Sensory-based interventions to enhance communication intervention in preverbal children with Autism Spectrum Disorder

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The language used in this thesis is English (U.K). Stylistic and language variations required by the specific journals where the manuscripts of the studies were submitted are indicated where applicable.

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“Do not grow old, no matter how long you live. Never cease to stand like curious children before the great mystery into which we were born.”

Albert Einstein

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This thesis is based on the following original articles:

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PLAGIARISM DECLARATION

FACULTY OF HUMANITIES

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DECLARATION

Full name:	Marinda Raubenheimer (Student)
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Title of Thesis:	Sensory-based interventions to enhance communication intervention in preverbal children with Autistic Spectrum Disorder

I declare that this thesis is my original work. Where secondary material was used it has been carefully acknowledged in accordance with University requirements.

I understand what plagiarism is and am aware of university policy and its implications in this regard.

22/02/2023

Signature **Date**

ETHICS STATEMENT

The author, whose name appears on the title page of this thesis, has obtained the applicable approval for the research described in this work.

The author declares that she has observed the ethical standards required in terms of the University of Pretoria's Code of Ethics for Researchers and the Policy guidelines for responsible research.

22/02/2023

Signature **Date**

ABSTRACT

Problem statement and rationale:

Speech-language therapists (SLTs) play a central role in the assessment and treatment of individuals with Autism Spectrum Disorder (ASD). The speech-language therapist's role is to understand and address sensory difficulties in this population to enhance intervention outcomes. However, training opportunities and limited guidelines and efficacy studies in the implementation of sensory-based interventions result in SLTs blindly implementing such interventions.

Aim:

To investigate the implementation of sensory-based interventions by SLTs and how such interventions influence the communication and responses of children with ASD.

Methods:

Three studies were conducted. Study 1 involved 65 SLTs from different settings across South Africa responding to an online questionnaire related to the nature, knowledge, perceived role, and outcomes of sensory-based interventions as implemented by SLTs. Studies 2 and 3 implemented an alternating treatment design involving two participants in Study 2, and three participants in Study 3. Preverbal children with ASD participated in either of two forms of vestibular input or a control activity before engaging in an interactive activity in Study 2 and a picture exchange activity in Study 3. Treatment 1 involved swinging whereas Treatment 2 involved rocking. The control activity involved a familiar matching activity.

Results:

The findings of Study 1 indicated that SLTs often implement sensory-based interventions using a variety of strategies and equipment despite the lack of guidelines and evidence base for such interventions. Accurate responses for more than half of the items were achieved in the knowledge section related to the prevalence and nature of sensory difficulties in children with ASD and strategies implemented in sensory-based interventions. SLTs achieved fewer accurate responses related to the differences between sensory-based interventions, and sensory integration therapy. Most respondents agreed that they have a role in addressing sensory difficulties in the

children they treat. Respondents acknowledged the value of collaboration with occupational therapists (OTs) by indicating that they often consult OTs regarding the treatment of shared clients and engage with these professionals in joint collaborative therapy. Working alongside OTs was identified as the main source of training and knowledge gained in addressing sensory difficulties in children with ASD. Positive outcomes of sensory-based interventions were indicated in engagement, responsiveness, communicative behaviours, and self-regulation of children with ASD during speech-language therapy.

Findings for Study 2 indicated that Participant 1 showed significantly more spontaneous communicative attempts after receiving vestibular input from Treatment 1 and Treatment 2 compared to the baseline condition. Positive findings were also indicated for Treatment 2 compared to the control condition and Treatment 1. Results for Participant 2 indicated a higher rate of spontaneous communicative attempts for Treatment 1 and 2 compared to the baseline phase. However, although a significant increase in spontaneous communicative attempts during both treatments appeared evident upon visual inspection of line graphs, no significant differences occurred for either treatment when compared to the control condition upon statistical analysis. In Study 3 an increase was indicated in the frequency of responses from the baseline condition and Treatment 1 for all three participants. Treatment 2 only brought about an increase in the frequency of responses for Participants 1 and 3. A significant improvement was also found for Participants 1 and 2 when receiving Treatment 1 and Treatment 2 compared to when they participated in the control activity.

Conclusion:

There is a gap between clinical practice and empirical research in the implementation of sensory-based interventions by SLTs. SLTs in this study acknowledged that they have a role in addressing sensory difficulties in the children they treat. However, most participants did not receive any formal training in providing sensory-based interventions. Despite the small sample sizes in the single-subject alternating treatment design implemented in Studies 1 and 2 some evidence of the positive influence of vestibular input on the responses and communicative attempts of participants was indicated. These novel findings hold valuable insights for clinical practice in speech-language pathology regarding training and the implementation of

sensory-based interventions, collaboration with OTs as well as future research on the efficacy of vestibular input to enhance speech-language therapy outcomes.

KEYWORDS

Sensory-based interventions

Speech-language therapist

Autism Spectrum Disorder

Communication

Preverbal

Occupational therapist

Vestibular input

ABBREVIATIONS

ABA:	Applied Behavioural Analysis
ADOS-2:	Autism Diagnostic Observation Schedule 2nd Edition
APA:	American Psychiatric Association
ASD:	Autism Spectrum Disorder
ASI:	Ayers Sensory Integration®
CWASD:	Children with Autism Spectrum Disorder
DSM-V:	Diagnostic and Statistical Manual of Mental Disorders Fifth Edition
ESCS:	Early Social Communication Scales
HPCSA:	Health Professions Council of South Africa
OT:	Occupational Therapist
PE:	Picture Exchange
PECS:	Picture Exchange Communication System
SAISI:	South African Institute for Sensory Integration
SBI:	Sensory-based Interventions
SD:	Standard Deviation
SLP:	Speech-Language Pathologist
SLT:	Speech-Language Therapist
SPM-P:	Sensory Processing Measure Preschool Edition
SPSS:	Statistical Package for Social Sciences
VI:	Vestibular Input
WHO:	The World Health Organisation

CHAPTER 1

INTRODUCTION

Every project is an opportunity to learn, to figure out problems and challenges, to invent and reinvent

DAVID ROCKWELL

Chapter Aim: This chapter provides an overview of communication and sensory difficulties in children with Autism Spectrum Disorder (CWASD). Sensory-based interventions (SBI) are discussed in relation to what it involves, recent research regarding their efficacy, and the speech-language therapist's (SLT) role in the implementation thereof. The rationale and research questions for investigating the implementation of SBI to enhance communicative outcomes in preverbal CWASD are also discussed.

1.1. Background

Autism Spectrum Disorder (ASD) is a complex neuro-developmental disorder that includes a heterogenous spectrum of individuals (Lord et al., 2018). The most recent diagnostic criteria as described in the Diagnostic and Statistical Manual of Mental Disorders 5th Edition – DSM V (APA, 2013), outlines two main areas of deficit: impairment in social communication and social interaction, as well as the presence of restricted, repetitive, and unusual sensory-motor behaviours. The DSM V now also includes hypo-responsiveness and hyper-responsiveness to sensory stimuli as key sensory features of ASD. The co-occurrence of certain genetic and psychiatric disorders is also acknowledged (APA, 2013). Even though the social and sensory deficits related to ASD can improve with specialised intervention, the core deficits occur persistently throughout the lives of those with this disorder. These deficits occur equally across different cultures, races, and social-economic classes with symptoms and severity varying considerably among individuals (Lord, 2018; Stronach & Wetherby, 2017). The diagnostic criteria for ASD are outlined in Table 1.1.

Table 1.1

Diagnostic criteria for ASD

Autism Spectrum Disorder - DSM V (299.0)	
Persistent deficits in social communication and social interaction that occur in multiple contexts • Deficits in social-reciprocity • Deficits in non-verbal communication • Deficits in developing, understanding, and maintaining relationships	**Restricted and repetitive patterns of behaviour, interests, or activities** • Stereotyped or repetitive motor movements, use of objects, or speech • Insistence on sameness, inflexible adherence to routines, or ritualised patterns of verbal and non-verbal behaviour • Highly restricted, fixated interests that are abnormal in intensity or focus • Hyperreactivity or hypo-reactivity to sensory input, or unusual interests in sensory aspects of the environment

A link exists between impairment in sensory processing and social-communicative competence in CWASD (Ayers, 1972; Dakopolos & Jahromi, 2019; Dunn et al., 2016; Kojovic et al., 2019). The development of communicative functioning as well as the nature of the social-communicative and sensory impairments related to CWASD will be explored further in section 1.2.

1.2. *Preverbal communication*

The development of preverbal communication is in its essence a social and reciprocal process (Salley et al., 2020). Typically developing infants connect and communicate with caregivers almost as soon as they are born and continue to develop these preverbal communicative responses and initiations up to the age of approximately 12 months when they launch into verbal communication. A lack of this back-and-forth communication or social reciprocity is a core feature of communication in CWASD (Backer van Ommeren et al., 2017). Table 1.2 outlines the contrast between the development of preverbal skills in typically developing children and CWASD.

Table 1.2

Preverbal development in typically developing infants and CWASD

Typically developing children	***Children with ASD***
• Attend more to faces of people compared to other stimuli from the environment (Libertus et al., 2017) and show an increase in attention to faces of familiar people (Gangi, 2018). • Social smile at six to eight weeks. • Six months: Reciprocal social babbling • Nine months: giving and showing objects • Nine to 12 months: rapid increase in functions such as requesting, commenting, interacting, and sharing attention. • Communicative functions develop simultaneously (Calloway et al., 1999)	• May attend less to faces of people during daily activities (Macari et al., 2021) and attend similarly to familiar and unfamiliar people (Gangi, 2018). • Reduced social smiling (Nichols et al., 2014). • Reduced babbling (Patten et al., 2014). • Reduced use of giving and showing gestures (Campbell et al., 2015; Delehanty & Wetherby 2021) • Communicate mainly for the purpose of behaviour regulation (Ellawadi & Weismer, 2014). • Communicative functions develop one at a time (Calloway et al., 1999).

A delay in the development of speech - and language skills is commonly described as the first cause for parental concern leading to medical examination investigating a possible diagnosis of ASD (Parmeggiani et al., 2019). Despite advances in intervention and educational programs, an estimated 30% of CWASD remain minimally verbal throughout their lifespan (Koegel et al., 2019; Norrelgen et al., 2015; Tager-Flusberg & Kasari, 2013). The social-communicative abilities in the preverbal population of CWASD vary significantly (Parmeggiani et al., 2019). Preverbal or minimally verbal CWASD either does not use any verbal language or has only acquired a few words or fixed phrases that are not used effectively for functional communication (Kasari et al., 2013; Tager-Flusberg & Kasari, 2013). The pre-linguistic features in minimally verbal CWASD include a typical approach to initiating communication (Maljaars et al., 2011), subtle communicative initiations expressed through manipulating others' hands or bodies to meet their needs (Keen et al., 2016), limited and poorly modulated eye contact for the purpose of communication (Trevisan et al., 2018), difficulty in adapting their behaviour to different social contexts, reading social cues, and engaging in imaginative play (Golya & McIntyre, 2018), limited and reduced frequency, range, and

quality of facial expressions (Keating & Cook, 2020), and a limited range and frequency of social gestures (Ramos-Cabo et al., 2019).

Preverbal CWASD's initiations are often restricted to the function of behaviour regulation (Ellawadi & Weismer 2014; Maljaars et al., 2011). Behaviours such as requesting desired objects or actions and protesting against unwanted stimuli occur significantly more often in CWASD compared to their typically developing peers and verbal CWASD (Chiang, 2008; Maljaars et al. 2011; Wetherby et al., 1998).

1.3. Early predictors of social-communicative deficits in CWASD

Research outlines many factors involved in predicting the development of intentional communication and language in CWASD. Oro-motor difficulties (Gernsbacher et al. 2008), poor speech production due to motor-planning difficulties (Chenausky et al., 2019; Saul & Norbury, 2020), low cognitive ability (Norrelgen et al., 2015), a lack of interest in play and social interaction (Hobson et al., 2013; León, 2019), and comorbidities related to autism (Ganz et al., 2014; Sievers et al., 2018) may contribute to the communicative impairment and response to intervention in CWASD. However, poor motor imitation and lack of joint attention are described as integral features related to the extensive communicative difficulties that CWASD presents with (Baranek et al., 2018; Nowel et al., 2020; Sandbank et al., 2017).

One of the earliest social-communicative skills to develop in children is joint attention and a lack thereof is evident in CWASD (Nowell et al., 2020). Joint attention relates to focusing attention and communication on an object or activity shared between two people (Saleh et al., 2017). The object or activity is not shared to request help, but purely for the social purpose of a shared experience (Weisberg & Jones, 2019). A delay in the development of joint attention occurs in CWASD. These children may not be able to shift their attention between people and objects or draw someone's attention for the purpose of sharing. Following another person's gaze or pointing gesture is also less consistent and limited (Saleh et al., 2017; Stallworthy et al., 2022). CWASD's response to joint attention does not only influence linguistic development. The development of expressive language skills also contributes to the development of joint attention, leaving CWASD at an even bigger disadvantage (Adamson et al., 2019). This distinct lack of joint attention has been linked to delayed development of motor imitation in CWASD.

Some researchers identified poor motor imitation as the most significant predictor of the development of functional communication (Sandbank et al., 2017). Through the development of reciprocal imitation, joint attention, and interactive play skills unfold. CWASD often presents with poor imitative skills (Vivanti et al., 2014; Woynaroski & Yoder, 2017). This deficit may relate to many factors including joint attention, social interest, and motor planning difficulties. Vivanti et al. (2014) found that pre-schoolers with ASD's imitative behaviours were limited, less accurate, and focused on instrumental learning rather than socialisation compared to typically developing peers. The control group focused more on the face of the person who performed certain actions as opposed to the ASD group which focused more on the function performed or the instrumental goal achieved. Sensory regulation difficulties in CWASD have a profound effect on their ability to appropriately attend to stimuli from their environment in order to develop social-communicative skills. In turn, it is hypothesised that joint attention at 13 months of age plays an integral role in the level of joint attention and sensory regulatory skills CWASD developed at the age of 22 months (Bottema-Beutel, 2016; Nowell et al., 2020). Sensory difficulties and their impact on CWASD will now be discussed in more detail.

1.4. Sensory difficulties in CWASD

In reviewing literature describing the sensory features of ASD, it is evident that sensory difficulties are present throughout the different levels of functioning in individuals with ASD (Schauder & Benneto, 2016). The inclusion of atypical responses to sensory stimuli in the diagnostic criteria of the DSM V (APA, 2013) followed many studies supporting the presence of sensory regulatory dysfunctions in the majority of the ASD population (Baranek et al., 2013; Case-Smith et al., 2014; Dakopolos & Jahromi, 2019; Green et al., 2016; Schauder & Bennetto, 2016). In her early study of CWASD, occupational therapist (OT) Jean Ayers (1979) identified deficits in sensory registration, modulation, manipulation of objects, and motivation. Sensory difficulties in individuals with ASD appear to be specifically related to sensory modulation (Ayers, 1972; Tomcheck & Dunn, 2007; Tomcheck et al., 2014). The early theory of Ayers implies that registration is not only when the central nervous system becomes aware of a stimulus in its environment, but also when this stimulus is interpreted (Ayers, 1979). She acknowledged the limbic and vestibular systems in sensory registration and interpretation (Ayers, 1979). This theory describes sensory modulation as the

neural process of adapting appropriately to the perceived stimulus (Ayers, 1979; Brown, et al., 2018). A disorder in sensory modulation results in poor/insufficient adjustment of responses in relation to sensory stimulation from the environment. Consequently, attention, arousal, activity level, and emotional regulation are negatively affected (Ayers, 1979). CWASD respond with various degrees of sensitivity to and avoidance of sensory stimulation (Simpson et al., 2019). The avoidance and even fear of vestibular stimulation prompted Ayers (1979) to formulate the theory of 'gravitational insecurity', whereas the avoidance of tactile input was labeled by her as 'tactile defensiveness'. Ayers also implicated the limbic system in finding that CWASD often lack the motivation to respond to sensory stimuli despite having the motor ability (Ayers, 1979). Contemporary neuroscience has confirmed Ayers' relation between deficits in sensory registration and the limbic system (Nair et al., 2013; Gibbard et al., 2018). The term 'limbic system' is currently referred to as the 'emotion-related brain regions' (Rolls, 2015). The prefrontal cortices have since been added to these regions (Damasio, 1998). These regions were found to differ in size as well as the function they perform in individuals with ASD (Ha et al., 2015; Libero et al., 2016). Dysfunctions of the emotion-related brain regions have also been linked with atypical neuro connectivity in CWASD (Müller & Fishman et al., 2018).

Three main deviant patterns of behaviours in response to sensory stimuli are identified in CWASD: hyper-responsiveness, hypo-responsiveness, and sensory-seeking behaviours (Ayers, 1979; Green et al., 2016; Posar & Visconte, 2018; Schauder & Bennetto, 2016; Tomchek & Dunn, 2007; Watson et al., 2012). These atypical responses occur throughout the lifespan across various response systems of individuals with ASD (APA, 2013).

Hyper-responsiveness to sensory stimuli was found to be an integral symptom in differentiating between typically developing pre-schoolers and those with ASD (Klintwall et al., 2011; Wiggins et al., 2009). However, when comparing pre-schoolers with ASD and children with delayed development, hypo-responsiveness was identified as a unique pattern in the population with ASD (Baranek et al., 2013; Baranek et al. 2006). In a review of the research studies profiling the sensory features in ASD, more evidence was found for a hypo-responsive sensory profile of the CASD population younger than 5 years of age (Kojovic et al., 2019; Watts et al., 2016). Hyper-responsive

and hypo-responsive as well as sensory-seeking behaviours will now be discussed according to the main sensory systems.

Longstanding theories in sensory integration include the tactile system, vestibular system, and proprioceptive systems as the main systems for regulating behaviour (Ayers, 1972). Dysfunction in any of these sensory systems is likely to have a negative effect on social engagement, cognitive functions, and participation in daily activities (Ayers, 1972; Dakopolos & Jahromi, 2019; Dunn et al., 2016; Kojovic et al., 2019; Sabatos-Devito et al., 2019). Table 1.3 outlines a summary of the main sensory systems and related response patterns in CWASD (Bundy & Lane, 2020; Schaaf & Mailloux, 2015).

Table 1.3

The main sensory systems and response patterns in CWASD *(adapted from Ayers,1972; Blanche et al., 2012; Bundy & Lane, 2020; Schaaf & Mailloux, 2015)*

Tactile System	Vestibular System	Proprioceptive system
The tactile system responds to touch and discriminates between what is touching us and where we are being touched. *Hyper-responsive tactile system* Easily gets 'over-stimulated' by tactile input and may therefore avoid or react negatively to certain textures or touch e.g., avoids or pulls away from touch; does not eat textured foods. *Hypo-responsive tactile system* Decreased awareness of tactile sensation e.g., does not explore or manipulate toys since their tactile system is less sensitive to information received when touching objects; touching, pressing, rubbing, or mouthing items regularly to seek tactile input.	The vestibular system refers to the semi-circular canals in the inner ear. This system is involved in posture, coordination, and balance. It provides information on the position of our body in relation to gravity. *Hyper-responsive vestibular system* Easily gets 'over-stimulated' by vestibular input and may therefore react negatively to movement e.g., may display fear or easily get nauseous from movement; avoiding play or exploring apparatus where feet leave the ground. *Hypo-responsive vestibular system* *Decreased awareness of vestibular sensation e.g., s*eeking sensory experiences through behaviours such as jumping, spinning, and rocking; may appear clumsy.	The muscles, joints, and tendons in the body are involved in the proprioceptive sensory system. This system is responsible for registering body awareness in order to perform motor activities. *Hyper-responsive and hypo-responsive proprioceptive system* Increased or decreased awareness of the body presents similarly since the input to this system can be both calming and alerting e.g., pushing, pulling, crashing, and biting behaviours.

The deviating responses to sensory stimuli (visible in Table 1.3) affect CWASD's ability to participate in daily functional activities, including communication. Intervention is required to address the various sensory difficulties in CWASD.

1.5. Sensory interventions

OTs reported that they frequently or always use vestibular, proprioceptive, and tactile input as opposed to any other direct intervention methods (Weitlauf et al., 2017). Two main approaches targeting sensory dysfunctions are identified in the literature: Ayers Sensory Integration® (ASI), and the use of SBI that is informed by the theory and practices of sensory integration (Posar & Visconti, 2018; Thomson-Hodgetts & Magill-Evans, 2018).

In Ayers' (1972) first publication of the ASI approach, she introduces the theory that behaviour and learning are greatly influenced by an inability to integrate sensory information from the sensory systems. Her theory is now supported by contemporary neuroscience, confirming the link between the processing and modulation of sensory information by the main sensory systems and neural functioning (Lane et al., 2019). ASI aims to create opportunities for the child to adapt their responses to sensory input, resulting in improved functioning in relation to environmental demands (Ayers, 1976; Bundy & Lane, 2020; Schaaf & Mailloux, 2015). ASI is a dynamic process involving various contextual elements. These elements include modifying activities according to the responses of the child. This adaptive process provides optimal opportunities for the child to experience success in adapting their responses in relation to the stimuli provided (Schoen et al., 2019). The child leads the selection of intervention activities with the therapist providing structure and support where needed. Play provides a motivating context for sensory integration intervention, and sensory perception is viewed as integral in developing motor functions (Schaaf & Mailloux, 2015). A number of studies have contributed to describing the benefits of ASI (Schoen et al., 2019; Watling & Hauer, 2015; Weitlauf et al., 2017). Sensory integration theory implies that sensory intervention strategies such as deep pressure, vestibular -, and proprioceptive input may influence the processing of sensory stimuli in the brain to achieve an optimal state of neural arousal (Lane et al., 2019). Based on this theory OTs also regularly implement and support SBI in the classroom or other learning environments to support learning in children with sensory deficits (Thomson-Hodgetts & Magill-Evans, 2018).

The SBI approach is informed by ASI (Benson et al., 2019; Posar & Visconti, 2018; Thomson-Hodgetts & Magill-Evans, 2018), and intended to provide sensory stimulation to support sensory modulation (Weitlauf et al., 2017). SBI differs from ASI in that it is not always individualised and is often adult-directed. In SBI a single form of input is commonly implemented e.g., bouncing or swinging (Schaaf & Davies, 2010). A survey study regarding the use of SBI in CWASD found that the majority of the OTs who participated in the study stated that they have used SBI in the ASD population, and would recommend such practices to positively influence attention, sensory seeking behaviours, and self-regulation (Thomson-Hodgetts & Magill-Evans, 2018). SBI is commonly implemented in classrooms where students and teachers are supported by therapists to implement specific isolated sensory strategies to aid the concentration and participation of learners (Benson, et al., 2019; Kaiser et al., 2020). Tactile, proprioceptive, and vestibular input strategies may be used to improve attention, participation, and activity levels. These activities may include brushing, massage, swinging, bouncing on a therapy ball, jumping on a trampoline, riding on a half wheel, crawling through a tunnel, wearing a weighted vest or compression by foam rollers (American Academy of Paediatrics, 2012; Barton et al., 2015; Lang et al., 2012; Wheble & Hong, 2006).

Despite many perceived benefits (Thomson-Hodgetts & Magill-Evans, 2018), the effectiveness of SBI remains inconclusive (Barton et al., 2015; Watling & Hauer, 2015). It has not been definitively established which processes are involved in achieving better outcomes for individuals with ASD receiving such interventions. Limited evidence also exists in the generalisation of positive intervention outcomes to a variety of learning contexts (Case-Smith et al., 2014; Weitlauf et al., 2017). Research regarding the efficacy of SBI remains inconclusive (Bodison & Parham, 2018; Case-Smith et al., 2014; Weitlauf et al., 2017). Validity in research studies investigating SBI has been criticised for not adhering to certain quality indicators (Bodison & Parham, 2018). Many studies have been found limited concerning the lack of guidelines provided for the duration of sensory input, insufficient outcome measures and, not considering the maturation effect (Murdock et al., 2014). The use of therapy balls to encourage participation and in-seat behaviour was found effective in some studies (Lin et al., 2012; Mills et al., 2018; Schilling & Schwartz, 2004). Positive effects were indicated following parent-implemented SBI for a period of 12 weeks using a variety of

sensory activities (Padmanabha et al., 2019). The intervention group scored significantly higher in areas such as making eye contact, responding to their names, and reduced evidence of hyperactivity and sensory-seeking behaviours compared to the control group. Other studies found that SBI strategies such as the use of therapy balls, weighted vests, and brushing have no effect on reducing unwanted behaviours (Bagatell et al., 2010; Davies et al., 2011; Reichow et al., 2010; Tomchek et al., 2016). Vestibular stimulation in the form of swinging is another commonly used SBI described in the research with varying results.

1.6. Vestibular input in sensory interventions

Early on it was recognised that the vestibular system has a significant impact on motor planning, visual processing, and neural activation (Ayers, 1972). Research in the field of neuroscience proved that vestibular information reaches many brain structures that play an important role in many critical functions, including arousal regulation (Lane et al., 2019). Increased alertness can be achieved by rapid or unpredictable movement of the body in space whereas slow, rhythmic movements may induce a calmer and more relaxed state (Horowitz et al., 2009; Sailesh et al., 2018). Ayers suggested the use of specific vestibular sensory input strategies e.g., swinging to influence cortical arousal in children to perform better in a variety of daily contexts (Ayers, 1975).

Swinging is a popular form of vestibular input (VI) used in SBI practices (Su et al., 2014). The literature specifies two types of swinging regularly implemented during SBI. Linear swinging has a calming effect and is therefore used to regulate vestibular sensory hyper-reactivity (Schaaf & Mailloux, 2015). Rotary swinging is employed when an individual displays signs of hypo-responsiveness to sensory stimuli in order to increase the sensory response to stimuli. Murdock et al. (2014) found no significant improvement in engagement, stereotypical/repetitive behaviours, and in-seat behaviour in a group of CWASD receiving slow, linear swinging in between table-top tasks compared to the control group. However, the study of Murdock et al. (2014) has been criticised as participants' level of arousal was not assessed prior to VI being provided. If participants were not found to be hyper-aroused, slow linear swinging would most likely not achieve an improvement in participation and engagement in the table-top activities (stringing beads, building a puzzle, and colouring) performed in this study (Bodison & Parham, 2018). A recent study investigated the effect of VI (jumping

on a small trampoline, spinning on a vestibular plate whilst sitting, and then lying down) on sequence learning in minimally verbal CWASD (Katz-Nave et al., 2020). The authors identified a significant improvement in skill learning in the group of CWASD who received VI compared to the control groups of CWASD who did not receive VI in between learning sessions. An increased response time and improved continuity of learning were presented in the group that received VI. The researchers contributed the beneficial effect of VI to improved attention and executive functioning achieved due to the neural activation caused by this type of sensory stimulation (Katz-Nave et al., 2020).

1.7. SLTs' role in the implementation of sensory interventions

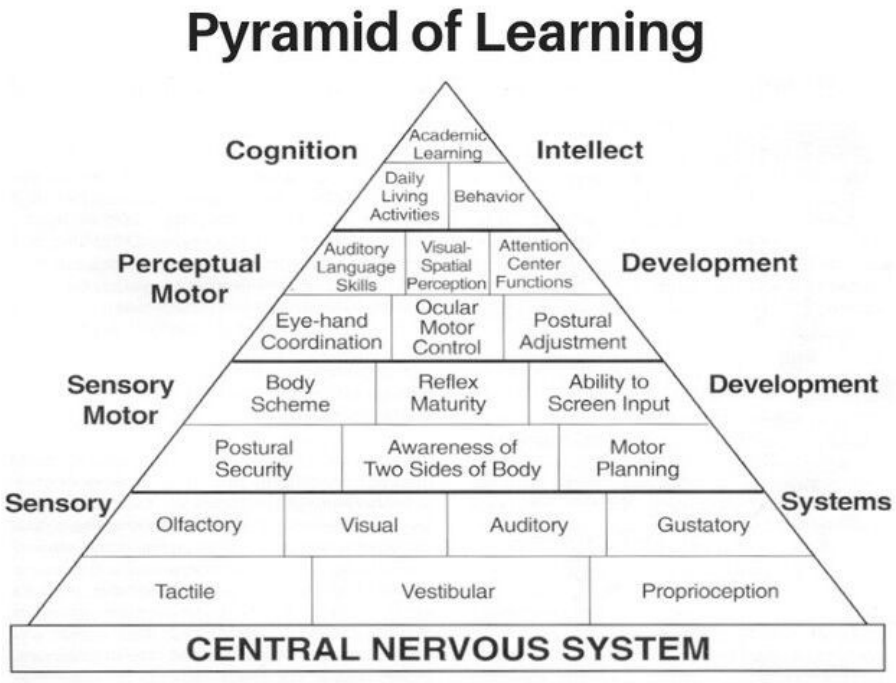
The development of higher cognitive functions such as communication and language abilities are influenced by sensory deficits (Ayers, 1972; Ayers & Mailloux, 1981; Baranek et al., 2013; McCormick et al., 2016; Tomcheck et al., 2016). The vestibular system is connected to the cognitive areas of the brain including the hippocampus and para-hippocampal region, parieto-insular vestibular cortex (PIVC), anterior parietal cortex, posterior parietal and medial superior temporal cortices, cingulated gyrus and retrosplenial cortical regions (Shinder & Taube, 2010). SBI involving vestibular input therefore reaches these brain regions and influence the associated cognitive functions, including language, associated with them.

