Evaluating and Enhancing Communication Skills in Four Adolescents with Profound and Multiple Disabilities

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Individuals with profound and multiple disability (PMD) experience more than one type of disability, typically severe to profound intellectual disability and significant motoric impairment. These complex impairments negatively affect many aspects of the person's functioning, such as daily living, academic, and social skills. Persons with PMD will often experience fluctuating levels of awareness, and often have such severe communication deficits that they rely on the use prelinguistic behaviours (PLBs) to communicate. It is often difficult for those working with these individuals to identify preferences and behavioural states indicative of engagement and motivation. As a result, these individuals often experience social isolation and a lower quality of life. The purpose of this research project was to evaluate the overall level of functioning and communicative abilities of four adolescents with PMD and identify instructional procedures that might enhance their natural method of communication, such that they are more readily understood. This was achieved through assessment and intervention based methods. First, the repertoire of forms and functions of specific PLBs in four participants with PMD were identified. Then, circumstances under which behaviours indicative of alertness and engagement were assessed. Next, the author validated the function of specific PLBs used to request the continuation or access to preferred stimuli. Subsequently, three intervention case studies were implemented to strengthen and/or enhance the PLB requesting behaviours of three participants using microswitch technology and individualised instructional strategies. Results suggested that individuals with PMD can and do demonstrate consistent PLBs used to request access to preferred stimuli. Specific PLBs of three participants were strengthened and/or enhanced, with two of these participants able to use a microswitch to activate a speech generating device to produce a communicative request. Implications of these results are discussed in terms of the overall outcomes for each participant and the challenges of implementing a whole communication assessment and intervention approach for this population of learners.

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Declaration by the author

This thesis is comprised of my original work conducted for the fulfillment of a PhD under the supervision of Jeff Sigafoos at Victoria University. None of the research included within this thesis has been previously submitted for another degree or diploma. Research conducted by other authors has been carefully referenced in text.

The research included in this thesis was approved under the project: Teaching communication skills to children with developmental disabilities. The ethical approval letter can be found in Appendix A. Input into the design of the three case studies, assistance in the analysis of the collected data, and edits on all chapters within this thesis were provided by my primary supervisor, Jeff Sigafoos. Additional edits on the final manuscript were provided by my second supervisor, Larah van der Meer. Aside from this input, the studies presented in this thesis were designed and conducted by me.

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Chapter One

An Introduction to Disability

The World Health Organisation (WHO) defines disability as the inability to function within the range of functioning that would be considered normal. These inabilities might occur with respect to physical and mental capabilities (WHO: World Report on Disabilities, 2011). The WHO definition places emphasis upon factors that can influence human functioning. Key factors are categorised into three main areas: (a) impairments in body functions, (b) limitations in participating or executing activities, and (c) restrictions involving participation in areas of daily functioning (Maulik, Mascarenhas, Mathers, Dua, & Saxena, 2011; WHO: World Report on Disabilities, 2011). Furthermore, as part of the WHO definition, the term disability is often used as an umbrella term that covers impairments, activity limitations, and participation restrictions. An impairment is characterised as a deficit in typical body functioning or impairment in body structure. An activity limitation, in contrast, refers to difficulty in physically executing a task or completing an action. Finally, the term participation restriction refers to a situation in which the deficits experienced by an individual affect the way in which he or she is expected to appropriately engage socially, or communicate with others in a typical daily situation (WHO World Report on Disabilities, 2011). Thus to have a disability essentially means to experience impairment in personal competency involving features of a person's body, as well as features of the society within which the person lives and interacts (Oliver, 1996; Lachapelle et al., 2005). To effectively overcome these difficulties, individuals identified as having a disability may require and/or benefit from interventions that are aimed at removing environmental and social barriers to effective functioning (WHO World Report on Disabilities, 2011).

Profound and Multiple Disability

As the term implies, profound and multiple disability (PMD) refers to a situation where the person has more than one type of disability that profoundly affects his or her functioning (Nakken & Vlaskamp, 2002). For example, there might be a combination of intellectual, physical, and sensory impairments. PMD is also often associated with additional health complications, such as seizure disorders, susceptibility to illness, and chronic pain (Nakken & Vlaskamp, 2002; Petry & Maes, 2007). