a pre-schooler with speech delay and autism spectrum disorder including oral practices and phonological processing obstacles can assist parents, caregivers, and teachers use and extend the multimodal communication patterns effectively and pleasantly.

METHODS

This study ethnographically addressed a single case study with a-four-year-preschooler, who still retained his speech delay with his social communication disorder as the participant. This study informationally designed an amalgamation onto my day-to-day living experience with Levi, the nickname that my wife, his siblings, and I used to call him every day. Levi was the youngest son of three siblings in my family. Levi was born at Hermina hospital, Surakarta, Indonesia in July 2021 with the weight of 3.73 kg through a C-section procedure since his mother was medically unsuccessful to born him with a normal birth during the COVID-19 pandemic. Levi was physically born normal, although the pediatrician then diagnosed him as a child with speech delay at primary-to-secondary ASD. Levi's physical and psychological development empirically seemed to be okay till his mother worried about when he was at one year old. So far, his mother never clearly heard Levi's babbling or unclearly pronounced a single word.

This ethnographic study accomplished the insightful qualitative analysis and interpretation with a single participant. The data corresponded with Levi's day-to-day life with his mother, siblings, and I at home. I naturally observed what happened with Levi's emotions and behaviours. I did some embedded observations, mixed-verbal and -nonverbal communications, and took pictures and shot videos of Levi as my systematic data collection through this study. So, I allocated my leisure times to follow the rhythm of Levi's life based on what I significantly saw and heard it daily. This ethnographic data was eclectic in accordance with Levi's agentive involvement and circumstantial interaction in producing nonverbal communication with his gesturally paralinguistic responsiveness. Levi's nonverbal communication addressed the substantially gestural responsiveness relating to requesting, responding, and complaining. However, its impressionism to assess Levi's nonverbal communication practicing more systematically and to deepen naturalistic observation and interpretation with adjusted experimentation.

The ethnographically naturalistic observation was constrained with what spontaneously revealed in Levi's gesturally paralinguistic responsiveness, although the naturally gestures did not comfort the spontaneous occurrences within his comparable emotions and behaviours. However, the results of

medical assessment protocols released by the clinic and hospital would not put into the procedural study and they kept to be confidential. Yet, Levi's gesturally paralinguistic responsiveness led to his request, response, and complaint had reflected his emotions and behaviours.

Data analysis explored and elaborated its iterative and unstructured roles addressing data description and inevitably treatment, examined relationships processes and situations, and interpreted the data (Sumekto et al., 2023; Reeves et al., 2013) through its naturalistic observation. Meanwhile, the eduistic linguistics annotator (ELAN) released by the Max-Planck-Gesellschaft (ELAN, 2021) partially assisted to analyse Levi's video recording files relating to his gesturally paralinguistic responsiveness to gain the nonverbal cues. This software analysed some chronological transcriptions, generic, and media synchronization annotation modes.

RESULTS AND DISCUSSION

Levi's Emotions and Behaviors

Levi's emotions and behaviors were experientially traced as the symptom that was beneath the unpredictable action. This sometimes happened when Levi was angry since his wishes were not met, he measurably banged up his forehead upon the wall and quickly ran then glided on the floor, walked with his tiptoes for uncertain reasons in the living room and sandy yard in front of the house, and turned his body around with unspecified rhythm to convey his happiness at most. In particular, Levi definitely stopped banging up his forehead upon the wall for more or less three months ago. Levi also ignored to touch the foods with typical textures, such as rice, chicken, meat, omelette, and other flavoured spicy foods and beverages. Being instead of those avoidant foods, he preferred to consume processed foods, such as chicken sausages, cheddar cheese slices, potatoes crispy, chocolate jams and bars, candies, cookies with chocolate flavour, and bread with chocolate jam.

Levi had just started to point out his progress by queuing up among the customers in front of the cashier when shopping at the minimarket by putting the foods he bought on the cashier's desk, as if Levi still needed an assistance from his father's orders. This moment happened once we accompanied him attend his therapy session at the hospital on the second week of June 2025. Levi's behaviour also revealed when he once or twice laid down his body naturally on the floor whilst listening to the songs or watching movies on YouTube. However, there was a different habit of Levi when eating packaged foods, such as chicken sausages, cheddar cheese slices, crispy potatoes, chocolate bars, candies, cookies with chocolate flavour, and bread with chocolate jam at the public areas and house. He still put his foods barely on computer desk and threw away the wrapping paper, but he remained to keep the wrapping paper when eating them in the public areas.

At his school environment, Levi was a noticeable pre-schooler with his typical behaviour. He was actively mobile in the class, did not sit down calmly as his other classmates. Although Levi's female classmates gently provoked him by pinching his cheeks and calling his name with loud sonority and long articulation, he still remained to be ignorant. Levi looked around and eagerly wished to grab the stuffs laying in the back row and the corners. He did not intentionally interact with the others, but his response alternately differed from when his teacher called and attempted to tote him. Levi still ignored to follow the ritual ablutions and to pray, but he was willing to listen to the shortly recited holy verses of the daily prayers, to shake his teacher's hand when arriving at school and going home, and to share his packed meals and toys with others. To the best of my knowledge, Levi was not an aggressive or a hyperactive boy. I never showed him coerce someone or stood for anything to gain his immediate desires. He used to back down and avoid conflicts with his friends of the same age.

But Levi's different experience at his Strawberry class also told us, that he involved in some class activities, such as practicing roleplay, showing obedience by placing shoes on its rack, tiding up the toys, showing interests in book literacy, arranging puzzle games, feeling excited with the music, and practicing physical activities—running on school yard, climbing up the nets, and walking on the plank. His academic rapport testified that Levi showed elegant behaviour by limitedly collaborating with his classmates, although he also protested with his friends when his toys were captured by his friend. All these class events were reported by Levi's teacher.

This study continued to analyze Levi's response, request, and complaint towards his nonverbal communication in terms of gestural paralinguistics found in both the entirely therapy sessions and daily home-activities. These observable activities were majorly portrayed in 2025. Levi used to be once scheduled in the occupational therapy at the pediatric clinic showed his disobedience behavior with his female therapist instruction. He refused to clap his hands in front of his therapy. The session was shortly allocated since Levi missed his good mood. His therapist noted that Levi initially cried with his prone position on the floor. After taking for five more minutes from his sulk, he smiled at her and looked okay. Another situation whenever Levi was home with us from his therapy session in the evening, he initiatively paid attention on the computer screen displaying children's animation songs from the YouTube. His right forefinger appointed the displayed image icon at the desktop as he signed to listen the songs. I helped him turn the sound up, then he started to watch the animation songs joyfully. His activity continued with the planet animation scene he watched. Levi also attempted to match the planet images displayed in the children book with the planet animation shown in the YouTube (Figure 1).

