Self-regulation, joint engagement, and vocabulary development in preschool children with

and without multi-system developmental delay

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Abstract

This study explored relationships between vocabulary size and self-regulation and joint engagement in 28 children with multi-system developmental delay (DD) aged 2;5 (years;months) to 5;6 and a language age-matched control group of 28 typically developing (TD) children aged 0;7 to 5;6 drawn from a larger sample of 77. Parents completed the ABASII, Second Edition (ABASII; Harrison & Oakland, 2003), with the Leisure, Self-direction, and Social subtests serving as measures of self-regulation and joint engagement. Vocabulary size was measured using an adaptation of the New Zealand version of the MacArthur Communicative Development Inventory: Toddlers (CDI; Reese & Read, 2000). Responses to the Language Use Inventory (O'Neill, 2007) were also collected for comparison with the CDI.

Group differences on vocabulary size and the ABASII Social and Self-direction subtests were not significant. However, children with multi-system DD scored significantly higher on the Leisure subtest. Data from the children with multi-system DD revealed a medium, positive correlation between the CDI total score and the raw score of the Leisure subtest, $r = 0.34$, $p = 0.075$ and for the TD children a strong, positive correlation $r = 0.51$, $p = 0.006$. For the children with multi-system DD, there was a medium, positive correlation between the CDI total score and the raw score of the Self-direction subtest, $r = 0.39$, $p = 0.038$ and a strong, positive correlation for the TD children, $r = 0.52$, $p = 0.005$. Similarly, for the children with multi-system DD there was a medium, positive correlation between the CDI total score and the raw score of the Social subtest, $r = 0.41$, $p = 0.032$ and a strong, positive correlation for the TD children, $r = 0.63$, $p < 0.001$. The results suggest a positive correlation between self-regulation and joint engagement and vocabulary development in both groups of children.

Introduction

When considering language development, both in typically developing (TD) children and in children with language delay or disorder, it is important to understand the many factors which contribute to a child's development. One framework that takes a broad view is the biopsychosocial approach (Engel, 1977) which argues that human development consists of interrelated biological, psychological and social dimensions. It views the social and psychological aspects of children's development with equal importance as the contribution made by the child's physiological make-up. However, often in studies of language development of children with disabilities there is a focus only on the child's etiology (i.e. the biological) to the exclusion of the social and the psychological. In this study, therefore, the aim is to explore the impact of non-linguistic factors other than etiology on language development.

Children with multi-system developmental delay (DD) almost always present with difficulties acquiring language (Berglund, Eriksson, & Johansson, 2001). In this study, a child with multi-system DD refers to a child who is delayed in all of the major developmental systems: communication, cognition, motor, and socio-emotional development. Most of these children are known to have reduced verbal lexicons for their age and are slow to develop single and multiple utterances. The precise relationship between their linguistic development and the development of their other systems, however, remains poorly understood, even though it is clinically important to consider all aspects of a child's development when designing interventions. This study investigates whether there are relationships between two areas of non-linguistic development (self-regulation and joint engagement) and vocabulary size in children with multi-system DD compared to children who are TD.

Vocabulary Development and Linguistic Development

One of the hallmark language characteristics of children with multi-system DD is slow vocabulary development (Berglund et al., 2001; Lembrechts, Maes, Vandereet, & Zink, 2010); however, we know that vocabulary development does not occur in isolation. There is evidence to suggest a relationship exists between vocabulary and other areas of linguistic development, including morphosyntax (Devescovi et al., 2005; Goodman & Bates, 1997) and phonology (Stoel-Gammon, 2011), such that vocabulary can be used as a legitimate proxy for overall language development.

The significant relationship between vocabulary and grammar in children with typical development is supported by Devescovi et al. (2005). They investigated the relationship between grammatical and lexical development in 233 English speaking children and 233 Italian speaking children aged between 1;6 (years;months) and 2;6. They found that vocabulary size is a strong predictor of grammatical development. Furthermore, they concluded that vocabulary is a significantly stronger predictor of grammatical development than age. Similarly, Goodman and Bates (1997) found that in TD children, vocabulary size at 1;8 was the best predictor of grammatical development at 2;4. In children with atypical development, (e.g. children with Down syndrome), grammar and vocabulary also appeared to be positively correlated.

There is also a relationship between phonological development and vocabulary in young children. Stoel-Gammon (2011) reports that the relationship between these two markers of language development is bi-directional. That is, phonological ability has been shown to affect language acquisition and vocabulary development has been shown to influence phonological development. For example, children with large vocabularies have more advanced phonological systems than those with small vocabularies.

Given these relationships between vocabulary development and other areas of linguistic development (Devescovi et al., 2005; Goodman & Bates, 1997; Stoel-Gammon, 2011), vocabulary can be used as a key indicator of overall language development.

In addition to the relationship between vocabulary and linguistic domains (i.e. grammar and vocabulary, phonology and vocabulary), it has been suggested that there is also a relationship between vocabulary development and non-linguistic performance (Adamson, Bakeman, Deckner, & Romski, 2009; Carpenter, Nagell, & Tomasello, 1998; Dromi & Zaidman-Zait, 2011; Markus, Mundy, Morales, Delgado, & Yale, 2001; McClelland et al., 2007; Nayena, O'Brien, Leerkes, Marcovitch, & Calkins, 2011; Tomasello & Todd, 1983; Wanless, McClelland, Acock, Chen, & Chen, 2011). More specifically, there are two areas of performance that are thought to be linked to vocabulary development and that are important developments in the preschool period. These are self-regulation and joint engagement, two aspects of development that in many ways go hand in hand. Each will be discussed individually.

Self-regulation

While the definition of self-regulation in early childhood continues to be debated (Lynn, Cuskelly, O'Callaghan, & Gray, 2011; McClelland et al., 2007; Thompson, 1994; Wanless et al., 2011), it can generally be described as the controlling, directing, and planning of one's emotions and behaviors, although some researchers in infant development consider self-regulation to be more related to temperament (e.g. Kochanska, Murray, & Harlan, 2000; Lundqvist-Persson, 2001; K. T. Murray & Kochanska, 2002; Rothbart & Posner, 2005) and therefore less directed by effortful control and cognitive processing.

Self-regulation includes an individual's ability to maintain, enhance, inhibit, or subdue emotion (Masters, 1991; Thompson, 1994). It encompasses a child's regulatory responses to an emotional state; for example, a child may seek out their parent or caregiver

when upset (Cole, Martin, & Dennis, 2004; Thompson, 1994) and furthermore, it incorporates the role of executive function such as, planning, strategy use, cognitive flexibility, management of attention, inhibitory control, and the incorporation of feedback (P. Anderson, 2002; Aylward, 2005; Happaney, Zelazo, & Stuss, 2004; Lynn et al., 2011).

For the purpose of this study, self-regulation is defined as 'the motivation and ability to control one's emotions and behaviours in potentially stressful situations' (von Suchodoletz, Trommsdorff, Heikamp, Wieber, & Gollwitzer, 2009, p.561). This definition acknowledges that self-regulation is a collection of integrated abilities and incorporates the role of temperament and responses a child may use or display to the emotional state experienced.

Self-regulation and language.

The ability to manage one's emotions and behaviours is foundational to learning (McClelland et al., 2007; National Institute of Child Health and Human Development Early Child Care Research Network, 2003), including the learning of language skills. In children from infancy through to 5 years of age, the capacity for self-regulation has been found to be related to general development. For instance, Lundqvist-Persson (2001) assessed 38 full-term infants with optimum health at 3 days of age using a screening instrument measuring neonatal regulation as 'low', 'ordinary' or 'high'. The instrument was developed based on the Neonatal Behavioural Assessment Scale (Brazelton & Nugent, 1995) and it assesses the baby on seven items including 'peak of excitement', 'rapidity of build-up', 'irritability', 'lability of states', 'cuddliness', 'consolability' and 'self-quieting activity'. These measures of self-regulation only took into account the child's emotional regulation and not the role of executive functioning. In a follow up study at 2;0, 36 of the infants were tested with the Griffiths' Mental Developmental Scales (Wheeler, 1954). The findings indicated that an infant with a low level of self-regulation is at risk for poorer language development and

poorer quality of social interaction development as measured by the subscales 'hearing and speech', 'eye and hand coordination' and 'personal-social development'. Furthermore, the authors postulate that infants with poor self-regulation are more dependent on supportive, nurturing parents.

Consistent with this view, the National Institute of Child Health and Human Development Early Childcare Research Network (2003) investigated the relationship between self-regulation and general development in older children. They defined self-regulation more along the lines of executive function as they measured self-regulation by looking at a child's sustained attention and inhibition of impulsive responding. Results showed that self-regulation at 4;6 was positively correlated with reading, math and linguistic ability scores. In another study, kindergarteners' capacity for self-regulation and teachers' ratings of second graders' self-regulation skills were significant predictors of reading achievement scores (Howse, Lange, Farran, & Boyles, 2003).

In addition to studies of self-regulation and general development, there has been interest in the specific relationship between self-regulation and vocabulary development. Nayena et al. (2011) measured self-regulation through the administration of executive functioning tasks. They administered these tasks as well as a vocabulary test to 254 children aged 3;6. Their mothers also completed questionnaires which assessed the child's shyness and home environmental stimulation. Results indicated that both executive functioning and home environmental stimulation were positively correlated with vocabulary size. The study then used the bootstrap procedure described by Preacher, Rucker, and Hayes (2007) to test for moderated mediation effects. The results indicated that children with better executive functioning skills developed stronger vocabularies, especially when they were raised within a more stimulating environment.

The relationship between self-regulation and vocabulary development has also been explored in older preschool-aged children. McClelland et al. (2007) investigated the predictive relationship between self-regulation skills and emergent literacy, vocabulary, and math skills in children aged between 3;6 and 6;4. The self-regulation skills of 310 children were assessed using the Head-to-Toes task (Cameron Ponitz et al., 2008), which looks at the child's inhibitory control, attention and working memory. In this task, children were required to play a game in which they were instructed to do the opposite of what the experimenter says. For example, if the experimenter instructed the child to touch their head, instead of following the command, the child was expected to do the opposite and touch their toes. Their emergent literacy, vocabulary, and math abilities were assessed using appropriate subtests from the Woodcock Johnson Tests of Achievement (Woodcock & Mather, 2000). Results revealed that self-regulation significantly and positively predicted growth in emergent literacy, vocabulary, and math skills. Furthermore, as skills in self-regulation increased, so did growth in emergent literacy, vocabulary, and math skills.

More recently, the same relationship in older children was explored by Wanless et al. (2011). Again, the Head-to-Toes task (Cameron Ponitz et al., 2008) was used to measure self-regulation and this was compared with early math skills, early vocabulary skills and teacher-rated regulation (Wanless et al., 2011). Results indicated that the Head-to-Toes task (Cameron Ponitz et al., 2008) was significantly related to early math and vocabulary skills after controlling for age, mother's education level and teacher-rated regulation. They concluded that for Taiwanese preschoolers, supporting the development of self-regulation in early childhood settings can promote early school success.

As expected, the relationship between self-regulation and language development is bidirectional in that language skills both impact and are impacted by a child's self-regulation development (Garber & Dodge, 1991). Parents and other adults may help children employ

strategies to regulate themselves. By adopting these strategies, children learn to recognise and understand their emotions. As Gallagher (1999) reported, language is an important tool in "self-reflection, verbal mediation, response inhibition, and behavioural direction" (p. 5). Furthermore, Kopp (1989, 1992) suggested that language skills provide an important tool for understanding and regulating children's emotions. Children use language to assist the process of self-talk, to communicate about social interactions, or to learn appropriate ways to manage certain emotions. In support of this view, Stansbury and Zimmerman (1999) reported that preschoolers' language abilities positively correlated with their ability to use distraction in a frustrating situation.

A relationship between language and self-regulation is further supported by Vallotton and Ayoub (2011). They used growth modeling of longitudinal data for 120 toddlers collected when children were 1;2, 2;0, and 3;0 to test the influence of spoken vocabulary and talkativeness on the growth of toddlers' self-regulation skills. Results revealed that both concurrent and prior vocabulary positively predicted children's levels of self-regulation. Furthermore, they found that vocabulary was a better predictor of self-regulation than talkativeness. They concluded that in early development, words are useful tools to employ in order to achieve self-regulation.

The studies discussed above strongly suggest that there is a relationship between self-regulation and language development in TD children (Howse et al., 2003; Lundqvist-Persson, 2001; National Institute of Child Health and Human Development Early Child Care Research Network, 2003). More specifically, they suggest a relationship between self-regulation and vocabulary development in children who are TD (McClelland et al., 2007; Nayena et al., 2011; Wanless et al., 2011). Furthermore, this relationship is reciprocal in that self-regulation skills impact language development and language impacts self-regulation development (Garber & Dodge, 1991; Kopp, 1989, 1992; Vallotton & Ayoub, 2011). We

now turn to what is known about the relationship between self-regulation and language development in children who are not TD.