The effect of SBI and specifically VI, on communication and language is particularly evident in the research literature (Bergo, 1992; Gallaher, 2015; Kantner et al., 1982; Longerbeam, 2013; Maddox, 1990; Magrun et al., 1981; Ray et al., 1988; Tew, 1984). It is proposed that - due to anatomical connections between the vestibular system and the auditory system - VI provided during sensory integration therapy may result in adaptive responses which may impact auditory processing (Salamati et al., 2014; Parush et al., 2007). It is therefore hypothesised that SBI and VI may directly impact the enhancement of speech and language skills, which are dependent on auditory processing (Ayers & Mailloux, 1981).

The research literature includes several studies associating vestibular dysfunction with language delays and disorders. Ayers (1979) concluded that a decrease in posterior nystagmus following vestibular input provides information on the functioning of the vestibular system. This conclusion resulted from a study where an increase in

expressive language ability and reduced post-rotary nystagmus occurred following the implementation of rotary movement (Ayers & Mailloux, 1981). Bailey (1978) explains four key domains of evolution to describe the link between the vestibular system and auditory processing. Cochlear nuclei were formed from vestibular nuclei in the brainstem, the evolvement of a separate vestibular and cochlear system, the link between the cranial nerves responsible for speech, language, and hearing with the vestibular nuclei and spinal cord, and the development of the cochlea from the vestibulocochlear system. When considering these relations, it is a logical conclusion that sensory input to one of these systems will also impact the other.

The Pyramid of Learning introduced by Taylor and Trott demonstrates the interconnectedness between the processing of stimuli by the sensory systems, and language and learning (Taylor & Trott, 1991). Throughout the years, researchers have continued to study the effect of VI on verbal behaviours in children with developmental delays.



Note. Reprinted with permission (Appendix I)

Figure 1

Pyramid of Learning (Taylor & Trott, 1991)

The connection between the vestibular system and the limbic system implies that the vestibular system plays a role in emotional regulation (Rajagopalan et al., 2017). It therefore also need to be considered that when an improvement in mood and anxiety can be achieved through VI strategies, it is likely that a positive change in communication and participation in speech-language therapy will also be achieved.

Early studies investigating the impact of VI on verbal expression produced conflicting results. Reily et al. (1983) found no increase in the variety and length of utterances in children who received slow, linear swinging on a platform swing. Ray et al. (1988) reported increased vocal behaviours during slow linear swinging. However, this increase in vocal behaviours was not retained following stimulation. Little difference in overall language ability was noted between a group of cognitively impaired children who received VI complimentary to speech-language therapy and a control group who received specific speech-language therapy alone. However, verbal gains in the group who also received VI were significantly higher than the scores of the control group (Kantner et al., 1982). Maddox (1990) found that participants with ASD produced significantly more vocalisations during self-initiated as well as therapist-initiated VI compared to vocal behaviours during tabletop activities. The research outcomes of increased vocal behaviours and language production during SBI have prompted SLTs to investigate the possible benefits of such interventions to enhance language and communicative outcomes.

OTs have a key role in treating sensory dysfunctions in CWASD (Bodison & Parham, 2018; Cascio et al., 2016). Since SLTs are involved alongside OTs in the assessment and intervention of CWASD (LaFrance et al., 2019; Jordan et al., 2016), they are also expected to understand and manage sensory difficulties in the children they treat (Preis & McKenna, 2014; Vitásková & Kytnarová, 2017). OTs often support SLTs, teachers, and other professionals involved in working with CWASD by providing specific SBI to promote engagement at school or in therapy (Benson et al., 2019; Bundy & Lane, 2020; Piller & Pfeiffer, 2016; Piller & Barimo, 2019). Practice-based evidence encourages SLTs to implement appropriate sensory strategies and make environmental accommodations to enhance performance during CI (Piller & Barimo, 2019; White et al., 2018). SLTs also play a role in implementing sensory modifications and SBI strategies such as providing deep pressure or swinging to support the development of self-regulation skills in children with sensory processing difficulties (Binns et al., 2019).

Clear guidelines for the use of SBI by SLTs are not available and the interdisciplinary collaboration between SLTs and OTs is imperative in informing the implementation of such interventions.

A limited number of studies investigating SBI strategies have been conducted by SLTs. In one such study evidence of increased communicative responses during speech therapy following slow, linear vestibular swinging has been noted in CWASD (Longerbeam, 2013). A follow-up study concluded that although slow, linear vestibular swinging significantly increased responses in one mode of communication, for example, gestures, a progression to other modes of communication did not occur (Gallaher, 2015). Multi-sensory input provided during sensory integration therapy has also been reported to increase communication, verbal expression, and performance during therapy. The results of a small study identified an increase in spontaneous communication, length of utterances, and participation in CWASD following occupational therapy targeting sensory integration (Preis & McKenna, 2014). The researchers related this improvement to the motivational and physical aspects of participating in multiple sensory challenges that are individually selected for each child. In an earlier study, children who received sensory integration therapy scored significantly higher on post-test language scores than the children who did not attend sensory integration therapy prior to speech-language therapy (Fallon, 1994). A significant increase in social responsiveness was identified in CWASD who received sensory integration therapy as well as fine motor intervention compared to the control group who only attended fine motor intervention (Pfeiffer et al., 2011).

1.8. Rationale and research questions

According to the researcher's knowledge, there have been no studies conducted investigating SBI by SLTs in South Africa. The present study is therefore both novel in design and specific to the context. Therapists in South Africa work in different settings in both the public and private sectors. South African therapists face unique challenges that come with opportunities to enhance their practices and service to the ASD population. Settings in the public sector often have long waiting lists whereas in the private sector, regular therapy is more possible (Guler et al., 2018). Furthermore, resources and access to mentorship is often limited for therapists working in the public sector (Van Stormbroek & Buchanan, 2016). Due to budget constraints healthcare

posts in the public sector are often frozen, adding to the existing therapists' workload (Department of Health – South Africa, 2011). Despite the many challenges existing in our country's healthcare and educational system, it is the responsibility of South African therapists to develop and implement resources that are appropriate to the context (Pascoe, 2011).

In the context of providing intervention to CWASD in South Africa, it is necessary to investigate the concepts of efficacy, effectiveness, and efficiency of speech-language therapy. Efficacy is described as the ability of an intervention to bring about positive change in a behaviour or ability of a person (Burches & Burches, 2020). When considering the South African context, where the opportunity to provide regular intervention in the public sector may be scarce, therapists need to ensure a therapeutic effect is achieved with the interventions provided. Effectiveness implies that the intervention provided needs to be relevant and of value to the larger population (Burches & Burches,2020). The therapist, therefore, needs to consider the benefit of a specific intervention to the whole population and not only to a small minority group in the South African context. Efficiency refers to an intervention delivering optimal benefits at minimal cost (Burches & Burches, 2020). This is especially relevant since resources, training opportunities, and funding for specialised interventions are limited in the public healthcare system in South Africa (Guler et al., 2018). When considering the concepts of efficacy, effectiveness, and efficiency in the implementation of SBI by SLTs, it is considered to be a non-invasive, low-cost intervention that can be implemented not only in a clinical setting, but also in classrooms and at home.

The preverbal population of CWASD requires extensive developmental support involving several disciplines (LaFrance et al., 2019). Studies to evaluate interventions for preverbal CWASD are limited compared to studies including verbal CWASD. As great variability occurs within the preverbal population, therapists should apply their clinical expertise to adapt and combine therapy approaches to meet the needs of this heterogeneous population (Watkins et al., 2017). Research in supplemental therapies and techniques that may support language development and communicative outcomes in this population is suggested (Brignell et al., 2018; Kasari et al., 2013; Lord et al., 2018; Weisberg & Jones, 2019).

Significant growth in the research of SBI in the ASD population has occurred in the past decade. Inconclusive evidence remains regarding the benefit of SBI outside the context of sensory integration therapy. Researchers in this area call for more studies investigating the benefits of such interventions pertaining to behaviour regulation, attention, participation, vocalisation, and language (Bodison & Parham, 2018; Case-Smith et al., 2014; Weitlauf et al., 2017). Further research regarding the implementation of SBI by SLTs to improve communication outcomes is also required (Gallaher, 2015; Preis & McKenna, 2014; Schooling, 2012).

SBI is often employed by several professions including SLTs when providing services to children with sensory disorders (Preis & McKenna, 2014). Whether implementing SBI may increase target behaviours in language and communication intervention has not been established definitively. A limited number of studies have been produced where SLTs investigate the effect of SBI on communication and language. The current research project will therefore contribute to the research conducted by SLTs investigating supplemental sensory strategies to improve language development and communicative outcomes.

Due to the increased co-occurrence of hyper-responsiveness and hypo-responsiveness to sensory stimuli, clinicians need to be able to provide appropriate sensory input in relation to the state of the subject. This may ensure more success in transferring skills to functional daily activities (Watson et al., 2012). As limited training and guidance are available to SLTs in the field of sensory integration strategies and therapy, OTs play an important role in collaborating with SLTs in the appropriate implementation of SBI as these professions are mostly both involved in providing intervention for CWASD (Jordan et al., 2016; LaFrance et al., 2019). The World Health Organisation (WHO) recommends that professionals should be trained to understand each other's disciplines in order to collaborate effectively. Interdisciplinary therapy is associated with positive learning outcomes for CWASD (White et al., 2018). However, this model of service delivery is not always accessible to South African therapists, and research to support collaborative therapy approaches is lacking. SLTs are expected to understand and sometimes incorporate sensory intervention techniques to meet the individual needs of their clients (Preis & McKenna, 2014; White et al., 2018). Clear guidelines as to the role and implementation of SBI by SLTs to target communicative outcomes are not yet available resulting in many therapists blindly implementing SBI

strategies. It is therefore required to establish the current nature, knowledge, and implementation of SBI strategies by SLTs. Furthermore, design-specific and novel contexts will contribute to the limited corpus of data available in this regard. This information may provide a basis to identify areas of knowledge to be expanded on, professional training required, and ways to expand interdisciplinary practices. The rationale of the present study and the specific link between VI and communication, therefore, guides the following research questions:

1. What is the nature of the SBI, knowledge of sensory processing and SBI, and perception of the role and outcomes of SBI as implemented by speech-language therapists?
2. Does VI provided prior to an interaction with a communicative partner affect the rate of communicative responses and spontaneous initiations of preverbal CWASD?
3. Does VI provided prior to an interaction with a communicative partner affect the rate and response time of CWASD in picture exchange communication?

CHAPTER 2

METHOD

> A method is more important than a discovery, since the right method will lead to new and even more important discoveries
>
> LEV LANDAU

Chapter Aim: This chapter states the aim and objectives of the research project. A detailed description of the methods used to conduct each of the research studies is provided.

2.1. Aim

The overarching aim of this research project was to investigate the implementation of SBI by SLTs and how such interventions influence the communication and responses of children with Autism Spectrum Disorder (CWASD). The objectives of Studies 2 and 3 specifically relate to the effect of VI on the communication of CWASD since this form of sensory input is specifically linked to changes in communicative behaviours (and therefore of value to the SLT) in the research literature.

The following objectives were investigated in three separate studies:

2.2. Objectives:

Study 1: To investigate the implementation of SBI by SLTs to enhance communication intervention in the CWASD.

Study 2: To determine the effect of VI on the frequency of spontaneous communicative attempts of preverbal CWASD during an interactive activity.

Study 3: To determine the effect of VI on the frequency of responses of preverbal CWASD using PE to request.

2.3. Research studies

All three studies have been submitted and/or accepted for publication in accredited peer-reviewed journals. The titles and journals of publication are summarised in Table 2.1.

Table 2.1

Summary of research studies

	Study 1	**Study 2**	**Study 3**
Title	Sensory-based interventions by speech-language pathologists	The influence of vestibular input on the communicative attempts of children with Autism Spectrum Disorder	The influence of vestibular input on the responses of children with Autism Spectrum Disorder using picture exchange communication to request
Journal of publication/submission	Advances in Communication and Swallowing	Communication Disorders Quarterly	Journal of Occupational Therapy, Schools & Early Intervention
Publication status	Published	Submitted – in review	Published
Chapter in thesis	Chapter 3	Chapter 4	Chapter 5

2.4. Research design

A quantitative survey design was used to collect data for Study 1. This research design allowed the researcher to investigate key information regarding practices, perceptions, and knowledge of the studied population online. This method is cost-effective and ideal for statistical analysis (Story & Tait, 2019). Key information regarding demographics, opinions, and experiences as well as common features relating to the studied population is gathered through survey research (Trochim et al., 2015). Questionnaires are one of the most used instruments in survey design (Ponto, 2015). An original questionnaire was developed as the instrument for data collection in Study 1.

Studies 2 and 3 implemented an alternating treatment design. This design is a type of single-subject research design. Single-subject research can include multiple participants allowing for more valid outcomes when results are replicated across participants. The alternating treatment design involves a rapid and random alternation of two or more treatments for an equal duration of time (Lobo et al., 2017). Single-subject research is deemed appropriate for establishing an evidence-based practice in speech-language therapy (Brobeck & Lubinsky, 2003; Byiers et al., 2012). Not only is single-subject research used to provide information for research, but also to guide clinical practice.

Researching the effects of a specific treatment on an individual is advisable in clinical practice (Byiers et al., 2012). In large-scale randomised control trials positive results may indicate that a specific intervention benefitted the population in general. Valuable information regarding individual responses to an intervention may not be identified or described sufficiently in such studies. The use of an alternating treatment design allows the researcher to identify individual differences within a group of participants – it emphasises the behaviour of each individual participant as a primary interest (Lobo et al., 2017). Causal relationships can be identified through the manipulation of the independent variable, the precise measurement of a dependent variable, and the control of extraneous variables. Each participant acts as their own control. Comparing participants to themselves allows the researcher to control variables such as socio-economic status, cognitive ability, concurrent interventions, and age. This design is therefore appropriate in a heterogeneous population such as the CWASD in Studies 2 and 3 due to the challenge of establishing matching groups for valid comparisons to be drawn in such a population (Alnahdi, 2013).

Although baseline measurements are not a requirement in an alternating treatment design, Studies 2 and 3 included a baseline phase to enhance the validity of possible outcomes (Lobo et al., 2017). In an alternating treatment design experimental control is achieved when the treatment activities and control activities implemented during the treatment phase can be clearly distinguished with no overlapping data paths (Byiers et al., 2012). Random assignment of participants to either of the two treatment conditions or the control condition implemented in Study 2 and Study 3 took place to allow for more valid outcomes (Rvachew & Matthews, 2017). As optional in this type of research design a control activity was included to enhance experimental control (Wolery et al.,

2010). Every attempt was made to implement the treatment and control conditions in the same manner and for the same duration of time apart from the variables that are studied (Byiers et al., 2012).

Single-subject research also holds some challenges for the researcher. Establishing at least five data points for the baseline phase, treatment phase, and post-treatment phase may prove difficult (Lobo et al., 2017). Studies 2 and Study 4 took place at the school of the participants in order to minimise travel, disruption to participants' daily routine, and exposure to extraneous variables in order to allow for more data points to be established in a shorter time frame. The shorter time frame allowed in the alternating treatment design makes it possible to control the effect of maturation on participants' responses.

In a study by Van Rie and Hefflin (2009), an alternating treatment design was implemented to investigate the effect of SBI on the responses of CWASD to a number of instructional tasks. In the current study, the effect of SBI on the responses of CWASD was investigated in relation to communication. Using an alternating treatment design Van Rie and Hefflin (2009) were able to measure the effect of two different SBI strategies in comparison with a control activity. The procedures and design of this investigation were considered due to the similarity in objectives of the current study.

To ensure the validity of research outcomes the method and research design should adhere to certain quality indicators (Council for Exceptional Children - CEC, 2014). The implementation of the core features with consideration of the quality indicators of single-subject research including the alternating treatment research design selected in Study 1 and Study 2 is outlined in Table 2.2.

Table 2.2

General design considerations for the alternating treatment design used in Study 1 and Study 2 *(adapted from Horner, 2005; Kratochwill et al., 2010; Kratochwill et al., 2014; Tate et al., 2016)*

Design component	Quality indicators applied in Study 2 and Study 3
Participants and research setting	Participants were selected according to specific inclusion criteria relevant to the research questions in each of the studies.
Dependent variable	The dependent variable in Study 2 was the frequency of the participants' spontaneous communicative attempts. The dependent variable recorded in Study 3 was the frequency of responses of participants.
Independent variable	The independent variable in Study 2 and Study 3 was VI provided through swinging or rocking.
Baseline	Baseline measurements for Study 2 and Study 3 took place over a 1-week period and included 3-4 data points for each participant.
Experimental control or internal validity	The procedures followed in both studies 2 and 3 were described in detail to allow for replicability and validity. A sufficient amount of data points was established for each participant over the treatment phase. An alternating treatment design allows for the repetition of measurements over a short period of time. Participants' parents confirmed that no changes in the participants' use of medication took place throughout their involvement in the research project. Participants did not receive speech-language therapy or occupational therapy during their involvement in the research project. Parents and school staff were instructed not to provide or encourage specific sensory input (e.g., jumping on a trampoline or swinging) prior to participants' involvement in the different phases of the research studies for the purpose of controlling extraneous variables. Participants did not receive occupational therapy involving SBI while they were involved in the research studies. Data collection took place early in the morning from 8:00-9:00 in order to minimise sensory input received from the environment on these days. A set time for data collection was introduced in order to control the variability of the participants' behaviour and state of arousal throughout different times of the day. The therapy room and classroom where data collection took place were organised to minimise distractions and allow for optimal regulation during data collection. The interactive activities as well as the treatment activities were presented randomly to enhance fidelity (Rvachew & Matthews, 2017). The type of movement applied throughout the treatment phase related to each participant's observed state of responsiveness at the time of data collection. In ensuring that the applied movement is adapted to the participants' sensory responses (hypo-responsive or hyper-responsive behaviours), the validity of outcomes is increased (Bodison & Parham, 2018; Van Rie & Hefflin, 2009). Independent observers completed a fidelity checklist related to data collection procedures and the assent of participants.
External validity	By including multiple participants in Studies 2 and 3, the validity of the outcomes is enhanced. If a treatment effect is detected in more than one participant, the outcomes are less likely to be coincidental. Including a small sample size in heterogenic populations such as CWASD ensures the detection and description of individual differences in such a population. Individual differences provide valuable information that should be considered when establishing the treatment effects in CWASD (Lobo et al., 2017).

2.5. Research context

Study 1 comprised a survey distributed to SLTs working in a variety of therapy contexts providing services to CWASD. Therapists based in private practices, hospital clinic settings, and school settings throughout South Africa were included in this study.

Studies 2 and 3 were conducted in an independent school setting in South Africa. The school provides education for CWASD with an average age of 3 to 11 years. Participants in these two research studies were selected from preschool classes. Instruction in the classrooms is individualised in English or Afrikaans, with parents of other native languages preferring English as the main language for classroom instruction and therapeutic intervention. This school setting has a fully equipped therapy room where data collection took place.

2.6. Research participants

Study 1: Through the anonymous link, 81 responses were captured by Qualtrics. After removing the respondents who did not give consent (n=5), those who spent less than one minute from entering the questionnaire to exiting it (n=8), and who only answered 'yes' to the consent question but didn't answer anything else (n=3), 65 respondents were left. Using the Software G*Power version 3.1.9.4 (Faul et al., 2007), for a level of significance of 5%, a sample size of 65, and an effect size of 0.5 (Cohen, 1992) the achieved power is 0.992 which is above the ideal value of 0.8. Participants were qualified SLPs working with CWASD across South Africa. SLPs from a variety of therapy settings were included, namely early intervention centers or clinics, public hospital therapy clinics, schools, and private practices. A description of the biographical information (Table 2.3), clinical background (Table 2.4), and caseloads of respondents (Table 2.5) are provided.

Table 2.3

Biographical information of respondents

Clinical Setting		Province of work		University where the qualification was obtained		Years of experience working with CWASD	
Pediatric clinic at a public hospital	8% (n=7)	Eastern Cape	6.4% (n=4)	University of Cape Town	29.2% (n=19)	1 - 5 years	44.6% (n=29)
School	36.4% (n=32)	Free State	7.7% (n=5)	University of Durban-Westville	6.2% (n=4)	6 - 10 years	21.5% (n=14)
Early intervention setting	8% (n=7)	Gauteng	48.4% (n=31)	University of Pretoria	23.1% (n=15)	More than 10 years	33.8 % (n=22)
Private practice	42% (n=37)	Kwa-Zulu Natal	12.5% (n=8)	University of Stellenbosch	12.3% (n=8)		
Other (did not specify)	5.7% (n=5)	Limpopo	1.6% (n=1)	University of the Witwatersrand	24.6% (n=16)		
		North-West	3.1% (n=2)	University of Limpopo	1.5% (n=1)		
		Western Cape	20.3% (n=13)	University of Kwa-Zulu Natal	1.5% (n=1)		
				Wichita State University	1.5% (n=1)		

Table 2.4

Caseload information of respondents

Regularity of treating CWASD		Number of children on caseload		Provision of joint collaborative therapy	
Occasionally	9.2% (n=6)	Up to five	24.6% (n=16)	Never	4.6% (n=3)
Often	55.4% (n=36)	Up to ten	36.9% (n=24)	Occasionally	33.8% (n=22)
Always	35.4% (n=23)	Up to twenty	23.1% (n=15)	Often	36.9% (n=24)
		More than twenty	15.4% (n=10)	Always	24.6% (n=16)

Table 2.5

Client-related information of respondents

Age range of CWASD treated		Presence of sensory difficulties in CWASD treated		Means of communication used by CWASD treated		Severity of symptoms of CWASD treated	
1 - 5 years	39.8% (n=47)	Occasionally	6.3% (n=4)	Body manipulation, gestures, and eye gaze with no functional language use	37% (n=51)	Mild	29.2% (n=42)
6 - 9 years	39.8% (n=47)	Often	48.4% (n=24)	Verbal production of words, phrases, or sentences in a functional manner	40.6% (n=56)	Moderate	39.6% (n=57)
10 – 15 years	16.8% (n=20)	Always	45.3 % (n=29)	Augmentative and assistive communication system	22.5% (n=31)	Severe	31.3% (n=45)
16 – 18 years	3.4% (n=4)						

Studies 2 and 3: A purposive sampling method was used to select participants for Studies 2 and 3 (Shorten & Moorley, 2014). All the children from an independent preschool for CWASD were considered for participation. Two learners from the preschool met the inclusion criteria for participation in Study 2, and three learners met the criteria for participation in Study 3. The inclusion criteria for these two studies are outlined in Table 2.6.

Table 2.6

Inclusion Criteria Studies 2 and 3

Criteria	Description
Diagnosis	Participants were diagnosed with ASD by a paediatrician specialising in CWASD after performing the Autism Diagnostic Observation Schedule™, second edition - ADOS™-2 (Lord et al., 2012).
Age	Children attending the preschool varied between 3 and 6 years of age. This age group has been selected since the preschool population of CWASD is underrepresented in this field of research (Koegel et al., 2019).
Expressive Language Ability	Participants were required to be at the preverbal stage of expressive language ability. At this stage, CWASD does not produce words in a spontaneous, consistent manner (Kasari et al., 2013). Means of communication in this population include body movement, body manipulation, vocalisations, gestures, eye gaze, word approximations, and social imitation (Keen et al., 2016). Children's expressive language level was confirmed by the primary researcher considering information from the 'Means and Functions of Communication Checklist' (Wetherby, 1995) provided by participants' parents and teachers.
Sensory Deficits	Participants presented with atypical vestibular processing as identified by the school's OT through clinical observation and using the Sensory Processing Measure – Preschool Edition (SPM-P-P) (Parham et al., 2007).
Comorbidities	Participants received a diagnosis of ASD with the absence of any comorbid conditions such as Epilepsy or fragile X syndrome.
Hearing and vision	Normal hearing and vision were confirmed by their medical records

Description of participants

Study 2: Participant 1 was a male aged 2 years and 7 months. Results of the SPM-P indicated dysfunction in balance and motion, movement-seeking behaviours, poor coordination, and rhythm. He was described as easily distracted by visual stimuli and it was noted that he enjoyed looking at spinning objects. Participant 1 did not present with functional language. He communicated by using others' hands or arms to fulfill a need. He also reached for wanted items.

Participant 2 was a male aged 5 years and 5 months. Dysfunction in balance and motion, vision, planning, and body scheme was indicated by the results of the SPM-P. He also presented with pushing and pulling behaviours and enjoyed looking at spinning objects. He occasionally used single words to request wanted items and sometimes echoed others' utterances.

Study 3: Participant 1 was a male aged 4 years, 1 month. He presented with dysfunctional balance and motion, poor coordination and rhythm, and movement-seeking behaviours. He appeared easily distracted by visual stimuli and enjoyed looking at spinning objects. No functional language use was indicated. He uses body movement, body manipulation, and vocalisation to communicate.

Participant 2 was a male aged 4 years and 4 months. Similar to Participant 1 he also presented with dysfunctional balance and motion, poor coordination and rhythm, and movement-seeking behaviours. He appeared easily distracted by visual stimuli and enjoyed looking at spinning objects. No functional language use was indicated. He uses body movement, body manipulation, and vocalisation to communicate.

Participant 3 was also a male aged 4 years, 5 months. Results of the SPM-P also indicated dysfunctional balance and motion. He presented with pushing and pulling behaviours. As with the other two participants, he did not use language functionally and used vocalisation, body movement, and body manipulation to communicate.

2.7. Material and apparatus

Study 1

Information gathered from the research literature (APA, 2013; Ayers, 1972; Baranek et al., 2013; Binns et al., 2019; Bundy & Lane, 2020; Case-Smith et al., 2014; Green et al., 2016; LaFrance et al., 2019; Lane et al., 2019; Padmanabha et al., 2019; Peña et al., 2021; Posar & Visconte, 2018; Schauder & Benneto, 2016; Schaaf & Mailloux, 2015; Schoen et al. 2019; Simpson et al., 2019; Tomcheck et al., 2014; Watts et al., 2016; Thompson-Hodgetts & Magill-Evans, 2018), sourced surveys related to SLPs and ASD (Gillon et al., 2017; Schwartz & Drager, 2008) supported the development of an original questionnaire to meet the objectives of this study (Appendix A). Qualtrics XM software was used to design the questionnaire layout, distribute the questionnaire electronically as well as capture and analyse data.

Study 2

Sensory Processing Measure-Preschool (SPM-P-P): The parents and teacher of each participant completed the Sensory Processing Measure-Preschool (SPM-P-P) (Glennon et al., 2011; Miller Kuhaneck et al., 2010a, 2010b). This measure is appropriate for use in young CWASD (Brown, 2018). The data from this measure were

scored and the sensory challenges for each participant were summarised by the OT involved in the treatment phase of the study.

Early Social Communication Scales - ESCS (Mundy et al., 2003): The activities, procedures, and scoring of the ESCS were considered in the design of the data collection procedures and analysis of the video recordings. This assessment is a valid and sensitive measure in identifying individual differences in the development of early non-verbal communication (Mundy et al., 2007).

Communicative Functions and Means Checklist (Wetherby, 1995) – this checklist was used to determine the communicative stage of proposed participants. It describes an individual's means and functions of communication.

Treatment 1 (Swing): The 'flying saucer' platform swing from 'PlayOn' depicted in Figure 2.1 was used to provide VI in Treatment 1 (T1). This swing creates a safe, contained space with side barriers. It can be used in a variety of developmental positions and allows both linear as well as rotary swinging.

Figure 2.1

Treatment 1 Apparatus

Treatment 2 (Half wheel): The half wheel from 'PlayOn' depicted in Figure 2.2 was used to provide VI in Treatment 2 (T2). The child could sit wide-legged over the wheel or lie in the arch of the wheel while being rocked back and forth by the OT in the clinical trials.

Figure 2.2

Treatment 2 Apparatus

Control activity (Lotto board): A wooden lotto board was used for the control activity in the clinical trials. This activity was familiar to participants.

Toys used during the interactive activities: The More than Words® program (Sussman, 2012), suggests the use of 'people toys' to create opportunities for communication. Such toys and activities may encourage interest in the child whilst still requiring adult involvement to operate. Similar toys are used in the assessment of communicative skills in CWASD (Lord et al., 2012; Mundy et al., 2003). Toys and activities were selected to encourage joint attention and communication (Lord et al., 2012, Mundy et al., 2003). Bubbles, picture books, wind-up toys, a battery-operated bunny, and a foam dart rocket were used.

Camcorder and tripod: A Canon HF R806 Full HD Video Camera was set up on a tripod to record the interactive activities during the clinical trials.

Study 3

As in Study 2, the SPM-P was completed by the parents and teachers of participants to describe the sensory challenges they experienced. The same treatment activities and control activities as in Study 2 were also used in Study 3. During the PE activity, laminated pictures from 'Boardmaker' were used to represent the reinforcers. The reinforcers for the PE activity included a light-up rubber ball, hopping toy bunny, music box, squishy toy, wind-up toys, and bubbles.

2.8. Data collection procedures

Study 1

Permission was received from administrators of the following groups for the distribution of the questionnaire via a link created by the Qualtrix XM software to which participants could respond anonymously: Allied Health in South Africa, South African Audiologists and Speech-Language Therapists, and Private Practice Growth Club. The link was distributed to these groups in May 2022. The link remained active for a period of six weeks for participants to submit their responses.

Study 2

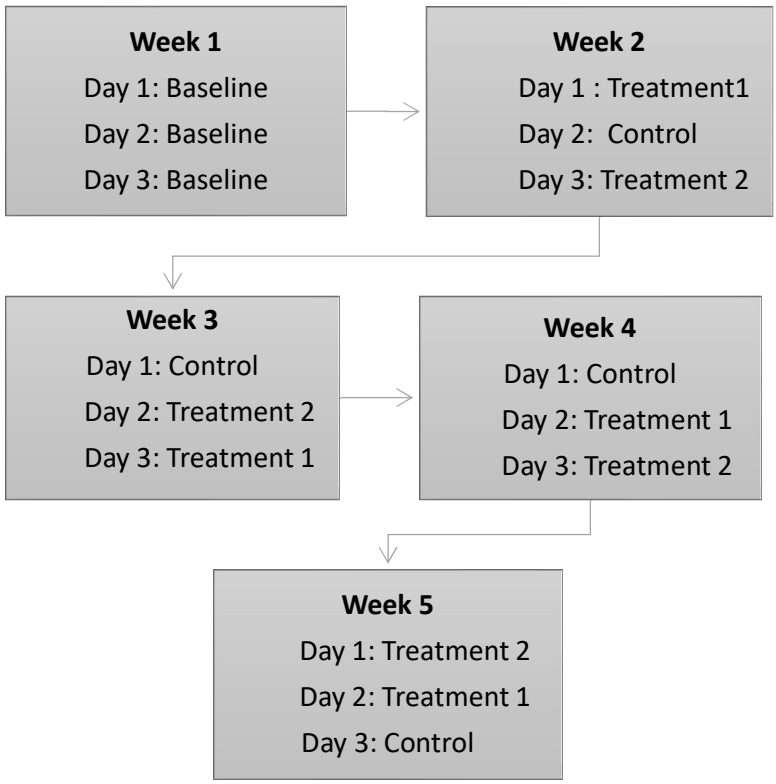
The primary researcher considered the procedures of the ADOS-2, Early Social Communication Scales: ESCS (Mundy et al., 2003), and the Communication and Symbolic Behaviour Scales Developmental Profile: CSBS-DP (Wetherby & Prizant, 2002) in the presentation of the interactive activities. As recommended by Mundy et al. (2003) the therapist responded to communicative initiations during the presentation of the interactive activities. When measuring social interactive behaviours absolute standardisation of procedures may compromise the validity of the measurements (Mundy et al., 2003). It was therefore necessary and possible to allow for slight variation in response to each participant's communicative initiations.

The OT and primary researcher implemented visual aids and keywords throughout the data collection phases to prepare and direct participants. During the baseline phase, the OT collected the participants from their classroom and accompanied them to the therapy room. During the treatment phase, the OT accompanied participants from the therapy room to the classroom where the interactive activities took place. The primary researcher positioned herself in front of participants in a face-to-face position across

the half-circular table during the interactive activities. The OT positioned herself beside participants in order to assist if necessary, during the treatment and control activities. The treatment activities were implemented for five minutes in the therapy room before continuing to the interactive activity (Murdock et al., 2014; Van Rie & Hefflin, 2009). The control activity was also completed within five minutes before continuing to the interactive activity in the classroom. During the interactive activities participants were seated across from the primary researcher before the toys were produced. The toy or activity was then presented with a verbal prompt 'Look!' Following this initial prompt, further prompts were only introduced when a participant remained irresponsive. During the presentation of these activities, the primary researcher responded naturally but briefly to communicative attempts from participants (Mundy, 2003). Figure 2.1 provides an example of the data collection process over a five-week period for a participant in Studies 2 and 3.

Figure 2.3

Data Collection Process: Study 2



Study 3

Before data collection commenced participants were required to partake in a preparation session where they received physical prompting to hand over the picture in response to being enticed by a reinforcer. Once participants handed over the picture spontaneously (without the need for a physical prompt) data collection continued without any further physical prompting.

The primary researcher positioned herself in front of participants in a face-to-face position across the half-circular table during the picture exchange activities. As in the preceding picture exchange sessions, each participant was enticed with a reinforcer before the picture of the reinforcer was placed in front of them on the table, and the researcher held out her hand to request the picture. The researcher then waited for a count of 5 seconds for the participant to pick up the picture and hand it over (Bondy & Frost, 1994). If the participant responded, the reinforcer was handed to him for a short period of time before the examiner encouraged the participant to hand it back by saying 'my turn' and gently taking the reinforcer. The sequence was then repeated. The primary researcher presented the picture exchange activities for a maximum of five minutes.

The OT collected participants from their classrooms and accompanied them to the therapy room. The OT and primary researcher implemented visual aids and emphasised keywords throughout the data collection phases to prepare and direct participants. The OT positioned herself beside participants during the treatment activities maintaining minimal interaction to assist them if required.

The OT observed participants' responsiveness upon entering the therapy room to determine the type of movement to be applied according to participants' state of arousal and responsiveness (Bodison & Parham, 2018). The OT applied fast-paced, higher-range movements throughout the treatment phase since all three participants presented with hypo-responsive sensory profiles and sensory-seeking behaviours (Schaaf & Mailloux, 2015). Swinging or rocking took place for five minutes before continuing to the picture exchange activity (Murdock et al., 2014; Van Rie & Hefflin, 2009).

2.9. Data processing and analysis

Study 1

The data captured by Qualtrics were exported to the Statistical Package for the Social Sciences (SPSS) version 26. SPSS was used for all data analysis. A level of significance of 5% was used. In order to find statistically significant associations between two categorical variables, the Chi-square test was used. The Shapiro-Wilk test was used to test for normality as it is known to have more power in detecting differences from normality (Field, 2018). The nonparametric Spearman correlation was used to investigate relationships between variables.

Studies 2 and 3

Data processing for both Studies 2 and 3 involved the clinical observation and blind analysis of the video recordings by a professional panel of three members namely an OT and two SLPs experienced in diagnosis and intervention for CWASD. Data were used to draw line graphs for visual inspection to determine the level, trend variability, consistency, the immediacy of the effect as well as any overlapping data patterns (Lobo et al., 2017; Price et al., 2017; Viera & Garrett, 2005). Further statistical analysis proceeded to calculate the extent of the positive findings in both studies (Rakap, 2015). NAP and Tau-U for comparisons between baseline and intervention (Lee & Cherney, 2018; Parker et al., 2009) were considered.

2.10. Ethical considerations

The study was approved by the Research Ethics Committee of the Faculty of Humanities at the University of Pretoria (96004976 HUM0180720). The study adhered to the ethical principles of autonomy, confidentiality, beneficence, non-maleficence, justice, truthfulness, and integrity (HPCSA, 2016; Leedy & Ormrod, 2019).

Autonomy was upheld through acquiring informed consent. Informed consent refers to the process in which a participant is informed about the risks, benefits, and alternatives of all aspects of their involvement in a research study (Leedy & Ormrod, 2019). The process of informed consent emphasises the researcher's responsibility to discuss all relevant information and provide an opportunity for participants to raise questions and concerns. In this process, a voluntary agreement of participation in a research study is reached (Leedy & Ormrod, 2019). The first item of the survey in Study 1 required

participants to indicate whether they consent to participate in the research project. The principal of the school that the participants attended and where data collection for Study 1 and Study 2 took place provided informed consent for the students to participate in the research project in the school's therapy room and classroom (Appendix B). Since participants were minors under the age of seven parental informed consent was obtained (Appendix C). Participants were not able to provide assent for participation since they were not able to communicate verbally or by using augmentative communication to provide definitive assent. Guess et al. (2008) state that it is necessary to monitor participants' communicative behaviours closely to ensure voluntary participation throughout the study (Appendix D). Autonomy was further ensured by allowing parents to observe data collection to be able to withdraw the participant at any time they feel necessary. Feedback regarding their child's participation was provided following each session.

Confidentiality was upheld throughout the research process. Respecting participants' privacy and confidentiality is integral to ethical research (Leedy & Ormrod, 2019). Research results should be reported in a confidential manner to ensure the privacy of participants (Nelson, 2016). All information regarding the participants in this research project, as well as all data acquired from the participants, were accessible to the primary researcher alone. Names of the respondents in Study 1 as well as the school, school staff, and child participants were not disclosed at any stage of this research project. The survey in Study 1 was set up and the questionnaire was distributed through an anonymous link provided by Qualtrics to ensure the confidentiality and anonymity of respondents. Surveys are electronically stored, and password protected allowing only the primary researcher to access the data. Blind analysis of anonymous video recordings took place for Study 1 and Study 2. Video recordings were stored electronically on the primary researcher's laptop, and access is password protected. The storage files were labeled with number codes – a document linking the participant to the code is stored separately and is password protected.

Beneficence and non-maleficence relate to the researcher's professional directive to conduct research that will serve and promote the welfare of the research participants – any harm to participants is to be avoided (Leedy & Ormrod, 2019). Participants in this study were not subjected to harm in any way, and all efforts were made to ensure their well-being. Precautions were taken to ensure the safety and comfort of each

participant from Study 2 and Study 3. Participants were not required to seize or adapt the use of any prescribed medications. Participants were involved in data collection sessions for less than 15 minutes per day in order not to tire them and to minimise the disruption to their routine. Participants in Study 2 and Study 3 were prepared for the use of equipment and activities presented in the research environment. Clear, comprehensive labeling (verbally and visually) of all equipment or activities was provided. Guidelines for behaviour observation (Appendix D) were followed and on three occasions data collection was halted since the participant appeared upset and unwilling to participate. Once the participant was comfortable and willing to participate, the activity continued. The contact details of the primary researcher and study supervisors were provided in the information letters to the parents of participants and the school principal, in order for them to be able to communicate directly with the primary researcher throughout the course of data collection.

Justice implies that methods of research should be fair and non-exploitative. Leedy and Ormrod (2019) emphasise the reasoned selection of participants to ensure the principle of justice in research ethics. In the current research project, the three sets of participants adhered to specific inclusion criteria required to meet the aim of the respective research studies. The ethical principle of justice also includes the researcher's ethical responsibility to be qualified and capable of conducting the research proposed (Mooney-Somers & Olsen, 2016). The primary researcher is a competent clinician registered with the Health Professionals Council of South Africa (STA 0020435). The primary researcher had 17 years of experience in working with CWASD at the time of data collection. The researcher is trained in the assessment, diagnosis, and intervention of CWASD. The OT who accompanied the participants and provided the treatment presented in Study 2 and Study 3 is a competent clinician who had 11 years of experience in working with CWASD and was registered with the Health Professionals Council of South Africa (OT0060321) at the time of data collection. The OT has an additional qualification as a certified provider of ASI with nine years of experience in providing ASI and SBI. The data collected in Study 2 and Study 3 were documented by a panel of trained healthcare professionals competent in working in the field of assessment and intervention in CWASD.

Truthfulness and integrity refer to the adherence to professional standards in conducting research studies. It includes truthful and empirical methods in the planning,

performing, and evaluation of research. Honesty, accuracy, efficiency, and objectivity are emphasised when considering the research principle of integrity (Leedy & Ormrod, 2019). In the current research project, the researcher complied with the professional standards of her profession through integrity, quality, and accountability. All authors were acknowledged for their contribution to the research. Plagiarism was avoided by paraphrasing and interpreting statements, and not using the exact words of the authors. The primary researcher refrained from exaggerating the objectives of the studies. Misleading information and biased representation were avoided. The primary researcher was responsible for the complete disclosure and reporting of all procedures, theories, and data used during the research process. The methods and results of all three studies of the research project were made available to the scientific community through publication in peer-reviewed scientific journals. Participants' parents, respondents, and the school involved were informed of the results, and where available they received an electronic copy of the published articles.

A *conflict of interest* may occur in circumstances where the researchers' ability to conduct or report research results truthfully and accurately is influenced by personal interests. It is the researchers' ethical responsibility to identify and manage any factors that may exist or arise causing a conflict of interest, thereby protecting research confidence (Romain, 2015). The primary researcher declared that no conflict of interest exists in any of the three studies conducted.

2.11. Reliability and Validity

Study 1

To ensure content validity the questionnaire in Study 1 was designed to include questions and statements based on research evidence. Likert-scale-type questions were included to allow for Cronbach's Alpha to be applied (Field, 2018). To identify possible mistakes or ambiguities in the questionnaire a single participant, an OT certified in Ayers Sensory Integration Therapy® with more than 10 years of experience in working with CWASD, was recruited to participate in a pilot study (Ruel et al., 2016). The participant in the pilot study revealed that the questions and statements in the questionnaire were relevant to achieving the research objectives. The participant agreed with the accuracy and interpretation of the statements in the questionnaire. As recommended by the participant three statements regarding proprioceptive activities

were added in the section where SLPs' knowledge of such activities was investigated, since these activities could have both a calming or arousing effect. Concern was raised regarding the length of the questionnaire. It was confirmed that although the questionnaire was lengthy, it was necessary to include many items for each theme of the Likert-scale type questions in order to be able to apply Cronbach's Alpha (Field, 2018).

Studies 2 and 3

The single-subject studies each included more than one participant, strengthening the validity of the results. Significant inter-rater agreement was established between the professional panel members' documentation of the communicative attempts and responses of participants in Studies 2 and 3.

Two independent observers completed a fidelity checklist (Appendix E) related to the data collection processes and procedures related to the assent of participants for Studies 2 and 3. This checklist was adapted from a fidelity checklist used in a similar study by Van Rie and Hefflin (2009). The checklist included questions to be answered 'Yes' or 'No' regarding the duration time of the treatment, control, and interactive activities that were presented. Questions related to participant assent (Guess et al., 2008) were also included.

Interrater reliability was determined by calculating Cohen's Kappa coefficients. Since the introduction of Cohen's kappa (Cohen, 1960), several paradoxes in its interpretation have been pointed out. The difficulties occur because kappa not only measures agreement but is also affected in complex ways by the presence of bias between observers and by the distributions of data across the categories that are used (referred to as "prevalence"). Byrt et al. (1993) introduced the prevalence-adjusted bias-adjusted kappa (PABAK) that adjusts Cohen's kappa for differences in prevalence and for bias between observers, and, accordingly, the PABAK was computed to establish the level of agreement between the two observers. Significant interrater reliability occurred between the independent observers.

Blind analysis of the video recordings took place and was documented by a professional panel consisting of three members. Interrater reliability was calculated by comparing the documentation of the responses of participants in a repeated video clip randomly selected from each week of data collection. The inter-agreement between

the three panel members was evaluated using Fleiss' kappa. Fleiss' kappa is used to determine the interrater agreement between more than two raters or panel members. The p-value associated with Fleiss' kappa was less than 0.05 (p-value < 0.001) in both studies 2 and 3, which indicates that when Fleiss' kappa differs statistically significantly from zero and is statistically significant (McHugh, 2012).

The alternating treatment design implemented in Studies 2 and 3 included a control activity to enhance experimental control (Wolery et al., 2010).

Each of the treatments and the control activity that was to be implemented for each participant on the different days of a week during the treatment phase was selected randomly. At the beginning of each week of the treatment phase, a label for each of the treatments and the control activity was drawn from a bucket by one of the independent observers to determine the order of the treatments and control activity to be implemented on the three different days of the week. The first label drawn was implemented on day 1 of the week, the second label was implemented on day 2 of the week, and the third label was implemented on day 3 of the week. This process was repeated for each participant at the beginning of each week of the treatment phase.

CHAPTER 3

Sensory-based Interventions by Speech-Language Pathologists

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Note: This article was edited in accordance with the editorial specifications of the journal and may differ from the editorial style of the rest of this thesis. The term speech-language pathologist (SLP) is used rather than speech-language therapist (SLT) as being used in Ireland where the journal is published.

Sensory-based Interventions by Speech-Language Pathologists

Keywords: sensory-based interventions, Autism Spectrum Disorder, speech-language pathologists, sensory difficulties, quantitative survey design, multi-disciplinary collaboration

Abstract

Background: The use of sensory-based interventions (SBI) by many parties including speech-language pathologists (SLPs) are evident despite limited proof of their efficacy. Insight into SLPs' implementation, knowledge, and perceptions of SBI are crucial to define and guide such practices in the field of speech-language therapy.

Objectives: The study aimed to gather information regarding the nature of SBI, knowledge of sensory processing and SBI, and perception of the role and outcomes of SBI as implemented by SLPs.

Method: A quantitative survey design was employed. Sixty-five SLPs working in early intervention clinics, public hospital clinics, school settings, and private practice responded to a questionnaire. Results were analysed using SPSS statistical software.

Results: Respondents indicated that they often implement SBI using various sensory activities and equipment. They answered more than half of the questions related to the prevalence and nature of sensory difficulties in children with Autism Spectrum Disorder (CWASD) accurately. Respondents answered fewer questions regarding the differences between SBI and sensory integration therapy accurately. Regular collaboration with and guidance from occupational therapists (OTs) were reported. Respondents acknowledged the role of SLPs in addressing sensory difficulties in CWASD. Positive outcomes for the implementation of SBI in speech-language therapy were stated.

Conclusion: Despite the limited evidence for the efficacy of SBI, SLPs regularly implement such practices to enhance therapy outcomes. The insights gathered from this study support reports of positive outcomes related to SBI. The need for more rigorous efficacy studies, clearer guidelines, and specialised training for SLTs in SBI are highlighted.

Introduction

Sensory difficulties are present in individuals with Autism Spectrum Disorder (ASD) across this heterogenic population (Baraneck et al., 2014; Schauder & Benneto, 2016). Atypical processing of sensory information amongst individuals with certain neurodevelopmental disorders including ASD is described as sensory modulation disorder (Tomcheck & Dunn, 2007, Miller et al., 2007). Longstanding research described five main sensory systems including the tactile, auditory, visual, vestibular, and proprioceptive systems (Ayers, 1972). Maladaptive responses to sensory stimuli occur as a result of the nervous system not processing sensory information received from the sensory systems effectively. Hypo-responsive behaviours, hyper-responsive behaviours, and sensory-seeking behaviours are described as sensory subtypes occurring in the ASD population (Green et al., 2016; Posar & Visconte, 2018; Schauder & Bennetto, 2016; Tomchek & Dunn, 2007; Watson et al., 2012). These difficulties have a profound effect on the development of social competence and joint attention of children with ASD (CWASD) (Dakopolos & Jahromi, 2019; Kojovic et al., 2019). Occupational therapists (OTs) implement Ayers Sensory Integration® (ASI) and Sensory-based interventions (SBI) to address and manage sensory difficulties in individuals (Posar & Visconti, 2018; Weitlauf, 2017).

In ASI opportunities are created for the child to adapt their responses to sensory input, resulting in improved functioning in relation to environmental demands (Ayers, 1976; Bundy & Lane, 2020; Schaaf & Mailloux, 2015). OTs experiencing positive outcomes from using various strategies in ASI guide other professionals including SLPs to use these strategies outside of the context of ASI (Benson et al., 2019). Implementation of such strategies in classrooms, in speech therapy, or at home is referred to as SBI. It is implemented to provide specific sensory experiences to individuals. Commonly used activities may include brushing, massage, swinging, bouncing on a therapy ball, jumping on a trampoline, riding on a half wheel, crawling through a tunnel, wearing a weighted vest or compression by foam rollers (Barton et al., 2015; Lang et al., 2012; Mills et al., 2016). These strategies are aimed at influencing neural arousal to achieve an appropriate level of alertness and engagement for learning to take place (Benson et al., 2019; Frauwirth et al., 2019; Piller & Barimo, 2019; Posar & Visconti, 2018; Thomson-Hodgetts & Magill-Evans, 2018).

Research regarding the efficacy of SBI remains inconclusive (Bodison & Parham, 2018; Case-Smith et al., 2014; Weitlauf et al., 2017). The use of therapy balls to encourage participation and in-seat behaviour was found effective in some studies (Lin et al., 2012; Mills et al., 2018; Schilling & Schwartz, 2004). Positive effects were indicated following parent-implemented SBI for a period of 12 weeks using a variety of sensory activities (Padmanabha et al, 2019). The intervention group scored significantly higher in areas such as making eye contact, in responding to their names, reduced hyper-activity and sensory seeking behaviours compared to the control group. Other studies found that SBI strategies such as the use therapy balls, weighted vests, and brushing to have no effect on reducing unwanted behaviours (Bagatell et al., 2010; Davis et al., 2011; Reichow et al., 2010; Tomchek & Koenig, 2016). Vestibular input (VI) in the form of swinging, jumping, and spinning is another commonly used SBI described in the research with varying results. Results of a recent study determined that jumping on a small trampoline and spinning on a vestibular plate positively influenced sequence learning in minimally verbal CWASD (Katz-Nave et al., 2020). An increased response time and improved continuity of learning were presented in the group that received VI. The researchers contributed the beneficial effect of VS to improved attention and executive functioning achieved due to the neural activation caused by this type of sensory stimulation (Katz-Nave et al., 2020). Researchers were

also interested in the effect of VI on communication and language. An early study identified significant verbal gains in the treatment group receiving VI compared to the control group (Kantner et al., 1982). However, Reily et al. (1983) found no increase in the variety and length of utterances in children who received slow, linear swinging on a platform swing. Ray et al. (1988) and Maddox (1990) reported increased vocal behaviours following VI provided by therapists. An increase in communicative behaviours (Gallaher, 2015; Longerbeam, 2013) and expressive language performance (Preis & McKenna, 2014) were indicated in more recent research by SLPs.

Researchers have called for further investigation into the effectiveness of SBI, as well as clearer guidelines for professionals implementing such practices (Bodison & Parham, 2018; Case-Smith et al., 2014; Preis & McKenna, 2014; Schooling, 2012; Watling & Hauer, 2015; Weitlauf et al., 2017). The positive reports on communication and language hold potential clinical implications for SLPs since they are involved alongside OTs in the assessment and intervention of CWASD (LaFrance et al., 2019; Jordan et al., 2016). SLPs are also expected to understand and manage sensory difficulties in the children they treat (Binns et al., 2019; Piller & Barimo, 2019; Preis & McKenna, 2014; Vitásková & Kytnarová, 2017; White et al., 2018). However as in other professions (Kaiser et al., 2020, May-Benson & Koomar, 2010; Mills et al., 2021) clear guidelines regarding the SLPs role and implementation of SBI to support speech-language therapy are not yet available. This situation may lead to SLPs blindly implementing techniques aiming to enhance therapy outcomes (Preis & McKenna, 2014). A small number of international studies investigating implementation and perceptions of SBI by OTs (Benson et al., 2019; Thompson-Hodgetts & Magill-Evans, 2018), para-educators (Kaiser et al., 2020) and parents (Padmanhaba, 2018; Peña et al., 2021) were identified in the research literature. Respondents in these studies reported positive outcomes in focus, participation, behaviour, and self-regulation related to the implementation of SBI in CWASD. The current study is the first to investigate the implementation and perceptions of SBI by SLPs. To provide a baseline for identifying areas of knowledge to be expanded on, professional training required, developing scope of practice for SLPs treating individuals with ASD, as well as encouraging interdisciplinary collaboration with OTs, the following research questions were posed: What is the nature of the SBI, the knowledge regarding SBI, perceived

outcomes of SBI strategies as well as the perceived role in the implementation of SBI by SLPs in their practices? Furthermore, the study aimed to identify any significant relations between the implementation of SBI and the number of years' experience, work setting, collaboration with OTs, and knowledge of respondents. Investigating relations between these factors may highlight challenges in accessibility, training opportunities, and gaining practical experience for SLPs required to use SBI in clinical practice.

Method

Ethical considerations

The study was approved by the Research Ethics Committee of the Faculty of Humanities at the University of Pretoria. The study adhered to the ethical principles of autonomy, confidentiality, beneficence, non-maleficence, and distributive justice (HPCSA, 2016). The first item in the questionnaire asked participants for their consent to participate. Confidentiality was maintained by distributing the questionnaire through an anonymous link posted online. All SLPs working with CWASD were invited to participate.

Study design

A quantitative survey design was used to collect data for this study. This research design allowed the researcher to investigate key information regarding practices, perceptions, and knowledge of the studied population online (Story & Tait, 2019).

Participants

Permission was received from the administrators of the following groups for the distribution of the questionnaire via a link to which participants could respond anonymously: Allied Health in South Africa, South African Audiologists and Speech-Language Therapists, and Private Practice Growth Club. The link was distributed to these groups in May 2022. The link remained active for a period of six weeks for participants to submit their responses.

A total of 81 respondents submitted their responses to the questionnaire to Qualtrics via the anonymous link. After removing the respondents who did not give consent (n=5), those that spent less than one minute from entering the questionnaire to exiting it (n=8), and that only answered yes to the consent question but didn't answer anything

else (n=3), 65 respondents were left. Using the Software G*Power version 3.1.9.4 (Faul et al., 2007), for a level of significance of 5%, a sample size of 65, and an effect size of 0.5 (Cohen, 1992) the achieved power is 0.992 which is above the ideal value of 0.8. Participants were qualified SLPs working with CWASD across South Africa. SLPs from a variety of therapy settings were included, namely early intervention centers or clinics, public hospital therapy clinics, schools, and private practices. A description of the biographical information, clinical background, and caseloads of respondents is available in Appendix A.

Materials used for data collection

Information gathered from the research literature (APA, 2013; Ayers, 1972; Baranek et al., 2013; Binns et al., 2019; Bundy & Lane, 2020; Case-Smith et al., 2014; Green et al., 2016; LaFrance et al., 2019; Lane et al., 2019; Padmanabha et al., 2019; Peña et al., 2021; Posar & Visconte, 2018; Schauder & Benneto, 2016; Schaaf & Mailloux, 2015; Schoen et al. 2019; Simpson et al., 2019; Tomcheck et al., 2014; Watts et al., 2016; Thompson-Hodgetts & Magill-Evans, 2018), together with the sourced surveys related to SLPs and ASD (Gillon et al., 2017; Schwartz & Drager, 2008) supported the development of an original questionnaire to meet the objectives of this study (Appendix B). Qualtrics XM software was used to design the questionnaire layout, distribute the questionnaire electronically as well as capture and analyse data.