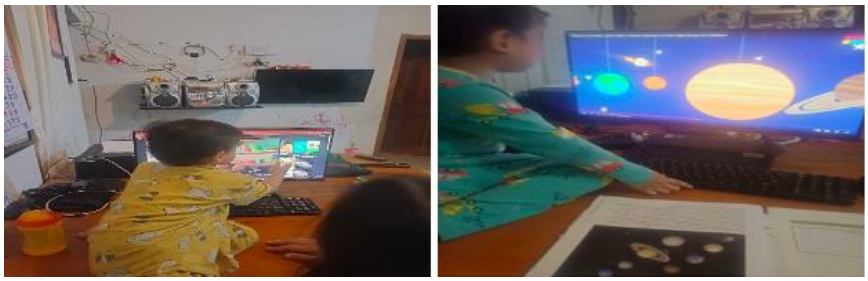

Figure 1. Animation Songs and Planet Images Play

Another response was revealed when Levi's attended a speech therapy at the paediatric clinic. The therapy programmed how to imitate feeding the fish. At the beginning session, Levi cried for more or less ten minutes since he just awaked from his sleep and fell silent. After Levi was ready, the therapist began the session by opening her mouth and saying, '*aaak*', meant eating in Indonesian term. Levi opened his mouth, but he hesitated to voice it. Substantially, Levi understood with what topic was learned by the therapist, although only his handy gesture appointed to the fish-toys and smile which signed its circumstance of understanding the therapy session.

On the other hand, Levi used not to enjoy the movie sounds or other tv programs in the last year. Levi responded or used gesture by covering his ears with his index fingers, hence he could not hear the sounds. Meanwhile, when watching the scary cartoons or advertisements, Levi attempted to hide himself behind his mother back silently. Levi also incidentally appointed his right index finger to the sky, seeing, and smiling at his mother when the rain fell. To express sense of happiness or amazement about the cartoons that sparked his good mood, Levi would clap his hands whilst laughing gently. Meanwhile, the sleeping time came particularly in the evening, Levi conveyed a sense of affection

to his mother by kissing her lips, but conversely when I wanted to have the same action from him, Levi ignored to do it, but he just passed his right or left cheek and or narrowed down his forehead to kiss. However, Levi could understand with the order to shake his hand, toast or give high five to others conditionally, as well as keep smiling and chuckling when he and I played toy car on the floor. Levi also understood with his mother's casual and unrepeated order to bring the opened crispy jar along with its cap to her. When Levi watched a cartoon on TV program, he knew a son slept with his father in a bedroom, then he immediately ran into the bedroom while appointing with his right forefinger inside that he used to sleep with his father either together.

This study also responded to Levi's speech therapy, from which he was ordered to wipe his tears with tissue and threw away the used tissue to the rubbish bin. Levi could understand the order by following his therapist gesture. When the therapist asked Levi to play with her, he purposefully made mistakes during the play, and this definitely showed his joke with the therapist like hiding this body under the table just to tease her. Conversely, when the occupational therapy just began, Levi was a bit cranky to get in the room. But the therapist let him do it for a while till his good mood recovered again. In one of his speech therapy sessions, Levi was once attracted to engage his female therapist's order in combining his both palms and looking for some request whilst saying words. Levi understood and obeyed the order to do so. Levi attempted to compose the puzzle game with a three-time attempt till he succeeded to match, but he naturally memorized the alphabets by typing them on desktop and appointed with his right forefinger (Figure 2). Levi's focus on this work session better.

Figure 2. Alphabetal Puzzles and Appointing the Alphabets on Computer

Further was about Levi's request conveying his day-to-day nonverbal communication. This empirical gestural paralinguistics revealed whenever Levi again laid on the desk, turning on the computer, and watching the cartoons at the YouTube channel. Levi, somehow asked for my help to move the chair position closer to the desk he sat down by gesturing his right palm and appointing his right index finger down since the desk and chair position were high and not safe for him. Levi's request conveyed some efforts to communicate with his parents by gently tapping their chests on requesting assistance, such as refreshing the cartoons at YouTube channel, grabbing his crispy snacks on the food shelf, and walking faster to gain his parents' attention. Levi's gestural paralinguistics was also revealed when requesting to unseal packed foods, to grab toys, and to refill the mineral water bottle by heading his hand to us. Besides that, Levi's fingers guided his parents' fingers to scratch parts of his irritating bodies, such as back, stomach, legs, and toes since he could not do it by himself. Last but not least, Levi's significant experience we evidenced about regarding his desire to have a cup of sundae ice cream with the chocolate topping at the McDonald fast food restaurant through his progressive expression. He expressed it by appointing with his left index finger and wording, *'mam, mam, mam'* (children term in Indonesia of desiring beverages and foods).

Furthermore, Levi's observable complaint relied on taking the vitamin for his brain stimulation. Levi inconveniently coordinated with us when being courted to take the syrupy vitamin. He used to strongly hide his head and cover his face or sometimes tightly circularized his hands on my back

whilst cradling. The fact was that Levi intentionally spouted the vitamin up out of this mouth to show his complaint. When showing an instance of disappointment since he was not allowed to operate computer, Levi screamed and babbled, once time called, *'ibuuu'*, which meant mother in Indonesian within his melancholy cry.

Levi's Gestures Portrayed in Eduistic Language Annotator

This study continued with Levi's portrayable gestures through the eduistic language annotator (ELAN). It analysed the annotations on the chronological transcriptions, generic, and media synchronization modes (Figure 3). The videotape partially showed Levi's emotions and behaviours as indicated his gesturally paralinguistic responsiveness. Therefore, this ethnographic study broadly addressed the holism of naturalistic ethnographic observations with the systematic severity of a more experimental approach in the single case study for a four-year-old pre-schooler with speech delay, including a longitudinal study of gestures revelation practiced in nonverbal communication. Herein, Levi's portrayable gestures captured by ELAN attributed his forefinger and hand-carrying assistance mode when asking for a help from his mother in clicking the cartoon menu provided by the YouTube channel. What it was substantially annotated by ELAN portrayed that Levi started to grab his mothers' forefinger in asking for a help of clicking a cartoon menu at the YouTube channel. Then, he appointed the screen to point his purpose. After viewing the cartoon, Levi watched it glance before switching it into another menu. When watching another cartoon, Levi stood up on the chair to show his joy, bowed his body in front of the computer screen, and stepped his hands up on the computer desk. His right hand moved again to fasten cartoon rhythm and watched it closer.

This videotape recorded two minutes and twenty-nine seconds. The substance of major gesture utilized directions and movements during responding and requesting his purposes of watching the cartoon at the YouTube channel. It experientially encompassed nonverbal attributions that clarified and modified the meaning of delivered messages gesturally. What revealed in ELAN's video recording basically addressed Levi's expectation to be a real-time paralinguistic responsiveness towards subjectively evidenced communication. By habitually gesturing his mostly right forefinger to the objects and experientially grabbing his mother's right forefinger in terms of asking for conditionally multiple requests, Levi just attempted to assign himself in conveying his indicative paralinguistics availabilities.

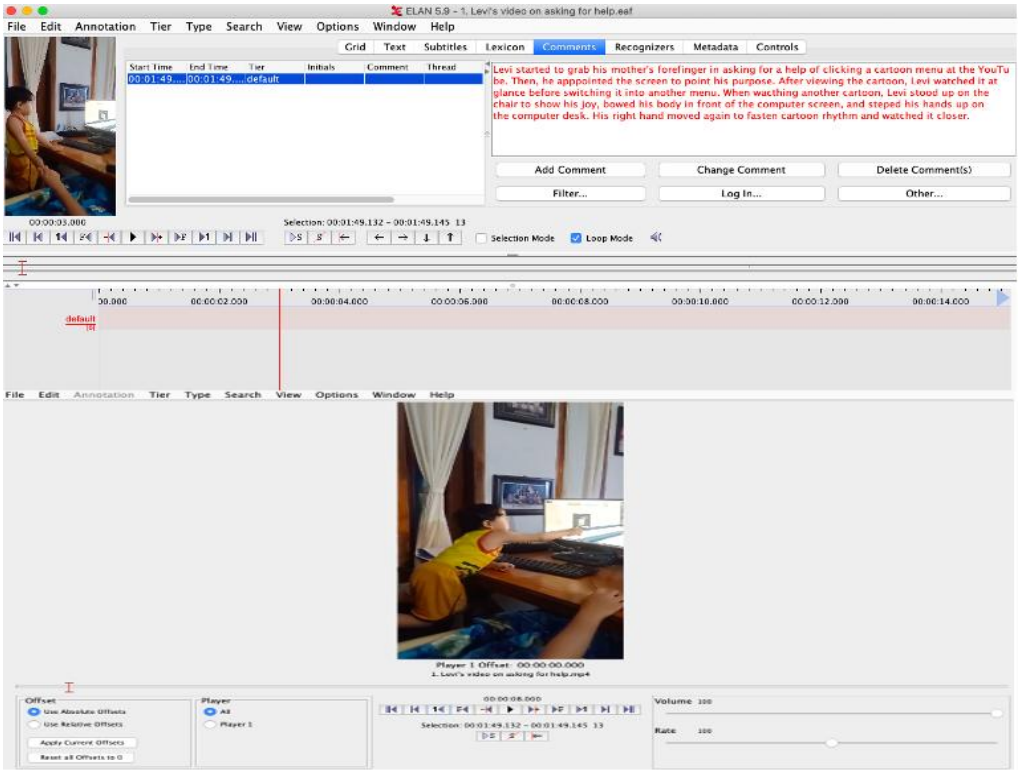

Figure 3. Annotation and Synchronization File through ELAN 5.9

Meanwhile, the serialized images clipped through ELAN video (Figure 4) supported Levi's gesturally paralinguistic responsiveness. The gestures proved Levi's lengthy consistent efforts to access and joy the cartoon at YouTube channel. In practice, Levi had been familiar with the computer accessibility with the guided advices, although he solely focused on his nonverbal communication of delivering gesturally paralinguistic responsiveness. Levi's nonverbal communication purposes were intensively conveyed around his nearest familial members (e.g.: mother, father, brother, and sister). Everyone could understand his intentions, but we used to tease him saying words when requesting some things gently. Among ten clips shown in Figure 5, Levi seemed to unchangeably focus on the computer screen. His eyes looked at the cartoon mode, whilst his bodily gestures diversely moved from one position to another one.

Levi's right hand on the first clip, for instance, grabbed his mother's right forefinger, but his facial expression kept straight ahead to the screen without looking towards his mother's face. Meanwhile, in the second clip Levi switched his previous gesture from grabbing his mother's finger into his appointing-right-forefinger position. This nonverbal cue also addressed his consistent joy to have the cartoon, as if he again ignored with his mother position sitting down beside him. If following the next clip till the last one, Levi's facial pose with gazing eyes seemed to be persistent in watching the carton, although his bodily gestures naturally budged.

Figure 4. Gestural Modes Sequentially with the Computer

Further, Levi's facial gestures partially conveyed his tantalized and casual joy during the break session of the family vacation at the Wisdom Park, Gadjah Mada university. He guided himself to move his head, gaze his eyes, open his mouth, whilst his both hands closely unite his opened mouth shown in the first clip. This moment expressed a surprise when Levi naturally did it by his own purpose. Meanwhile, what shown in the second clip relied on portraying his fear of something by grasping his fingers amidst the others and closing his eyes with pitiful face, although the real situation at the park did not portray severely. The third clip constituted with Levi's mockery action to unpredictable moment.

Levi realized the scene when the camera in front of him focused on shooting him for seconds, he intentionally mocked the moment by opening his mouth playfully and waving his hands up and down regularly before he turned around to his first position. The last clip conveyed a teasing mode, where Levi gazed his eyes and opened his mouth whilst babbling something as a sign that he attempted to walk closer to me and to touch the camera. But, after moving two steps back from his reach, I kept recording his action until he posed it so. These modes empirically portrayed the significance of authenticity, nature, and self-confidence, and amusingness profile shown through Levi's facial gestures.

Figure 5. Levi's Facial Gestures on the Outdoor Play

Moreover, Levi's eyes contact signal portrayed his playful eyes of signing something within two turning ways—open and shut modes in terms of conveying messages when he rode the go-cart. Levi's smiles accordingly dragged his upper lip, pressed upper and lower lips, and led to his cheek alveolus. Moreover, Levi's eyes position looked to rapidly open and shut whilst mobilising his action on the

go-cart. These portraits were captured in an occasion where he was not feeling comfortable with the instruction and unfamiliar assistance served by the go-cart staff. Therefore, Levi signed to reject those things by shutting, opening, and shutting his eyes, although this time he did not babble anything.

Herein, part of this study discussed some findings on how the paralinguistic responsiveness supported to Levi's daily communication. First of all, Levi was initially programmed to have a normal birth. When his mother experienced contractions with the amniotic fluid breaking at the hospital, when her womb had already dilated seven and to be ready to give birth to Levi. But the X-ray Rontgen showed that Levi's shoulder hooked his mother's uterus wall and made him difficult to born normally. Realizing this difficult situation, the gynecologist decided to pass a Cesarean section on his mother. He firstly cried in the evening at 11:37 p.m. with the weight of 3.73 kg and the body length of 52 cm at his birth when his mother succeeded born him, whilst I heard his cry from outside of the cesarean operation chamber on Monday, July 2021.

Levi was a four-year-old boy, who stayed with his speech delay. Recently, Levi's height was 96 cm and his weight was 14.35 kg. He had not produced any single meaningful word, but he could babble clearly to address his understandable response, requests, and complaints by all family members in the house. Levi had been previously hit by a febrile seizure with 39°C in 2012 and 2025. The general practitioner previously assessed and diagnosed Levi with hypothyroidism, unspecified (E03.9), specific developmental disorders of speech and language (F80).

Then, the general practitioner recommended his mother to see the pediatricians for Levi's sustainably intensive medical assessment. One of the pediatricians recommended us to test Levi's blood at the laboratory on February 17, 2025. The result released that Levi's thyroid hormone of primarily thyroxine (Free T4) that produced the thyroid gland and ran a crucial role in regulating his brain development (e.g.: speech delay, mobility, and orders) was 1.48 ng/dl, whilst the medical reference was in between .8 to 1.7 ng/dl for children of 1 to 5 years old.

When Levi was 3.6-year-old, his medical assessment was continued on February 15, 2025 with Denver II instrument for screening his gross motoric skills, language, fine motoric skills, and social personality. Meanwhile, Levi's medical check-up was scheduled again on March 18, 2025 for assessing his ear, nose, and throat (ENT) or otorhinolaryngology and brainstem evoked response audiometry (BERA) test for assessing his hearing capacity that measured his brain's response to sounds. Both ENT and BERA test results were normal.

On the other hand, Levi's further medical assessment on March 26 2025 recorded that his secondary social communication disorder (SCD) and autism spectrum disorder (ASD), whose integrated functions derived their sensory processing and personal verbal communication disorders were just diagnosed. Three pediatricians recommended him to attend the series of occupational and speech therapies as scheduled once a-week-therapy on Wednesday at the children's pediatric department in the hospital. My wife and I also scheduled him to have the same additional therapies twice a-week-therapy on Tuesday and Thursday or Friday at the pediatric clinic closed to our residence. Levi's therapies practically involved plays, communications, imitations, sensory and motor behaviours, attention or focus, visual tracking, and social emotional behaviours. Paediatricians' diagnosis empirically recorded children with the ASD had normal or high intelligence. They could be fast learners, but had difficulties in addressing communications upon what they habitually understood with their social relationships. Levi's case personally experienced matters of what he had adapted conditionally at school with his classmates and teachers, intimately interacted with us at home, and socialized his public life at indoor and outdoor venues which convinced us that everything seemed to be fine. Although his social interaction directly with the others was still very limited and rigorous, Levi might be well-guided to shake hand and toast with high five mode.

Regarding Levi's case, Sivaraman, Virues-Ortega, and Roeyers (2020; van Laarhoven et al., 2019) point out that children with ASD have social communication and interaction impairments entailing nonverbally communicative behaviours and social-emotional reciprocity, repetitively restrictive interests (e.g., lining up toy-cars, alphabets, and composing puzzles), fixed mindset, unfavourable response to specific interests and activities (American Psychiatric Association, 2013), and lacking of joint attention with friends as well as social skills development harmonizing with an exceptionally verbal language (Chahin et al., 2020), being symptomized in children's life of first three years (Vahia, 2013).

On the other hand, the unique strengths and talents attempt to maximize occupational performance, by restricting participatory abilities of meaningful activities and daily occupations through emotional regulation interventions (Hample, Mahler, & Amspacher, 2020) as the identifiable children with ASD-like symptomatology (Harrison et al., 2020), and exploring their brain development alterations and arising individual cognitive with its variant interpretation and comprehension towards sensory information (Jutla, Foss-Feig, & Veenstra-VanderWeele, 2021). Therefore, Levi retrained vulnerable with his spoken expression or verbal obstacles, where this had better refer to the diagnosis sessions, scheduled by the pedestrians and attend relevant therapies that managed his speech and occupational obstacles since he had experienced with.

This longitudinal study incorporated observation and videotape records of a pre-schooler who retrained with his speech delay. Herein, the gesturally paralinguistic responsiveness attributed Levi's emotions and behaviors relating to his responses, requests, and complaints to anticipate his verbal communication barriers. He still currently stayed with speech delay which derived his social communication disorder. Levi functionally faced oral or verbal obstacle to produce words, but his babbles addressed his responses, requests, and complaints instead of oral productions.

Empirically, Levi did not imitate sounds when he was nine months, babble in his twelve months, pronounce a single word clearly in his sixteen months, produce more than two phrases in his twenty-four months, and speak up anything in his four years. These conditional empirics proved him how to appoint his right and left forefingers, to smile, to shake his right hand, gently to tap his right and left palms, and to gaze and wink his eyes were eligible as Levi's nonverbal communication with us. By portraying Levi's experience, Benavides-Lopez, Hofstede, and Robillard (2020) point out that interactions originally convey tangibly sustainable gestures to accommodate emotionally and behaviourally meaningful messages at reachable spaces of how the nonverbal communication systems were engaged within multiple intentions. Herein, gesture effectively conveys spatial information like expressing hands to show comparable positions and conveying spoken expressions along with utterances perception impliedly (Clough & Duff, 2020). Gesture can also deliberate mental imagery, manipulation, and reinterpretation, to perceive imageries elicitation (Kamermans et al., 2019), and to lead significantly multiple gesture frequencies (Cánovas et al., 2020). Meanwhile, gestures may address predictive cues preceding words initiation. This situation can significantly predict the early social and symbolic communication skills (Morgan et al., 2019).