Self-regulation in children with specific language impairment (SLI) has been explored (Fujiki, Brinton, & Clarke, 2002) as well as self-regulation in children born extremely preterm and very preterm (C. A. Clark, Woodward, Horwood, & Moor, 2008). Neither study delves into the impact self-regulation development has on language in these populations of children. Fujiki, Spackman, Brinton, and Hall (2004) examined the relationship between self-regulation, language ability, and reticent behavior in 43 children with SLI and 43 TD peers. Children were selected from two age ranges: 5;0 to 8;0 and 9;0 to 12;0. The Emotion Regulation Checklist (Shields & Cicchetti, 1997, 1998) was administered to measure self-regulation, the Teacher Behaviour Rating Scale (Hart & Robinson, 1996) was completed by the child's teacher as a measure of reticence, and The Comprehensive Assessment of Spoken Language (Carrow-Woolfolk, 1999) was used to measure language ability. Regression analysis indicated that self-regulation and language ability were significant predictors of reticence. Further analysis indicated that there was no significant difference in predictive power of self-regulation or language on reticence.

In summary, while the relationship between self-regulation and language, in particular vocabulary size, has been explored in children who are TD, the same relationship has not been investigated in children with multi-system DD. Fujiki et al. (2004) has initiated this research with a study including children with SLI but there still remains a significant absence in the literature on what this relationship looks like in children with a range of diagnoses that result in multi-system DD. It is important that this relationship is further explored as we know that children with multi-system DD frequently present with challenges with self-regulation and the impact of this on vocabulary development remains unknown.

Joint Engagement

Mother-infant interactions provide a child with many learning opportunities (Bruner, 1983). Although researchers have often been focused on how these interactions affect cognitive and social-emotional development, there is some research that looks at the influence of mother-infant interactions on language development (Carpenter et al., 1998; Dromi & Zaidman-Zait, 2011; Markus et al., 2001; Tomasello & Todd, 1983). There are a number of different ways in which dyadic interactions may contribute to language development, and vocabulary development in particular. Between 0;9 and 1;0, important milestones emerge in children's development such as gaze following, social referencing, imitation, and the use of gesture to direct attention (Tomasello, 1995). One important area of development is joint engagement, where both mother and child are focused on the same object while maintaining an awareness of each other's focus (Carpenter et al., 1998; Tomasello & Todd, 1983). Central to this behavior is the infant's ability to coordinate their attention between another person and object or event, known as joint attention (Bakeman & Adamson, 1984)

By definition, joint engagement involves the infant not only attending to an object, but also attempting to share this attention with another person (Bakeman & Adamson, 1984; Trevarthen & Hubley, 1978), often indicated behaviourally by alternating their gaze between an object and their mother, or other adult (Carpenter et al., 1998; Tomasello, 1995). Joint engagement episodes do not have to include a physical object as an infant may look at an adult in response to a noise they have heard. Similarly, joint engagement does not have to include visual attention towards an adult as the infant may already be visually focused on an object while auditorally attending to the adult (Tomasello, 1995). All of these described interactions between an infant and adult are episodes of joint engagement. The following section looks at the relationship between joint engagement and language.

Joint engagement and language.

Bruner (1983) examined the relationship between joint engagement and language development. He proposed that early infant-parent interactions occur at times during which infants and parents are focused on the same object or event. While attention is focused so intently within this interaction the child is able to take notice of their parent's language and begin to make word/object associations. In addition, joint engagement episodes between an infant and an adult help a child to learn that other people can be intentional agents for communication (Tomasello, 1995). Bruner (1983) described joint engagement as being vital developmental opportunities for children to learn a culture's way of interacting and learning to code their world through vocabulary. Furthermore, Adamson and Bakeman (2006) reported that as a child acquires a vocabulary of words, the opportunities for joint engagement expands. This is because the focus of the shared attention is shifted from present objects to symbols that refer to them, to future and past events, and to internal states.

Empirical studies provide evidence for a relationship between joint engagement and language development in TD children. Tomasello and Todd (1983) investigated the relationship between lexical acquisition and the way mothers and children regulate each other's attentional states. Results of a study of six mother-infant dyads showed that mothers who maintained high levels of joint engagement during unstructured play sessions with their 12 month old infants had children with larger vocabularies at 1;6. Results of cross-lagged correlations showed that it was the joint engagement episodes that contributed to the children's lexical acquisition rather than vice versa. More recently, Dromi and Zaidman-Zait (2011) tried to identify inter-correlations between toddlers' non-linguistic behaviours that co-occur during the transition to speech. The Hebrew Parent Questionnaire for Communication and Early Language (Camaioni, Castelli, Longobardi, & Volterra, 1991) was administered to 154 parents of toddlers aged 1;0 to 1;3. The questionnaire guided parents to observe and rate

their toddler as they interacted in six different contexts at home. Seven communicative behaviours were extracted from the questionnaire data: Crying, Vocalisations, Collaboration with Adults, Pointing, Words, Joint Engagement in a Peek-a-Boo Game and Triadic Interaction in Book Reading. Results showed that participation in social games that involved joint engagement and book reading activities were positively associated with the toddlers' vocabulary size.

The same relationship was also explored by Carpenter et al. (1998) who assessed 24 infants monthly from 0;9 to 1;3 and then again at 1;6 and 2;0 during a ten-minute free play session. Joint engagement between 0;11 and 1;1 was positively related to word comprehension between 0;9 and 1;3 and was positively related to word production at 1;2. A stronger pattern of results was found when the authors took into consideration the age when infants first spent a significant amount of time in joint engagement (e.g. 30 seconds), rather than chronological age. Measures were set to begin at a starting point defined by the month when an infant first reached a minimal level of joint engagement, as well as one and two months later. Significant correlations were reported with these adjusted levels of joint engagement and word production. The authors concluded that the relationship between word production and joint engagement does not emerge until infants spend a significant amount of time in joint engagement.

A longitudinal study of the relationship between joint engagement and early vocabulary was carried out by Markus et al. (2001). They recruited 21 infant-parent dyads for participation. Early infant language, responding to joint engagement skill, and cognitive development were assessed at 1;0. Child-caregiver interactions were recorded and children's responding to joint engagement skill and their language were assessed at 1;6. Developmental outcome using the MacArthur Communicative Development Inventories (L Fenson et al., 1993) and Bayley Scales of Infant Development-II was assessed at 1;9 and 2;0. Results

indicated that individual differences in child-caregiver episodes of joint engagement were related to language at 1;6. In addition, vocabulary at 1;0 and responding to joint engagement skill were associated with some aspects of child-caregiver interaction, as well as subsequent language development.

To summarise, research involving joint engagement in TD children indicates that engagement with another can facilitate language learning (Akhtar, Dunham, & Dunham, 1991; Carpenter et al., 1998; Tomasello & Farrar, 1986; Tomasello, Mannle, & Kruger, 1986; Tomasello & Todd, 1983). More specifically, there appears to be a relationship between joint engagement and early vocabulary size in TD children (Carpenter et al., 1998; Tomasello & Farrar, 1986; Tomasello & Todd, 1983). We now turn to what is known about the relationship between joint engagement and vocabulary development in children who are not TD.

One longitudinal study by Adamson et al. (2009) observed TD toddlers and young children with autism and Down syndrome while they interacted with their caregivers. After being filmed up to five times over a 1-year period, children's receptive and expressive language was assessed using the Peabody Picture Vocabulary Test – Third Edition (Dunn & Dunn, 1997) and Expressive Vocabulary Test (Williams, 1997). Results indicated that a certain level of vocabulary is needed for a child to actively infuse symbols into joint engagement. In all three groups of children, variations in how often children were observed in symbol-infused supported joint engagement predicted the growth in their receptive and expressive vocabularies.

More recently, Farrant, Maybery and Fletcher (2011) investigated the relationships between joint engagement, joint attention, imitation, and conversation skills by establishing a model of these relationships in TD children and children with SLI. The Affective Model they developed suggests that joint engagement provides the foundation from which

communication skills develop. They found that joint attention and imitation mediated the relationship between joint engagement and conversation skill.

The argument that joint engagement provides a foundation from which communication skills develop, is also supported by research suggesting that disordered communication development is among the outcomes associated with emotional deprivation during infancy and early childhood (Greenspan & Shanker, 2004; Spitz, 1946). Furthermore, interventions that are designed to increase socio-emotional engagement have been shown to have a positive effect on the linguistic competence of those with impaired communication (Zeedyk, 2006). The quality or security of infant-caregiver attachment has been found to positively relate to later language development in TD children (Kaneko, 1997; Klann-Delius & Hofmeister, 1997; Main, 1983; A. D. Murray & Yingling, 2000; Salerni, Calvo, & D'Odorico, 2001) and children with Down syndrome (Rauh & Calvet, 2004).

However, while the relationship between joint engagement and language development in TD children has been explored, the same relationship in children with multi-system DD has not. Other studies (e.g. Adamson et al., 2009; Farrant et al., 2011) have made a good start, however, there is a need for more research, ideally looking at this relationship in children that have a wide range of etiologies. It is important this relationship is further explored as we know that children with multi-system DD do frequently present with difficulties engaging with others and the effect of this on vocabulary development remains unclear.

Measures of Self-regulation, Joint Engagement, and Vocabulary

The review of the literature in the preceding sections shows that there are a number of different ways of assessing self-regulation, joint engagement, and vocabulary development. This section will discuss what measures have been used in research to date and discuss the measures selected for the current study.

Self-regulation and joint engagement measures.

One of the difficulties in examining the relationship between language and self-regulation in both TD children and children with multi-system DD is identifying the measures that best reveal self-regulatory behavior. Teacher ratings such as the 'Emotion Regulation Checklist' (Shields & Cicchetti, 1997, 1998) are frequently used to assess a child's regulation. This assessment asks the teacher to rate a child, aged 6;0 to 12;0, on a 4-point Likert scale (1 = never and 4 = almost always) on both positive and negative aspects of emotion regulation, for example, 'is easily frustrated' and 'responds positively to neutral or friendly overtures by peers'. Teacher ratings provide valuable information about a school-age child, however, one of the limitations is that teacher ratings can differ from parent ratings (Hundert, Morrison, Mahoney, & Vernon, 1997), child reports (Kunter & Baumert, 2006) and direct assessments (Loo & Rapport, 1998; Mahone et al., 2002; Mahone & Hoffman, 2007). Teacher ratings can also be limited as a tool for measuring self-regulation as across schools within a country and across countries, there are differences in teacher expectations (Wanless et al., 2011).

Another method of measuring self-regulation is by evaluating components of children's executive function separately and then combining the scores (Carlson, 2005; Smith-Donald, Raver, Hayes, & Richardson, 2007). For instance, Carlson (2005) administered a battery of executive functioning tasks on 602 children aged between 1;10 and 6;11. The battery of tasks that were administered varied depending on the child's age. Aggregating such scores can be problematic if the separate measures are weakly correlated (Archibald & Kerns, 1999; Espy & Bull, 2005; Oh & Lewis, 2008). This method is also limited as examining these skills individually does not test the child's ability to use each of the skills in tandem.

The Head-to-Toes task (Cameron Ponitz et al., 2008) and the more complicated version, the Head-Toes-Knees-Shoulders task (Cameron Ponitz et al., 2008; Matthews, Ponitz, & Morrison, 2009; McClelland et al., 2007) are often used to directly assess regulation in young children by requiring the child to integrate attention, working memory, and inhibitory control and use these skills to alter the behavior they elicit. These tasks require a motor response from children and are challenging even for some TD children, let alone children with multi-system DD.

Sound measures of joint engagement are equally challenging to find, particularly for children with multi-system DD, in part because of the physical difficulties they may have. Even with TD children, obtaining accurate measures of behaviours that represent joint engagement can be difficult. Many studies attempt to measure joint engagement through analysing and coding recordings of dyadic social interactions between an infant and parent (Adamson, Bakeman, & Deckner, 2004; Adamson et al., 2009; Adamson, Deckner, & Bakeman, 2010; R. Feldman & Greenbaum, 1998). Some studies choose to provide the child with a set of toys. Sometimes this is part of a protocol, for example, the Communication Play Protocol (Adamson & Bakeman, 1999). One of the limitations to this measure of joint engagement includes creating a naturalistic environment for the interaction to occur within. Furthermore, there are various ways in which to code the interactions. Adamson et al. (2004) used a state based coding system that was based on codings used previously in Bakeman and Adamson (1984). They segmented the child's engagement states into 11 categories, including 'unengaged', 'onlooking', 'person', 'object', 'supported joint', 'coordinated joint', 'symbol only', 'person-symbol', 'object-symbol', 'symbol-infused supported joint' and 'symbol-infused coordinated joint'. R. Feldman and Greenbaum (1998) assessed affect expression and affect attunement using codes adapted from the Rating Scale of Interactional Style (G. N.

Clark & Seifer, 2006) and assessed symbolic play and internal state talk using a coding system developed by Tamis-LeMonda and Bornstein (1991, 1994).

An alternative to measuring observed behaviours, is the use of questionnaires. Farrant et al. (2011) measured a child's socio-emotional engagement retrospectively using a scale developed specifically for their study. Primary caregivers of children aged 4;0 to 7;0 rated how often in early childhood their child displayed the described attention or behavior on a 5-point scale ranging from 'almost never' to 'almost always' with a maximum possible score of 20 for the Socio-Emotional Engagement Scale. They found the reliability of the Socio-Emotional Engagement Scale for this study to be acceptable (alpha = .74). The use of retrospective parent reports has so far been limited to studies of children with autism (Baird et al., 2000; Robins, Fein, Barton, & Green, 2001). Its limitations lie in the fact that the measure relies on the parent's recall of their child in the early years. Dromi and Zaidman-Zait (2011) also used a questionnaire form, but not retrospectively. They administered The Hebrew Parent Questionnaire for Communication and Early Language which is a structured questionnaire based on the one developed by Camaioni et al. (1991). This parent report measure looks more broadly at the intercorrelations between non-linguistic behaviours that children use and the onset of speech. They extracted seven communicative behaviours from the questionnaire form to encompass a measure of these non-linguistic behaviours, one of which was joint engagement.

Rating scales for teachers as well as classroom observations have also been used to measure joint engagement. Cameron Ponitz et al. (2008) asked a group of classroom teachers to rate children's behavioural self-control on a 5-point scale using the Teacher's Self-Control Rating Scale, which has shown reliability and validity in relation to observations of children's classroom behavior and achievement in prior research (Humphrey, 1982). They also used an adapted version of the Observed Child Engagement Scale (National Institute of

Child Health and Human Development: Early Child Care Research Network, 2002). Using a 7-point Likert scale, observers rated children on five classroom behaviours: joint engagement, attention, self-reliance, compliance, and disruptive behavior. These were averaged to form a single indicator of joint engagement. Although this provided useful information about children in the school setting, it does not paint a full picture of a child's joint engagement in general.

Although studies to date have tended to use hands-on testing it is possible to ask parents questions about functional behaviours that depend on self-regulation and joint engagement. Research supports the importance of recording the knowledge held by family members who know their child the best. Bagnato and Simeonsson (2008) argue that 'authentic' assessments, as opposed to 'conventional' assessments that rely on standardised measures, are a fairer test of a child's development, especially for children aged between 0;0 and 6;0 at developmental risk or with neurodevelopmental disabilities where moderate or severe difficulties are evident or expected. An assessment is described as being 'authentic' when information is gathered about functional behaviour in natural settings, highlighting strengths and needs, using direct observation and recordings, rating scales, interviews and observed samples of natural or facilitated play and daily living skills. Parents ought to be engaged throughout the assessment process and the assessment should teach children and guide the goals of intervention. Bagnato and Simeonsson (2008) criticize the use of assessments that are not developed for or validated on young children with developmental disabilities. Furthermore, they argue that a fair assessment should not involve unfamiliar adults, unrealistic test demands and non-functional item selection as they fail to assess a child's 'true' capabilities within a child's everyday routine.

The Adaptive Behaviour Assessment System, Second Edition (ABASII; Harrison & Oakland, 2003) is a parent completed rating scale designed to assess a child's functional daily

living skills between 0;0 and 5;0. The comprehensive range of adaptive skills and broad adaptive domains measured by the ABASII correspond to the specifications identified by the American Association of Mental Retardation (AAMR; 1992, 2002) and the Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision (American Psychiatric Association, 2000) and the Individuals with Disabilities Education Act. Bagnato, Neisworth, and Pretti-Frontczak (2010) describe the ABASII as a tool that exemplifies authenticity. They find this assessment conforms to all of the criteria for an authentic assessment including being an assessment for focusing on adaptive skills as broad, functional competencies that underlie a child's ability to function within their home and their community. Its functional domains (Communication, Community use, Functional Pre-academics, Home Living, Health and Safety, Leisure, Self-direction, Self-care, Social, and Motor) represent daily skills in real-life settings and provide a General Adaptive Composite age-scaled score, three other age-scaled composite scores, as well as both raw and scaled scores for each of the subtests.

The ABASII is designed to be used in diagnostic assessment, intervention planning, and treatment programmes for individuals with various disabilities and mental and physical disorders. Although not widely used in research, the ABASII has been used in three recently published studies. Tham et al. (2012) examined the prevalence and trajectory of sleep disturbances and associated factors in children up to the age of 2;0 following a traumatic brain injury and used data from the raw scores of the Communication and Self-care subtests. Shellmer et al. (2011) investigated the cognitive and adaptive functioning of 14 patients after liver transplantation for maple syrup urine disease. Adaptive functioning was measured using the General Adaptive Composite (GAC) score of the ABASII. The GAC score was also used to test adaptive ability 10 years after a diagnosis of traumatic brain injury between 2;0 and 12;0 in 76 children (V. Anderson, Godfrey, Rosenfeld, & Catroppa, 2011).

For the purpose of this study, three subtests of the ABASII: Leisure, Self-direction, and Social, were chosen to measure self-regulation and joint engagement. These three subtests were selected for use as the items within these subsections best reflected self-regulation and joint engagement. Leisure, the subtest that seeks information on a child's play skills, has items such as 'plays simple games like peek-a-boo', 'plays with toys, games or other fun items with other people', 'plays with other children when asked', and 'waits for his/her own turn in games or other fun activities'. The Self-direction subtest includes items that look at a child's ability to regulate themself and address their physical and emotional needs, for example, 'stops fussing or crying when picked up or spoken to', 'entertains self in crib or bed for at least one minute after waking', 'finds something to do for at least five minutes without demanding attention', 'controls temper when a parent or other adult takes a toy or object away', and 'resists pushing or hitting another child when upset or angry'. The Social subtest of the ABASII asks about a child's interaction skills with others, for example, 'smiles when he/she sees parent', 'relaxes body when held', 'displays a special closeness or relationship to parent', and 'says when he/she feels happy, sad, scared, or angry'.

The MacArthur Communicative Development Inventories (L Fenson et al., 1993) and the Language Use Inventory (LUI; O'Neill, 2007) are also assessments that are considered 'authentic' according to Bagnato and Simeonsson (2008). Both are parent-report measures that ask the parent to mark their child's development on a range of functional areas of development and require the parents to draw on their direct observations of their child's language and use of language. Both assessments will be discussed in the following section.

Vocabulary development measures.

The MacArthur Communicative Development Inventories is a well-researched and internationally validated parent questionnaire designed to provide information on children's

expressive vocabulary. It relies on parents to identify all of the words that are in their child's expressive vocabulary.

Various studies have found that this parent report measure is effective in characterising children's early language skills (Dale, 1991; Dale, Bates, Reznick, & Morisset, 1989; Miller, Sedey, & Miolo, 1995; Thal, O'Hanlon, Clemmons, & Fralin, 1999). In addition, Charman et al. (2005) examined the predictive validity of symptom severity, cognitive and language measures taken at 2;0 and 3;0 to outcomes at 7;0 in a sample of children diagnosed with autism at 2;0. This study used the raw total number of words produced on the MacArthur Communicative Development Inventories as a measure of language expression. H. M. Feldman et al. (2005) investigated the concurrent and predictive validity of parent reports of child language at 2;0 and 3;0. Again, this study used the raw total number of words that the child says from the list as one of the measures of language. More recently, Mayor and Plunkett (2011) developed a statistical estimate of infant and toddler's total vocabulary size based on analysis of their MacArthur Communicative Development Inventories total word score. They suggest that this is a more valid method of estimating TD children's total vocabulary size than the MacArthur Communicative Development Inventories total word score.

The current study used the New Zealand MacArthur Communicative Development Inventory: Words and Sentences (CDI; Reese & Read, 2000). This is a variation to the version developed by L Fenson et al. (1993) and includes 41 changes to the vocabulary words to account for the New Zealand dialect (e.g. 'stroller' was changed to 'pushchair', 'diaper' was changed to 'nappy'). This study modified the form to include a column for asking if the child can sign the word. This was an approved modification to the original form. Parents were asked to go through the list and tick which words the child says verbally and which ones the child can sign. In this study, words ticked in the 'Vocabulary Checklist' section,

regardless of whether it is ticked in the word column, sign column or both, were counted as being present in the child's vocabulary. This adaptation acknowledges that a child, especially a child with multi-system DD, can express a word, other than through spoken language.

The LUI, like the CDI, is another example of an 'authentic' assessment, as identified above. It relies on parents to document their observations of their child's use of gesture and language for a range of pragmatic purposes. There are 14 subscales used to assess a child's communication in a wide range of settings and for a variety of functions including, requesting help, sharing focus of attention, asking and commenting about things and people, guiding interactions with other people, sharing humour, talking about language and words, adapting communication to perspectives of other people, and building longer sentences and stories. Pesco and O'Neill (2012) examined the predictive validity of the LUI. Parents of 348 children who had completed the LUI on their child between the ages of 1;6 and 3;11 were reassessed between 5;0 and 6;0 with standardised, norm-referenced language measures and a parent report of developmental history. The relationship between the LUI total score and later measures was examined through a variety of statistical procedures. The results provided initial support for the LUI's predictive validity, particularly for children 2;0 to 3;11, and suggest that the LUI can indicate later language outcomes. The current study also used the LUI total score as the overall score of a child's pragmatic language skills.

Summary

A number of relationships between self-regulation and joint engagement on one hand and vocabulary development on the other have been identified. Furthermore, the relationship between self-regulation and vocabulary appears to be bidirectional in that self-regulation abilities predict vocabulary development and learning words appears to assist in self-regulation. The relationship between self-regulation and vocabulary development as well as joint engagement and vocabulary development has been explored in children who are

typically developing. With the exception of a small amount of research on children with SLI (Farrant et al., 2011; Fujiki et al., 2004) and one study on children with autism and Down syndrome (Adamson et al., 2010), there is very little research on this relationship in children with a range of etiologies that reflect complex multi-system DD. This gap in the literature deserves focus as we know that these are two areas of non-linguistic development that children with multi-system DD struggle with. The impact of self-regulation and joint engagement on vocabulary size in this population of children remains unknown and yet knowledge of this relationship has the potential to change clinical thinking in this area.

The current study consists of a main quantitative study, supplemented by a more qualitative case study. The quantitative study aimed to address the following research questions:

1. Do children with multi-system DD differ from language age-matched, TD children on vocabulary size, self-regulation, and joint engagement?

2. What is the relationship between vocabulary size, as a measure of language development, and self-regulation and joint engagement in children with multi-system DD and children who are TD?

It is hypothesised that given the strong relationships between language and self-regulation and joint engagement among typically developing children that children with multi-system DD will not differ from their language age-matched, TD peers on vocabulary size, levels of self-regulation or joint engagement. Furthermore, it is hypothesised that strong correlations will be found which will suggest a close relationship between self-regulation and joint engagement and language development.

The case study provides a description of a child with Down syndrome drawn from the quantitative study participants. The case study will explore the following:

1. What is the relationship between vocabulary size and self-regulation and joint engagement for this one child?

2. How do these relationships change over time and what might be the reasons for those changes?

Method

Participants

The participants consisted of two groups: one group of children with multi-system developmental delay (DD) and another group of typically developing (TD) children. A description of the participant groups is as follows:

The group of children with multi-system DD was 28 children (18 males and 10 females), aged between 2;5 and 5;6 attending the Champion Centre, a centre-based non-governmental early intervention service in Christchurch, New Zealand. The children presented with a range of diagnoses including, Down syndrome, the consequences of prematurity, developmental dyspraxia, autism spectrum disorder, and global developmental delay. The children with multi-system DD presented with delayed development as determined by General Adaptive Composite (GAC) scores derived from the Adaptive Behaviour Assessment System, 2nd Edition (ABASII). The GAC score is an overall score of adaptive behaviour derived from accumulation of the subtest scores on the ABASII. This group had GAC scores that ranged from 40 to 88 ($M = 63.14$, $SD = 12.93$). Criteria for inclusion in the study were:

1. developmental delay in all of the major developmental systems: cognition, communication, motor and socio-emotional development as measured by a GAC score 1.25 standard deviation or more below the mean on the qualitative ranges specified for the GAC score on the ABASII.

2. aged between 2;5 and 6;0. The age, 2;5 was selected as this is the age we considered the children with multi-system DD are likely to have intentional expressive language to analyse. In addition, clinical observations determined that this was the age by which most children attending the Champion Centre have intentional expressive language.