Validity and Reliability

The statements in the questionnaire were based on current research in the field of SBI in CWASD to ensure content validity. To identify possible mistakes or ambiguities in the questionnaire a single participant, an OT certified in Ayers Sensory Integration Therapy® with more than 10 years of experience in working with CWASD, was recruited to participate in a pilot study (Ruel et al., 2016). The participant in the pilot study revealed that the questions and statements in the questionnaire were relevant to achieve the research objectives. The participant agreed with the accuracy and interpretation of the statements. Three statements were added regarding proprioceptive activities as the participant recommended investigating SLPs' knowledge of such activities possibly having both a calming and arousing effect. Concern was raised regarding the length of the questionnaire. It was confirmed that it

was necessary to include many items for each theme of the Likert-scale type questions in order to be able to apply Cronbach's Alpha (Field, 2018).

Cronbach's alpha was applied to enhance internal consistency and scale reliability (Field, 2018). Cronbach alpha is a measure of internal consistency for an instrument. Cronbach values above 0.7 are acceptable (Field, 2018) and indicate that the instrument (questionnaire) is reliable. Several Likert-scale type questions or statements related to a single theme are required to perform Cronbach values in survey research (Field, 2018). For the Likert-scale type questions in the questionnaire of the current study, the Cronbach values were 0.93 for the theme investigating perceived outcomes of SBI and 0.739 for the theme investigating the perceived role of SLPs in the implementation of SBI. All Cronbach alpha values calculated for the questionnaire in this study are above 0.7, indicating reliability.

The applicability of the research was enhanced by obtaining a representative sample of South African SLPs that participated in the study. A strobe checklist was completed (von Elm et al., 2008) to guide the comprehensive reporting of all relevant information.

Data Processing and Analysis

Statistical analysis of data was conducted by a statistician associated with the Department of Science, Mathematics, and Technology Education of the University of Pretoria. The data captured by Qualtrics were exported to the Statistical Package for the Social Sciences (SPSS) version 26. SPSS was used for all data analysis. A level of significance of 5% was used. In order to find statistically significant associations between two categorical variables, the Chi-square test was used. If the p-value was less than 0.05, the association was statistically significant.

The Shapiro-Wilk test was used to test for normality as it is known to have more power in detecting differences from normality (Field, 2018). Since the p-value is not greater than 0.05, the percentage of correct answers is not normally distributed. Thus, the nonparametric Spearman correlation was used instead of the parametric Pearson correlation to investigate relationships between variables. If the p-value is less than 0.05, the correlation was found statistically significant.

Results

Nature of SBI implemented by SLPs

Half of the SLPs who responded indicated often implementing SBI (50%; n=29). Thirty-one percent of respondents (n=18) indicated occasionally implementing SBI. Only 5% (n=3) of respondents never implement SBI when working with CWASD. Significant relationships were identified between the implementation of SBI (dependent variable) and work setting as well as the province (county or state) where respondents worked (independent variable). More than half of the studied population always consult the OT involved in the treatment of the child (56.9%; n=33), with only a small percentage never consulting an OT before treatment (8.6%; n=5). Occasional consultation with an OT was indicated by 6.9% of respondents (n=4), while 27.6% of respondents (n=16) indicated that they would often consult an OT when treating a shared client.

The majority of respondents (56.9%; n=37) indicated implementing jumping, 43.1% (n=28) swinging, 50.8% (n=33) bouncing, 76.9% (n=50) sensory toys, and 58.5% (n=38) sensory boxes. A smaller number used adjusted seating (33.8%; n=22) and oral-sensory stimulation (36.9%; n=24). Only 21.5% (n=14) of respondents make use of weighted equipment, 15.4% (n=10) perform weight-bearing exercises, 18.5% (n=12) massage their clients, and 15.4% (n=10) use half wheels. The main indicated reasons for implementing SBI included making sessions more enjoyable (58.5%; n=38), increasing focus and concentration (70.8%; n=46), increasing communicative behaviours (72.3%; n=47) as well as managing unwanted behaviours (58.5%; n=38). The majority of respondents (69%; n=40) always target language and communicative skills while implementing SBI, while 24.1% (n=14) often incorporate these targets. Most respondents occasionally require assistance when implementing SBI (50%; n=29). 36.2% (n=21) of respondents often require assistance, and 10.3% (n=6) always require assistance when implementing SBI.

Knowledge of SLPs regarding sensory difficulties in CWASD and SBI

On a scale consisting of the options ‘poor’, ‘fair’, ‘good’, and ‘excellent’, 42.1% (n=24) of respondents reported that they only have a fair knowledge of sensory difficulties in CWASD. A small number (5.3%; n=3) of respondents indicated having excellent knowledge of these difficulties. 78.1% (n=45) of respondents have never received any formal training in the implementation of SBI to support speech-language therapy. Only

7% (n=4) of the respondents always feel confident when implementing SBI, whereas 52.6% (n=30) feel so occasionally, and 31% (n=20) often feel confident. When respondents were requested to indicate which sources of training they accessed to gain knowledge in the treatment of children with sensory difficulties, the following were identified: working collaboratively with an OT (81.5%; n=53), self-study or literature review (61.5%; n=40), attending professional training courses (43.1%; n=28), special interest groups (26.2%; n=17). Only 3.1% (n=2) indicated their graduate studies and 6.2% (n=4) their post-graduate studies as a source of training in sensory difficulties.

Participants' knowledge in the areas of sensory difficulties and the implementation of SBI was further investigated by participants indicating the truthfulness of a series of statements. The mean percentage of correct answers for the prevalence and nature of sensory difficulties (Q23-39) was 68.3%. For the next theme on the discrimination between sensory integration therapy and SBI (Q40-53; Q55-57), 45.6% of respondents correctly distinguished between these two different treatment approaches. 64.2% of correct answers were captured in statements related to sensory strategies implemented in therapy (Q58-72; Q54). Kruskal-Wallis (KW) test was run to investigate whether there were significant differences between the universities as well as the number of years experience of SLTs (1-5 years, 6-10 years, more than 10 years) and the percentage correct answers in this section. No significant differences were found.

SLPs' role in the implementation of SBI

SLPs' perceptions of their role in the implementation of SBI were investigated by requesting participants to indicate to what extent they agreed with a series of statements. The highest percentage of respondents indicated strong agreement with the statements supporting the role of SLPs in addressing sensory difficulties in individuals they treat (Q 26; Q 33; Q 36). Strong agreement was also indicated in statements describing the necessity to collaborate with OTs to guide and enhance the outcomes of SBI implemented in therapy (Q 28; Q 32; Q 35; Q 29). Respondents mostly agreed that it is necessary for SLTs to attend and have access to theoretical as well as practical training in SBI Q 31; Q 24; Q 37). Most respondents indicated strong agreement with statements that SLPs needed to access and implement various sensory equipment to provide sensory experiences to the children they treat (Q 27; Q

29; Q 38). Table 1 summarises the results of SLPs' perceptions of their role in addressing sensory difficulties and implementing SBI.

Table 1: SLPs' *perceptions of their role in addressing sensory difficulties and implementation of SBI in the children they treat*

SLPs have a role in addressing sensory difficulties in the children they treat					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 26	57.1% (n=20)	42.9% (n=15)	-	-	-
Q 33	77.1% (n=27)	20.0% (n 7)	-	2.9% (n=1)	-
Q 36	45.7% (n=16)	37.1% (n=13)	5.7% (n=2)	8.6% (n=3)	2.9% (n=1)
Collaboration with OT is necessary to guide and enhance the outcomes of SBI implemented in therapy					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 28	100% (n=35)	-	-	-	-
Q 32	-	-	-	11.4% (n=4)	85.7% (n=30)
Q 35	88.6% (n=31)	8.6% (n=3)	2.9% (n=1)	-	-
Q 29	94.3% (n=33)	2.9% (n=1)	-	2.9% (n=1)	-
The necessity of and access to theoretical and practical training related to SBI					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 31	22.9% (n=8)	8.6% (n=3)	5.7% (n=2)	31.4% (n=11)	31.4% (n=11)
Q 34	71.4% (n=25)	25.7% (n=9)	-	2.9% (n=1)	-
Q 37	77.1% (n=27)	17.1% (n=6)	2.9% (n=1)	2.9% (n=1)	-
SLPs are required to access and implement various sensory equipment to provide sensory experiences to the children they treat					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 27	57.1% (n=20)	42.9% (n=15)	-	-	-
Q 29	61.8% (n=21)	32.4% (n=11)	2.9% (n=1)	2.9% (n=1)	-
Q 38	91.4% (n=32)	5.7% (n=2)	2.9% (n=1)	-	-

SLPs perceptions regarding outcomes of SBI

In the final section of the questionnaire SLPs' perceptions related to the outcomes of SBI were investigated. Once again, respondents were required to indicate their level of agreement with a series of statements. The highest percentage of participants strongly agreed that SBI enhanced therapy outcomes (Q 40, Q 43, Q 45). Furthermore, respondents strongly agreed with positive outcomes in relation to engagement and responsiveness (Q 41, Q 44, Q 53), behaviour (Q 42, Q 46, Q 50), and communication (Q 148, Q 51, Q 54). Most respondents strongly agreed that they would recommend the use of SBI to other SLPs (Q 45, Q 47, Q 52). Table 2 outlines the responses to the statements regarding SLPs' perceptions regarding the outcomes of SBI.

Table 2: *SLPs' perceptions regarding outcomes of SBI*

SBI enhances therapy outcomes					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 40	64.7% (n=22)	29.4% (n=10)	5.9% (n=2)	-	-
Q 43	79.4% (n=27)	17.6% (n=6)	2.9% (n=1)	-	-
Q 45	79.4% (n=27)	17.6% (n=6)	-	-	2.9% (n=1)
Children are more engaged and responsive when SBI is incorporated in speech-language therapy					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 41	73.5% (n=25)	26.5% (n=9)	-	-	-
Q 44	42.4% (n=14)	36.4% (n=12)	18.2% (n=6)	-	3.0% (n=1)
Q 53	52.9% (n=18)	29.4% (n=10)	14.7% (n=5)	2.9% (n=1)	-
Implementation of SBI results in improved behaviour					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 42	70.6% (n=24)	29.4% (n=10)	-	-	-
Q 46	67.6% (n=23)	32.4% (n=11)	-	-	-
Q 50	73.5% (n=25)	23.5% (n=8)	-	2.9% (n=1)	-

SBI increases communicative behaviours					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 48	67.6% (n=23)	23.5% (n=8)	5.9% (n=2)	2.9% (n=1)	-
Q 51	61.8% (n=21)	26.5% (n=9)	8.8% (n=3)	2.9% (n=1)	-
Q 54	50% (n=17)	32.4% (n=11)	17.6% (n=6)	-	-
I would recommend the implementation of SBI to other SLPs					
Question	*Strongly Agree*	*Somewhat Agree*	*Neither agree nor disagree*	*Somewhat disagree*	*Strongly disagree*
Q 45	81.8% (n=27)	15.2% (n=5)	3.0% (n=1)		-
Q 47	61.8% (n=21)	26.5% (n=9)	8.8% (n=3)	2.9% (n=1)	-
Q 52	90.9% (n=30)	9.1% (n=3)	-	-	-

Discussion

SBI are implemented with the intention to influence CWASD's state of arousal during therapy, in the classroom or at home for the child to attend, participate, and learn more effectively (Case-Smith et al., 2014; Lane et al., 2019; Reynolds et al., 2017). This study confirms that even though limited empirical evidence for the efficacy of SBI exists, many therapists continue to implement such strategies in practice as they find it beneficial (May-Benson & Koomar, 2010; Preis & McKenna 2014). A discussion of the results of the study according to the objectives now follows.

Nature of SBI implemented by SLPs

Most respondents indicated that they often implement SBI. Respondents from the Free State implemented SBI significantly more often than those from Kwa-Zulu Natal. This finding may be explained by possible differences in service delivery models across states. Accessibility to interdisciplinary collaboration, specialised equipment, and individual therapy services are influenced by various factors e.g., government funding, availability of posts, and caseload distribution may explain this finding (Thomson-Hodgetts & Magill-Evans, 2018). Furthermore, respondents based in early intervention settings indicated implementing SBI significantly more often than respondents working in paediatric clinics in public hospitals (p-value of 0.032). One possible explanation may be that early intervention centers provide regular therapy services whereas pediatric clinics in public hospitals operate on a monthly consultative service model

due to long waiting lists (Guler et al., 2018). Furthermore, early intervention settings tend to be private institutions and may therefore be better equipped to provide SBI compared to state public hospital clinics. OTs providing community service in the public sector indicated limited resources and lack of mentorship as challenges to service provision (Van Stormbroek & Buchanan, 2016). Respondents' motivation for implementing SBI was the next factor to be determined. When comparing the work setting to respondents' involvement in joint collaborative therapy with an OT, no significant differences between settings were found.

As with OTs (Benson et al., 2019; Thompson-Hodgetts & Magill-Evans, 2018), para-educators (Kaiser et al., 2020) and parents (Padmanhabha, 2019; Peña et al., 2021) from international studies, South African SLPs implement SBI to increase focus, concentration, participation and reduce unwanted behaviours. Additionally, SLPs in the current study's main motivation for implementing SBI was to increase communicative behaviours. This motivation together with the finding that most respondents indicated always incorporating language and communicative targets while implementing SBI, supports the recommendation that SBI should be implemented to enhance and not replace traditional therapy targets (Schooling, 2012).

In contrast to studies investigating the use of SBI by OTs, para-educators and parents indicating most often using massage, joint compression, oral sensory equipment, trampolines, and deep pressure activities (Kaiser et al., 2020; Peña et al., 2021; Thompson-Hodgetts & Magill-Evans, 2018), the most commonly used SBI by the SLPs participating in the current study were jumping, swinging, bouncing, sensory toys and sensory boxes. Less commonly used were oral-sensory stimulation, adjusted seating, weighted equipment, weight-bearing exercises, and massage. This may be due to the selected activities providing movement (vestibular input). Such activities have been linked to an increase in communication (Ayers & Mailloux, 1981; Fallon, 1994; Longerbeam, 2013; Preis & McKenna, 2014). The selected sensory play activities may have been chosen due to the opportunities such activities lend to target language and communication (Sussman, 2012). The selection of certain activities or equipment may also relate to the availability of such equipment or resources in different work settings.

Knowledge of SLPs regarding sensory difficulties in CWASD and SBI

Both the OTs in the study by Benson et al. (2019), as well as the SLPs from the current study, indicated the need for advanced education and training in SBI to improve confidence in the use of such interventions. Although it is concerning that most respondents in this study have not received any formal training in relation to sensory difficulties and SBI, the results have highlighted the value of multi-disciplinary collaboration with OTs to support and guide knowledge and skill development in sensory difficulties in CWASD and the implementation of SBI. Other sources commonly accessed to gain knowledge included self-study/literature reviews, attending professional training courses, and special interest groups. As with school-based OTs (Benson et al., 2019), only a small number of respondents regarded their university studies as a source of sufficient training related to sensory difficulties in children. No significant statistical differences were identified between the percentage of items answered correctly in the 'knowledge of SBI' and respondents' years of experience or the universities they qualified from. Despite a lack of formal training reasonable knowledge was indicated regarding sensory difficulties in CWASD and SBI strategies. Participants achieved a slightly lower mean percentage of correct answers when responding to questions regarding the differences between SBI and sensory integration therapy. This may be due to SLPs in the current study indicating that they mainly gaining knowledge in clinical practise from working with OTs rather than from formal theoretical training. These findings highlight the need for SLPs to receive formal training regarding sensory difficulties and strategies to address these difficulties to enhance therapy outcomes. An introduction to this topic is suggested in pre-graduate university training. In-depth post-graduate training in the theoretical as well as practical implementation of SBI should be available for SLPs working in this field.

SLPs role in the implementation of SBI

Most respondents strongly agreed that SLPs have a role in addressing the sensory difficulties in children and should access a variety of equipment and activities to do so. These findings provide practice-based evidence for the use of SBI. However, further research investigating the efficacy of SBI in relation to language and communicative targets are required for reviewing and expanding the current scope of practice guidelines and developing training programmes for SLPs.

The highest percentages of positive responses with any of the statements in the current study were related to the value and necessity of collaboration with OTs when sharing clients with sensory difficulties (Q 81: 100%; Q 84: 85.7%; Q87: 88.6%; Q91: 94.3%). The main source of training in sensory difficulties and SBI were also indicated to be from working alongside OTs, as opposed to para-educators indicating a trial-and-error approach to implementing SBI (Kaiser et al., 2020). The positive findings regarding collaborating with OTs in the current study are in line with the recommendations from the American Occupational Therapy Association (AOTA) stating that OTs should thoroughly assess children with sensory difficulties before SBI strategies are recommended. Furthermore, these guidelines stipulate that OTs are responsible to guide and train parents and professionals in the implementation of SBI (Frauwirth et al., 2019).

SLT perceptions regarding outcomes of SBI

As in previous studies investigating parents, teachers, and therapists' perceptions regarding the outcomes of SBI many positive effects were perceived by the SLPs in the current study (Benson et al., 2019; Kaiser et al., 2020; Padmanhabha, 2019; Peña et al., 2021; Thomson-Hodgetts & Magill-Evans, 2018). Most of the respondents strongly agreed that implementing SBI during speech-language therapy increased engagement, responsiveness, and communicative behaviours and decreased unwanted behaviours.

As with OTs (Thomson-Hodgetts & Magill-Evans, 2018), SLPs positive experiences in the outcomes of SBI were reflected in their strong agreement in recommending such interventions to other SLPs working with children with sensory difficulties. The study by Benson et al. (2019) indicated that the more experienced the OTs in this study were, the more likely they were to recommend SBI as an intervention. No significant differences in years of experience in working with CWASD and recommendation of SBI were identified in the current study. It may therefore be concluded that SLPs implementation of SBI relates largely to their work setting and related accessibility to equipment and interdisciplinary collaboration with OTs. Increased knowledge and confidence as more experienced practitioners do not necessarily result in SLPs implementing SBI more often. Nor does inexperience appear to deter therapists from using SBI on a regular basis.

Most respondents in the current study as well as the previously discussed survey studies (Benson et al., 2019; Kaizer et al., 2020; Padmanhabha, 2019; Peña et al., 2021; Thomson-Hodgetts & Magill-Evans, 2018) indicated that they experienced positive outcomes related to SBI. However, researchers and practitioners need to be cautious of the phenomenon of confirmation bias when relating perceived positive outcomes to the efficacy of SBI. This phenomenon may occur when respondents are invested in the outcomes studied (Mcray, 2015).

The insights from the findings of this study confirm the gap between clinical practice and empirical research in the implementation of SBI not only by SLPs, but OTs, parents, and educators alike (Barton et al., 2015; Case-Smith et al., 2014). Furthermore, the study draws attention to the need for training SLPs in sensory difficulties and SBI and SLPs acknowledgement of their role in addressing sensory difficulties in the children they treat.

Clinical implications and recommendations

The findings of this study confirm that many SLPs from a variety of settings regularly implement SBI. They perceive positive outcomes and would recommend SBI to other SLPs.

The results also indicated the valued role of collaborative intervention with OTs in guiding and training SLPs in SBI. These collaborative practices have not been clearly defined and documented. SLPs may play a valuable role in further exploring and documenting the principles and benefits of joint intervention. SLPs are called upon to initiate high-quality efficacy studies in collaborative practices with OTs.

Even though guidelines and training opportunities for SLPs in sensory difficulties and SBI are limited, it is important to ensure the ethical implementation of such interventions in clinical practice. It is recommended that SLPs will take responsibility in seeking further training and information as well as mentorship from OTs specialising in this area to ensure ethical conduct.

Strengths and limitations

The current study is the first study investigating the implementation of SBI by SLPs. Although scarce studies investigating the efficacy of SBI have been conducted by SLPs, no previous studies have included SLPs as respondents in survey research

related to SBI. The study highlighted important issues related to training, accessibility, practice-based evidence, and efficacy in the implementation of SBI by SLPs.

Although a representative sample of SLPs responded, only South African SLPs were included. The small sample size limits the generalisation of the findings in this study. Respondent fatigue (O'Reilly-Shah, 2017) needs to be considered due to the length of the survey in the current study. The length of the questionnaire may have caused respondents to get tired causing a deterioration in the quality of their responses.

Future research

Available research studies in the implementation of SBI are limited. Therefore, further research in the efficacy of SBI is required to ensure that clinicians base their clinical decisions on the best evidence available for such practices. Most of the studies that are available did not include sufficient information regarding the duration of treatments, internal variables, and measurement of outcomes (Murdock et al., 2014).

Researchers are urged to carefully consider the quality indicators in efficacy studies (Bodison & Parham, 2018). As a profession closely involved in providing assessment and intervention for individuals with various neurodevelopmental disorders, SLPs are called upon to contribute to the evidence base for the practices they find beneficial. Without further research by SLPs regarding the influence of SBI on the communication and language of the population they treat, support for such interventions in pre-graduate training and the scope of practice documents will remain limited.

Including a research design that allows the researcher to collect qualitative data e.g., interviews or focus group discussions may be valuable in providing further insights into respondents' perceptions and experiences. Including a larger international sample of participants in a future qualitative research study may be valuable in comparing the implementation of SBI by SLPs from different countries. Survey studies investigating the perceptions of para-professionals, teachers, parents, and OTs in relation to SBI are available (Benson et al., 2019; Kaizer et al., 2020; Padmanhabha, 2019; Peña et al., 2021; Thomson-Hodgetts & Magill-Evans, 2018). However, to our knowledge, the perceptions of individuals with ASD receiving SBI have not been studied. A study investigating the experience and perceptions of individuals receiving SBI may be valuable in providing further insight into the influence of these interventions.

Conclusion

This study aimed to investigate the implementation of SBI by SLPs in CWASD. SLPs from various work settings across South Africa responded to an online questionnaire. The findings provide valuable insights into SLPs' implementation of SBI in CWASD contributing to practice-based evidence for the implementation of SBI. Further research by SLPs related to the efficacy of SBI in their practices is recommended.

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Competing interests

The authors have declared that no competing interests exist.

Author contributions

The first author conceived of the presented idea and developed and interpreted the theory and results of the study. The second and third authors guided and verified the methods and supervised the proposed theory, methods, and findings of this work. The fourth author analysed and interpreted the data statistically.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

CHAPTER 4

The influence of vestibular input on the communicative attempts of children with Autism Spectrum Disorder

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Note: This article was edited in accordance with the editorial specifications of the journal and may differ from the editorial style of the rest of this thesis. The term speech-language pathologist (SLP) is used rather than speech-language therapist (SLT) as used in the country where the journal is published.

Abstract

Background: Communicative challenges in Autism Spectrum Disorder often involve reduced communicative attempts and behaviors. The current study investigated how vestibular input as a Sensory-based intervention influenced the frequency of spontaneous communicative attempts of preverbal children with Autism Spectrum Disorder.

Method: An alternating treatment research design was implemented including a baseline phase and an alternating phase including two treatment activities and a control activity. Data was documented by a professional panel and analysed using line graphs as well as inferential and descriptive statistics.

Results: Both participants showed significantly more spontaneous communicative attempts during an interaction after receiving either of the two Sensory-based interventions compared to baseline and control conditions.

Conclusion: The results indicate a positive influence of vestibular input activities on the frequency of communicative attempts of preverbal children with Autism Spectrum Disorder.

Keywords: Autism Spectrum Disorder, communicative attempts, Sensory-based interventions, vestibular input, preverbal

Introduction

Autism Spectrum Disorder (ASD) is characterised by persistent challenges in social communication. These challenges may include limited communicative attempts, lack of social reciprocity, limited nonverbal communication, and an inability to adapt to the social context to build relationships (APA, 2013). Lack of social reciprocity may include an atypical approach when initiating communication, as well as a limited range of communicative functions (Maljaars et al., 2011; Shumway & Wetherby, 2009). Due to restrictive verbal as well as non-verbal means of communication, the communicative intentions of preverbal children with ASD are often subtle and expressed through the manipulation of others' bodies or hands (Keen et al., 2016; Shumway & Wetherby, 2009). Furthermore, sensory difficulties are present throughout the various levels of functioning in individuals with ASD (Schauder & Benneto, 2016). Hypo-responsiveness and hyper-responsiveness to sensory stimuli are described in the DSM-V (APA, 2013) as the main dimensions of atypical sensory processing in individuals with ASD. These difficulties have a profound effect on children with ASD's social competence and joint attention (Dakopolos & Jahromi, 2019; Kojovic et al., 2019).

Seeking sensory experiences through behaviors such as jumping, spinning, and rocking may be the result of a hypo-responsive vestibular system. Such behaviors may negatively impact children with ASD's ability to engage in an interaction, participate in, and perform activities addressing higher cognitive functions (Ayers, 1972; Lane et al., 2019). The past decade has seen more studies emerging investigating the implementation of Sensory-based interventions

(SBI) to enhance engagement, learning, and performance. However, evidence-based research in this area is still limited. SBI involve providing sensory experiences and modifying the environment to influence neural arousal and provide sensory experiences to consequently enhance functioning in many contexts and tasks (Benson et al., 2019; Case-Smith et al., 2014; Lane et al., 2019; Reynolds et al., 2017).

Ayers suggested the use of specific vestibular input (VI) strategies e.g., swinging to influence the registration of movement and cortical arousal in children to perform better in a variety of daily contexts (Ayers, 1979). Despite limited research evidence of the effectiveness of such strategies they are widely used and associated with positive outcomes in classrooms (Benson et al., 2019) and clinical settings by occupational therapists (OTs) and speech-language pathologists (SLPs) (Weitlauf et al., 2017; Raubenheimer et al., 2022).

In a study employing an alternating treatment design, Van Rie and Hefflin (2009) documented a functional relation between exposure to VI by swinging prior to task engagement, and the accuracy of responses to a task. Another participant in this study's performance increased after bouncing on a therapy ball before task engagement. A more recent study investigated the effect of VI (jumping on a small trampoline, spinning on a vestibular plate whilst sitting, and then lying down) on sequence learning in minimally verbal children with ASD (Katz-Nave et al., 2020). The authors identified a significant improvement in response time and continuity during skill learning in the group of children with ASD who received VI in between learning sessions compared to the control group. These researchers contributed the beneficial effect of VI to improved attention and executive functioning achieved due to the neural activation caused by this type of sensory input (Katz-Nave et al., 2020). Recent studies found increased cognitive strategy use and executive functioning in classroom settings following vestibular and proprioceptive sensory input (Mills et al., 2021; Mills & Chaparro, 2018). For the SLP the effect

of VI on communication is of interest as the implementation of VI during communication intervention may enhance therapy outcomes.

Early on it was theorised that VI positively influences auditory processing due to its effect on neural arousal consequently having a direct impact on speech and language skills (Ayers & Mailloux, 1981; Lane et al., 2019). Over the years, researchers have continued to study the effect of VI on verbal behaviors in children with developmental delays. In one study increased communicative responses during speech therapy following slow, linear swinging in children with ASD occurred (Longerbeam, 2013). A follow-up study concluded that although slow, linear vestibular swinging significantly increased responses in one mode of communication, for example, gestures, a progression to other modes of communication did not occur (Gallaher, 2015). The results of another small study identified an increase in spontaneous communication, length of utterances, and participation in children with ASD following occupational therapy targeting sensory integration (Preis & McKenna, 2014). The researchers related this improvement to individually selected sensory challenges considering the motivational and physical aspects of each participant. In an earlier study of children who received sensory integration therapy, the treatment group scored significantly higher on post-test language scores than the children who did not attend sensory integration therapy prior to speech-language therapy (Fallon, 1994). Research regarding the efficacy of SBI remain scarce and inconclusive (Bodison & Parham, 2018; Case-Smith et al., 2014; Weitlauf et al., 2017). Validity in research studies investigating SBI have been criticised for not adhering to certain quality indicators (Sandbank et al., 2020; Bodison & Parham, 2018).

Researchers called for rigorous studies investigating the benefits of SBI pertaining to behavior regulation, attention, participation, vocalisation, and language (Bodison & Parham, 2018; Case-Smith et al., 2014; Preis & McKenna; Sandbank et al, 2020; Weitlauf et al., 2017). Furthermore,

there are limited studies to evaluate interventions for preverbal children with ASD compared to studies including verbal children with ASD (Koegel et al., 2019). Preverbal (sometimes referred to as minimally verbal) children with ASD do not use any verbal language or have only acquired a few words or fixed phrases that are not used effectively for functional communication (Kasari et al., 2013; Tager-Flusberg & Kasari, 2013). The current study aimed to contribute to the research base for SBI in children with ASD in relation to communication by investigating the effect of VI on the communicative attempts of preverbal children with ASD during an interactive activity. The posited research question is therefore: does VI provided prior to an interactive activity affect the frequency of spontaneous communicative attempts of a preverbal child engaging in an interactive activity?

Method

Design

The study implemented a multiple single-participant alternating treatment design allowing for the identification of individual differences in response to different treatments and treatment conditions (Byiers et al., 2012; Lobo et al., 2017). This design permitted the identification of causal relationships through the manipulation of the independent variable (VI), the precise measurement of the dependent variable (spontaneous communicative attempts), and the control of extraneous variables (age, cognition, other interventions, etc.) (Lobo et al., 2017; Price et al., 2017).

Ethical Considerations

The study was approved by the Research and Ethics Committee, Faculty of Humanities, University of Pretoria (HUM018/0720). Participants' parents provided informed consent for participation in the study. Strict guidelines were followed to ensure participants' safety during

treatment. The primary researcher and OT closely monitored the behavior of the participants since they did not have the means to communicate verbally or to use augmentative communication to provide assent (Guess et al., 2008). Activities did not continue in a case where a participant displayed any behavior indicating discomfort, anxiety, or fear.

Setting

The study took place at an independent school for children with ASD consisting of three preschool classrooms with a maximum of 7 learners in a classroom. A teacher and classroom assistant or para-professional supports the learners in each classroom. The SBI employed in this study was provided by an OT certified in the provision of sensory integration therapy in the school's therapy room. A steel bar was added to the room for the suspension of the therapy swing (Treatment 1). Other than the sensory equipment required for the treatments, other equipment was removed from the room to minimize distractions. The school's security camera was mounted in the corner of the ceiling of the therapy room. The interactive activity was presented in a small separate classroom by the primary researcher, an SLP experienced in assessing communicative skills in children with ASD. The classroom was also cleared of any equipment and resources apart from the circular table used for the presentation of the activity. The tripod and camcorder were set up approximately two meters away to the side of the table. A wooden box surrounded the tripod to obscure it.

Participant Screening and Selection

As per purposive sampling (Etikan et al., 2016), children from the preschool classes whose parents provided written informed consent were screened for eligibility to participate according to the selection criteria (Etikan et al., 2016). Medical records of participants needed to indicate a confirmed diagnosis of ASD by a developmental paediatrician or other suitable professional trained in the diagnosis of ASD using the Autism Diagnostic Observation Schedule – second

edition: ADOS-2 (Lord et al., 2012) without the presence of co-morbidities (e.g., Epilepsy or Down Syndrome). Normal hearing and vision screening results also needed to be indicated. Furthermore, the selection criteria required participants to be at a preverbal stage of communicative development. Atypical vestibular processing, namely specifically sensory seeking behaviors or hypo-responsiveness to vestibular sensory input activities needed to be indicated in the results of the Sensory Processing Measure Preschool Edition (SPM-P) (Glennon et al., 2011; Miller Kuhaneck et al., 2010a, 2010b. Participants could not receive speech-language therapy or occupational therapy for the duration of their involvement in the data-collection phase of the study. Any changes in medication needed to be reported to the primary researcher since participants could not be included if a change in prescription medication e.g., Risnia occurred during data collection.

Participants' medical records were reviewed to determine whether a diagnosis of ASD was confirmed by a developmental pediatrician following the completion of the ADOS-2. Medical records were also reviewed to determine the results of vision and hearing screening tests. Results from the ADOS-2, as well as the 'Communicative Means and Functions' checklist (Wetherby, 1995) completed by the parents and teachers of the children in the preschool classrooms were used to determine the communicative stage of participants. The Sensory Processing Measure (SPM-2) (Glennon et al., 2011; Miller Kuhaneck et al., 2010a, 2010b) was completed by the classroom staff and parents of participants. An occupational therapist (OT) with post-graduate training in sensory integration therapy scored and interpreted the results from this assessment in order to confirm and describe response patterns of the sensory systems of the proposed participants. Parents of participants provided written permission for their child to be excluded from occupational and speech-language therapy for the duration of data collection. Parents also provided written agreements to inform the primary researcher of any changes in medication used by children during the time of data collection. Two children from

the preschool classes met the selection criteria. Information describing each participant is outlined in Table 1.

Table 1

Description of Participants

Variable	Participant 1	Participant 2
Gender	Male	Male
Age	2 years, 7 months	5 years, 5 months
SPM Results	Dysfunction in the areas of balance and motion, vestibular processing, planning, vision, hearing and touch. The participant seeks out movement and presents with poor coordination and rhythm. He appears unaware of auditory stimuli and odors but distracted by visual stimuli. He enjoys looking at spinning objects.	Dysfunction in the areas of balance and motion, vision, planning and body scheme. The participant seeks activities like pushing and pulling and often jumps. Visual stimuli distract him. He enjoys looking at spinning objects.
Language and communication	No functional language. Manipulates others' hands or arms to fulfill a need. Reaches for wanted items.	Occasionally uses single words to request desired items. Sometimes echoes other's utterances. Occasionally points to desired items.

Study phases

Baseline data were collected on three consecutive days over a period of one week. During this phase, VI was not provided prior to the presentation of the interactive activity. Four data points

were established for Participant 1, and three data points were established for Participants 2 and 3 during the baseline phase. The week after baseline data was collected the treatment phase commenced. This phase was conducted over a four-week period. Data collection took place on three consecutive days during each of the four weeks of the treatment phase. Either the control activity (lotto board), a swinging activity (Treatment 1), or rocking activity (Treatment 2) preceded the interactive activity in this phase.

Materials and Equipment

The Sensory Processing Measure-Preschool (SPM-P) (Glennon et al., 2011; Miller Kuhaneck et al., 2010a, 2010b) was used to select eligible participants. This scale is completed by a parent and/or teacher of children between 2 and 5 years of age. It provides a comprehensive profile of children's sensory processing difficulties and is appropriate for use in young children with ASD (Brown, 2018). The 'Communicative Functions and Means Checklist' (Wetherby, 1995) was completed by teachers and parents to provide the information required to determine the communicative stage of the proposed participants. This checklist describes the means and functions of an individual's communication. Equipment used to provide VI included the 'flying saucer' platform swing from 'PlayOn' (Treatment 1). This swing creates a safe, contained space with side barriers. It allows swinging in a variety of developmental positions and movements. Treatment 2 included the 'half wheel' from 'PlayOn'. This wheel allows participants to sit wide-legged over the wheel or lie in the arch of the wheel. The treatment activities were recorded by the school's security camera mounted in the corner of the ceiling in the therapy room. A wooden lotto board was used as a contrasting activity to the movement activities implemented during the treatments. Participants chose a familiar puzzle used in their classroom that they were able to complete without assistance. This activity required participants to pick up a wooden picture and match it to the picture on the puzzle board. The primary researcher used bubbles, picture books, wind-up toys, a battery-operated bunny, and a foam dart rocket

during the interactive activities. These activities were chosen to encourage joint attention and provide communicative opportunities (Lord et al., 2012, Mundy et al., 2003; Wetherby & Prizant; 2002). A Canon HF R806 Full HD Video Camera was set up on a tripod surrounded by a wooden box to record participants' responses during the interactive sessions.

Data Collection Process

The primary researcher considered the procedures of the procedures of the ADOS-2 and Early Social Communication Scales: ESCS (Mundy et al., 2003) in the presentation of the interactive activities. As recommended by Mundy et al. (2003) the therapist responded naturally but briefly to communicative initiations during the presentation of the interactive activities. The OT and primary researcher implemented visual aids and keywords throughout the data collection phases to prepare and direct participants. During the baseline phase, the OT collected the participants from their classroom and accompanied them to the classroom where the interactive activities took place. During the treatment phase, the OT accompanied participants to the therapy room to participate in the selected activity and then to the classroom where the interactive activities took place. The primary researcher was positioned in front of participants in a face-to-face position across the half-circular table during the interactive activities. A soft mattress was placed under the swing and the swing cables were secured by the OT prior to each treatment session. The OT positioned herself beside participants in order to assist if required during the treatment and control activities. The treatment activities were implemented for five minutes in the therapy room before continuing to the interactive activity (Murdock et al., 2014; Van Rie & Hefflin, 2009). The control activity was also completed within five minutes before continuing to the interactive activity in the classroom. Upon entering the classroom where the interactive activity took place, the therapist waited for the participant to be seated before introducing the toy or activity with a verbal prompt 'Look!'. Following this initial prompt, further prompts were only introduced when a participant remained irresponsive.

Data processing

Severe and complex communication difficulties are more difficult to assess using standardised assessments. Direct observation, precise description, and quantification of the communicative functions and means measured provide a more representative analysis of children with ASD's social communicative skills (Maljaars et al., 2011). Data processing involved the clinical observation and blind analysis of the video recordings by a professional panel of three members to ensure reliable documentation of the data collected. The panel consisted of an OT and two SLPs trained and experienced in the assessment and intervention of children with ASD. Only spontaneous communicative attempts of participants were documented on a record form. A communicative attempt was considered to be spontaneous if it was not preceded by any communicative prompt such as an expectant pause, gesture, or verbal prompt. Due to the challenges in determining directed eye contact/eye gaze from video recordings (Higuch et al., 2018), this study did not include eye contact or eye gaze in the analysis. Table 2 outlines the communicative means considered during the documentation of participants' spontaneous communicative attempts. The panel calculated and documented the total spontaneous communicative attempts for each video recording. This data was then analysed.

Table 2

Means of Communication

Communicative behavior/means of communication	Description
Body movements	Body movement may be used to request or to indicate anticipation and shared enjoyment.
Body manipulation	Using the body of another person as a tool; for example: putting the hand of another person onto a lid to open without coordinated eye contact. Body manipulation may also include standing in close proximity to another person to indicate a need; for example: wanting to go to the toilet.
Gesture	Spontaneous hand or body movements used communicatively.
Vocalisation	Speech sounds, grunts, and exclamations.
Facial expression	Behaviors such as smiling, frowning, and gasping to intentionally express emotion.
Verbal	Verbal means included the use of onomatopoeia, word approximations, words, and phrases.

Note. Adapted from Keen et al., 2016; Lord et al., 2012; Shumway & Wetherby, 2009; Wetherby & Prizant, 2002

Data Analysis

Statistical analysis of data was conducted by a statistician associated with the Department of Science, Mathematics, and Technology Education of the University of Pretoria. Line graphs were drawn to level, trend variability, consistency, the immediacy of the effect as well as any overlapping data patterns (Price et al., 2017). Descriptive statistical analysis proceeded to further analyse the treatment effects (Lane & Gast, 2014; Rakap, 2015). NAP and Tau-U for comparisons between baseline and intervention (Lee & Cherney, 2018; Parker et al., 2009) were considered.

Reliability

More than three data points were established during the baseline and treatment phase for each participant over a period of 5 weeks which controlled for the maturation effect (Lobo et al., 2017). Data collection took place from 8:00 am - 9:00 am each day in order to minimise the sensory input or stimulation received from the environment on the days of data collection and account for participants' behavior or alertness varying during different times of the day. The treatments, control activity, and interactive activity to be implemented for each day of the week were selected randomly to enhance fidelity (Rvachew & Matthews, 2017).

To enhance procedural reliability the presentation of the interactive activities and treatment activities were standardised as far as possible. The same rooms were used, and the therapists were seated in the same positions for the implementation of the activities. The treatment equipment was removed from the therapy room on the days that the control activity was implemented. Only the selected treatment equipment (swing or half wheel) remained in the therapy room during treatment days. Movements were provided for exactly 5 minutes on each occasion during the treatment phase. Since participants presented with hypo-responsive sensory profiles and sensory-seeking behaviors a fast-paced but steady perpendicular motion was

applied during the treatments throughout the treatment phase (Bodison & Parham, 2018). Only one treatment was administered per day during data collection since anecdotal evidence suggests that the effects of VI may last 6-8 hours after being administered which may have compromised the findings (Benson et al., 2019; Vos, 2015). The interactive activities continued for a maximum period of 5 minutes. An independent technician edited the video recordings of the interactive sessions to include the middle 2 minutes of each recording in order for an equal amount of data to be documented by panel members for each participant. By not including the first and last minutes of the recordings the primary researcher also attempted to control for participants getting settled in the environment at the beginning of the session and boredom or lack of interest that may have occurred at the end of the session.

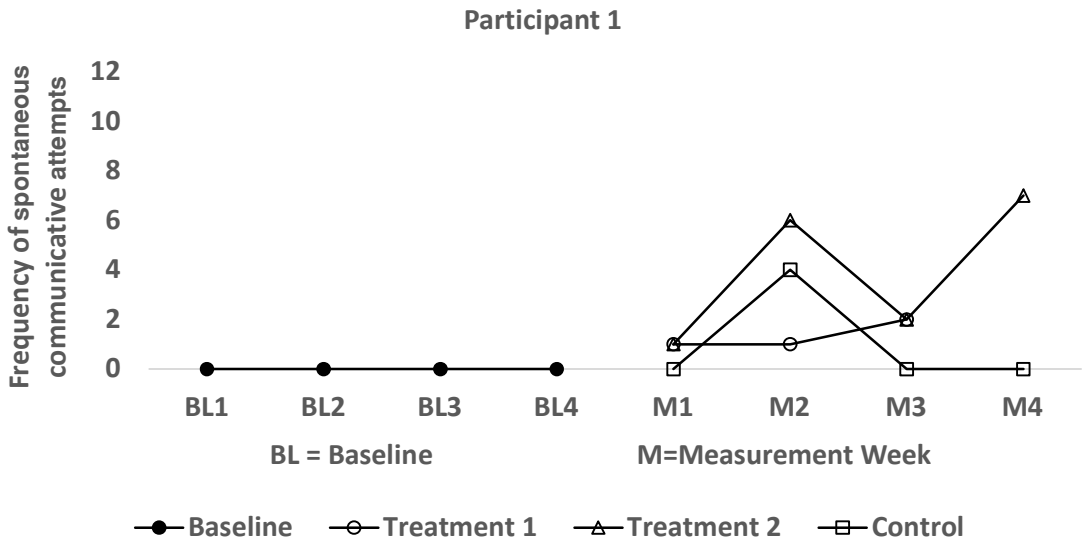
Two special education teachers acted as independent observers to determine the procedural reliability of the treatment and interactive activities. Randomly selected video recordings from each week of data collection were viewed. The observers then completed a fidelity checklist indicating whether procedures were followed accurately in the recorded data sessions observed. The PABAK (Byrt et al., 1993) to calculate inter-reliability between the two observers equaled 0.636 indicating substantial positive agreement (Viera & Garret, 2005). Fleiss Kappa was calculated at 93.5, indicating acceptable agreement in the documentation of data between the three panel members (Rakap, 2015).

Results

The results are visually presented in a line graph for each participant followed by an outline of the visual analysis and descriptive statistics. Figure 1 represents the results for Participant 1 and Figure 2 represents the results for Participant 2.

Figure 1

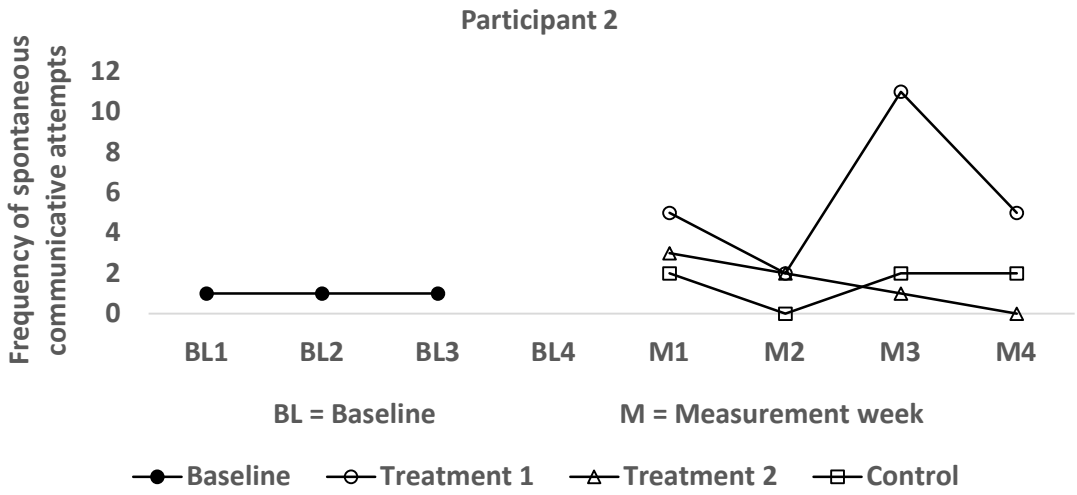
Frequency of Spontaneous Communicative Attempts: Participant 1



Visual analysis of Figure 1 and descriptive statistical results indicate that all the values for absolute level change, mean level change, median level change, and relative level change are positive, indicating an improvement from baseline to both treatment activities. The values of the control activities were the lowest for all values except for relative level change where it is only lower than Treatment 1. With the majority of the control values being the lowest, control had the smallest improvement.

Figure 2

Frequency of Spontaneous Communicative Attempts: Participant 2



Visual analysis of Figure 2 indicated that all the values for absolute level change, mean level change, median level change, and relative level change are positive, indicating an improvement from baseline to the treatment activities, with those values of the control activities being the lowest for all values except for median level change where it was only lower than Treatment 1. With the majority of the control values being the lowest, control had the smallest improvement. None of the trends in the baseline, for any of the participants, were statistically significant ($p > 0.05$), thus, there was no need for baseline correction in the statistics that follow. The p-value equaled 0.034 (< 0.05) for baseline vs Treatment 1 for Participant 1 and Participant 2, respectively. This indicates a significant improvement between baseline and intervention. For Participant 1, there was a significant improvement between baseline and Treatment 2 ($p = 0.021$), however, this was not the case for Participant 2 ($p = 0.596$). It is noteworthy that all p-values for the comparison of baseline vs control were well above 0.05, showing there were no statistically significant differences between the baseline and control values. The results when both participants were combined for the Tau-U and the NAP, respectively, and all differences

between baseline and treatments were indicated as statistically significant at a 5% level of significance. When comparing baseline vs control, the results were not statistically significant for the Tau-U test (p = 0.248), however, it was for the NAP Tau non-overlap test (p = 0.032). Finally, we wanted to investigate whether there were significant differences between the control and the treatments. For single-case study designs, the standardized mean difference (SMD) test is typically used with the divisor being either the pooled SD or the SD of the control group (Andrade, 2020), with the latter being used in this study. For Participant 1 the difference was only significant for Treatment 2 (p=0.003) and for Participant 2 the difference was only significant for Treatment 1 (p= <0.001).

Discussion

SBI interventions are regularly employed to facilitate on-task behavior, increase focus, and enhance self-regulation (Raubenheimer et al., 2022; Camarata et al., 2020; Preis & McKenna 2014). Results of increased communication and language performance following SBI hold promise for SLPs working to support the communicative development of preverbal children with ASD (Gallaher, 2015; Longerbeam, 2013; Preis & McKenna, 2014).

Findings indicated that Participant 1 showed significantly more spontaneous communicative attempts after receiving VI from Treatment 1 and Treatment 2 compared to baseline. However, a significant increase was only indicated for Treatment 1 when compared to the control condition. Participant 1 produced significantly more spontaneous communicative attempts during Treatment 2 compared to Treatment 1. Results for Participant 2 indicated a higher rate of spontaneous communicative attempts for Treatment 1 compared to the baseline and control data. However, no significant differences occurred in the rate of spontaneous communicative attempts for Treatment 2 compared to baseline or control activities.

The results of this study varied across participants and between treatments and should therefore be interpreted with caution. The findings support previous research findings indicating that individual CWASD respond differently to SBI (Van Rie & Hefflin, 2009). Despite variations and limited data, as in similar studies there is some evidence of increased performance after receiving VI (Gallaher, 2015; Katz-Nave, 2020; Longerbeam, 2013; Mills et al., 2021; Mills & Chaparro, 2018; Van Rie & Hefflin, 2009). The increases in spontaneous communicative attempts during the treatment phase in this study are thought to be the result of positive changes in neural arousal brought about by VI resulting in higher performance in cognitive functions including language and communication (Ayers, 1972; Katz-Nave et al., 2020; Lane et al., 2019). Another theory drawn from the results is that by providing VI through movement, participants were less likely to engage in movement seeking behaviors during the interactive activity. They may therefore have been more able to focus on this activity rather than their need for movement (Benson et al., 2019).

Clinical Impact

The results of this study contribute to the emerging body of research supporting the use of SBI to possibly increase communicative attempts of children with ASD resulting in more opportunities to shape and expand on their communicative behaviors. Furthermore, the implementation of SBI strategies is a low-cost and non-invasive procedure. Collaboration between OTs trained in sensory integration therapy and SLPs trained in communication intervention is highlighted in this study and encourages interdisciplinary intervention in this population.

Study Limitations and Future Research Directions

The current study has many limitations. As a single-subject research study, the participant sample was limited to two participants selected from a single context. Repetition of this study

on a larger study sample across different settings will be necessary to support the findings. Challenges in the absolute standardisation of interactive activities and individual preferences for specific activities diminish the positive findings. Establishing more data points over a longer period for each activity will be valuable in future studies to support the current research.

Chapter 5

The influence of vestibular input on the responses of children with Autism Spectrum Disorder using picture exchange communication to request

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Abstract

Aim: Vestibular input (VI) activities are linked with skill learning, engagement and communication. This study investigated the influence of VI activities on the responses of non-verbal children with Autism Spectrum Disorders (CWASD) when prompted to request a reinforcer using picture exchange communication.

Design: A single subject alternating treatment design was implemented. Three participants were selected from a classroom supporting non-verbal CWASD.

Method: Baseline data points were collected over a one-week period followed by the treatment phase where three data points were collected over a four-week period. Participants engaged in

VI activities or a control activity prior to a picture exchange communication activity. Data was documented by a professional panel. Data analysis included visual and statistical analysis.

Results: Participants' responses increased significantly after receiving VI. An immediate effect was identified. This finding holds value for educators and therapists aiming to increase the consistency and pace of responding and skill learning in CWASD. Participants responded differently to the two treatments.

Conclusion: The findings hold value for therapists and educators to support responsiveness and skill learning to aid communication in children with Autism Spectrum Disorder. Inter-disciplinary collaboration between occupational therapists and speech-language pathologists is highlighted.

Keywords: Children with Autism (CWASD), Vestibular input (VI), Sensory-based interventions, picture exchange communication

Introduction

Despite advances in education and intervention, an estimated 30 % of children with Autism (CWASD) remain minimally verbal throughout their lifespan (Koegel et al., 2019). Furthermore, sensory difficulties are present throughout the different levels of functioning in CWASD (Schauder & Bennetto, 2016). These difficulties have a profound effect on the development of social competence and joint attention (Dakopolos & Jahromi, 2019).

Three main deviant response patterns to sensory stimuli are identified in CWASD: Hyper-responsiveness, hypo-responsiveness, and sensory-seeking behaviors (Ayers, 1979; Green et al., 2016; Posar & Visconte, 2018; Schauder & Bennetto, 2016; Tomchek & Dunn, 2007;

Watson et al., 2012). These atypical responses occur throughout the lifespan across various response systems of individuals with ASD (APA, 2013).

Longstanding theories in sensory integration include the tactile system, vestibular system, and proprioceptive systems as the main systems for regulating behavior (Ayers, 1972). The tactile system responds to touch and discriminates what is touching us and where we are being touched. (Bundy & Lane, 2020; Schaaf & Mailloux, 2015). When an individual has a hyper-responsive tactile system, they are over-stimulated by tactile input and may avoid or react negatively to certain textures or touch e.g., avoiding or pulling away from touch, or reacting negatively to certain textured foods. Whereas an individual with a hypo-responsive tactile system has decreased awareness of tactile sensations. In CWASD this may present as limited exploration of the environment or manipulation of toys since their tactile system is less sensitive to information received when touching, pressing, rubbing, or mouthing items (Bundy & Lane, 2020; Schaaf & Mailloux, 2015). The vestibular system refers to the semi-circular canals in the inner ear. This system is involved in posture, coordination, and balance. It provides information on the position of our body in relation to gravity (Bundy & Lane, 2020; Schaaf & Mailloux, 2015). With a hyper-responsive vestibular system an individual is over-stimulated by vestibular input and may therefore react negatively to movement e.g., may display fear or easily get nauseous from movement; avoiding play or exploring apparatus where feet leave the ground. A hypo-responsive vestibular system results in decreased awareness of vestibular sensation e.g., seeking sensory experiences through behaviors such as jumping, spinning, and rocking; may appear clumsy (Bundy & Lane, 2020; Schaaf & Mailloux, 2015). The muscles, joints, and tendons in the body are involved in the proprioceptive sensory system. This system is responsible for registering body awareness in order to perform motor activities (Bundy & Lane, 2020; Schaaf & Mailloux, 2015). Hyper-responsiveness and hypo-responsiveness of the

proprioceptive system presents similarly since input to this system can be both calming and alerting e.g., pushing, pulling, crashing, and biting behaviors (Bundy & Lane, 2020; Schaaf & Mailloux, 2015). Dysfunction in any of the main sensory systems is likely to have a negative effect on development and learning in CWASD.

A relationship between deviant sensory patterns and the development of engagement is evident. Hypo-responsiveness to sensory stimuli impacts the ability of CWASD to attend to and participate in social as well as non-social activities (Nowell et al., 2020). Hypo-responsiveness to stimuli from the environment may prevent CWASD to respond to their name, respond to bids for joint attention, imitate others and engage in play with others and with toys (Baranek et al., 2006; Baranek et al., 2013; Nowell et al., 2020). Repetitive behaviors have also been linked to hypo-responsiveness, further limiting CWASD's social and play engagement (Freuler et al., 2012). Motor development in CWASD may also be affected by deviant sensory response patterns. Atypical processing of the proprioceptive system for instance, negatively impact on postural stability and motor planning (Blanche et al., 2012). Difficulties with vestibular processing are also linked to motor planning difficulties as well as challenges with visual processing (Ayers, 1972; Lane et al., 2019). Although the functioning of all the sensory systems may impact on engagement and participation in CWASD, this study focussed on the positive findings related to the vestibular system and its influence on neural arousal.

Providing vestibular input (VI) through movement has a significant impact on neural arousal (Ayers, 1972; Lane et al., 2019). Neural arousal influences an individual's ability to register and interpret sensory information (Ayers, 1979). VI reaches the reticular formation in the brainstem where arousal regulation occurs (Kilroy et al., 2019). Fast-paced movements are associated with an increase in neural arousal, whereas slow, linear movements can decrease

arousal (Schaaf & Mailloux, 2015). Ayers suggested the use of specific vestibular sensory input strategies e.g., swinging to influence cortical arousal in children to perform better in a variety of daily contexts (Ayers, 1979).

In a study employing an alternating treatment design, Van Rie and Hefflin (2009) documented a functional relation between exposure to VI by swinging prior to task engagement, and the accuracy of responses to a task. Another participant in this study's performance increased after bouncing on a therapy ball before task engagement. Murdock et al. (2014) found no significant improvement in engagement, stereotypical/repetitive behaviors, and in seat-behavior in a group of CWASD receiving slow, linear swinging in between table-top tasks compared to the control group. However, the study of Murdock et al. (2014) has been criticised as participants' level of arousal was not assessed prior to VI being provided. If participants were not found to be hyper-aroused, slow linear swinging would most likely not achieve an improvement in participation and engagement in the table-top activities (stringing beads, building a puzzle, and coloring) performed in this study (Bodison & Parham, 2018). A recent study investigated the effect of VI (jumping on a small trampoline, spinning on a vestibular plate whilst sitting, and then lying down) on sequence learning in minimally verbal CWASD (Katz-Nave et al., 2020). The authors identified a significant improvement in skill learning in the group of CWASD who received VI compared to the control groups of CWASD who did not receive VI in between learning sessions. An increased response time and improved continuity of learning were presented in the group that received VI. The researchers contributed the beneficial effect of VI to improved attention and executive functioning achieved due to the neural activation caused by this type of sensory stimulation (Katz-Nave et al., 2020). These positive findings provide a rationale for the current study. Could the positive influence of VI in responsiveness and skill learning of

CWASD also occur when teaching preverbal children to use an alternative and augmentative system of communicating such as picture exchange?

The term 'preverbal' population in this study refers to the heterogeneous group of children that either does not use any verbal language or have acquired only a few words or fixed phrases that are not used effectively for functional communication (Kasari et al., 2013; Tager-Flusberg & Kasari, 2013). The preverbal population of CWASD often requires support to develop alternative or augmentative means of communication (Iacono et al., 2016).

Picture exchange communication is commonly implemented to support communication in CWASD who do not make use of verbal communication (Flippin et al., 2010). The Picture Exchange Communication System (PECS) developed by Bondy & Frost (1998) is the first known picture-based program used successfully in young CWASD. Compared to other augmentative communicative systems the PECS system does not require eye contact, verbal or motor imitation, or symbolic matching as prerequisites for implementing the system (Bondy & Frost, 2001). It's a low-tech and child-initiated communication system that can be implemented at an age as early as 2 years. The core principle of the PECS is for the communicator to give a representative picture to a communication partner in exchange for a desired item. A functional communicative interaction is therefore created (Bondy & Frost, 1998).

Since great variability occurs within the preverbal population, therapists should apply their clinical expertise to adapt and combine therapy approaches to meet the needs of this heterogeneous population (Watkins et al., 2017). Occupational therapists (OTs) often recommend and implement VI activities in special education classrooms e.g., swinging to influence cortical arousal which in turn enhances attention, participation, learning, and communication (Benson et al., 2019; Thompson-Hodgetts & Magill-Evans, 2018; Weitlauf et

al., 2017). However, evidence for these interventions outside of the context of sensory integration therapy remains limited and inconclusive, and researchers called for more studies investigating the benefits of such interventions pertaining to behavior regulation, attention, participation, vocalisation, and language (Weitlauf et al., 2017; Bodison & Parham 2018; Case-Smith et al., 2014; Preis & McKenna, 2014). The current study yields to the call for efficacy studies in Sensory-based interventions such as VI as well as for studies to include preverbal CWASD (Brignell et al., 2018; Lord et al., 2018). This study was initiated to investigate more effective skill learning when alternative/augmentative communication systems are introduced in the preverbal population of CWASD. The following research question is posited: What influence will VI have on the frequency of responses of CWASD using picture exchange to request a reinforcer?

Method

Design

The study implemented a multiple single-participant alternating treatment design. This design permitted the identification of causal relationships through the manipulation of the independent variable (VI), the precise measurement of the dependent variable (requesting responses), and the control of extraneous variables (age, cognition, other interventions, etc. (Lobo et al., 2017). Each participant acts as their own control allowing researchers to limit the influence of variables such as socio-economic status, cognitive ability, concurrent interventions, and age (Lobo et al., 2017, Price et al., 2017).

Ethical considerations

The study was approved by the Research and Ethics Committee, Faculty of Humanities, University of Pretoria (HUM018/0720). Participation in the study was voluntary and participants could withdraw from the study at any time. Safety precautions were taken when setting up the equipment and providing the movement (rocking and swinging) The parents of the participants and the school's principal provided informed consent to participate in the study. Confidentiality was maintained during data capturing and storage (HPCSA, 2016). Activities did not continue in a case where a participant displayed discomfort, anxiety, or fear (Guess et al., 2008).

Participants

Due to the small population of CWASD meeting the selection criteria for this study, participants were selected through purposive sampling (Etikan et al., 2016) from a preschool class at an independent school for CWASD. The selection criteria required participants to have a confirmed diagnosis of ASD by a developmental pediatrician using the Autism Diagnostic Observation Schedule, second edition (ADOS-2) (Lord et al., 2012). Participants were required to be between the ages of 3-5 years, and at a preverbal stage of communication. Participants' medical records should indicate normal hearing and vision. Only children who were not using or exposed to picture exchange communication were eligible for participation. Participants' parents had to agree that they will not engage in any treatment or therapy for the duration of data collection.

Setting

The study took place at an independent school for CWASD situated in Bloemfontein, the capital of the Free State province or county. There is a high demand for specialised education for CWASD in the Free State. Special schools equipped to support CWASD in the Free State and surrounding rural areas are scarce (Botha, 2014). Although there has been a growth in the number of privately owned centers established to meet the growing need for autism-specific services in this area, the school where this study took place remains one of a handful of facilities offering educational services to this population.

The school consists of three preschool classes with a maximum of 7 learners in a classroom. A teacher and classroom assistant or para-professional supports the learners in each classroom. The participants in this study were selected from the 'high support classroom' where learners do not yet communicate verbally.

The Sensory-based interventions employed in this study were provided in the school's therapy room. A steel bar was added to the room for the suspension of the therapy swing required as a treatment in this study. Other than the sensory equipment required for the treatments, other equipment was removed from the room to minimize distractions. The PECS activity was presented in a separate small classroom. The classroom was also cleared of any equipment and resources apart from the circular table used for the presentation of the activity.

Personnel

An independent occupational therapist certified in the provision of sensory integration therapy implemented the treatments in the school's therapy room. The primary researcher, a speech-language pathologist (SLP) presented the PECS activity. A professional panel consisting of

three members, an OT, and two SLPs experienced in diagnosis and intervention for CWASD observed the recorded data collection sessions and documented the responses from participants. Statistical analysis of data was conducted by a statistician associated with the Department of Science, Mathematics, and Technology Education of the University of Pretoria.

Materials and Equipment

The parents and teachers of each participant completed the SPM-P (Parham et al., 2007). The SPM-P uses a norm-referenced, standardised rating scale. This scale is completed by a parent and/or teacher of children between 2 and 5 years of age. It provides a comprehensive profile of children's sensory processing difficulties and is appropriate for use in young CWASD (Brown, 2018).

Equipment used in the treatment phase to provide VI included the 'flying saucer' platform swing manufactured and distributed by 'PlayOn' in Johannesburg, South Africa (Treatment 1). This swing creates a safe, contained space with side barriers. Treatment 2 included the 'half wheel' also manufactured and distributed by 'PlayOn'. These treatments were selected for their safety as well as the range of movement they allowed.

The control activity involved a wooden lotto board where participants placed four pictures onto the board. This activity was selected due to its simplicity (matching a large wooden piece to a matching picture) and its familiarity to participants.

The picture exchange activity based on the PECS was selected since this activity is suitable for CWASD with minimal functional communication (Bondy & Frost, 1998). A laminated picture representing each reinforcer was prepared. The selected reinforcers included a light-up rubber ball, toy bunny, music box, squishy toy, wind-up toys, and bubbles. These reinforcers were

selected for their sensory properties and possible communicative opportunities they offered since they often require an adult to operate or activate the toy (Sussman, 2012).

A Canon HF R806 Full HD Video Camera was set up on a tripod to record participants during the interactive sessions.

Dependent variables

The dependent variable studied was the presence or absence of a response from a participant when enticed with a reinforcer. A response involved the participant picking up the picture and handing it over to the primary researcher when enticed with a reinforcer.

Procedures

Participant screening and selection

As per purposive sampling, children from the preschool classes of the selected school were screened for eligibility to participate according to the above-stated selection criteria (Etikan et al., 2016). Participants' medical records were reviewed to determine whether a diagnosis of ASD was confirmed by a developmental paediatrician following completion of the ADOS-2. Results from the ADOS-2 as well as the 'Communicative Functions and Means Checklist' (Wetherby, 1995) completed by the parents and teachers of the children in the preschool classrooms were used to determine the communicative stage of participants. The Sensory Processing Measure (SPM-2) (Parham et al., 2007) was completed by the classroom staff and parents. The occupational therapist scored and interpreted the results from this assessment in order to confirm atypical response patterns of the vestibular system of the proposed participants.

Three children from the preschool classes met the selection criteria. All three participants were male between 4-5 years of age. They used body movement; body manipulation and vocalisation

as means of communication. Each participant presented with hypo-responsive behaviors and sensory-seeking behaviors namely excessive swinging and spinning in the area of vestibular processing.

Study phases

Baseline phase

Baseline data were collected on four consecutive days over a period of one week. During this phase, VI was not provided prior to the presentation of the picture exchange activity.

Treatment phase

The treatment phase continued over a five-week period. Data collection took place on three consecutive days during each of the five weeks of the treatment phase. Either the control activity, swinging activity (Treatment 1), or rocking activity (Treatment 2) preceded the picture exchange activity. The researcher presented a different reinforcer during the picture exchange activity on each day of the week.

Data collection

Before data collection commenced participants were required to partake in a preparation session where they received physical prompting to hand over the picture in response to being enticed by a reinforcer. Once participants handed over the picture spontaneously (without the need for a physical prompt) data collection continued without any further physical prompting.

The primary researcher positioned herself in front of participants in a face-to-face position across the half-circular table during the picture exchange activities. As in the preceding picture exchange sessions, each participant was enticed with a reinforcer before the picture of the reinforcer was placed in front of them on the table, and the researcher held out her hand to

request the picture. The researcher then waited for a count of 5 seconds for the participant to pick up the picture and hand it over (Bondy & Frost, 1998). If the participant responded, the reinforcer was handed to him for a short period of time before the examiner encouraged the participant to hand it back by saying 'my turn' and gently taking the reinforcer. The sequence was then repeated. The primary researcher presented the picture exchange activities for a maximum of five minutes.

The OT collected participants from their classroom and accompanied them to the therapy room. The OT and primary researcher implemented visual aids and emphasised keywords throughout the data collection phases to prepare and direct participants. The OT positioned herself beside participants during the treatment activities maintaining minimal interaction in order to assist them if required.

The OT observed participants' responsiveness upon entering the therapy room treatment to determine the type of movement to be applied according to participants' state of arousal and responsiveness (Bodison & Parham, 2018). The OT applied fast-paced, higher-ranged movements throughout the treatment phase since all three participants presented with hypo-responsive sensory profiles and sensory-seeking behaviors (Schaaf & Mailloux, 2015). Swinging or rocking took place for five minutes before continuing to the picture exchange activity (Murdock et al., 2014; Van Rie & Hefflin, 2009).

Data analysis

Data processing involved the clinical observation and blind analysis of the video recordings by a professional panel of three members namely an OT and two SLPs experienced in diagnosis and intervention for CWASD. A participant picking up and handing over the picture in response to enticement with the reinforcer or an absence of a response was documented. The number of

responses for each participant for each recorded session of data collection was then processed and a line graph was drafted for each participant to be inspected visually.

Data analysis in single-participant research relies mostly on the visual inspection of line graphs alone to determine the level, trend variability, consistency, the immediacy of the effect as well as any overlapping data patterns (Lobo et al., 2017; Viera & Garrett, 2005). When an effect of the independent on the dependent variable is identified, further statistical analysis is suggested to calculate the extent of the effect (Rakap, 2015). Since an effect was identified upon visual inspection of the line graphs in this study, statistical analysis proceeded to determine the significance of the treatment effects. The Tau-U test was used since this is a nonparametric test for single-subject research that is appropriate for small data sets and does not have any restricting assumptions such as normality or independence (Lee & Cherney, 2018).

Reliability

With an alternating treatment design repetition of measurements over a short period of time is possible. This allows for control of the maturation effect (Lobo et al., 2017). As recommended, the study included more than three data points for each participant during the treatment phase (Lobo et al. 2017). Data collection took place from 8:00 am - 9:00 am each day in order to minimise the sensory input received from the environment on the days of data collection. Furthermore, having a set time for data collection may contribute to controlling the variability of children's behavior and state of arousal throughout different times of the day. The treatment or control activity that was implemented for each day of the week as well as the reinforcers that were used on each was selected randomly to enhance the fidelity of treatments (Rvachew & Matthews, 2017).

To enhance procedural reliability standardising the presentation of the picture exchange activity as well as the VI activities were crucial. Swinging and rocking movements were provided for exactly 5 minutes on each occasion. The positioning of the primary researcher and participant and the steps for the presentation were the same for each session of data collection according to the PECS procedures (Bondy & Frost, 1998).

The picture exchange activity continued for a maximum of 5 minutes for each day of data collection. However, video recordings were edited to only include the middle 2 minutes of each recording to allow for an equal amount of data to be documented by the professional panel for each participant.

The documentation of randomly selected clips by the three panel members was compared to determine inter-panel reliability. The Fleiss Kappa was calculated at 0.792, indicating substantial agreement in the documentation of data between the three panel members (Rakap, 2015).

Inter-panel reliability was calculated by comparing' the documentation of the responses of participants in a repeated video clip randomly selected from each week of data collection. The inter-agreement between the three panel members was evaluated using Fleiss' kappa. Fleiss' kappa is used to determine the inter-rater agreement between more than two raters or panel members. The p-value associated with Fleiss' kappa is less than 0.05 (p-value < 0.001), which indicates that when Fleiss' kappa differs statistically significantly from zero and is statistically significant (McHugh, 2012). The documentation of randomly selected clips by the three panel members was compared to determine inter-panel reliability. The Fleiss Kappa was calculated at 0.792, indicating substantial agreement in the documentation of data between the three panel members (Rakap, 2015).

Results

The results of the current study are visually presented in a line graph for each participant with a Table 1 displaying the visual data descriptively. Figure 1 represents the results for Participant 1. Participant 2. Figure 3 represents the results for Participant 3.

Figure 1

Response to prompt to request a reinforcer: Participant 1

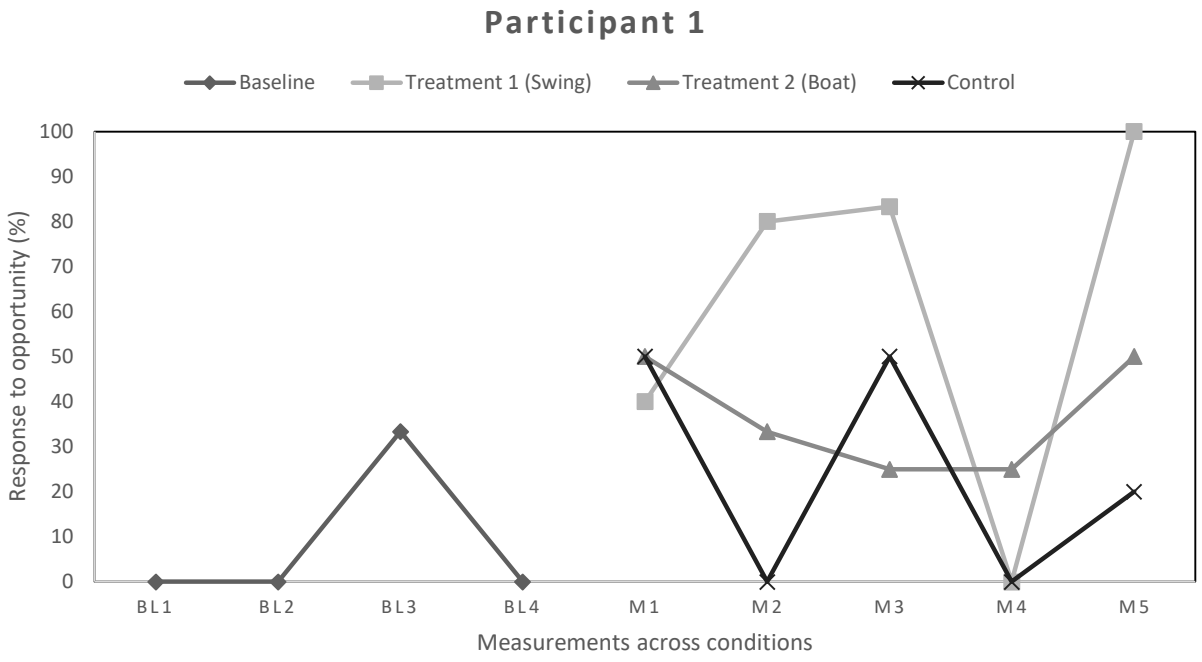

Figure 2

Response to prompt to request a reinforcer: Participant 2

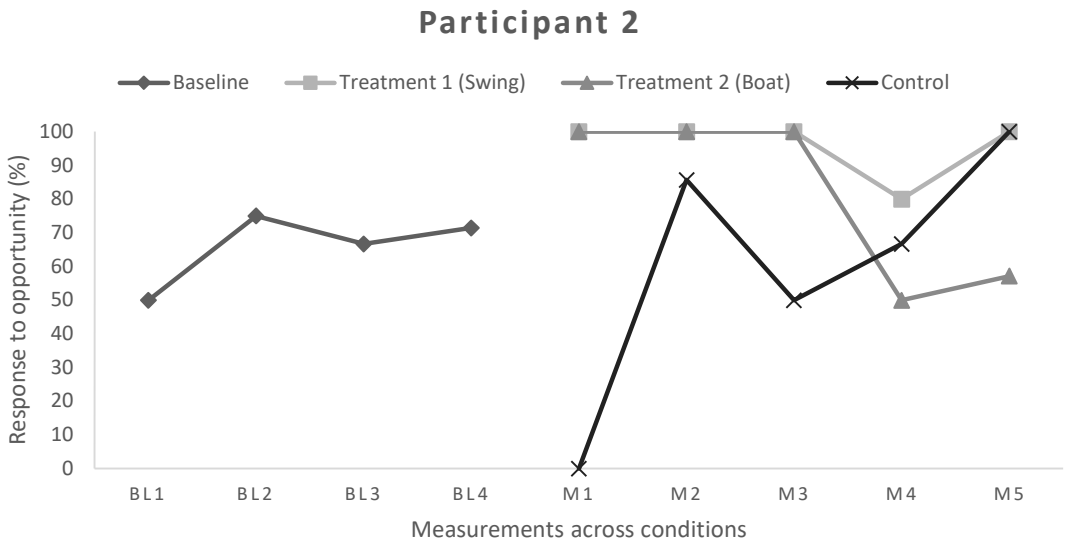

Figure 3

Response to prompt to request a reinforcer: Participant 3

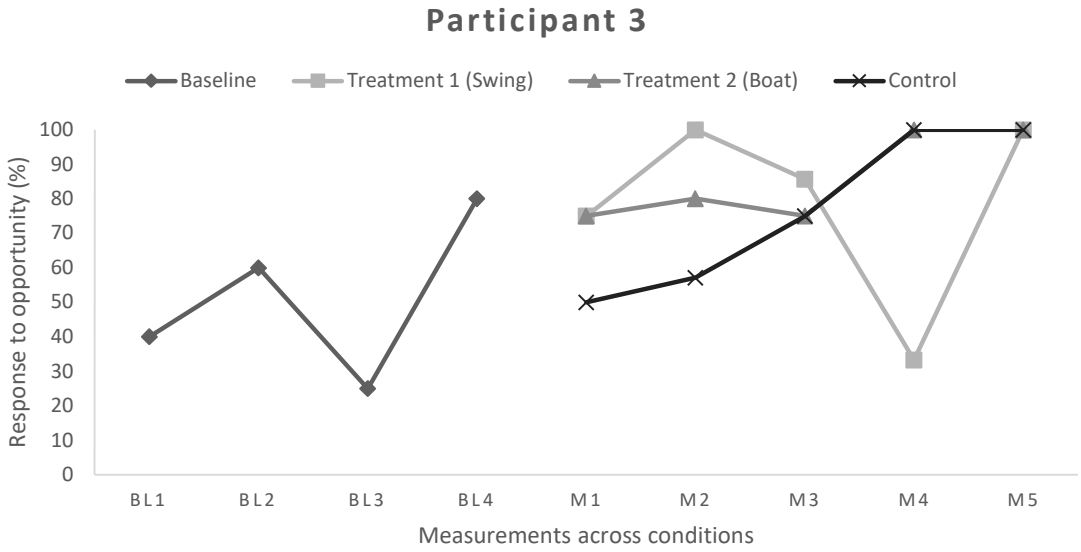

Table 1

Descriptive statistics for line graphs

	Descriptive statistics	Baseline	Treatment 1	Treatment 2	Control
Participant 1	Mean	8.33	60.67	36.67	24.00
	Median	0.00	80.00	33.33	20.00
	SD	16.67	40.44	12.64	25.10
	IQR	25.00	71.67	25.00	50.00
	Absolute level change	N/A	40.00	50.00	50.00
	Mean level change	N/A	52.33	28.33	15.67
	Median level change	N/A	80.00	33.33	20.00
	Relative level change	N/A	43.33	25.00	8.33
Participant 2	Mean	65.77	96.00	81.43	60.48
	Median	69.05	100.00	100.00	66.67
	SD	11.06	8.94	25.56	38.74
	IQR	19.94	10.00	46.43	67.86
	Absolute level change	N/A	28.57	28.57	-71.43
	Mean level change	N/A	30.23	15.65	-5.30
	Median level change	N/A	30.95	30.95	-2.38
	Relative level change	N/A	30.95	30.95	-26.19
Participant 3	Mean	51.25	78.81	86.00	76.43
	Median	50.00	85.71	80.00	75.00
	SD	23.94	27.52	12.94	23.36
	IQR	46.25	45.83	25.00	46.43
	Absolute level change	N/A	-5.00	-5.00	-30.00
	Mean level change	N/A	27.56	34.75	25.18
	Median level change	N/A	35.71	30.00	25.00
	Relative level change	N/A	35.00	25.00	1.07

Absolute change, mean level change, median level change, and relative change

The descriptive statistics for the line graphs in Table 1 indicate that the mean/median of Treatment 1 and Treatment 2 are higher than those of the baseline assessment and that the mean/median of the control behavior is very similar to the mean/median of the baseline for each participant. Positive values for absolute level change, mean level change, median level change, and relative level change in both treatments were also indicated for each participant. An improvement from baseline to treatment is evident with the values of the control being the lowest.

From Table 1 it can be seen that all the values for absolute level change, mean level change, median level change, and relative level change for Treatment 1 and Treatment 2 are positive, indicating an improvement from baseline to the second phase. On the other hand, the values for control are negative, showing deterioration. It should be noted that the absolute level change indicated deterioration for all three conditions. The significance of the positive findings in absolute change, mean level change, median level change, and relative change was then calculated.

Trends in baseline

To support the visual analysis NAP and Tau-U were calculated for comparisons between baseline and treatment data (Lane & Gast, 2014; Lee & Cherney, 2018). Firstly, it needed to be determined if positive findings may have occurred even without treatment. Therefore, the first statistics conducted were to investigate whether the trend of the baseline was statistically significant. The p-value for Participant 1 was 0.734. The p-value for Participant 2 and Participant 3 was calculated at 0.497. None of the trends in the baseline, for any of the three

participants, was statistically significant ($p > 0.05$). Therefore, there was no need for baseline correction in the statistics that follow.

Baseline vs treatments and control

Tau-U test for comparisons between the baseline, treatments, and control were calculated at a 5 % and 10 % level of significance for each participant. Table 2 outlines the results of this test.

Table 2

Tau-U test for comparisons between baseline, treatments, and control

Participant	Comparison	Tau-U	SD Tau-U	NAP	SD NAP	Z	p-value
1	Baseline vs Treatment 1 (swing)	0.750	0.408	0.875	0.408	1.837	0.066**
2	Baseline vs Treatment 1 (swing)	1.000	0.408	1.000	0.408	2.450	0.014*
3	Baseline vs Treatment 1 (swing)	0.600	0.408	0.800	0.408	1.470	0.142
1	Baseline vs Treatment 2 (boat)	0.750	0.408	0.875	0.408	1.837	0.066**
2	Baseline vs Treatment 2 (boat)	0.350	0.408	0.675	0.408	0.857	0.391
3	Baseline vs Treatment 2 (boat)	0.750	0.408	0.875	0.408	1.837	0.066**
1	Baseline vs Control	0.400	0.408	0.700	0.408	0.980	0.327
2	Baseline vs Control	0.000	0.408	0.500	0.408	0.000	1.000
3	Baseline vs Control	0.500	0.408	0.750	0.408	1.225	0.221

Note. N/A = *Significant at 5% level of significance **Significant at 10% level of significance

From Table 2 the p-value equals 0.014 (< 0.05) for baseline vs Treatment 1 for Participant 2, indicating a significant improvement between baseline and intervention. No significant

difference was indicated for baseline vs Treatment 2 for Participant 2 ($p = 0.391$). It is worth noting that although the p-value for baseline vs Treatment 1 for Participant 1 ($p = 0.066$) and those for the baseline vs Treatment 2 for Participant 1 ($p = 0.066$) and Participant 3 ($p = 0.066$) are not statistically significant at a 5% level of significance, they are statistically significant at a 10% level of significance, indicating a significant improvement for Treatment 1 (Participant 1) and Treatment 2 (Participants 1 and 3) when considering a higher chance (10% vs 5%) of making a Type I error of finding a significant result when, in fact, there isn't one. As these p-values are very close to 0.05, one could argue that, if a larger sample size was used (i.e., more measurements at the baseline of intervention), a statistically significant result at 0.05 may have been evidenced.

When comparing the baseline conditions vs control conditions throughout, the results were not statistically significant for the Tau-U test ($p = 0.203$). It is noteworthy that all p-values for the comparison of baseline vs control are well above 0.05 and 0.10, showing there are no statistically significant differences between the baseline and control values. These results further strengthen the assumption that the findings are significant and that the treatments were effective.

The results of the standardized mean difference test (Lane & Gast, 2014) indicated statistically significant differences between Treatment 1 and control conditions for Participant 1 and Participant 2. No significant difference was detected between Treatment 2 and the control conditions for any of the three participants. The difference between Treatment 1 and the control conditions was not significant for Participant 3.

Discussion

VI activities are implemented by therapists to influence neural arousal and consequently positively impact performance and engagement in tasks (Benson et al., 2019). The present study contributes to the positive findings of previous studies investigating the influence of VI on engagement and performance in CWASD (Ayers, 1972; Lane et al., 2019; Benson et al., 2019; Thompson-Hodgetts & Magill-Evans, 2018; Weitlauf et al., 2017).

An increase was indicated in the frequency of responses from the baseline condition and Treatment 1 for all three participants. Treatment 2 only brought about an increase in the frequency of responses for Participants 1 and 3. Katz-Nave et al. (2020) also found positive results related to response time and continuity of learning in the treatment group that received VI (spinning, jumping, and swinging) compared to the control group. A single-subject study similar to the current research study indicated an increase in the accuracy of responses to a learning task in one participant after swinging, and improved task engagement in another participant after bouncing on a therapy ball (Van Rie & Hefflin, 2009). A significant improvement was also found for Participants 1 and 2 when receiving Treatment 1 and Treatment 2 compared to when they participated in the control activity. The increase in responses during the treatment activities occurred immediately supporting the effectiveness of the treatments rather than the impact of rehearsal of the activity (Byiers et al., 2012).

As in previous efficacy studies, the current study contributes improvements in skill learning and responsiveness in CWASD to increased neural arousal following such activities (Katz-Nave et al., 2020; Preis & McKenna, 2014; Van Rie & Hefflin, 2009). VI in the form of movement activities such as spinning, swinging, and bouncing reach many parts of the brain and has been linked to positive changes in alertness, learning and functioning for many years.

The positive effect indicated after engaging in such activities may be attributed to neural activation (Ayers, 1972; Lane et al., 2019; Preis & McKenna, 2014).

The participants in this study responded differently to the two methods of VI used in Treatments 1 and 2. This finding further contributes to the understanding that many phenotypes and variations in sensory processing exist in CWASD (Simpson et al., 2019). Although some individuals clearly benefit from this input, others' performance may not increase significantly with certain forms of VI (Van Rie & Hefflin, 2009). The slight deterioration in performance as measurements progressed is speculated to be the result of the motivational levels of the participant decreasing over time resulting in boredom due to the repetition of activities.

Implications for practice

The finding that VI had a positive influence on the frequency of responses when requesting a reinforcer through picture exchange holds value for practitioners. VI strategies may be used by practitioners to increase the consistency and pace of skill learning in the CWASD that they treat. Even small improvements in the initiation of communicative behaviors to request using picture exchange may bring about a valuable contribution to the non-verbal or minimally verbal population of CWASD (Howlin, et al., 2007).

An OT trained in sensory integration therapy provided the VI activities in this study, while the primary researcher, an SLP, presented the picture exchange communication activity. This study is encouraging interdisciplinary collaboration to the benefit of the ASD population (Piller & Barimo, 2019). Following the results of this study, therapists are encouraged to deliver combined services to enhance therapy outcomes (White et al., 2018).

Limitations of study

To our knowledge, this study is the first study to investigate the influence of VI on CWASD's responses in a communicative task using picture exchange. Although scarce studies investigating the influence of VI on skill learning and performance are available in the field of education and psychology (Katz-Nave et al., 2020; Van Rie & Hefflin, 2009), no studies could be found in the field of speech-language pathology. It is also the only known study where an OT trained in sensory integration therapy and an SLP collaborated to incorporate each profession's skills and expertise in the areas of sensory interventions and picture exchange communication.

The participant selection included three non-verbal CWASD since this population is under-represented in research compared to the older verbal population of CWASD. Researchers called for further studies including this population (Brignell et al., 2018; Lord et al., 2018). The alternating treatment design implemented in this study allowed for individual differences and treatment effects to be identified in this heterogeneous population that may have gone unnoticed in a larger randomised control trial (Etikan et al., 2016). Including a control activity further strengthens the validity of the outcomes (Byiers et al., 2012).

The small sample size and multiple single-case context of this study, as in most single-subject research studies, unfortunately, limit the generalisation of the findings to the larger population. The short time span of data collection also limits the interpretation of the data in relation to maintenance and further improvements as treatment progress (Dakopolos & Jahromi, 2019).

Future research directions

Replication of this study where a larger sample size and multiple contexts are included may establish further support for the implementation of VI during intervention in the larger population of CWASD. Investigating the maintenance of a positive effect over a longer period of time is also suggested. Further studies in the influence of Sensory-based interventions including VI on other communicative and linguistic skills are also required since these practices are commonly implemented even though sufficient evidence-based research studies are not available (Preis & McKenna, 2014). Clear guidelines regarding the duration or intensity of VI activities required to yield an effect are not yet available (Case-Smith et al., 2014) making further research regarding the specifications of these practices critical.

Conclusion

The study indicated an increase in the frequency of responses to request a reinforcer through picture exchange when participants received VI prior to participation. The findings hold valuable insights for clinical practice and education to enhance responsiveness and skill learning in CWASD.

Conflict of Interest

The authors have declared that no conflict of interest exists.

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Data Availability

Data is availabn request from the first author.

CHAPTER 6

DISCUSSION, IMPLICATIONS, AND CONCLUSION

> Knowing is not enough; we must apply. Wishing is not enough; we must do.
> JOHANN WOLFGANG VON GOETHE

Chapter Aim: The aim of this chapter is to summarise and draw conclusions from the research findings, discuss the implications, and critically evaluate the research that was conducted. Subsequently, the clinical impact is discussed, recommendations for future research are made and the limitations of the study are described in this chapter.

6.1. Introduction

Research studies related to the influence of SBI on the communication of CWASD are scarce. However, as with this novel research project, anecdotal evidence and evidence from small clinical studies suggest positive changes in the communication and language performance of CWASD after receiving SBI. VI activities such as swinging, spinning, jumping, and rocking are among the SBI related to an increase in communicative behaviours and language functioning of CWASD. Although OTs commonly introduce and provide SBI outside of the context of sensory integration therapy, SLTs also play a role in implementing SBI to support and enhance performance in therapy. A lack of guidelines and training opportunities for SLTs and anecdotal evidence of positive outcomes following interdisciplinary intervention between SLTs and OTs in this area motivated the current thesis.

6.2. Summary of research findings

Three studies were conducted to meet the aim of this compilation research project. The project aimed to investigate the implementation of SBI by SLTs to enhance communication intervention. The findings of Study 1 provide further evidence that, even though limited empirical evidence for the efficacy of SBI exists, many therapists continue to implement such strategies in practice as they find it beneficial (May-Benson & Koomar, 2010; Preis & McKenna 2014). Respondents to the questionnaire in this initial study presented with a fair knowledge related to the prevalence and nature of sensory difficulties in CWASD and the strategies implemented in SBI. More than half of the items in these sections were answered factually correctly. However, the findings indicated that respondents were less knowledgeable in their understanding of how SBI differs from sensory integration therapy; and likewise, regarding the nature of sensory difficulties in CWASD and strategies implemented in SBI.

Most of the respondents in Study 1 agreed that they have a role in addressing sensory difficulties in the children they treat. The respondents acknowledged the value of collaboration with OTs by indicating that they often consult OTs regarding the treatment of shared clients and engage with these professionals in joint collaborative therapy. Working alongside OTs was identified as the main source of training and knowledge gained in addressing sensory difficulties in CWASD. Respondents identified positive outcomes in engagement, responsiveness, communicative behaviours, and self-regulation of CWASD when SBI is implemented in speech-language therapy. No significant relations were identified between the respondents' implementation of SBI and their years of experience or the university they qualified

from. Respondents from early intervention settings implemented SBI more often compared to respondents working in paediatric clinics in state hospitals. This finding may be due to early intervention centers providing regular therapy services whereas paediatric clinics in public hospitals operate on a monthly consultative service model due to long waiting lists (Guler et al., 2018). Furthermore, it needs to be considered that therapy facilities in the public sector may lack the resources or equipment needed to provide SBI. They may also not have sufficient guidance from a mentor in how and when to implement such interventions (Van Stormbroek & Buchanan, 2016).

The findings of Study 2 contribute to the evidence that SBI provide VI through swinging and rocking may have a positive influence on the communicative behaviours of CWASD. Both participants in this study showed an increase in their responses to the communicative prompts after receiving the treatments (swinging or rocking) compared to the baseline and control conditions. The results of Study 2 provide further support that the responses of CWASD to sensory input vary between individuals (Van Rie & Hefflin, 2009). The increase in communicative behaviours found in this study may relate to positive changes in neural arousal after receiving VI (Ayers, 1972; Katz-Nave et al., 2020; Lane et al., 2019).

Study 3 investigated the influence of VI on non-verbal CWASD's responses when prompted to request a reinforcer using PE. Participants showed a significant increase in handing over a picture to request a reinforcer following VI compared to baseline conditions. A significant improvement was also found for Participants 1 and 2 when receiving Treatment 1 (swinging) and Treatment 2 (rocking) compared to when they participated in the control activity. The increase in responses during the treatment

activities occurred immediately supporting the effectiveness of the treatments rather than the impact of rehearsal of the activity. The participants in this study responded differently to the two methods of VI used in Treatment 1 and 2. This finding further contributes to the understanding that many phenotypes and variations in sensory processing exist in CWASD (Simpson et al., 2019).

6.3. Implications of the study

The findings of this study hold implications for clinical practice and further research in SBI and VI. Clinical implications will now be discussed in relation to the role of the SLT and SLTs' rationale for implementing SBI, training for SLTs in SBI, and future research directions.

6.3.1. Rationale and role of the SLT in implementing SBI

Linguistic development and speech production are deemed higher cognitive functions – these functions are supported by sensory processing, motor functioning and perceptual development as demonstrated in the Pyramid of Learning demonstrated in Figure 1 of this document (Taylor & Trott, 1991).

It is the role of OTs to treat sensory challenges and motor functioning through sensory integration therapy. However, SLTs should understand sensory processing and sensory interventions since they may influence responsiveness and expressive language (Preis & McKenna, 2014). Anzalone and Williamson (2001) noted four factors influenced by sensory integration that is required for an individual to respond to the input they receive: arousal, attention, affect, and action. The connection between the vestibular system and the auditory system as well as the limbic system is

of importance for the SLT. This connection suggests that input delivered to provide vestibular stimulation may bring about positive changes in auditory processing and emotional regulation, which will logically also influence communication, participation and language use positively. Providing sensory prior to activities targeting speech, language and communication may therefore increase the success of therapy.

The current research project was the first attempt to investigate the implementation of SBI by SLTs. The increased frequency of communicative behaviours presented in the findings of Studies 2 and 3 are encouraging for the implementation of SBI during communication intervention in speech-language therapy. An increase in the frequency of communicative behaviours during an interactive activity and a PE activity following VI may result in more opportunities for the SLT to model, shape, and expand on children's communicative attempts, ultimately resulting in better therapy outcomes. The positive findings show support for the theory that VI influences neural arousal since participants presented as hypo-responsive to sensory input and displayed a higher frequency of responses after receiving VI (Ayers, 1972; Katz-Nave et al., 2020; Lane et al., 2019; Preis & McKenna, 2014).

The positive influence of VI neural arousal resulting in increased communicative behaviours in this and other studies, provides a rationale for the role of the SLT in the implementation of SBI. Even though the findings of this study support the role of SLTs' implementation of SBI, to understand and implement SBI effectively, it is necessary for SLTs to receive training in this area.

6.3.2. Training

Although SLTs in this study acknowledged their role in the implementation of SBI, they indicated not receiving any formal training in this area. The need for training SLTs in sensory difficulties and SBI is therefore highlighted.

The South African Institute for Sensory Integration (SAISI) allows SLTs to attend an introductory course addressing the theory of sensory integration therapy. However, practical training is only available to OTs since sensory integration therapy does not fall within the scope of SLTs. SLTs are however accepted to international sensory integration practitioner training abroad. 'Sensory Integration Education' offers comprehensive practitioner training for occupational therapists, physiotherapists, and speech-language therapists (Sensory Integration Education, n.d.).

It is proposed that additional practitioners' training for SLTs will also be offered in South Africa. This training will allow SLTs to develop a deeper knowledge and understanding of sensory processing and how to address such difficulties to enhance speech-language therapy. Additional to the theory model currently offered by SAISI, a practical module where SLTs may work under the guidance of OTs trained in sensory integration therapy is suggested. Safe use and rationale for the implementation of equipment providing vestibular and proprioceptive input e.g., swings, rocking equipment, weighted equipment, therapy balls, etc. are required. A clinical placement under the guidance of an OT will provide SLTs with an opportunity to identify sensory challenges and observe different states of arousal in children in order to implement appropriate Sensory-based intervention strategies. Selection and implementation of SBI strategies should be practiced and evaluated to ensure competence after completing such a placement.

6.3.3. Interdisciplinary collaboration

Inter-disciplinary collaboration in assessment and treatment of CWASD is key in addressing the core challenges impacting functional living as well as the co-morbid symptoms of the ASD population (Bowman et al., 2021). The importance of collaboration between OTs trained in sensory integration therapy and SLPs working with CWASD is emphasised and supported by the findings in this study. OTs often take on a supportive role to guide other professionals including SLTs in implementing SBI outside of the context of SBI. Where the setting and resources allow, joint OT and SLT therapy sessions may positively influence therapy outcomes and nurture an awareness and enhancement of each team member's key role (White et al., 2018). In a study combining simultaneous intervention from OTs, SLTs, and a professional trained in the Applied Behavioural Approach (ABA), the key role of the OT involved exposing participants to sensory stimuli or experiences and adapting exposure according to the responsiveness of the individual. The SLT was responsible for prompting a communicative response by presenting a reinforcer. Furthermore, the SLT expanded on the length and complexity of the participants' verbal language (White et al., 2018) – this role may also apply to enhancing the communicative response of the individual by adding means or modeling a verbal response when none was provided. Respondents in Study 1 indicated that this collaboration was the main source of training and information they received regarding the implementation of SBI. Collaborative practices between the OT providing the SBI treatment activities, and the SLT implementing activities and prompts providing opportunities for communication presents as a model for suggested collaborative practices between these professionals.

6.3.4. Future research directions

The insights from Study 1 identify a gap between clinical practice and empirical research in the implementation of SBI not only by SLTs, but OTs, parents, and educators alike (Barton et al., 2015; Case-Smith et al., 2014; Ouellet et al., 2018). This study calls for SLTs to document their clinical-based evidence and conduct efficacy research in the implementation of SBI by SLTs.

Participants in Studies 2 and 3 responded differently to the two forms of VI provided during the treatment phase. These findings highlight the importance of individualising treatment strategies in this diverse population. Further research in the SBI strategies may lead to the development of clearer guidelines for the suitability of various treatments and equipment related to the various sensory subtypes in CWASD. Further investigation into the influence of variation in the duration of implementation of different SBI may also provide valuable information in developing further guidelines for such practices.

6.4. Strengths and limitations

Study 1 is the first study to include SLTs as respondents in survey research related to SBI. This study highlighted important issues related to training, accessibility, practice-based evidence, and efficacy in the implementation of SBI by SLTs.

Studies 2 and 3 yielded to the call for efficacy studies in SBI. The implementation of a single-subject alternating treatment design in both these studies allowed for the identification of different responses of individuals to the treatments that would not have been possible in a larger randomised trial. These two studies contributed to the limited

available research indicating positive findings related to SBI and communication. Including a control activity in the alternating treatment sequence further strengthened the findings of Studies 2 and 3. Both these studies included the preverbal population of CWASD providing valuable findings for this population that is underrepresented in the research. Furthermore, Studies 2 and 3 included an OT certified in ASI to provide the VI activities. This highlights the role of the OT as an expert in this area but also the importance of collaboration of OT and SLT when intervention is provided to CWASD.

Limitations of Study 1 include the length of the questionnaire, possibly causing respondent fatigue (O'Reilly-Shah, 2017). The questionnaire did not include qualitative data, which may have provided further insights into respondents' selections of answers and statements. The questionnaire in Study 1 was not distributed internationally, limiting generalisation to the global population of SLTs.

In Studies 2 and 3 the small sample sizes limit the generalisation of the findings to the larger ASD population. Furthermore, extending the research to include more data points may have strengthened the findings. Maintenance of effect and further improvements were not determined due to the short period of data collection.

6.5. Conclusion

SBI are commonly implemented by SLTs despite limited training, guidelines for implementation, and evidence of their efficacy. Although SLTs collaborate with OTs regarding suitable implementation of SBI, they do not have access to formal practical training therein in South Africa.

The current study provided valuable data that encourage the use of SBI by SLTs as non-invasive low-cost strategies to increase engagement and communicative responses in CWASD. Furthermore, the study provides information that may be of value in developing suitable training tailored for SLTs in SBI. Most importantly the need for further research to establish the efficacy of such practices to support communication intervention in CWASD is highlighted.

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APPENDICES

Appendix A

STUDY 1: QUESTIONNAIRE

Implementation of Sensory-based intervention (SBI) by speech-language pathologists (SLPs)in children with Autism Spectrum Disorder (CWASD)

Thank you for participating in the research survey. This survey consists of five sections: 1. Professional background, 2. Nature of SBI implemented during CI, 3. Knowledge of sensory deficits and SBI, 4. Perceptions of the SLTs role in providing SBI during CI and 5. Perceptions of the outcomes of SBI in relation to CI.

Consent

1. Do you consent to take part in this research study by completing the survey below?

No	1
Yes	2

Professional background

2. What setting do you work in? (Please check all that apply).

School setting	1
Paediatric clinic at hospital	2
Early intervention centre	3
Private practice	4
Other (please specify):	5

3. Which province do you work in?

Eastern Cape	1
Free State	2
Gauteng	3
KwaZulu Natal	4
Limpopo	5
Mpumalanga	6
Northern Cape	7
North-West	8
Western-Cape	9

4. Which University did you qualify from?

University of Cape Town	1
University of Durban – Westville	2
University of Pretoria	3
University of Stellenbosch	4
University of the Witwatersrand	5
Other (please specify):	6

5. How many years of experience do you have working with CWASD?

1 – 5 years	1
6-10 years	2
More than 10 years	3

6. How often do you provide therapy for CWASD?

Occasionally	1
Often	2
Always	3

7. How many CWASD do you currently provide regular therapy to?

Up to 5	1
Up to 10	2
Up to 20	3
More than 20	4

8. What ages of CWASD do you work with? Please check all that apply.

1 - 5 years	1
6 - 9 years	2
10 – 14 years	3
15 – 18 years	4

9. What means of communication do the CWASD that you work with use? Please check all that apply.

Preverbal/Minimally verbal (Using no words or only a few words that are not produced for functional communication)	1
Verbal (Using phrases and sentences in a functional communicative manner)	2
Augmentative and assistive technology (may include the use of switches, picture exchange, speech generating devices etc.	3

10. How would you describe the cognitive ability of the CWASD that you work with?

High functioning	1
Low functioning	2
Both high and low functioning	3

11. Are you involved in providing joint collaborative speech-language therapy and occupational therapy?

Never	1
Occasionally	2
Often	3
Always	4

12. In your opinion, how often do the CWASD that you treat present with sensory difficulties?

Never	1
Occasionally	2
Often	3
Always	4

Nature of SBI implemented during CI

13. How often do you implement SBI during CI?

Never	1
Occasionally	2
Often	3
Always	4

14. Please indicate all types of SBI and SBI equipment that you using during CI?

I do not use sensory equipment	1
Swinging	2
Jumping/Bouncing	3
Massage	4
Brushing	5
Ball seat	6
Weighted equipment e.g., vests, balls or blankets	7
Weight bearing exercises e.g., yoga	8
Half wheel	9
Sensory toys (toys with lights, spinning toys etc.	10
Sensory play e.g., sensory boxes filled with sand or noodles	11
Oral sensory stimulation	12
Other (please specify):	13

15. Do you collaborate with the occupational therapist (OT) involved with the treatment of the child before implementing SBI during CI?

Never	1
Occasionally	2
Often	3
Always	4

16. Do you target language and communication while performing SBI strategies?

Never	1
Occasionally	2
Often	3
Always	4

17. Do you require assistance when implementing SBI during CI?

Never	1
Occasionally	2
Often	3
Always	4

18. What is your goal when implementing SBI during CI (Please tick all that apply)?

To achieve optimal arousal	1
To make sessions more enjoyable	2
To manage unwanted behaviours	3
To increase communication and vocal behaviour	4
To encourage in-seat behaviour	5
To treat sensory sensitivities e.g., tactile defensiveness	6
To target motor planning	7
To increase body-awareness	8
Other (please specify):	9

Knowledge of sensory deficits and SBI

19. How would you rate your knowledge of sensory difficulties in ASD and the use of SBI?

Very poor	1
Poor	2
Fair	3
Good	4
Excellent	5

20. Have you received any formal training in using SBI strategies when providing speech-language therapy?

No	1
Yes	2

21. Please indicate all sources and methods that were accessed to gain knowledge in the treatment of children with sensory dysfunctions.

Working collaboratively with an occupational therapist	1
Self-study/literature review	2
Graduate studies	3
Post-graduate studies	4
Attending professional training courses	5
Special interest groups	6

Attending a theory course in Ayers Sensory Integration Therapy ®	7
Other (please specify):	8

22. Do you feel confident in providing therapy to children with sensory difficulties?

Never	1
Occasionally	2
Often	3
Always	4

23. Please indicate whether the following statements are true or false.

	Sensory deficits in CWASD	True	False	Don't know
a.	Most CWASD present with sensory deficits.	1	2	3
b.	Atypical responses to sensory stimuli are included in the diagnostic criteria for ASD.	1	2	3
c.	CWASD rarely present with hypo-responsive and hyper-responsive behaviour in response to sensory stimuli.	1	2	3
d.	Sensory difficulties in CWASD may depend on race, culture or socio-economic status.	1	2	3
e.	Sensory deficits in CWASD affect joint attention.	1	2	3
f.	Only some CWASD present with sensory deficits.	1	2	3
g.	Sensory deficits in CWASD do not affect social competence.	1	2	3
h.	CWASD often present with hypo-responsive and hyper-responsive behaviour in response to sensory stimuli.	1	2	3
i.	CWASD usually present with accompanying sensory processing difficulties.	1	2	3
j.	Atypical responses to sensory stimuli are not included in the diagnostic criteria for ASD.	1	2	3
k.	Joint attention in CWASD IS not influenced by sensory deficits.	1	2	3
l.	Sensory difficulties in CWASD does not depend on race, culture or socio-economic status.	1	2	3
m.	A diagnosis of ASD includes the presence of atypical responses to sensory stimuli.	1	2	3
n.	Engaging in social interactions are compromised by the presence of sensory processing difficulties.	1	2	3

o.	Being over alert or seeking sensory input are often observed in CWASD.	1	2	3
p.	A higher incidence of ASD occurs in communities of low-socio economic standing.	1	2	3
q.	Sensory difficulties in CWASD predict social developmental outcomes.	1	2	3
r.	Sensory processing difficulties affect CWASD's ability to take part in a joint activity.	1	2	3

24. Please indicate whether the following statements are true or false.

Treating sensory deficits in CWASD		*True*	*False*	*Don' t know*
a.	Sensory integration therapy is commonly implemented by occupational therapist to treat sensory deficits.	1	2	3
b.	Sensory integration therapy and SBI are the same thing.	1	2	3
c.	OTs support teachers and other professionals in implementing sensory integration therapy.	1	2	3
d.	SBI is often adult directed.	1	2	3
e.	SBI is based on sensory integration therapy.	1	2	3
f.	SBI can be implemented in any context or environment.	1	2	3
g.	OTs support teachers and other professionals in implementing SBI.	1	2	3
h.	The focus of SBI is to facilitate optimal neural arousal.	1	2	3
i.	SBI is child directed.	1	2	3
j.	Sensory integration therapy can be implemented in any context or environment.	1	2	3
k.	Sensory integration therapy can be implemented by any professional working with CWASD.	1	2	3
l.	Sensory integration therapy is based on using isolated sensory interventions in various environments outside of the clinic.	1	2	3
m.	Children direct SBI.	1	2	3
n.	SBI strategies can be used outside the context of sensory integration therapy to alert a hypo-responsive child.	1	2	3
o.	Sensory integration therapy is clinic-based and uses sensor - rich experiences targeting children's adaptive responses to sensory stimuli.	1	2	3
p.	SBI strategies can be used to calm an over-active child.	1	2	3
q.	Sensory integration therapy can be implemented in the classroom.	1	2	3

r.	The focus of sensory integration therapy is to facilitate optimal neural arousal.	1	2	3
s.	Clinicians, teachers and parents direct SBI.	1	2	3

25. Please indicate whether the following statements are true or false.

SBI strategies		*True*	*False*	*Don't know*
a.	Fast, rapid movement are alerting.	1	2	3
b.	When a child presents as hypo-responsive, a crunchy snack may be considered to increase alertness.	1	2	3
c.	Applying deep pressure may calm an over-aroused child.	1	2	3
d.	Slow linear movement is alerting.	1	2	3
e.	Weight bearing exercises may be considered when a child presents as hyper-responsive or hypo-responsive.	1	2	3
f.	Sucking activities may have a calming effect.	1	2	3
g.	When a child presents as hyper-responsive deep pressure activities should be considered.	1	2	3
h.	Slow linear movement may calm hyper-responsive children.	1	2	3
i.	Riding down a ramp on a half wheel may alert a hyper-responsive child.	1	2	3
j.	Biting crunchy foods may have a calming effect.	1	2	3
k.	Brushing is used to treat tactile defensiveness.	1	2	3
l.	Deep pressure activities can be calming as well as alerting.	1	2	3
m.	Sitting on a ball seat may result in children with sensory difficulties being able to complete table-top activities more successfully.	1	2	3
n.	When a child presents ad hypo-responsive slow linear swinging should be considered.	1	2	3
o.	Sucking activities may have an alerting effect.	1	2	3
p.	SBI strategies can be used outside the context of sensory integration therapy to alert a hypo-responsive child.	1	2	3
q.	Jumping on a trampoline provides vestibular and proprioceptive input.	1	2	3
r.	SBI strategies can be used to calm an over-active child.	1	2	3
s.	Sensory integration therapy can be implemented in the classroom.	1	2	3
t.	The focus of sensory integration therapy is to facilitate optimal neural arousal.	1	2	3
u.	Clinicians, teachers and parents direct SBI.	1	2	3

The role of SLTs in implementation of SBI

Please indicate your level of agreement with the following statements:

		Strongly disagree	Agree	Neutral	Agree	Strongly agree
26.	SLTs have a role in addressing sensory difficulties in children they treat.	1	2	3	4	5
27.	SLTs require access to a variety of equipment that can provide sensory experiences to children they treat.	1	2	3	4	5
28.	OTs may provide valuable information to support SLTs in the management of children with sensory difficulties.	1	2	3	4	5
29.	SLTs may use swings, therapy boards and half wheels to incorporate SBI in speech-language therapy.	1	2	3	4	5
30.	SLTs may use swings, therapy balls and half wheels to provide sensory experiences appropriate to the children they treat.	1	2	3	4	5
31.	SLTs require training only in the theoretical aspects of SBI.	1	2	3	4	5
32.	It is not necessary for SLTs and OTs to collaborate regarding SBI in shared clients.	1	2	3	4	5
33.	SLTs may implement sensory activities to facilitate improved therapy outcomes.	1	2	3	4	5
34.	SLTs should have access to certified Ayers sensory integration therapy (ASI®).	1	2	3	4	5
35.	Interdisciplinary therapy leads to better outcomes for CWASD.	1	2	3	4	5
36.	SLTs are expected to manage sensory deficits affecting children's performance in therapy.	1	2	3	4	5
37.	SLTs require formal training in both theory and practical aspects of sensory difficulties and treatment to equip them in providing more effective intervention.	1	2	3	4	5
38.	Using equipment to provide specific sensory input according to children's sensory needs may support speech-language therapy.	1	2	3	4	5
39.	SLTs have a responsibility to refer children with sensory deficits to an OT trained in sensory integration therapy.	1	2	3	4	5

Outcomes of SBI

Please indicate your level of agreement with the following statements:

		Strongly disagree	Agree	Neutral	Agree	Strongly agree
40.	Combining SBI with other approaches are more effective than only using other forms of input.	1	2	3	4	5
41.	Children appear to be more engaged when SBI are incorporated in speech-language therapy.	1	2	3	4	5
42.	CWASD display less disruptive behaviour when SBI are incorporated during CI.	1	2	3	4	5
43.	Supporting CWASD's sensory needs during CI lead to better therapy outcomes.	1	2	3	4	5
44.	Sitting on a therapy ball may encourage on-task behaviour.	1	2	3	4	5
45.	SLTs should consider using SBI to support CI.	1	2	3	4	5
46.	CWASD are more cooperative when CI is supported by SBI.	1	2	3	4	5
47.	I would recommend using SBI to support CI.	1	2	3	4	5
48.	CWASD appear to be more communicative when SBI is implemented during CI.	1	2	3	4	5
49.	CWASD benefit from SBI used during CI.	1	2	3	4	5
50.	CWASD appear calmer and more content when speech-language therapy is supported by SBI.	1	2	3	4	5
51.	CWASD are more imitative when SBI are implemented during CI.	1	2	3	4	5
52.	I would advise SLTs working with CWASD to receive training in SBI.	1	2	3	4	5
53.	Movement help CWASD to be more responsive.	1	2	3	4	5
54.	CWASD are more vocal when SBI strategies are being implemented during CI.	1	2	3	4	5

Thank you sincerely for your participation and contribution to this research study.

APPENDIX B

Informed Principal Consent

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Fakulteit Geesteswetenskappe
Lefapha la Bomotho

Humanities 100. Since 1919

INFORMED CONSENT LETTER: SCHOOL PRINCIPAL

Study Title:

Effect of vestibular input on the communicative attempts of preverbal children with Autism Spectrum Disorder.

Principal Investigator:

Mrs. Marinda Raubenheimer

Supervisors:

Dr. Salome Geertsema, Department Speech & Language Pathology (UP)

Dr. Mia le Roux, Department Speech & Language Pathology (UP)

Institution:

University of Pretoria

Contact details:

Marinda Raubenheimer cell: 076 432 6708 e-mail: marindarau@gmail.com

Salome Geertsema e-mail: salome.geertsema@up.ac.za

Mia le Roux e-mail: mia.leroux@up.ac.za

Date and time of first informed consent discussion:

Year	Mnth	Day		Hr	Min

Dear School Principal

Re: Permission to conduct a research study at your school involving learners from your school.

1. Introduction

I am a PhD student at the Department of Speech-Language Pathology and Audiology at the University of Pretoria. As part of the requirements for this degree, I am conducting a research study regarding the effect of Sensory-based interventions on the communicative behaviours of children with autism I am herewith requesting to conduct this research study at your school. I would like to recruit learners from your preschool to participate in this research study. The involvement of a teacher at your school to act as an independent observer completing a fidelity checklist as well as the assistance of the school's OT are also requested. Participation in this study is entirely voluntary. You may refuse to participate or withdraw at any time during the study. Parental consent will be received before commencement of any intervention trials.

Please ensure that you have read all the information provided regarding the project, and that you fully understand what is involved before you agree to participate in this study. Please do not hesitate to ask any questions to further explain any areas of this research study that you do not fully understand, or that you need more information on.

2. Purpose and contribution of the study

The aim of this study is to determine the effect of vestibular input (movement activities) in the form of swinging and rocking on a half wheel, on the communication of children with Autism Spectrum Disorder. This study will contribute to the research evidence of the influence of Sensory-based interventions on the communication of children with Autism Spectrum Disorder.

3. Study Procedures

The data collection sessions will take place in the therapy room of your child's school. The data collection session will be conducted by the primary researcher, a speech-language therapist, and assisted by an occupational therapist trained in providing sensory integration therapy. These sessions will take place during school hours. It is

requested that on the mornings of data collection, no specific sensory input (eg. Jumping on trampoline or swinging) will be provided before participation in the intervention trials – you will be informed of the days that your child will participate in the study should they be selected.

In the first week of data collection children will be encouraged to engage in interactive play activities e.g., bubble blowing or playing with a wind-up toy. Following this phase, the treatment phase will commence for a maximum period of six weeks. In this phase children will engage in either swinging, rocking on a half wheel or completing a lotto board before again being encouraged to participate in an interactive activity. Please note that all data collection sessions will be videotaped for the purpose of being analysed by a panel of three professionals working in the field of Autism Spectrum Disorders.

4. Potential Risk of Discomfort

There are no potential risks involved in participating in this study. Safety precautions for the movement activities will be implemented throughout the data collection sessions. Every effort will be made to let participants feel secure and supported throughout these sessions. Should a participant show any sign of upset or discomfort, they will not have to continue with the activity.

5. Benefits of study

Although there is no direct benefit to the school for participation in the study, children participating may benefit developmentally from the therapeutic intervention presented in the study trials.

6. Ethical Approval

This research study has been approved by the Faculty of Humanities' Research and Ethics committee of the University of Pretoria, telephone numbers: (012) 356-3084 / (012) 356-3085. A copy of the letter of approval may be obtained from the researcher should you wish to review it.

7. Compensation

Participation is voluntary. No compensation will be offered for participation in the study.

8. Confidentiality

All information collected regarding participants will be kept strictly confidential. Research reports and articles published in scientific journals will not include any information that may identify your child. Video recordings will only be handled by the principal investigator. The principal investigator and the three panel members will be the only persons who will watch the video clips. The professional panel will sign confidentiality agreements. The school's involvement as well as any information regarding the school will be treated as confidential.

9. Data storage

Any data collected during the course of this research project will be stored in hard copy and electronic copy for 15 years as per the regulations of the University of Pretoria for data storage. The data will be stored in a data repository in room 3-1 Department of Speech and Language Therapy & Audiology at the University of Pretoria.

Thank you very much for your consideration.

Marinda Raubenheimer
Student Researcher

Dr. S. Geertsema
Main Supervisor

Dr. M. Le Roux
Co-Supervisor
Speech-Language Pathology

Prof. J. van der Linde
HEAD: Department of
and Audiology

INFORMED CONSENT

- I confirm that the person requesting my consent for conducting this research study at my school has told me about the nature and process, risks or discomforts as well as the benefits of the study.
- I have received, read and understood the above written information about the study.
- I have had adequate time and opportunity to ask questions and I have no objections for children from my school to participate in this study.
- I am aware that the information obtained in the study, including any personal details, will be anonymously processed and presented in the reporting of results.
- I understand that my consent for participation in this study is voluntary, and that I can withdraw consent at any time during the research project.
- I have received a signed copy of this informed consent agreement.

Petroné van Heerden

Signed: School Principal *Name in print*

Date: 07/03/3021

Marinda Raubenheimer

Signed: Student Researcher *Name in print*

Date: 07/03/2021

Faculty of Humanities
Fakulteit Geesteswetenskappe
Lefapha la Bomotho

Humanities 100. Since 1919

INFORMED CONSENT LETTER: SCHOOL PRINCIPAL

Study Title:

The effect of vestibular input on the responses of children with Autism Spectrum Disorder using picture exchange to request.

Principal Investigator:

Marinda Raubenheimer, M. Communication Pathology

Supervisors:

Dr. Salome Geertsema, Department Speech & Language Pathology (UP)

Dr. Mia le Roux, Department Speech & Language Pathology (UP)

Institution:

University of Pretoria

Contact details:

Marinda Raubenheimer cell: 076 432 6708 e-mail: marindarau@gmail.com

Salome Geertsema e-mail: Salome.geertsema@up.ac.za

Mia le Roux e-mail: mia.leroux@up.ac.za

Date and time of first informed consent discussion:

Year	Mnth	Day		Hr	Min

Dear School Principal

Re: Permission to conduct a research study at your school involving learners from your school.

1. Introduction

I am a PhD student at the Department of Speech-Language Pathology and Audiology at the University of Pretoria. As part of the requirements for this degree, I am conducting a research study regarding the effect of sensory strategies on the communicative behaviours of children with Autism Spectrum Disorder. I am herewith requesting to conduct this research study at your school. I would like to recruit learners from your school to participate in this study. The involvement of a teacher at your school to act as an independent observer as well as the assistance of the school's OT is also requested. Participation in this study is entirely voluntary. You may refuse to participate or withdraw at any time during the study. Parental consent will be received before commencement of any intervention trials. Please ensure that you have read all the information provided regarding the project, and that you fully understand what is involved before you agree for this study to participate. Please do not hesitate to ask any questions to further explain any areas of this research study that you do not fully understand, or that you need more information on.

2. Purpose and contribution of the study

The aim of the study is to determine the effect of vestibular input in the form of linear and rotary movement provided by swinging and rocking on a half wheel, on the responses of participants using picture exchange to request a reinforcer. This study will contribute to the research evidence of the effectiveness of Sensory-based interventions in children with Autism Spectrum Disorder.

3. Study Procedures

The data collection sessions will take place in the therapy room of your school. These sessions will be conducted the primary researcher, a speech-language therapist, and assisted by an occupational therapist trained in providing sensory integration therapy. Data collection will take place in the therapy room as well as a small classroom of your school. The sessions will take place during school hours. It is requested that on the mornings of data collection, no specific sensory input (e.g., jumping on trampoline or

swinging) will be provided before children's participation in the data collection sessions in order to ensure that more reliable research results will be obtained.

During the first week of data collection children will be encouraged to pick up a picture and hand it to the researcher to request a desired item e.g., a squishy toy or music box. Following this phase, the treatment phase will commence where children will engage in either swinging, riding on a half wheel or completing a insert lotto board before again being encouraged to participate in the picture exchange activity. Please note that all sessions will be videotaped. The video recordings will be analysed by a panel of three professionals working in the field of Autism Spectrum Disorders.

4. **Potential Risk of Discomfort**

There are no potential risks involved in participating in this study. Safety pre-cautions for the movement activities will be implemented throughout the trials. Every effort will be made to let participants feel secure and supported throughout the trials. If child ren show any sign of upset or discomfort, they will not have to continue with the activity.

5. **Benefits of study**

Although there is no direct benefit to the school for participation in the study, learners participating may benefit developmentally from the therapeutic intervention presented in the study trials.

6. **Ethical Approval**

This research study has been approved by the Faculty of Humanities' Research and Ethics committee of the University of Pretoria, telephone numbers: (012) 356-3084 / (012) 356-3085. A copy of the letter of approval may be obtained from the researcher should you wish to review it.

7. **Compensation**

Participation is voluntary. No compensation will be offered for participation in the study.

8. **Confidentiality**

All information collected regarding participants will be kept strictly confidential. Research reports and articles published in scientific journals will not include any information that may identify any of the participants or the school involved.

Video recordings will only be handled by the principal investigator. The principal investigator and the three panel members will be the only persons who will watch the video clips. The professional panel will sign confidentiality agreements.

The school's involvement as well as any information regarding the school will be treated as confidential.

9. Data storage

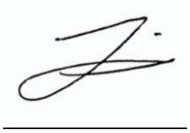
Any data collected during the course of this research project will be stored in hard copy and electronic copy for 15 years as per the regulations of the University of Pretoria for data storage. The data will be stored in a data repository in room 3-1 Department of Speech and Language Therapy & Audiology at the University of Pretoria.

Thank you very much for your consideration.

Marinda Raubenheimer
Researcher

Dr. S. Geertsema
Main Supervisor

Dr. M. Le Roux
Co-Supervisor



Prof. J. van der Linde
Head of Department Speech-Language Pathology & Audiology

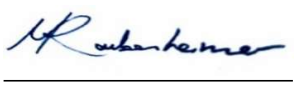
INFORMED CONSENT

- I confirm that the person requesting my consent for conducting this research study at my school has told me about the nature and process, risks or discomforts as well as the benefits of the study.
- I have received, read and understood the above written information about the study.
- I have had adequate time and opportunity to ask questions and I have no objections for children from my school to participate in this study.
- I am aware that the information obtained in the study, including any personal details, will be anonymously processed and presented in the reporting of results.
- I understand that my consent for participation this study is voluntary, and that I can withdraw consent at any time during the research project.
- I have received a signed copy of this informed consent agreement.

Petroné van Heerden

Signed: School Principal *Name in print*

Date: 07/03/2021



Marinda Raubenheimer

Signed: Researcher *Name in print*

Date: 07/03/3032

APPENDIX C

Informed Parental Consent

Faculty of Humanities
Fakulteit Geesteswetenskappe
Lefapha la Bomotho

Parental / Legal guardian informed consent form

Study Title:

Effect of vestibular input on the communicative behaviours of preverbal children with ASD using picture exchange to request

Principal Investigator:

Mrs. Marinda Raubenheimer

Supervisors:

Dr. Salomé Geertsema, Department Speech-Language Pathology and Audiology

Dr. Mia le Roux, Department Speech-Language Pathology and Audiology

Institution:

University of Pretoria

Contact details:

Marinda Raubenheimer cell: 076 432 6708 e-mail: marindarau@gmail.com

Salomé Geertsema e-mail: salome.geertsema@up.ac.za

Mia le Roux e-mail: mia.leroux@up.ac.za

Date and time of first informed consent discussion:

Year	Month	Day		Hr	Min

Dear Parent / Caregiver

Re: Research Study

1. Introduction

I am currently registered for the degree PhD in Speech-Language Pathology. As part of the requirements for this degree, I am conducting a research study regarding the effect of Sensory-based interventions on the communicative behaviours of children with Autism Spectrum Disorder. You are herewith invited to let your child participate in this research study. This document will provide you with information to help you to decide if your child may participate in this project. Please ensure that you have read all the information provided, and that you fully understand what is involved before you agree for your child to participate. Please do not hesitate to ask any questions to further explain any areas of this research study that you do not fully understand, or that you need more information on.

2. Purpose of study

To determine the effect of vestibular input (movement activities on the communicative attempts of preverbal children with Autism Spectrum Disorder using the.

3. Study Procedures

The data collection sessions will take place in the therapy room of your child's school. These sessions will be conducted by the primary researcher (speech-language therapist) and assisted by an occupational therapist who is trained in providing sensory integration therapy. Data collection will take place during school hours. As a parent you are very welcome to attend any of the sessions that your child will be participating in. It is requested that on the morning of the sessions, no specific sensory input (e.g., jumping on trampoline or swinging) will be provided before participation in the research sessions to ensure that more reliable research results will be obtained. Please inform the principal investigator of any changes in your child's use of medication or other interventions they may be involved in during their participation in this project.

During the first week of the study children will be accompanied to a classroom where they will be encouraged to engage in a picture exchange activity. This activity involves your child being encouraged to pick up a picture and hand it to the researcher to

request a desired item for example a squishy toy or music box. Following this phase, the treatment phase will commence where children will engage in either swinging, rocking on a half wheel or completing a lotto board before again being encouraged to participate in the picture exchange activity. Please note that all sessions will be video recorded. The video recordings will be analysed by a panel of three professionals working in the field of Autism Spectrum Disorders.

4. **Potential Risk of Discomfort**

There are no potential risks involved in participating in the study as all safety pre-cautions for the movement activities will be implemented throughout the intervention sessions. Every effort will be made to let your child feel secure and supported throughout their participation. If your child shows any sign of upset or discomfort, they will not have to continue with the activity.

5. **Contribution of study**

This study will contribute to the research evidence of the effectiveness of Sensory-based interventions in children with Autism Spectrum Disorder.

6. **Benefits of participation**

Your child may benefit developmentally from the therapeutic intervention presented in the study trials.

7. **Ethical Approval**

This research study has been approved by the Faculty of Humanities' Research and Ethics committee of the University of Pretoria, telephone numbers: (012) 356-3084 / (012) 356-3085. A copy of the letter of approval may be obtained from the researcher should you wish to review it.

8. **Compensation**

Participation is voluntary. No compensation will be offered for participation in the study. Your child can refuse to participate or stop at any time during the study. Your child's withdrawal will not affect his/her access to therapy, or any other aspect that they are involved in at school.

9. Confidentiality

Any information collected regarding your child will be treated as strictly confidential. Research reports and articles published in scientific journals will not include any information that may identify your child. Video recordings will only be handled by the principal investigator. The principal investigator, three panel members and an independent observer (a teacher from Blaize Academy) will be the only persons who will watch the video clips. All parties involved will sign confidentiality agreements.

10. Data storage

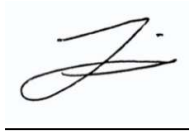
Any data collected during the course of this research project will be stored in hard copy and electronic copy for 15 years as per the regulations of the University of Pretoria for data storage. The data will be stored in a data repository in room 3-1 Department of Speech and Language Therapy & Audiology at the University of Pretoria.

Thank you very much for your consideration.

Marinda Raubenheimer
Researcher

Dr. S. Geertsema
Main Supervisor

Dr. M. Le Roux
Co-Supervisor



Prof. J. van der Linde
Head of Department Speech-Language Pathology & Audiology

INFORMED CONSENT

- I confirm that the person requesting my consent for my child to take part in this study has told me about the nature and process, risks or discomforts as well as the benefits of the study.
- I have received, read and understood the above written information about the study.
- I have had adequate time and opportunity to ask questions and I have no objections for my child to participate in this study.
- I am aware that the information obtained in the study, including any personal details, will be anonymously processed and presented in the reporting of results.
- I agree that all study sessions that my child is involved in will be video recorded to be analysed by a professional panel consisting of three members.
- I agree to avoid my child engaging in excessive movement activities (eg. swinging, jumping on trampoline) on the mornings of trials in order to ensure more reliable research results.
- I agree to declare any changes in my child's use of prescribed medication during the period of the research trials.
- I understand that my consent for participation in this study is voluntary, and that my child will not be penalised in any way should my child wish not to participate or continue with the activities – my child is participating willingly.
- I understand that I can withdraw my child's participation in this study at any time I wish.
- I have received a signed copy of this informed consent agreement.

_____	_____	_____
Signed: Parent/Legal Guardian	*Name in print*	*Date*
_____	_____	_____
Signed: Parent/Legal Guardian	*Name in print*	*Date*
_____	_____	_____
Signed: Principal Researcher	*Name in print*	*Date*

Study Title:

The effect of vestibular input on the communicative attempts of preverbal children with Autism Spectrum Disorder.

Principal Investigator:

Mrs. Marinda Raubenheimer

Supervisors:

Dr. Salomé Geertsema, Department Speech-Language Pathology and Audiology

Dr. Mia le Roux, Department Speech-Language Pathology and Audiology

Institution:

University of Pretoria

Contact details:

Marinda Raubenheimer cell: 076 432 6708 e-mail: marindarau@gmail.com

Salomé Geertsema e-mail: salome.geertsema@up.ac.za

Mia le Roux Linde e-mail: mia.leroux@up.ac.za

Date and time of first informed consent discussion:

Year	Month	Day

Hr	Min

Dear Parent / Caregiver

Re: Research Study

1. Introduction

I am currently registered for the degree DPhil in Speech-Language Pathology. As part of the requirements for this degree, I am conducting a research study regarding the effect of sensory strategies on the communicative behaviours of children with Autism Spectrum Disorder. You are herewith invited to let your child participate in this research study. This document will provide you with information to help you to decide if your child may participate in this project. Please ensure that you have read all the information provided, and that you fully understand what is involved before you agree for your child to participate. Please do not hesitate to ask any questions to further explain any areas of this research study that you do not fully understand, or that you need more information on.

2. Purpose of study

The aim of this study is to determine the effect of vestibular input (movement activities) in the form of swinging and rocking on a half wheel, on the communication of children with Autism Spectrum Disorder.

3. Study Procedures

The data collection session will take place in the therapy room of your child's school. These sessions will be conducted by the primary researcher (speech-language therapist) and assisted by an occupational therapist who is trained in providing sensory integration therapy. Data collection will take place during school hours. As parent you are very welcome to attend any of the sessions that your child will be participating in. It is requested that on the mornings of data collection, no specific sensory input (e.g., jumping on trampoline or swinging) will be provided before participation in the sessions in order to ensure that more reliable research results are obtained. You will also be expected to declare any changes in your child's use of prescribed medications.

During the first week of data collection children will be encouraged to engage in a variety of interactive activities for example bubble blowing. Following this phase, the treatment phase will commence where children will engage in either swinging, rocking

on a half wheel or completing a lotto board before again being encouraged to participate in an interactive activity. Please note that all trials will be videotaped. The video recordings will be analysed by a panel of three professionals working in the field of Autism Spectrum Disorders.

4. **Potential Risk of Discomfort**

There are no potential risks involved in participating in the study as all safety pre-cautions for the movement activities will be implemented throughout the trials. Every effort will be made to let your child feel secure and supported throughout the trials. If your child shows any sign of upset or discomfort, they will not have to continue with the activity.

5. **Contribution of study**

This study will contribute to the research evidence of the effectiveness of Sensory-based interventions in children with Autism Spectrum Disorder. Your child's participation in this study is entirely voluntary. Your child can refuse to participate or stop at any time during the study. Your child's withdrawal will not affect his/her access to therapy, or any other aspect they are involved in at school.

6. **Benefits of study**

Your child may benefit developmentally from the therapeutic intervention presented in the study trials.

7. **Ethical Approval**

This research study has been approved by the Faculty of Humanities' Research and Ethics committee of the University of Pretoria, telephone numbers: (012) 356-3084 / (012) 356-3085. A copy of the letter of approval may be obtained from the researcher should you wish to review it.

8. **Compensation**

Participation is voluntary. No compensation will be offered for participation in the study.

9. **Confidentiality**

Any information collected regarding your child will be treated as strictly confidential. Research reports and articles published in scientific journals will not include any

information that may identify your child. Video recordings will only be handled by the principal investigator. The principal investigator and the three panel members will be the only persons who will watch the video clips.

Thank you very much for your consideration.

Marinda Raubenheimer
Researcher

Dr. S. Geertsema
Main Supervisor

Dr. M. Le Roux
Co-Supervisor

Prof. J. van der Linde
Head of Department Speech-Language Pathology & Audiology

INFORMED CONSENT

- I confirm that the person requesting my consent for my child to take part in this study has told me about the nature and process, risks or discomforts as well as the benefits of the study.
- I have received, read and understood the above written information about the study.
- I have had adequate time and opportunity to ask questions and I have no objections for my child to participate in this study.
- I am aware that the information obtained in the study, including any personal details, will be anonymously processed and presented in the reporting of results.
- I agree that all trials that my child is involved in will be video-taped to be analysed by a professional panel consisting of three members.
- I agree to avoid my child engaging in excessive movement activities (eg. swinging, jumping on trampoline) on the mornings of trials in order to ensure more reliable research results.
- I agree to declare any changes in my child's use of prescribed medication during the period of the research trials.
- I understand that my consent for participation in this study is voluntary, and that my child will not be penalised in any way should my child wish not to participate or continue in the trials – my child is participating willingly.
- I understand that I can withdraw my child's participation in this study at any time I wish.
- I have received a signed copy of this informed consent agreement.

_____	_____	_____
Signed: Parent/Legal Guardian	*Name in print*	*Date*
_____	_____	_____
Signed: Parent/Legal Guardian	*Name in print*	*Date*
_____	_____	_____
Signed: Principal Researcher	*Name in print*	*Date*

APPENDIX D

Assent for participants in Study 1 and Study 2

Participants in the current study will be learners from the level 1 classroom of an independent school for CWASD. The learners from this classroom are not yet able to point out pictures or communicate effectively using a picture exchange communication system. Before any activities are presented learners will be informed both verbally and by using visual aids of the activity that will proceed. This process will also be repeated when transitioning from one activity to another. As learners will not have the verbal means or ability to point out choice using visual aids, it will be necessary to monitor their communicative behaviours closely to ensure voluntary participation throughout the study (Guess, et al., 2008). Should participants display any of the following behaviours, they will not be expected to proceed with the proposed activity:

A. Pulling away from the therapist
B. Vocalisation using a distressed tone of voice
C. Crying or whining
D. Protesting body movements for example pushing a toy or therapist away
E. Reaching out to be removed from equipment
F. Pulling therapist towards exit
G. Startled or anxious facial expression

The treatment fidelity checklist (Appendix B) to be completed by an independent observer will include items to ensure that this process for assent of participants during the research procedures will be implemented.

APPENDIX E

Fidelity Checklist *(adapted from Van Rie & Hefflin, 2009)*

Number	Yes	No	Step Description
1			*Was the participant prepared for the treatment activity by labelling the activity and using a gesture?*
2			*Did the participant willingly proceed with the treatment activity?*
3			*Was the treatment provided for 5 minutes?*
4			*Was treatment seized and/or support provided if the participant displayed signs of protest, distress or discomfort?*
5			*Did the therapist prepare the child to participate in each interactive activity by labelling the activity and using a visual aid?*
6.			*Did the participant willingly follow the therapist and engaged in the activity?*
7.			*Was the participant seated correctly for each of the activities?*
8.			*Did the participant willingly follow the therapist to the area to engage in the interactive play activity?*
9.			*Did the therapist seize the activity if the child displayed any signs of protesting, discomfort or distress (pulling away, vocalising in upset tone of voice, starting to cry or using any body movement to protest)?*
10.			*Was the participant encouraged to participate and follow guidelines using comforting and reassuring verbal and non-verbal means of communication?*
11.			*Was the interactive activity presented for a maximum of 5 minutes?*

Appendix F

Letter of acceptance Study 1

Date: Oct 07, 2022
To: "Marinda Raubenheimer" u96005976@tuks.co.za
From: "Advances in Communication and Swallowing" g.ricci@iospress.nl
Subject: Your Submission ACS-220004R2

Ref.: Ms. No. ACS-220004R2
Sensory Based Interventions by Speech Language Pathologists in Children with Autistic Spectrum Disorders
Advances in Communication and Swallowing

Dear Mrs Raubenheimer,

I am pleased to tell you that your work has now been accepted for publication in Advances in Communication and Swallowing. It was accepted on Oct 07, 2022, comments from the Editor and Reviewers can be found below.

Your paper will now be sent to the publisher's typesetting office. Assuming there are no technical errors with the manuscript then, after the paper has been typeset, you will be informed by e-mail and asked to proofread the final copy. At this stage the galley proof of your paper will also be published online in the 'pre press' section of the journal. After final publication in an issue of the journal you will receive a complimentary PDF copy of the final published article which will include the final page numbers.

Should you not receive your proof copy within 6-8 weeks from now, please contact the publisher at editorial@iospress.nl and ensure to mention your manuscript number in the e-mail subject line: ACS-220004R2.

Thank you for submitting your work to the journal, we look forward to receiving your future work as well.

With kind regards

Irene P. Walsh
Editor-in-Chief
Advances in Communication and Swallowing

Comments from the Editors and Reviewers:

APPENDIX G

Letter of Submission Study 2

Communication Disorders Quarterly <onbehalfof@manuscriptcentral.com> 6 Feb 2023, 21:12 (3 days ago)
to me, salome.geertsema, mia.leroux, marien.graham

06-Feb-2023

Dear Mrs. Raubenheimer:

Your manuscript entitled "The influence of vestibular input on the communicative attempts of children with Autistic Spectrum Disorder" has been successfully submitted online and is presently being given full consideration for publication in Communication Disorders Quarterly.

Your manuscript ID is CDQ-011-Feb-23.

You have listed the following individuals as authors of this manuscript:
Raubenheimer, Marinda; Geertsema , Salome; le Roux, Mia; Graham, Marien

Please mention the above manuscript ID in all future correspondence or when calling the office for questions. If there are any changes in your street address or e-mail address, please log in to ScholarOne Manuscripts at https://mc.manuscriptcentral.com/cdq and edit your user information as appropriate.

You can also view the status of your manuscript at any time by checking your Author Center after logging in to https://mc.manuscriptcentral.com/cdq.

As part of our commitment to ensuring an ethical, transparent and fair peer review process SAGE is a supporting member of ORCID, the Open Researcher and Contributor ID (https://orcid.org/). We encourage all authors and co-authors to use ORCID iDs during the peer review process. If you have not already logged in to your account on this journal's ScholarOne Manuscripts submission site in order to update your account information and provide your ORCID identifier, we recommend that you do so at this time by logging in and editing your account information. In the event that your manuscript is accepted, only ORCID iDs validated within your account prior to acceptance will be considered for publication alongside your name in the published paper as we cannot add ORCID iDs during the Production steps. If you do not already have an ORCID iD you may login to your ScholarOne account to create your unique identifier and automatically add it to your profile.

Thank you for submitting your manuscript to Communication Disorders Quarterly.

Sincerely,
Kevin Miller
Communication Disorders Quarterly
kevinmiller432@gmail.com

APPENDIX H

Proof of Acceptance Study 3

Journal of Occupational Therapy, Schools, & Early Intervention - Decision on Manuscript ID WJOT-2022-0064.R1 External Inbox ×

Journal of Occupational Therapy, Schools, & Early Intervention <onbehalfof@manuscriptcentral.com> Thu, 2 Feb, 23:28 (7 days ago)
to me

02-Feb-2023

Dear Dr Marinda Raubenheimer:

Ref: The influence of vestibular input on the responses of children with Autism Spectrum Disorder using picture exchange communication to request

Our reviewers have now considered your paper and have recommended publication in Journal of Occupational Therapy, Schools, & Early Intervention. We are pleased to accept your paper in its current form which will now be forwarded to the publisher for copy editing and typesetting. The reviewer comments are included at the bottom of this letter.

Accepted papers will be transmitted for production. The first and most important task for authors at that point will be to complete an online author agreement form. Please make sure you complete it as soon as you receive the publisher notice about it.

The publisher also requests that proofs are checked through the publisher's tracking system and returned within 48 hours of receipt.

Thank you for your contribution to Journal of Occupational Therapy, Schools, & Early Intervention and we look forward to receiving further submissions from you.

Sincerely,
Dr Swinth
Editor, Journal of Occupational Therapy, Schools, & Early Intervention
yswinth@pugetsound.edu

APPENDIX I

Permission for replication of the Learning Pyramid

On Sat, Nov 19, 2022 at 1:53 am, Maryann C Trott <MTrott@salud.unm.edu> wrote:

Thanks for the request Miranda. Please use this citation for the Pyramid: Taylor, K & Trott, M (1991) in Williams, S and Shellenberger, S (1994) *How does your engine run?* Albuquerque, NM. Therapyworks.
All the best as you pursue your degree!
Maryann

From: marinda raubenheimer <marindarau@yahoo.com>
Sent: Friday, November 18, 2022 1:57 PM
To: Maryann C Trott <MTrott@salud.unm.edu>
Subject: Pyramid of learning

[[-- External - this message has been sent from outside the University --]]

Dear Maryann

I am currently completing my PHD at the university of Pretoria and would like to request your permission to include the pyramid of learning in my thesis.

Thank you kindly for your consideration.

Regards
Marinda Raubenheimer