The applied behaviours analysis intervention tends to be very specific about the particular skills being taught and tested. Developmental interventions, especially those with a focus on social interaction and communication, attempt to develop competencies of shared attention using a range

of strategies within the framework of the overall aims of the intervention (Carruthers et al., 2020). Social communication development in very young children provides critical information relevant to the identification, assessment, and treatment of early communication delays and disorders. The key transition from prelinguistic to linguistic communication, and a thorough understanding of its associated developmental milestones and how these early achievements in social communication predict later language outcome is at centre of this realm of study (Morgan et al., 2019).

Regarding Levi's gesturally paralinguistic responsiveness, Wade et al. (2020) facilitates an associate learning to children with speech delay, who may conditionally engage them in voicing, gesturing, and facially expressing stimuli regarding their amused roles that are correlatively verifiable. Facing an impoverished psycho-social persuasion within inconducive social environments may disactivate social communication opportunity including interpersonal contribution restrictions that delight emotion controls.

The vestibular rhythm shown by Levi's facial gestures (Figure 6) brought two types of recognition awareness, so called by identification and verification which also resulted to the rotation and interpretation, accuracy, and complexity. However, to realize this distinctive gesture, local appearance-based techniques of extracting localized spots and key-points-based techniques of attracting in the face image really supported the facial gestures (e.g.: nose, mouth, cheeks, and eyes) to indicate more thorough (Kortli et al., 2020). On the other hand, what evidence had been shown in Figure 7, Levi practically showed his eyes contact signal that addressed the specimen of emotions, such as closed-eyes-face with a bit anxiety, normal-eyes-face, and closed-eyes-face with a teasing cue. Meanwhile, the neutral, fear, sadness, happiness, and anger modes can also accommodate the significant portraits (Lasagna et al., 2020) along with the other eligible eyes contact conditionally. Shortly, eye contact represents generic reduction of saccadic suspension and enhances preceding gaze reflectively, and impacts either eye movements programming or apparent gaze following mechanisms, at least a salience contextually. Its reflectiveness can be enhanced after eye contact and identifiable as the mechanisms highlighting social life orientation (Dalmaso et al., 2020), since eye contact intervenes information linkage between vigorous face and social zones across the brain interaction (Noah et al., 2020).

This study was also collectively aware of some limitations regarding a single case study with a pre-schooler with his speech delay. So that, any cross-sectional among the similar findings from the extended participants were not comparable. Next, the potential ambiguity on data collection and analysis would open any gaps of validity, reliability, measurability, and tangibility due to the naturalistic observation processes and qualitative descriptive analyses conditionally. This study might also lead to the conflict of interest due to the author and participant relationships objectivity and accessibility. Hence, this study could lead to potential biases since the concisely observational schemes referred to Levi's father merely. Then, the findings also solely depended on the author's naturalistic observation when this study was conducted as if in-depth interview with the paediatricians and therapist might be very possible to comprehend the findings. After that, this study empirically analyzed the gesturally paralinguistic responsiveness as part of bridging the nonverbal communication through the ethnographically single case study, but it did not significantly extend the neurological studies of speech delay, social communication and autism spectrum disorders in order to gain the robust analyses.

CONCLUSION

This study experientially addresses how a pre-schooler with speech delay emotionally and behaviourally derives his gesturally paralinguistic responsiveness including responses, requests, and complaints. It contributes major nonverbal language practices as part of his communication pattern. To the best of my knowledge, Levi has a better life quality on his four-years old with his strong efforts on producing vocabulary orally and socialize his interaction frequently out of his parents and siblings' life. Levi's frequency of producing babbling daily has been surprising us, from which it positively indicates that he will potentially start pronouncing words soon. Levi's different ability from other children on his age effectively relates to nonverbal communication through appointing his forefingers, gently tapping his palms, gazing and winking his eyes, shaking his face, and pursing his lips. Levi's gesturally paralinguistic responsiveness attempts to convey the intentional meanings in terms of showing his responses, requests, and complaints.

Levi's videotape clips annotation through ELAN partially shows the chronological transcriptions, generic, and media synchronization to qualify his gestures responsiveness. Levi's social communication development becomes progressive conditionally. Levi can enjoy adapting himself in the public space without hesitation and meeting with the foreigners he never meets before. Nevertheless, Levi still looks reluctant or inhospitable with them, but when he is asked to shake his hands to others, he eagerly extends his right hand and or toasts with a high five style. Levi still regularly attends his speech and occupational therapies once a week, whereas the sustainable visit with the paediatricians has been scheduled once a month. Furthermore, this study recommends any valid, reliable, measurable, tangible, trustworthy, and comparable instruments from both quantitative and qualitative are subject to considerably determine in line with the neuroscience and psychometric assessments of accomplishing the findings variance, particularly regarding paralinguistic patterns.

REFERENCES

Adams, J. N., Feldman, H. M., Huffman, L. C., & Loe, I. M. (2015). Sensory processing in preterm preschoolers and its association with executive function. *Early Human Development*, *91*(3), 227–233. https://doi.org/10.1016/j.earlhumdev.2015.01.013

Ahmmed, A. U., & Mukherjee, D. (2021). Auditory processing and non-auditory factors associated with hyperacusis in children with auditory processing disorder (APD). *Hearing, Balance and Communication*, *19*(1), 4–15. https://doi.org/10.1080/21695717.2020.1727216

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Washington, DC: American Psychiatric Publishing. Retrieved May 15, 2025, from https://dn790004.ca.archive.org/0/items/APA-DSM-5/DSM5.pdf

Baksh, R. A., Abrahams, S., Bertlich, M., Cameron, R., Jany, S., Dorrian. T., Baron-Cohen, S., Allison, C., Smith, P., MacPherson, S. E., & Auyeung, B. (2020). Social cognition in adults with autism spectrum disorders: Validation of the Edinburgh Social Cognition Test (ESCoT). *The Clinical Neuropsychologist*, *35*(7), 1275-1293. https://doi.org/10.1080/13854046.2020.1737236

Behera, A., Matthew, P., Keidel, A., Vangorp, P., Fang, H., & Canning, S. (2020). Associating facial expressions and upper-body gestures with learning tasks for enhancing intelligent tutoring systems. *International Journal of Artificial Intelligence in Education*, *30*, 236–270. https://doi.org/10.1007/s40593-020-00195-2

Benavides-Lopez, J. L., Hofstede, H., & Robillard, T. (2020). Novel system of communication in crickets originated at the same time as bat echolocation and includes male-male multimodal communication. *The Science of Nature*, *107*(9), 1–6. https://doi.org/10.1007/s00114-020-1666-1

Berken, J. A., Miller, E., & Moncrieff, D. (2020). Auditory processing disorders in incarcerated youth: A call for early detection and treatment. *International Journal of Pediatric Otorhinolaryngology*, *128*, 1–6. https://doi.org/10.1016/j.ijporl.2019.109683

Bernardis, P., & Gentilucci, M. (2005). Speech and gesture share the same communication system. *Neuropsychologia*, *44*, 178–190. https://doi.org/10.1016/j.neuropsychologia.2005.05.007

Cánovas, C. P., Valenzuela, J., Carrión D. A, Olza I., & Ramscar, M. (2020). Quantifying the speech-gesture relation with massive multimodal datasets: Informativity in time expressions. *PLoS ONE*, *15*(6), 1–18. https://doi.org/10.1371/journal.pone.0233892

Caridakis, G., Wagner, J., Raouzaiou, A., Lingenfelser, F., Karpouzis, K., & Andre, E. (2013). A cross-cultural, multimodal, affective corpus for gesture expressivity analysis. *Journal of Multimodal User Interfaces*, *7*, 121–134. https://doi.org/10.1007/s12193012-0112-x

Carruthers, S., Pickles, A., Slonims, V., Howlin, P., & Charman, T. (2020). Beyond intervention into daily life: A systematic review of generalisation following social communication interventions for young children with autism. *Autism Research*, *13*(4), 506–522. https://doi.org/10.1002/aur.2264

Chahin, S. S., Apple, R. W., Kuo, K. H., & Dickson, C. A. (2020). Autism spectrum disorder: Psychological and functional assessment, and behavioral treatment approaches. *Translational Pediatrics*, *9*(1), S66–S75. https://doi.org/10.21037/tp.2019.11.06

Chen, M-H., Chen, Y-L., Bai, Y-M., Huang, K-L., Wu, H-J., Hsu, J-W., Su, T-P., Tsai, S-J., Tu, P-C., Li, C-T., Lin, W-C., & Wu, Y-T. (2020). Functional connectivity of specific brain networks related to social and communication dysfunction in adolescents with attention-deficit hyperactivity disorder. *Psychiatry Research*, *284*, 1–32. https://doi.org/10.1016/j.psychres.2020.112785

Clough, S., & Duff, M. C. (2020). The Role of gesture in communication and cognition: Implications for understanding and treating neurogenic communication disorders. *Frontiers in Human Neuroscience*, *14*(323), 1–22. https://doi.org/10.3389/fnhum.2020.00323

Dalmaso, M., Alessi, G., Castelli, L., & Galfano, G. (2020). Eye contact boosts the reflexive component of overt gaze following. *Scientific Reports*, *10*(4777), 1–10. https://doi.org/10.1038/s41598-020-61619-6

Delgado-Lobete, L., Pértega-Díaz, S., Santos-del-Riego, S., & Montes-Montes, R. (2020). Sensory processing patterns in developmental coordination disorder, attention deficit hyperactivity disorder and typical development. *Research in Developmental Disabilities*, *100*, 1–8. https://doi.org/10.1016/j.ridd.2020.103608

Dellapiazza, F., Michelon, C., Vernhet, C., Muratori, F., Blanc, N., Picot, M-C., Baghdadli, A. (2020). Sensory processing related to attention in children with ASD, ADHD, or typical development: results from the ELENA cohort. *European Child & Adolescent Psychiatry*, *30*, 283–291. https://doi.org/10.1007/s00787-020-01516-5

de Beer, C., Hogrefe, K., Hielscher-Fastabend, M., & de Ruiter, J. P. (2020). Evaluating models of gesture and speech production for people with Aphasia. *Cognitive Science*, *44*, 1–22. https://doi.org/10.1111/cogs.12890

de Brouwer, A. P.M., Jamra, R. A., Körtel, N., Soyris, C., Polla, D. L., Safra, M., Zisso, A., Powell, C. A., Rebelo-Guiomar, P., Dinges, N., Morin, V., Stock, M., Hussain, M., Shahzad, M., Riazuddin, S., Ahmed, Z. M., Pfundt, R., Schwarz, F., de Boer, L., Reis, A., Grozeva, D., Raymond, F. L., Riazuddin, S., Koolen, D. A., Minczuk, M., Roignant, J-Y., van Bokhoven, H., & Schwartz, S. (2018). Variants in *PUS7* cause intellectual disability with speech delay, microcephaly, short stature, and aggressive behavior. *The American Journal of Human Genetics*, *103*(6), 1045–1052. https://doi.org/10.1016/j.ajhg.2018.10.026

Division of Birth Defects (2018). National center on birth defects and developmental disabilities. *Centers for disease control prevention*. Retrieved 12th April 2025 from https://www.cdc.gov/ncbddd/index.html

ELAN. (2021, July 6). *ELAN–Previous releases*. Nijmegen: Max Planck Institute for Psycholinguistics. https://archive.mpi.nl/tla/elan/previous

Galiana-Simal, A., Vela-Romero, M., Romero-Vela, V. M., Oliver-Tercero, N., García-Olmo, V., Benito-Castellanos, P. J., Muñoz-Martinez, V., & Beato-Fernandez, L. (2020). Sensory processing disorder: Key points of a frequent alteration in neurodevelopmental disorders. *Cogent Medicine*, *7*(1), 1–12. https://doi.org/10.1080/2331205X.2020.1736829

Gupta, R., Audhkhasi, K., Lee, S., & Narayanan, S. (2016). Detecting paralinguistic events in audio stream using context in features and probabilistic decisions. *Computer Speech and Language, 36,* 72–92. https://doi.org/10.1016/j.csl.2015.08.003

Hample, K., Mahler, K., & Amspacher, A. (2020). An interoception based intervention for children with autism spectrum disorder: A Pilot Study. *Journal of Occupational Therapy, Schools, & Early Intervention*, *13*(4), 339–352. https://doi.org/10.1080/19411243.2020.1743221

Harrison, K. B., McCredie, M. N., Reddy, M. K., Krishnan, A., Allison Engstrom, A., Posey, Y. S., Morey, L. C., & Loveland, K. A. (2020). assessing autism spectrum disorder in intellectually able adults with the personality assessment inventory: Normative data and a novel supplemental indicator. *Journal of Autism and Developmental Disorders*, *50*(11), 3935–3943. https://doi.org/10.1007/s10803-020-04450-2

Hartman, J., & Paradis, C. (2020). Figurative meaning in multimodal work by an autistic artist: A cognitive semantic approach. *Language and Cognition*, *13*(1), 1–33. https://doi.org/10.1017/langcog.2020.20

Jutla, A., Foss-Feig, J., & Veenstra-VanderWeele, J. (2021). Autism spectrum disorder and schizophrenia: An updated conceptual review. *Autism Research*, *15*(3), 384–412. https://doi.org/10.1002/aur.2659

Kamermans, K. L., Pouw, W., Fassi, L., Aslanidou, A., Paas, F., & Hostetter, A. B. (2019). The role of gesture as simulated action in reinterpretation of mental imagery. *Acta Psychologica*, *197*, 131–142. https://doi.org/10.1016/j.actpsy.2019.05.004

Kita, S. (2009). Cross-cultural variation of speech-accompanying gesture: A review. *Language and Cognitive Processes*, *24*(2), 145–167. https://doi.org/10.1080/01690960802586188

Kita, S., Alibali, M. W., & Chu, M. (2017). How do gestures influence thinking and speaking? The gesture-for-conceptualization hypothesis. *Psychological Review*, *124*(3), 245–266. https://doi.org/10.1037/rev0000059

Kong, A. P-. H., Law, S-. P., Kwan, C. C-. Y., Lai, C., & Lam, V. (2015). A coding system with independent annotations of gesture forms and functions during verbal communication: Development of a database of speech and gesture (DoSaGE). *Journal of Nonverbal Behaviour*, *39*, 93–111. https://doi.org/10.1007/s10919-014-0200-6

Kortli, Y., Jridi, M., Al Falou, A., & Atri, M. (2020). Face recognition systems: A survey. *Sensors*, *20*(2), 1–36. https://doi.org/10.3390/s20020342

Küpper, C., Stroth, S., Wolff, N., Hauck, F., Kliewer, N., Schad-Hansjosten, T., Kamp-Becker, I., Poustka, L., Roessner, V., Schultebraucks, K., & Roepke, S. (2020). Identifying predictive features of autism spectrum disorders in a clinical sample of adolescents and adults using machine learning. *Scientific Reports*, *10*, 1–11. https://doi.org/10.1038/s41598-020-61607-w

Kwon, A. Y., Vallotton, C. D., Kiegelmann, M., & Wilhelm, K. H. (2018). Cultural diversification of communicative gestures through early childhood: A comparison of children in English-, German-, and Chinese-speaking families. *Infant Behavior and Development*, *50*, 328–339. https://doi.org/10.1016/j.infbeh.2017.10.003

Lasagna, C. A., McLaughlin, M. M., Deng, W. Y., Whiting, E. L., & Tso, I. F. (2020). Deconstructing eye contact perception: Measuring perceptual precision and self-referential tendency using an online psychophysical eye contact detection task. *PLoS ONE*, *15*(3), 1–20. https://doi.org/10.1371/ journal.pone.0230258

Lin, Y-. L. (2020). A helping hand for thinking and speaking: Effects of gesturing and task planning on second language narrative discourse. *System*, *91*, 1–10. https://doi.org/10.1016/j.system.2020.102243

Michal, M., Kormos, J., Brunfaut, T., & Ratajczak, M. (2019). The role of working memory in young second language learners' written performance. *Journal od Second Language Writing*, *45*, 31–45. https://doi.org/10.1016/j.jslw.2019.03.002

Mills, K. A., Stone, B. G., Unsworth, L., & Friend, L. (2020). Multimodal language of attitude in digital composition. *Written Communication*, *37*(2), 1–32. https://doi.org/10.1177/0741088319897978

Morgan, L., Delehanty, A., Dillon, J. C., Schatschneider, C., & Wetherby, A. M. (2019). Measures of early social communication and vocabulary production to predict language outcomes at two and three years in late-talking toddlers. *Early Childhood Research Quarterly*, *51*, 366-378. https://doi.org/10.1016/j.ecresq.2019.12.005

Naderi, A., & Yazdi, M. H. (2018). An anthropological study on female peddlers' lingual and paralingual advertising in the subway in Tehran. *Pertanika Journal of Social Sciences & Humanities*, *26*, 83–102.

Nugrahaningsih, N., & Porta, M. (2019). Soft biometrics through hand gestures driven by visual stimuli. *ICT Express*, *5*(2), 94–99. https://doi.org/10.1016/j.icte.2018.04.014

Noah, J. A., Zhang, X., Dravida, S., Ono, Y., Naples, A., McPartland, J. C., & Hirsch, J. (2020). Real-time eye-to-eye contact is associated with cross-brain neural coupling in Angular Gyrus. *Frontiers in Human Neuroscience*, *14*(19), 1–10. https://doi.org/10.3389/fnhum.2020.00019

Pichel, B. (2016). From facial expressions to bodily gestures: Passions, photography and movement in French 19th-century sciences. *History of the Human Sciences*, *29*(1), 27–48. https://doi.org/10.1177/0952695115618592

Potdevin, D., Clavel, C. & Sabouret, N. (2021). Virtual intimacy in human-embodied conversational agent interactions: the influence of multimodality on its perception. *Journal of Multimodal User Interfaces*, *15*, 25–43. https://doi.org/10.1007/s12193-020-00337-9

Prosperi, M., Santocchi, E., Muratori, F., Narducci, C., Calderoni, S., Tancredi, R., Morales, M. A., & Guiducci, L. (2019). Vocal and motor behaviors as a possible expression of gastrointestinal problems in preschoolers with autism spectrum disorder. *BMC Pediatrics*, *19*(1), 1–10. https://doi.org/10.1186/s12887-019-1841-8

Ranford, J., MacLean, J., Alluri, P. R., Comeau, O., Godena, E., LaFrance, W. C., Ann Hunt, A., Stephen, C. D., & Perez, D. L. (2020). Sensory processing difficulties in functional neurological disorder: A possible predisposing vulnerability? Psychosomatics, 61(4), 343–352. https://doi.org/10.1016/j.psym.2020.02.003

Reeves, S., Peller, J., Goldman, J., & Kitto, S. (2013). Ethnography in qualitative educational research: *AMEE Guide No. 80. Medical Teacher*, *35*, 1365–1379. https://doi.org/10.3109/0142159X.2013.804977

Saeed, H. T., Abdulaziz, B., & AL-Dabboo, S. J. (2018). Prevalence and risk factors of primary speech and language delay in children less than seven years of age. *Journal of Community Medicine & Health Education*, *8*(2), 1–4. https://doi.org/10.4172/2161-0711.1000608

Sampietro, A. (2019). Emoji and rapport management in Spanish WhatsApp chats. *Journal of Pragmatics*, *143*, 109–120. https://doi.org/10.1016/j.pragma.2019.02.009

Shriberg, L. D. (2019). Motor speech disorders in idiopathic speech delay and in complex neurodevelopmental disorders using the speech disorders classification system: Introduction. *Clinical Linguistics & Phonetics*, *33*(8), 677–678. https://doi.org/10.1080/02699206.2019.1595737

Simones, L. (2019). Understanding the meaningfulness of vocal and instrumental music teachers' hand gestures through the teacher behavior and gesture framework. *Frontiers in Education*, *4*(141), 1–13. https://doi.org/10.3389/feduc.2019.00141

Sivaraman, M., Virues-Ortega, J., Roeyers, H. (2020). Social referencing skills in children with autism spectrum disorder: A systematic review. *Research in Autism Spectrum Disorders*, *70*, 1–11. https://doi.org/10.1016/j.rasd.2020.101528

So, W-. C., & Wong, K. -Y. M. (2017). Tracing the development of spatially modulated gestures in the manual modality in nonsigning Chinese-speaking children. *Applied Psycholinguistics*, *39*(3), 527–544. https://doi.org/10.1017/S0142716417000510

Soma, C. S., Wampold, B. E., Flemotomos, N., Peri, R., Narayanan, S., Atkins, D. C., & Imel, Z. E. (2023). The silent treatment? Changes in patient emotional expression after silence. *Counselling & Psychotherapy Research*, *23*(2), 378–388. https://doi.org/10.1002/capr.12537

Sparrow, K., Lind, C., & van Steenbrugge, W. (2020). Gesture, communication, and adult acquired hearing loss. *Journal of Communication Disorders*, *87*, 1–13. https://doi.org/10.1016/j.jcomdis.2020.106030

Sumekto, D. R. (2022). How do gestures actualize young learners' affection: Sympathizing George's gestures as depicted in The Slithery Day. *Humaniora, 13*(2), 99–109. https://doi.org/10.21512/humaniora.v13i2.7871

Sumekto, D. R., & Setyawati, H. (2020). Revealing lecturer's paralinguistic attribution: How the visual manner contributes to students' non-cognitive skills. *Indonesian Journal of Applied Linguistics, 9*(3), 559-571. https://doi.org/10.17509/ijal.v9i3.23206

Sumekto, D. R., Dardjito, H., Sukur, S. G., Andriani, Y. S., Olam, R. M., & Sulistyorini, D. A. (2024). Paralinguistic features in students' storytelling within multimodal communications. *LLT Journal: A Journal on Language and Language Teaching*, *27*(2), 997–1018. https://doi.org/10.24071/llt.v27i2.8701

Sumekto, D. R., Pranawa, E., Taufiqulloh, T., Ghozali, I., & Yuwono, S. E. (2023). How does Ocha attend her lectures? Lessons learnt from an adult learner with a Cinderella complex. *Pedagogika*, *144*(4), 100–118. https://doi.org/10.15823/p.2021.144.6

Sumekto, D. R., Taufiqulloh, T., Setyawati, H., Hikmah, S., & Ghozali, I. (2021). Understanding the paralinguistic features disclosure depicted in the lecturer's visual modes of writing class instruction. *3L: Language, Linguistics, Literature*, *27*(4), 173–192. https://doi.org/10.17576/3L-2021-2704-13

Trujillo, J. P., Vaitonyte, J., Simanova, I., & Özyürek, A. (2019). Toward the markerless and automatic analysis of kinematic features: A toolkit for gesture and movement research. *Behavior Research Methods*, *51*, 769–777. https://doi.org/10.3758/s13428-01810868

Vahia, V. N. (2013). Diagnostic and statistical manual of mental disorders 5: A quick glance. *Indian Journal of Psychiatry*, *55*(3), 220–223. https://doi.org/10.4103/0019-5545.117131

van Laarhoven, T., Stekelenburg, J. J., Eussen, M. L. J. M., Vroomen, J. (2019). Electrophysiological alterations in motor-auditory predictive coding in autism spectrum disorder. *Autism Research*, 12(4), 589–599. https://doi.org/10.1002/aur.2087

Vidal, B. (2019). A somatic poetics of crisis cinema: The gesture of self-harm in three Spanish films. *Hispanic Research Journal*, *20*(1), 42–57. https://doi.org/10.1080/14682737.2019.1584472

Wade, M., Zeanah, C. H., Fox, N. A., & Nelson, C. A. (2020). Social communication deficits following early-life deprivation and relation to psychopathology: A randomized clinical trial of foster care. *The Journal of Child Psychology & Psychiatry*, *61*(12), 1360–1369. https://doi.org/10.1111/jcpp.13222

Wessel-Tolvig, B., & Paggio, P. (2016). Revisiting the thinking-for-speaking hypothesis: Speech and gesture representation of motion in Danish and Italian. *Journal of Pragmatics*, *99*, 39–61. https://doi.org/10.1016/j.pragma.2016.05.004

Winn, M. B. (2020). Accommodation of gender-related phonetic differences by listeners with cochlear implants and in a variety of vocoder simulations. *Acoustical Society of America*, *147*(1), 174–190. https://doi.org/10.1121/10.0000566

Wood, A., Martin, J. D., Alibali, M. W., & Niedenthal, P. M. (2018). A sad thumbs up: Incongruent gestures and disrupted sensorimotor activity both slow processing of facial expressions. *Cognition and Emotion*, *33*(6), 1–14. https://doi.org/10.1080/02699931.2018.1545634

Wu, H., Zhang, S., Liu, J., Qiu, J., & Zhang, X. (2018). The gesture disagreement problem in free-hand gesture interaction. *International Journal of Human–Computer Interaction*, *35*(3), 1–13. https://doi.org/10.1080/10447318.2018.1510607

Zepeda-Mendoza, C., Goodenberger, M. L., Kuhl, A., Rice, G. M., Hoppman, N. (2019). Familial segregation of a 5q15-q21.2 deletion associated with facial dysmorphism and speech delay. *Clinical Case Reports*, *7*(6), 1154–1160. https://doi.org/10.1002/ccr3.2186