3. English being the primary language spoken. Children for whom Maori and/or New Zealand sign language were a secondary language were also included.

4. informed consent of parents (and where appropriate children) in conformity to the ethical approval for the study.

5. Agreement from the therapists working with a child with multi-system DD that participation would not put undue stress on the child and/or their family

The TD group consisted of 77 children, aged between 0;7 and 5;6 recruited through word of mouth. Their GAC scores ranged from 74 to 139 ($M = 104.40$, $SD = 13.58$) which suggested typical development. An initial pool of 86 children and their parents were invited to participate in the study and were sent a set of questionnaire forms. Seven sets of forms were not returned. One child was excluded as he was born 8 weeks prematurely and it was unclear what impact this had had on his development. One child was eliminated as assessment results showed that she did not yet have enough expressive language to analyse and her language skills did not match her to a child within the group of children with multi-system DD. Criteria for inclusion in the study included:

1. no identified developmental delay in any of the major systems of development: cognition, communication, motor, and socio-emotional development.

2. born at more than 38 weeks gestation.

3. aged between 0;7 and 5;6. These ages were chosen as an estimate of the developmental age span of the children in the cohort. Seven months was selected as

being the beginning of the stage of triadic communication (Trevarthen & Hubley, 1978). Furthermore, Owens (2008) reports that within this stage, the infant uses conventional gestures, vocalisations, or both to communicate intention. The emergence of intentional communication is demonstrated through a child's use of gesture, paired with eye contact with the child's communication partner, consistent sounds and use of intonation to represent certain intentions, and persistent attempts to communicate.

4. English being the primary language spoken. Children for whom Maori or and/or New Zealand sign language were their secondary language were also included.

5. informed consent of parents (and where appropriate children) in conformity to the ethical approval for the study.

To create a set of 28 matched pairs, each child with multi-system DD was matched to one child in the TD group by language age as calculated by the age equivalence scores derived from the children's raw scores on the Communication subtest of the ABASII. To check that the ABASII Communication score was a valid basis for calculating language age, these scores were compared to both the MacArthur Communicative Development Inventory: Toddlers, New Zealand English Adaption (CDI) total word score and the Language Use Inventory (LUI) total score for all children in the matched pair sample. A Pearson product-moment correlation coefficient was computed to assess the relationship between the CDI total score and the raw scores of the ABASII Communication subtest in children with multi-system DD and in children who are TD. In the group of children with multi-system DD, there was a strong, positive correlation, $r = 0.78$, $n = 28$, $p < 0.001$. The children who were TD also demonstrated a strong, positive relationship, $r = 0.82$, $n = 28$, $p < 0.001$. Figure 1 illustrates the relationship between the CDI total score and the raw scores of the ABASII Communication subtest.
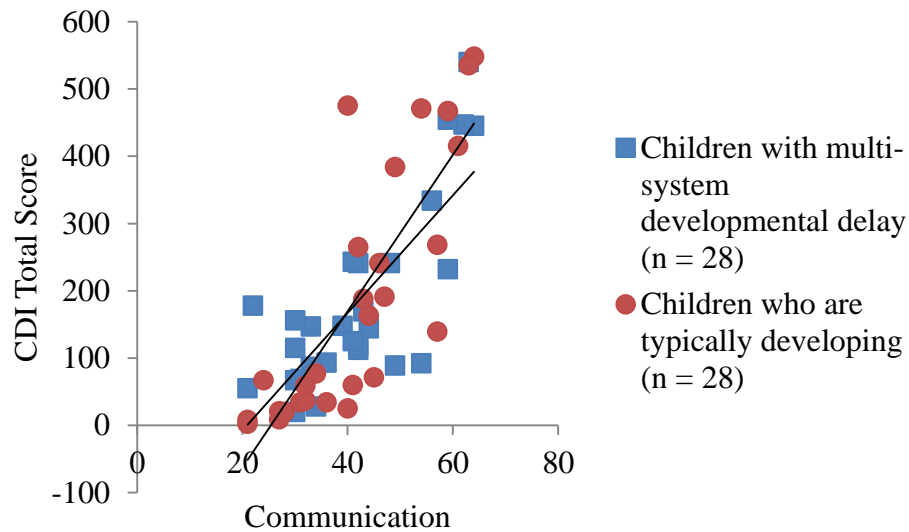
Figure 1. The relationship between the CDI total score and the raw score of the

Communication subtest of the ABASII in the children with multi-system DD and language

age-matched, TD children.

A Pearson product-moment correlation coefficient was computed to assess the

relationship between the LUI total score and the ABASII Communication subtest in children

with multi-system DD and children who are TD. In the group of children with multi-system

DD, there was a strong, positive correlation, $r = 0.87$, $n = 28$, $p < 0.001$. The children who are

TD, also demonstrated a strong, positive correlation, $r = 0.87$, $n = 28$, $p < 0.001$. Figure 3

illustrates the relationship between the LUI total score and the raw scores of the ABASII
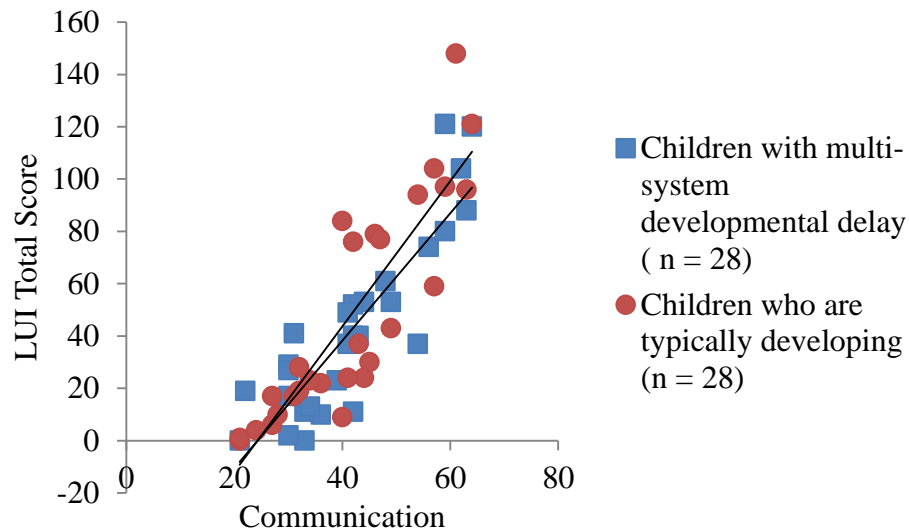
Communication subtest in both groups.

Figure 2. The relationship between the CDI total score and the LUI total score in the children with multi-system DD and language age-matched, TD children.

To verify that the CDI score was a valid indicator of broader language skills, a Pearson product-moment correlation coefficient was computed to assess the relationship between the CDI total score and the LUI total score in children with multi-system DD and children who are TD. In the group of children with multi-system DD, there was a strong, positive correlation, $r = 0.87$, $n = 28$, $p < 0.001$. The children who are TD also demonstrated a strong, positive relationship, $r = 0.88$, $n = 28$, $p < 0.001$. It was thought that the high correlations may have been a result of the LUI including two questions about a child's expressive vocabulary, some of which ask about the same words as what are present in the CDI. Exploratory analysis showed that this was not the case. Even when the score from the items in the LUI that assess vocabulary were removed from the LUI total score, the correlations were just as strong. Figure 3 illustrates the relationship between the CDI total score and the LUI total score in both groups.
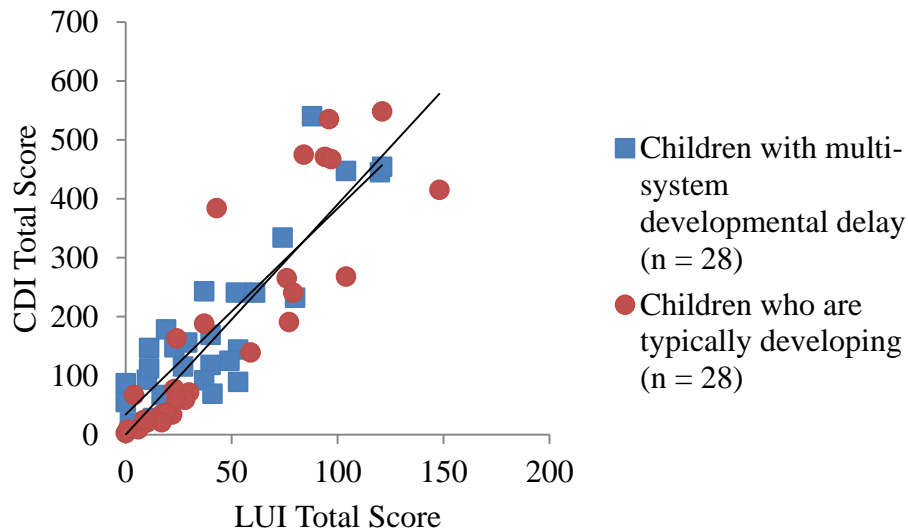
Figure 3. The relationship between the CDI total score and the LUI total score in the children with multi-system DD and language age-matched, TD children.

Ethical approval for the data collection and analysis was received by Dr. Susan Foster-Cohen from the Human Ethics Committee of the University of Canterbury as part of a longer term study of which this study forms a part. As this approval did not include a control group, additional ethical approval was sought and gained for the data collection and analysis of the control group.

Measures and Procedure

Each child's parent was asked to complete three questionnaires on their child's development:

1. ABASII (Harrison & Oakland, 2003)

2. CDI (Reese & Read, 2000)

3. LUI (O'Neill, 2007)

The parent questionnaires (ABASII, CDI and LUI) were completed by parents independently at home. For the children with multi-system DD, parents were either given the battery of assessments when they attended the Champion Centre with their child for their

regular therapy session or sent the battery of assessments in the post. They were encouraged to bring back the set of forms when they next came into the Champion Centre or they were given a self-addressed envelope to post back the forms once complete. For the children who were TD, parents were either sent the forms in the post or they were given to them in person. Parents were asked to post back the forms once complete via a provided, self-addressed envelope.

Data Analysis

Group differences between children with multi-system DD and TD children were analysed using a paired-samples t-test. Pearson product-moment correlation co-efficient scores were calculated to measure the relationship between vocabulary and the non-linguistic measures.

Results

Descriptive Statistics

Table 1 presents descriptive statistics for the children with multi-system developmental delay (DD) and the typically developing (TD) children on the General Adaptive Composite (GAC) score, the MacArthur Communicative Development Inventory: Toddlers, New Zealand English Adaption (CDI) total score, the Language Use Inventory (LUI) total score and the three subtests of the Adaptive Behaviour Assessment System, 2nd Edition (ABASII): Leisure, Self-direction, and Social. It allows comparisons between the children with multi-system DD ($n = 28$) and both the total sample of TD children ($n = 77$) and the subset of that group matched on language age to the children with multi-system DD ($n = 28$) as calculated from the raw score of the ABASII Communication subtest using the ABASII manual (Harrison & Oakland, 2003).

Table 1.

Range, Means (M), and Standard Deviations (SD) of the GAC, CDI, LUI, and Scaled Scores

of the Leisure, Self-direction, and Social Subtests of the ABASII

	Multi-system DD (n = 28)			TD (n = 77)			Language age-matched, TD (n = 28)		
	Range	M	SD	Range	M	SD	Range	M	SD
GAC	40-88	63.14	12.93	74-139	104.40	13.58	74-139	103.61	15.85
CDI	20-540	185.32	139.41	0-675	371.25	256.91	2-548	188.36	185.00
LUI	0-121	43.29	34.61	0-161	89.01	57.16	0-148	48.18	41.52
Leisure	1-10	5.86	2.27	6-17	11.70	2.46	7-17	11.86	2.72
Self-direction	1-12	4.96	2.85	5-17	11.38	2.71	6-16	10.93	3.03
Social	1-10	5.14	2.68	4-16	10.82	2.92	5-16	10.64	3.12

An independent-samples t-test was conducted to compare the GAC score and the scaled scores of the ABASII subtests: Leisure, Self-direction, and Social in children with multi-system DD ($n = 28$) and the children who were TD ($n = 77$). There was a significant group difference in the GAC score between children with multi-system DD ($M = 63.14$, $SD = 12.93$) and TD children ($M = 104.40$, $SD = 13.58$); $t(103) = 13.94$, $p <0.0001$. In addition, there was a significant group difference in the scaled score of the Leisure subtest between children with multi-system DD ($M = 5.86$, $SD = 2.27$) and TD children ($M = 11.70$, $SD = 2.46$); $t(103) = 10.98$, $p < 0.0001$. There was also a significant group difference in the scaled score of the Self-direction subtest between the children with multi-system DD ($M = 5.14$, $SD = 2.85$) and TD children ($M = 11.38$, $SD = 2.71$); $t(103) = 10.58$, $p < 0.0001$ and a significant

difference in the scaled score of the Social subtest between the children with multi-system DD (M = 5.14, SD = 2.68) and TD children (M = 10.82, SD = 2.92); $t(103)$ = 8.99, $p <$ 0.0001.

These significant differences between the children with multi-system DD and TD children across the GAC score and the scaled scores of the ABASII subtests strongly suggest that these are two distinct groups of children on these parameters. The next set of comparisons addresses the between group differences of the two groups of 28 children matched on language age.

A paired-samples t-test was conducted to compare the GAC score and the scaled scores of the ABASII subtests: Leisure, Self-direction, and Social in children with multi-system DD (n = 28) and language age-matched, TD children (n = 28). There was a significant group difference in the GAC score between children with multi-system DD (M = 63.14, SD = 12.93) and language age-matched, TD children (M = 103.61, SD = 15.85); $t(27)$ = 11.79, p <0.0001. In addition, there was a significant group difference in the scaled score of the Leisure subtest between children with multi-system DD (M = 5.86, SD = 2.27) and language age-matched, TD children (M = 11.86, SD = 2.85); $t(27)$ = 9.79, $p <$ 0.0001. There was also a significant group difference in the scaled score of the Self-direction subtest between children with multi-system DD (M = 4.96, SD = 2.85) and language age-matched, TD children (M = 10.93, SD = 3.03); $t(27)$ = 8.86, $p <$ 0.0001 and a significant group difference in the scaled score of the Social subtest between the children with multi-system DD (M = 5.14, SD = 2.68) and the language age-matched, TD children (M = 5.14, SD = 2.68); $t(27)$ = 7.42, $p <$ 0.0001.

The significant group differences between the children with multi-system DD and the 28 language age-matched, TD children across the GAC scores and the scaled scores of the ABASII subtests again strongly suggests that these are two distinct groups on these measures. Furthermore, given strong group differences are present using both samples of TD

children it indicates that the subset of 28 is a good representation of the larger group of 77 children. The results presented below will therefore be confined to the group of 28 children selected from the larger sample of 77 TD children compared to the language age-matched 28 children with multi-system DD. It is also important to note that while the group comparisons in this section used the scaled scores of the ABASII, the matched pairs were compared on the raw scores of the ABASII.

Paired Sample Group Differences

A paired-samples t-test was conducted to compare the CDI total score in children with multi-system DD and language age-matched, TD children. There was no significant difference in the CDI total score for children with multi-system DD (M = 185.32, SD = 139.41) and language age-matched, TD children (M = 188.36, SD = 185.00); $t(27)$ = -0.07, p = 0.910.The large standard deviations reported in both groups is a reflection of how variable vocabulary size is at all ages. Variability in children's vocabulary size is documented and supported by L. Fenson and Dale (1994).

A paired-samples t-test was conducted to compare the LUI total score in children with multi-system DD and language age-matched, TD children. There was no significant group difference in the LUI total score for children with multi-system DD (M = 43.29, SD = 34.61) and language age-matched, TD children (M = 48.18, SD = 41.52); $t(27)$ = 0.38, p = 0.352.

A paired-samples t-test was conducted to compare the Leisure subtest of the ABASII in children with multi-system DD and language age-matched, TD children. There was a significant group difference in the raw scores for the Leisure subtest for children with multi-system DD (M = 45.04, SD = 9.33) and language age-matched, TD children (M=40.71, SD=8.76); $t(27)$ = 1.82, p = 0.004. The children with multi-system DD scored higher on the Leisure subtest of the ABASII compared to their language age-matched, TD peers.

A paired-samples t-test was conducted to compare the Self-direction subtest in the ABASII in children with multi-system DD and language age-matched, TD children. There was no significant difference in the raw scores for the Self-direction subtest for children with multi-system DD ($M = 43.04$, $SD = 11.91$) and language age-matched, TD children ($M = 39.57$, $SD = 11.22$); $t(27) = 1.14$, $p = 0.085$.

A paired-samples t-test was conducted to compare the Social subtest of the ABASII in children with multi-system DD and language age-matched, TD children. There was no significant difference in the raw scores for the Social subtest for children with multi-system DD ($M = 45.68$, $SD = 11.07$) and language age-matched, TD children ($M = 42.39$, $SD = 11.33$); $t(27) = 1.12$, $p = 0.088$.

In summary, children with multi-system DD do not differ from their language age-matched, TD peers on vocabulary size. The children with multi-system DD scored higher on the Leisure subtest of the ABASII than their language age-matched, TD peers but there were no group differences between the groups on their scores on the other two subtests: Self-direction and Social.

Relationships between Vocabulary and Self-direction, Social and Leisure Subtests

Pearson product-moment correlation coefficients were computed to assess the relationship between language and non-linguistic measures. Several authors have offered guidelines for the interpretation of a correlation (Buda & Jaraynowski, 2010; Cohen, 1988). This study has used these guidelines to report the strength of the correlations found. A correlation coefficient of .10 is thought to represent a weak or small association; a correlation coefficient of .30 is considered a moderate correlation; and a correlation coefficient of .50 or larger is thought to represent a strong correlation.

Pearson product-moment correlation coefficients were computed to assess the relationship between the CDI total scores and the raw scores of the Leisure subtest of the

ABASII in the children with multi-system DD and the children who are TD. In the children with multi-system DD, there was a medium, positive correlation, $r = 0.34$, $n = 28$, $p = 0.075$. In the children who were TD, there was a strong, positive relationship, $r = 0.51$, $n = 28$, $p = 0.006$. Figure 4 illustrates the relationship between the CDI total score and the Leisure subtest of the ABASII in both groups of children.
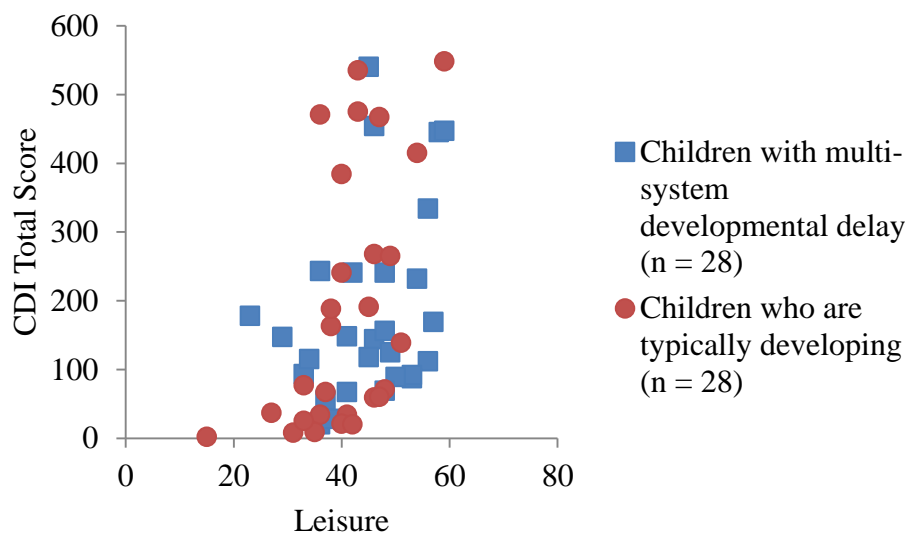

Figure 4. Scatter plot showing correlations between the CDI total score and the raw score of the Leisure subtest of the ABASII in the children with multi-system DD and language age-matched, TD children.

Pearson product-moment correlation coefficients were computed to assess the relationship between the CDI total scores and the raw scores of the Self-direction subtest of the ABASII in children with multi-system DD and children who are TD. In the children with multi-system DD, there was a medium, positive correlation, $r = 0.39$, $n = 28$, $p = 0.038$. In the children who were TD, there was a strong, positive relationship, $r = 0.52$, $n = 28$, $p = 0.005$. Figure 5 illustrates the relationship between the CDI total score and the Self-direction subtest of the ABASII in both groups of children.
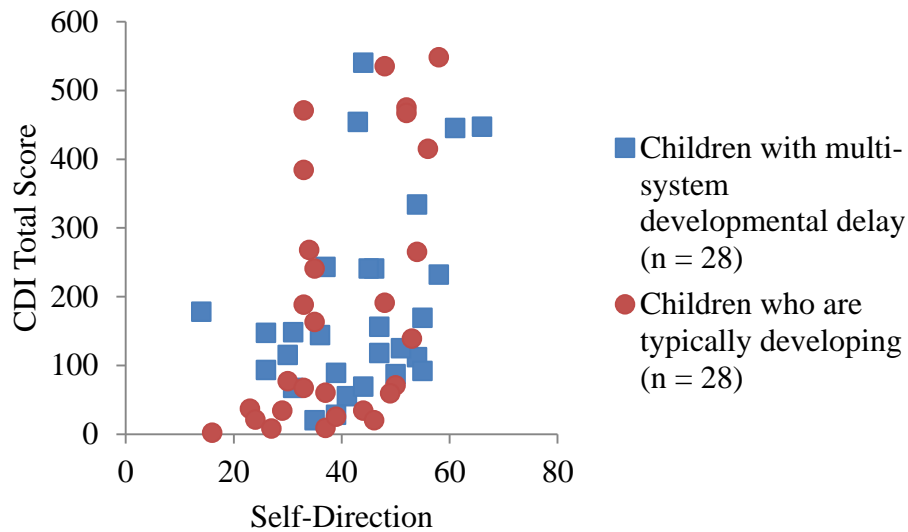
Figure 5. The relationship between the CDI total score and the raw score of the Self-direction subtest of the ABASII in the children with multi-system DD and language age-matched, TD children.

Pearson product-moment correlation coefficients were computed to assess the relationship between the CDI total scores and the raw scores of the Social subtest of the ABASII in children with multi-system DD and children who are TD. In the children with multi-system DD, there was a medium, positive correlation, $r = 0.41$ $n = 28$, $p = 0.032$. In the children who are TD, there was a strong, positive relationship, $r = 0.63$, $n = 28$, $p < 0.001$. Figure 6 illustrates the relationship between the CDI total score and the Social subtest of the ABASII in both groups of children.
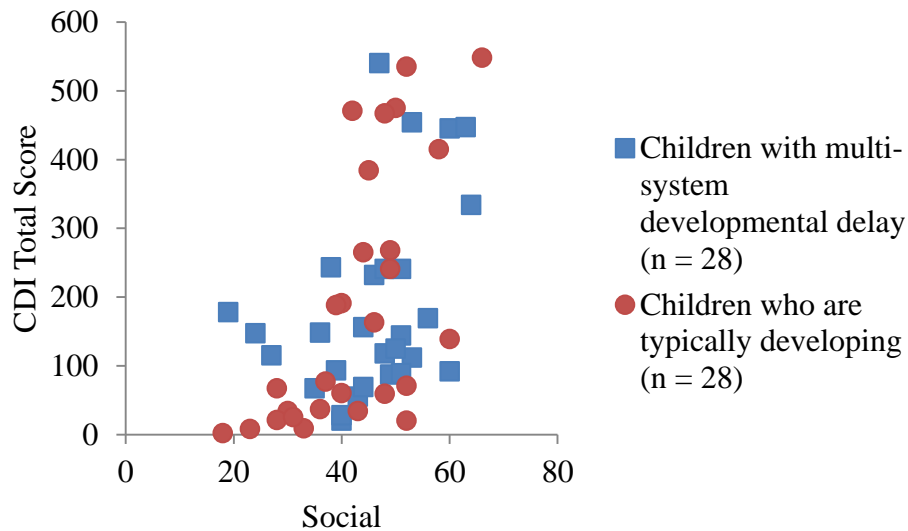
Figure 6. The relationship between the CDI total score and the raw score of the Social subtest of the ABASII in the children with multi-system DD and language age-matched, TD children.

Overall, there were positive relationships between the CDI total scores and the raw scores of the three ABASII subtests: Leisure, Self-direction, and Social in the group of children with multi-system DD and in the TD children. The correlation between the CDI total score and each of the subtests is stronger in the children who are TD. All of the correlations are significant, except for the correlation between the CDI total score and the Leisure subtest for the children with multi-system DD, although it is close to significance.

Case Study: Richard

In addition to the main part of the study, one of the children from the group of children with multi-system developmental delay (DD), Richard, was selected to be reported on as a case study. Richard has a diagnosis of Down syndrome and he was born prematurely. Richard was chosen as a case study as he had multiple data points collected over time.

Richard was assessed using the Adaptive Behaviour Assessment System, 2nd Edition

(ABASII), the MacArthur Communicative Development Inventory: Toddlers, New Zealand

English Adaption (CDI), and the Language Use Inventory (LUI) on four occasions, 6 months

apart. The assessment schedule for Richard is presented in Table 2.

Table 2

Age (years;months) of Administration of Assessments.

	ABASII	CDI	LUI
Richard	3;11, 4;5, 4;11, 5;5	3;11, 4;5, 4;11, 5;5	3;11, 4;5, 4;11, 5;5

For the case study, Richard's main file at the Champion Centre was used to gain

background information on his development. The files provided case history information

including information on the pregnancy, birth, and early development and also therapy notes

from the multidisciplinary team members involved in his intervention. As well as gaining

information on Richard through their main file, informal discussions were held between the

author and his current therapy team to further enhance the understanding of this child. The

case study will include a brief summary of Richard's birth history and family circumstances.

It will then analyse the results of his parent questionnaire forms over the four occasions they

were collected and will include discussion on the relationship between vocabulary size and

self-regulation and joint engagement and how this relationship changes over time.

Background Information

Richard was born prematurely at 30 weeks and 6 days gestation weighing 1235

grams. He was born by caesarean section following abnormal Doppler's and scans that

revealed he was not growing well. Up until this point in the pregnancy, all scans showed a

normal, healthy fetus, including a scan for nuchal translucency. During the neonatal period, there was evidence of an intracranial cyst. Further testing found this to be of normal variant. Richard also failed two hearing screens during the neonatal period and was subsequently seen twice more by the Audiology Department. He did not have a normal test on either occasion. Richard spent 7 weeks in the Neonatal Intensive Care Unit. At no point during this stay was it suggested that he had Down syndrome. His growth was excellent, his tone was considered normal, he had no cardiac concerns and he had no feeding difficulties during the first three months of life. Examination of Richard's physical features at 3 months of age raised the question of Down syndrome. Subsequent chromosomal testing confirmed the diagnosis of Trisomy 21 (Down syndrome).

Although Richard was thought to have poor hearing in the early stages, formal testing was unable to investigate this entirely. When Richard was 1;8, grommets were inserted. When Richard was 1;11, Acoustic Immittance testing showed a type A tympanogram on the right consistent with normal middle ear pressure and movement, and a type B tympanogram of high volume on the left, consistent with a patent grommet. Visual Reinforcement Audiometry (VRA) showed reliable responses down to 20dB HL across the frequency range .5 to 4 kHz for stimuli presented via the sound field and through the right insert phone. Unfortunately the left ear was unable to be tested. Richard was followed up again at 4;7 where results showed that he had good middle ear function and normal hearing in at least one ear across the speech frequency range. Separate ear testing showed normal hearing in both ears for a high frequency sound. It was thought that Richard has sufficient hearing for normal speech and language development.

Richard's vision was assessed at 3;7 and was within acceptable limits. It was rechecked at 5;3 and Richard was found to be long-sighted but no correction was needed and it was thought that this would likely correct itself with time.

Richard began attending the Champion Centre on a weekly basis from 0;6 to 2;4 and then on a fortnightly basis for the next 19 months. At age 4;1, Richard entered a transition-to-school weekly programme until he went to school at 6;0. A review of the speech language therapist's notes indicated that Richard was turning to sounds, making a variety of vowel-like sounds and smiling at other people from 0;8. Richard said his first word at age 1;1 which was 'mum'. This increased to 'dada', 'baby' and 'ball' at age 1;9. By 2;0, Richard was using a mixture of sign and words to express his needs and wants. He also reportedly enjoyed playing peek-a-boo with familiar and unfamiliar adults. At 2;3 Richard was reported to have several single words, mostly nouns. During his third year of life he was reported to increase the amount of nouns, start using learnt phrases e.g. 'up above' and 'Humpty Dumpty', and begin saying some verbs e.g. 'finish'.

Results of Parent Questionnaires

Richard's expressive vocabulary, as measured by the CDI at 3;11 and subsequently thereafter, included both spoken words and signs. Richard predominantly used spoken words to communicate but sign has consistently been an adjunct to his expressive communication skills. Figure 7 shows the trajectory of his vocabulary development through both spoken words and signs over time. It does not distinguish between those items that are solely words or solely signs from those where both the word and sign are used.
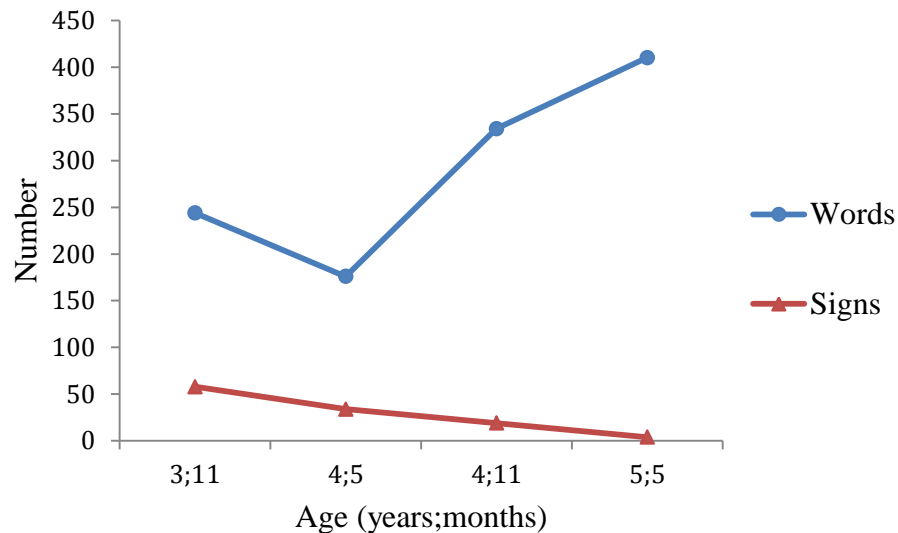
Figure 7. Number of signs and words in Richard's expressive vocabulary over time.

Over time, the number of signs decreased. This occurred as Richard learnt to use the spoken word for that item, for example, over the course of a year between the age of 4;5 and 5;5, Richard stopped using the sign and used the spoken word instead for 'cat', 'chicken', 'cow', 'duck', 'elephant', 'fish', 'horse', 'lamb', 'pig', 'rooster', and 'sheep'. Typically, Richard begins using a word in his expressive vocabulary through sign and word before later transitioning to only using the verbal word, for example at the data points of 3;11, 4;5 and 4;11 Richard would use a combination of word and sign for 'chicken' and 'cow' but by 5;5 Richard was using the spoken word only. He does not appear to express many words by sign alone or transition straight to the spoken word. The exception was the phrase 'give me five'. When Richard was 4;5 he used this phrase through sign alone but by age 5;5 he was using the spoken words only. It is possible that he did pair the sign with the spoken words for a short period of time between assessments. Table 3 shows the total number of words in Richard's vocabulary at each time point as well as the number of spoken words, the number of signs, and the number of signs that were also spoken words.

Table 3

Total Vocabulary, Spoken Words, Signs, and Spoken words and Signs over time

Age (years;months)	Total vocabulary size	Spoken words	Signs	Signs and spoken words
3;11	244	244	58	58
4;5	177	176	34	33
4;11	334	334	19	19
5;5	410	410	4	4

Richard's expressive vocabulary on the CDI, as reported by his mother, does not reflect a smooth trajectory of an increasing number of items. At the age of 4;5, the number of lexical items in his repertoire appears to reduce considerably. At 3;11 Richard was reported to have 244 words on the CDI. This reduced to 177 at 4;5 then increased again to 334 at 4;11 and then to 410 at 5;5. If we use the algorithm provided by Mayor and Plunkett (2011) to estimate total vocabulary size, the fall and rise in the size of Richard's vocabulary appears to be even more noticeable. Figure 8 shows the trajectory of Richard's expressive vocabulary over time with the total vocabulary size by calculation demonstrating an even more noticeable decrease at age 4;5.
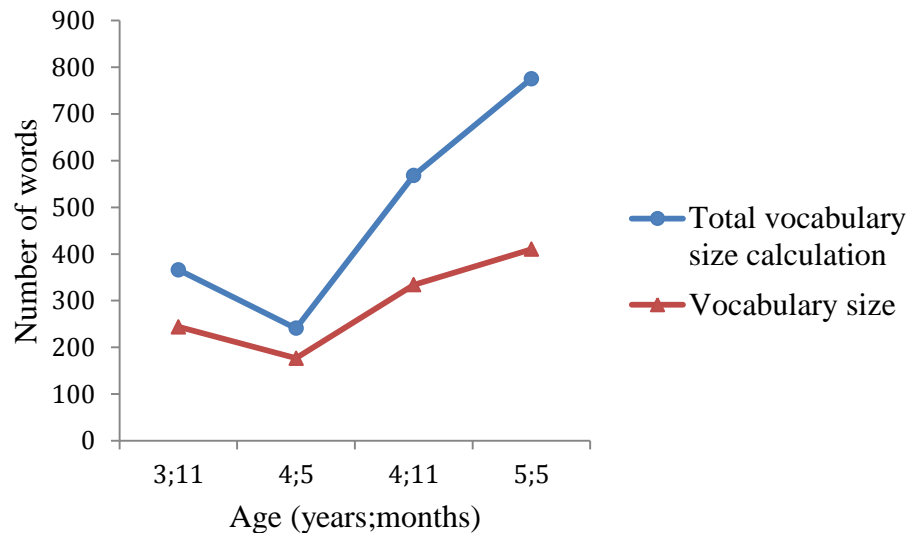
Figure 8. Richard's CDI results as reflected through the algorithm produced by Mayor and Plunkett (2011) for estimating total vocabulary size.

At the time of the apparent reduction in the size of Richard's expressive vocabulary at age 4;5, there were a number of stressors on this family which may have had an impact on Richard's ability to achieve self-regulation and joint engagement. These stressors, including the magnitude 6.3 earthquake that struck the Canterbury Region in New Zealand on the 22nd of February 2011 as well as the large aftershock on the 13th of June 2011 had a significant impact on their routines. Richard was unable to attend both his preschool and the Champion Centre. Richard's parents described his state as 'stressed' following the period of earthquakes and numerous aftershocks. Coping with post-earthquake stress in the family took its toll on both parents. As well as these stressors on family life, in August 2011 at 4;5, Richard developed chicken pox. All of these factors may have taken their toll on Richard's ability to remain regulated and be engaged with another. They certainly seemed to have coincided with an apparent reduction in Richard's expressive vocabulary development. Research supports the hypothesis that experiencing adverse circumstances such as natural disasters, impacts on development. Pane, McCaffrey, Kalra, and Zhou (2008) investigated the combined impact of

Hurricanes Katrina and Rita in 2005 on school students. Results showed that some of the students who experienced both of the hurricanes demonstrated difficulties that included mental health or behavioural problems, and academic setbacks. Negative achievement effects were most evident in those students who remained displaced for the duration of the academic year. While Richard was not displaced from his preschool or the Champion Centre for a long period of time, life was still interrupted well after the main earthquakes due to constant aftershocks, and living and travelling within broken homes and communities.

Richard's decrease in expressive vocabulary may also have been related to the rise in his frustration and anxiety levels reported in June, 2011 when Richard was 4;3. At this time, Richard's mother reported that he had become aggressive, particularly when tired. It was also more difficult transitioning Richard from one place to another and he displayed an increased dislike to riding in the car. Again, these are examples of Richard not being able to be in a calm and regulated state for engagement and learning. During this period of time, Richard may not have been focused towards using words to demonstrate his expressive vocabulary.

By the time the next assessment was completed at 4;11, Richard had increased his expressive vocabulary from 177 to 334 words. Although only a reduction in the total vocabulary score of 67 words, Richard actually 'lost' 95 words between the two time points as some of the words he gained at 4;11 were completely new words. Of the 95 words that Richard apparently 'lost' at 4;5, 65 were regained 6 months later at 4;11. Richard lost words across a range of grammatical categories, (e.g. verbs, nouns, sound effects, pronouns) but the majority of words were common nouns, for example, 'finger', 'toe', 'bucket', 'glasses', 'highchair' and 'window'. This may suggest that Richard was originally able to use such noun words to label items in his environment but without the meaning attached to such words for promoting this continued use.

Alternatively, due to the various stresses on the family, there may have been fluctuations in Richard's mother's ability to give sufficient attention to the details of his language development across the time period studied. For example, given the challenges at the time of the assessment at 4;5, it may have been that her completion of the CDI was less accurate than at other periods of his life. That said, there is no obvious mirroring of the reduction in CDI scores in either the LUI scores or the Leisure, Self-direction, and Social scores over time. Instead, the LUI scores rise steadily across the time period and his ABASII subtest raw scores stay much the same over the 18 month period. Richard's mother filled in the battery of parent report measures at the same time, so it is unlikely she filled one form in less accurately than the others. It may be that this mirroring effect was not seen in the LUI or the ABASII subtests as these assessments look closer at a child's functional skills. Figure 9 illustrates this trajectory across each assessment and illustrates the reduction in the CDI total score and that this is not mirrored in the other assessments.
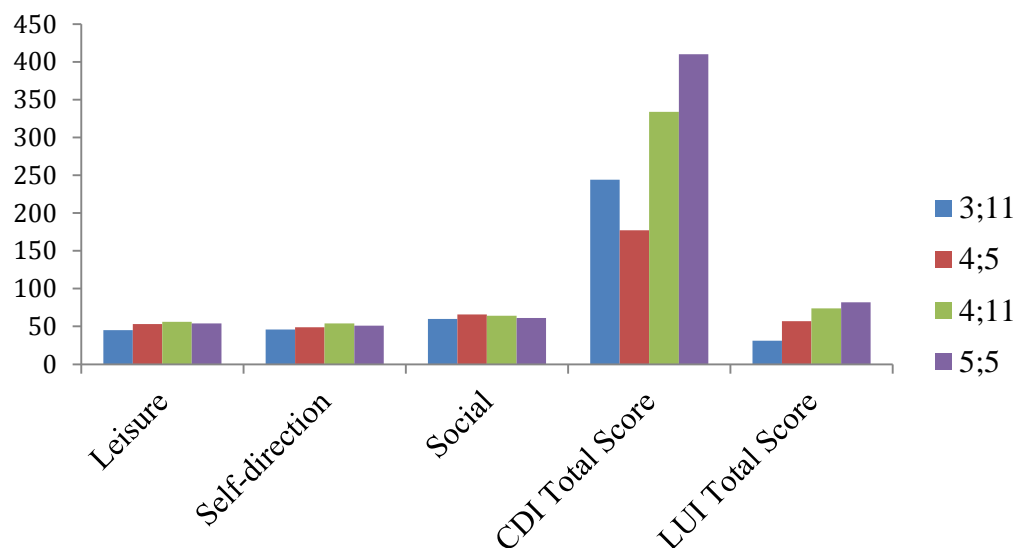

Figure 9. Raw scores of the ABASII subtests: Leisure (maximum score of 66), Self-direction (maximum score of 75), Social (maximum score of 72), CDI total score (maximum score of 675) and LUI total score (maximum score of 161) over time.

Furthermore, it we were to treat the four data points of Richard's assessment batteries as independent children, the level of correlation remains consistent between the CDI total score and the raw scores of the Leisure and Self-direction subtests. Pearson product-moment correlation coefficients were computed to assess these relationships. Richard demonstrated a medium (Buda & Jaraynowski, 2010; Cohen, 1988), positive correlation between the CDI total score and Leisure raw score, $r = 0.42$, $p = 0.58$ which is similar to the correlation found in the group of children with multi-system DD where there was also a medium, positive correlation, $r = 0.34$, $n = 28$, $p = 0.075$. There was also a medium, positive correlation between Richard's CDI total score and his Self-direction raw score, $r = 0.58$, $p = 0.42$ which again is similar to the medium, positive correlation found in the children with multi-system DD, $r = 0.39$, $n = 28$, $p = 0.038$. Interestingly, when the correlation between Richard's CDI total score and Social raw score was computed, there was a medium, negative correlation, $r = -0.47$, $p = 0.53$ which is different to the medium, positive correlation found in the group of children with multi-system DD, $r = 0.41$ $n = 28$, $p = 0.032$. So while there may be a pattern of medium, positive correlation between the CDI total score and the Social subtest of the ABASII in children with multi-system DD in general, this result is not reflected in every child's profile within that group which again highlights how important it is to consider each child as an individual.

Interestingly, when you compare Richard's scaled scores on the three subtests over time, he does not score higher in the Leisure subtest as suggested by the group data presented in the results section. In fact, Richard's strength out of the three subtests is the Social subtest which ironically relies heaviest on being a verbal communicator. For example, some of the items in the Social subtest are 'greets other children', 'says "thank you" when given a gift', 'says when he/she feels happy, sad, scared, or angry' and 'apologises if he/she hurts the

feelings of others'. Figure 10 illustrates Richard's progress on each of the three ABASII subtests over time and includes the mean scaled score of the group of children with multi-system DD.
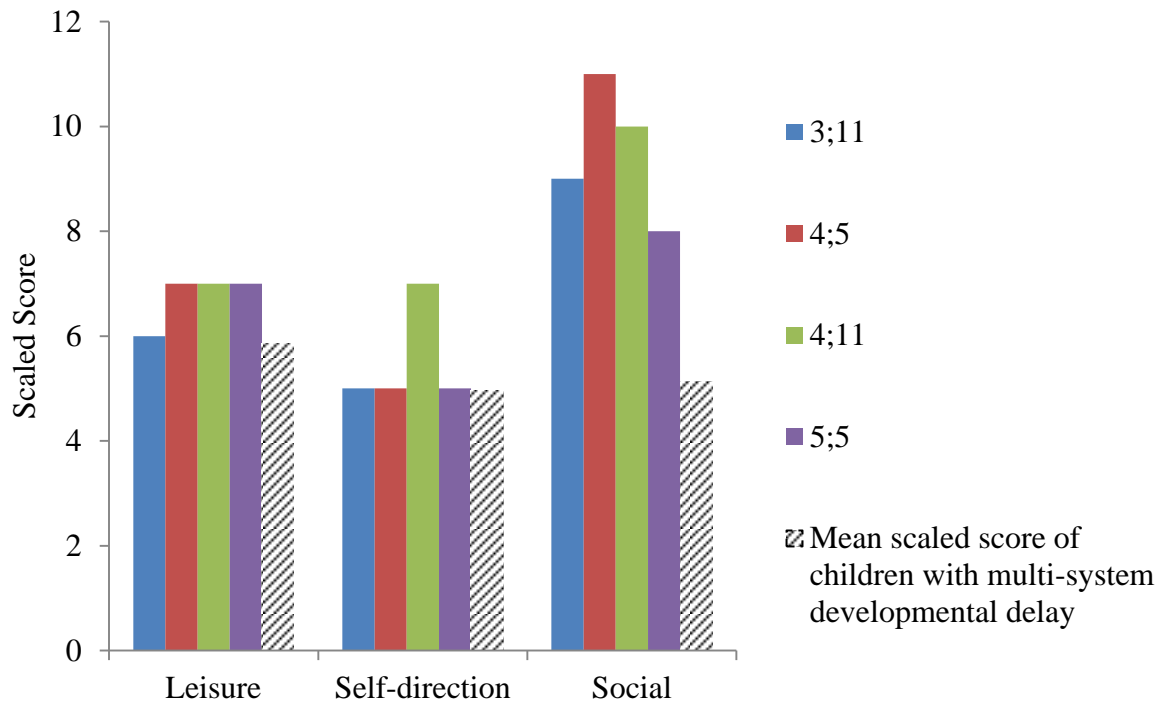

Figure 10. Scaled scores of the ABASII subtests: Leisure, Self-direction and Social over time

As discussed in the method section, the CDI total score and LUI total score are well correlated for both the group of children with multi-system DD and the group of TD children. If we were to treat Richard's four data points as if they were individual children, his CDI and LUI scores continue to demonstrate a strong, positive correlation over time $r = 0.71$, $p = 0.29$, just like his peers who have multi-system DD and his language age-matched TD peers. Interestingly, even when Richard's vocabulary decreased at age 4;5, his use of language, as measured by the LUI, increased steadily. This may suggest that Richard was using this time to attach meaning to the words he had in his vocabulary. So while Richard's mother reported

a reduction in his expressive vocabulary, he may well have only lost those words that he did not use meaningfully. Certainly this hypothesis is supported by Richard's subsequent scores on the CDI which show that many of the words that were lost, were picked up again with time. In looking at Richard's LUI questionnaire at 4;5, there is a notable increase in two areas: 'requests for help' and 'questions and comments about self and others'. So instead of increasing his vocabulary, Richard was perhaps using what words he already had to increase the functionality of his speech. This included increasing his ability to ask for help, for example, since in the questionnaire completed at 3;11, Richard was reported to have begun to use the word 'help', to ask an adult to do something difficult, and to ask to make a toy work or for an adult to fix a toy. Similarly, in the same time period, Richard began to say what his name is and what other people's names are, announce where he is and where someone else is, say how he is feeling physically, inform others of what he thinks of something and what he wants to do, states how someone feels emotionally, and says when he wants to do something on his own. Figure 11 shows how even through a temporary reduction in Richard's vocabulary at 4;5, his LUI continued to increase at a steady rate.
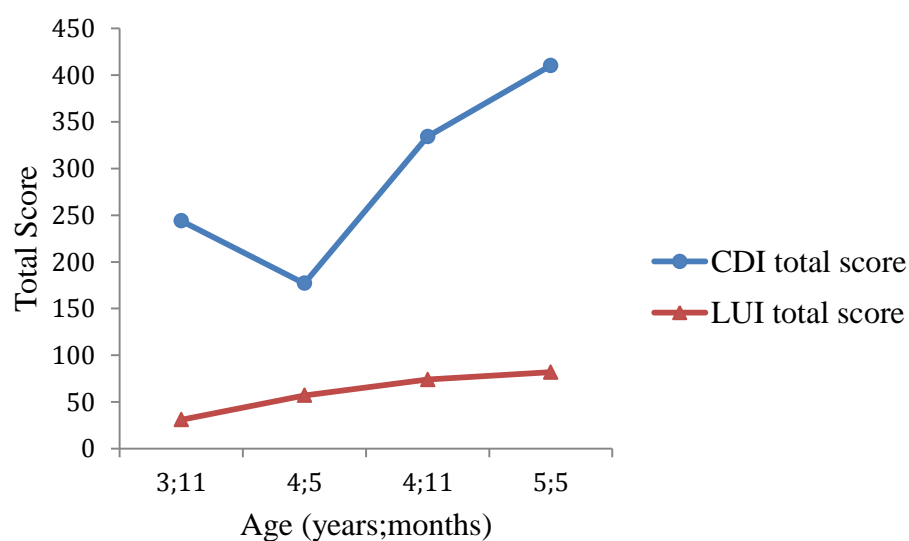

Figure 11. CDI total score and LUI total score over time

As Figure 12 shows, at 5;5, most areas of development on the ABASII had dropped off or plateaued relative to his same-age, TD peers. The Communication subtest of the ABASII was the only area of development to increase significantly. This supports the notion that children may make development in one area and then switch to working on another skill set. According to Owens (2005), TD children between the age of 0;7 and 1;0, may learn a few words within a short period and then plateau. More energy is then put into cementing a child's ability to walk and explore.
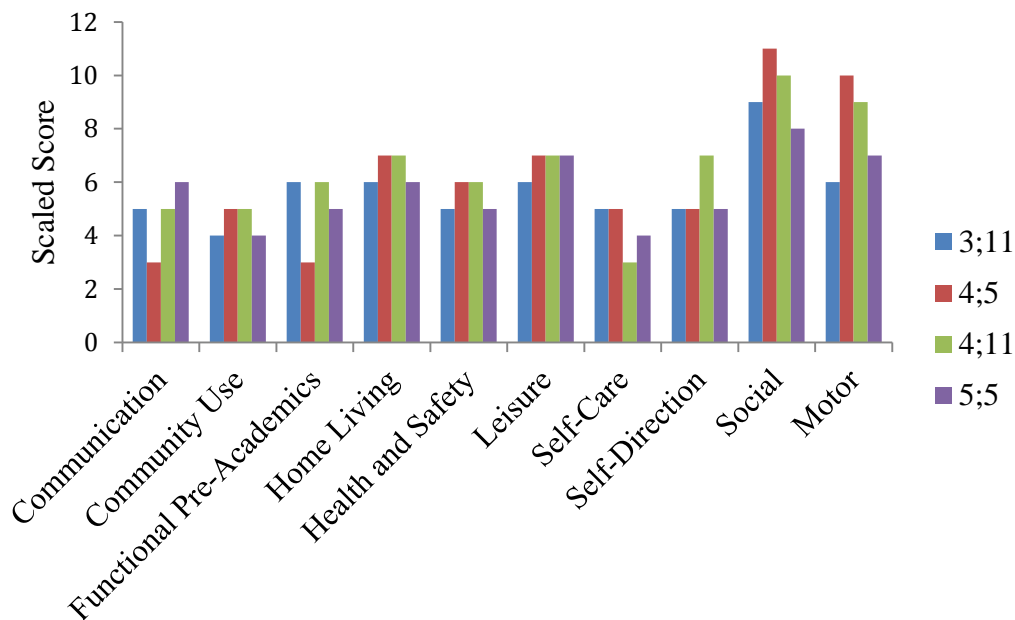
Figure 12. Scaled scores of the ABASII subtests over time

In summary, Richard's expressive vocabulary is made up of both spoken words and signs. He appears to drop the sign once the spoken word is more established. Richard has become less reliant on sign but it is still present as an adjunct to his expressive communication. Richard's CDI total score over time is not a trajectory of increasing items as one might expect. Instead there was a noticeable reduction in the number of words in his

repertoire at 4;5. There were a number of family stressors that may have influenced Richard's ability to remain self-regulated and achieve joint engagement and may explain why this occurred. Despite Richard's uneven profile of his CDI scores, the same unevenness was not mirrored in his scores on the LUI nor the ABASII subtests. For the most part, Richard's scores correlated similarly to those reported in the group of children with multi-system DD. There was a medium, positive correlation between Richard's CDI total scores and his raw scores on the Leisure and Self-direction subtests, similar to the results of the group. There was, however, a medium, negative correlation between his CDI total scores and his raw scores on the Social subtests which does not mirror the results of the group. Richard demonstrated a strong, positive correlation over time between his CDI total scores and LUI total scores, which was also reported in the group. The results highlight that although Richard is one of the 28 children included in the group of children with multi-system DD, he does not always follow the group pattern of his peers in this group. Every child's assessment results need to be considered, especially with the child's full background known. Richard has a diagnosis of Down syndrome but he was also born prematurely. Both diagnoses may influence how Richard scores on the assessment battery and teasing out which results are due to which diagnosis is impossible. Considering Richard as a whole, with consideration for his biological, psychological and social aspects of development is essential.

Discussion

Relationship between Vocabulary and Self-regulation and Joint Engagement

The aim of the study was to investigate whether there is a relationship between vocabulary and self-regulation and joint engagement in children with multi-system developmental delay (DD) and children who are typically developing (TD). Initially this study looked at whether there were group differences between the children with multi-system

DD and children who are TD. The correlation between vocabulary development, as measured by the MacArthur Communicative Development Inventory: Toddlers, New Zealand English Adaption (CDI), and self-regulation and joint engagement, as measured by three subtests of the Adaptive Behaviour Assessment System, 2nd Edition (ABASII) was then investigated. In the absence of a direct measure of self-regulation and joint engagement, the three subtests of the ABASII (Leisure, Self-direction, and Social) were a reasonable measure to use. The three subtests were chosen as they had numerous items within each section that measured the functional skills that reflect self-regulation and joint engagement, for example, 'plays simple games like peek-a-boo', 'plays with toys, games or other fun items with other people', 'waits for his/her own turn in games or other fun activities', 'stops fussing or crying when picked up or spoken to', 'entertains self in crib or bed for at least one minute after waking', 'controls temper when a parent or other adult takes a toy or object away', 'resists pushing or hitting another child when upset or angry', 'smiles when he/she sees parent', 'relaxes body when held', 'displays a special closeness or relationship to parent', and 'says when he/she feels happy, sad, scared, or angry'.

It was hypothesised that children with multi-system DD will not differ from their language age-matched TD peers on measures of language development. Results supported this and demonstrated that children with multi-system DD do not differ from their language age-matched TD peers on vocabulary size. A strong correlation was also found between the CDI total score and the raw score of the ABASII Communication subtest, the test used to match the children in both groups, suggesting that the ABAS Communication subtest did indeed reflect a measure of language age. The children with multi-system DD scored higher in raw score terms on the Leisure subtest of the ABASII than their language age-matched, TD peers but there were no group differences on the raw scores on the other two subtests: Self-direction and Social. This did not fit entirely with our hypothesis that there would be no

group differences between the two groups of children on all three subtests of the ABASII. Why children with multi-system DD scored higher than their language age-matched, TD peers on the Leisure subtest could be due to a number of reasons. Firstly, in matching a group of children with multi-system DD to children with the same language-age, inevitably the children who were TD were much younger. Furthermore, a child with multi-system DD is usually delayed in different areas of development by varying amounts so by matching them by language age, the children may not have matched in any other area of development. In addition, the majority of the children with multi-system DD had a diagnosis of Down syndrome, either as a primary diagnosis or a dual-diagnosis. Perhaps Leisure, a subtest of children's play skills, is an area of development that is not as delayed as communication in children with Down syndrome. This is supported by Motti, Cicchetti, and Sroufe (1983) who looked at the quality and level of play of children with Down syndrome at age 3 to 5 years. They found that when corrections were made for mental age, the play of these children with Down syndrome was similar to that of TD children. Lastly, the items in the Leisure subtest rely less heavily on being a verbal communicator, especially in comparison to the Self-direction and the Social subtest.

There were positive correlations between the CDI total scores and the raw scores of the three ABASII subtests: Leisure, Self-direction, and Social in the group of children with multi-system DD and in the group of TD children. The hypothesis that vocabulary development and non-linguistic developments, self-regulation and joint engagement, would be correlated was supported. The notion that vocabulary correlates with measures of self-regulation in children who are TD is consistent with other research (McClelland et al., 2007; Nayena et al., 2011; Vallotton & Ayoub, 2011; Wanless et al., 2011). Likewise, the results that vocabulary development correlates with joint engagement in children who are TD is consistent with other studies (Carpenter et al., 1998; Dromi & Zaidman-Zait, 2011; Markus et

al., 2001; Tomasello & Todd, 1983). The correlation between the CDI total score and each of the subtests is stronger in the children who are TD, consistent with the hypothesis. The one study found that reports on the relationship between vocabulary and joint engagement in children other than those who are TD, also reported that there is a correlation between these two measures in both groups of children. Adamson et al. (2009) reported that for children with autism, children with Down syndrome and for TD children, measures of joint engagement contributed to differences in both receptive and expressive vocabulary, over and above initial language capacity. This is not a surprising finding in the current study as the children who have multi-system DD are not necessarily delayed equally in all areas of development. All of the correlations were significant, except for the correlation between the CDI total score and the Leisure subtest for the children with multi-system DD. The area of uniqueness in this study is the Leisure subtest as unlike the other measures, there was a significant between group difference on the Leisure subtest and this subtest did not correlate as significantly with vocabulary as the other measures, Self-direction, Social and the Language Use Inventory (LUI) total score. Reasons for this have already been explored.

Parent reports of joint engagement, self-regulation and vocabulary size are widely accepted and used in developmental research (Dale, 1991; Dromi & Zaidman-Zait, 2011; Farrant et al., 2011; Miller et al., 1995; Thal et al., 1999). Nevertheless, there is some evidence to suggest that parent reports of their child's language skills are systematically higher than laboratory measures (Harris & Chasin, 1999) and this can be more pronounced in the early stages of language acquisition (Salerni, Assanelli, D'Odorico, & Rossi, 2007), However, Salerni et al. (2007) highlights the fact that parent reports are more likely to be representative of their child's communication skills because parents have multiple opportunities to observe their child in naturalistic settings in a variety of contexts. This is consistent with Bagnato and Simeonsson (2008) who endorse assessments such as the

ABASII, CDI and LUI for being parent-report measures that are functional and allow parents to draw on observations of their child in naturalistic settings, given they know their child best. Thus, although parent report measures of child development have some limitations, there are a number of reasons why they were appropriate to the aims of the present study.

Practical Implications

This study supported the notion that having a group of children with a range of diagnoses that reflects multi-system DD is reasonable to compare with TD children. Separating the children into diagnoses is making assumptions that children will perform in a certain way. However, the biopsychosocial theory suggests that we must consider a child as a whole, looking at the impact of not only his or her biological make-up but also their psychology and social development and the way in which these three areas interrelate (Engel, 1977). Furthermore, Cornish, Roberts, and Scerif (2012) recognise that developmental profiles in children with different disorders change over time across infancy, childhood, and adulthood. Development is not something that remains static nor does it typically reach an age plateau. This study concludes that it is important to include the subtle changing profiles of children that are driven by individual differences.

Given there was a between group difference between children with multi-system DD and children who are TD in the Leisure subtest, a test that primarily looks at a child's play skills, and given there was not a significant correlation between the CDI total score and the Leisure subtest, perhaps play skills are not as closely linked to language as the items within the subtests of Self-direction and Social.

Limitations

One limitation of this study is that the group of children in the TD group were collected by word of mouth and therefore not a true random sample. The types of parents who responded to the invitation to participate were most likely to be better educated and

more language oriented than the average parent. Although this data was not analysed, parent's professions were informally collected as it is a question on the front of the ABASII form. A sample of the recorded professions of the parent's included 'teacher', 'speech language therapist', 'lawyer', and 'occupational therapist'. For this reason it is likely that the children will have more advanced language for their age than a truly random sample of children. We collected the group of children through word of mouth as we were seeking matches for the children with multi-system DD and therefore were looking for children who were likely to have the same language-age as those children. We used the GAC score to check that the TD group of children was of a normal distribution and that they differed from the group of children with multi-system DD. The results indicated that there was a reasonable distribution and a significant between group difference given the sample size and the above limitations.

It was important to match the children with multi-system DD to a TD child by language age as this allowed us to see what differences there were in the other areas of development, that are not contributable to their chronological age. This is suggested by Cornish et al. (2012) as being the preferable approach to matching two groups of children and should be used instead of matching by chronological age as it is necessary to show that improvement does occur with increased development and that performance has not plateaued due to chronological age alone. By matching children with a disability to TD, same-age peers, the information provided will state the obvious conclusion that children with developmental disabilities are behind their same-age peers. However, some caution must be given to the way in which the two groups of children were matched by language age in this study. While the children are matched on language age, we cannot guarantee that they are also matched on all other areas of development that we are interested in, for example, Leisure, Self-direction, and Social. In the future, there are ways of matching the children with

multi-system DD with all of the possible matches in the group of TD children. It may be that two or three children in the TD sample would be a match for one child in the group of children with multi-system DD. This method of data analysis may help to work out which TD child matches the closest and is therefore the overall best match for that child.

It is also possible that there is an autocorrelation between the ABASII subtests chosen to measure self-regulation and joint engagement and the CDI total word score, the measure of vocabulary size. Some of the test items within the ABASII subtests, more so in the Self-direction and Social subtest than the Leisure subtest, suggest that a child needs to be verbal to be marked as having a certain skill, for example, one of test items in the Self-direction subtest states ''asks permission from adult when needed, for example, "may I play outside"'. This item implies that a child needs to have those words or similar words in their expressive vocabulary and some of those words ('I', 'play', and 'outside') are test items within the CDI. Most of the test items in the ABASII subtests that rely on verbal communication, occur much later into the subtest and therefore with the children with multi-system DD and their language age-matched peers, such test items were not scored given the child's developmental skill level. The impact of this possible autocorrelation in this study is not likely to have had a significant influence however, the actual impact has not been fully explored.

Future Research

This study raises a number of questions requiring further research. Firstly, it is of importance to determine whether similar results would be found when studying a larger group of children. Results from this study indicated that there is a relationship between vocabulary development and self-regulation and joint engagement. A similar study with an increased number of participants would increase the validity and strengthen clinical applications.

Future studies should also look at this relationship over time. This study was able to look at change over time through a case study analysis of one child but future research could look at this development over time across children with a range of etiologies that reflect multi-system DD. Alternatively, change over time could be looked at in specific etiologies to see if there is a general pattern of how children develop with certain diagnoses.

Conclusion

In conclusion, this study suggests that there is a relationship between self-regulation and joint engagement and vocabulary development in children with and without multi-system developmental delay (DD). Self-regulation and joint engagement were found to be correlated with vocabulary development in children with a range of etiologies that reflect complex multi-system DD and in language age-matched peers who were typically developing (TD) children. Results showed no significant difference between the two groups on vocabulary or on the Social and Self-direction subtests of the Adaptive Behaviour Assessment System, 2nd Edition (ABASII). However, the children with multi-system DD scored significantly higher than their language age-matched, TD peers on the Leisure subtest, suggesting more advanced play skills relative to language skills. For the children with multi-system DD, there was a medium, positive correlation between the MacArthur Communicative Development Inventory: Toddlers, New Zealand English Adaption (CDI) total score and the raw score of the three ABASII subtests of interest: Leisure, Self-direction, and Social. In the children who were TD, there was a strong, positive correlation between the CDI total score and the raw score of the three ABASII subtests: Leisure, Self-direction, and Social. The results suggest that self-regulation and joint engagement are key areas of development to consider when looking at language development in children with and without multi-system DD. We already know that there is a relationship between self-regulation and joint engagement and

vocabulary development in children who are TD and now this study contributes to understanding this same relationship in children with multi-system DD. This is an important finding given that self-regulation and joint engagement skills are affected in children with multi-system DD. This study suggests that while there are challenges to adopting a biopsychosocial approach to child development, understanding language development on its own is near impossible. It is imperative to take into consideration all aspects of a child's development when considering progress or lack of progress in an area of development and the current case study is an example of this. Richard proved that while some of his development mirrored that of his peers with multi-system DD, there were times when his development did not mirror his peers and it was through looking at Richard as a whole child that helped to understand the reasons why. It is always challenging to find a clinically appropriate and easily accessible way for parents to help clinicians understand their child, especially a child with multi-system DD. The parent report measures used in this study are an example of how asking parents for information on the functional skills of their child can lead to important understandings.

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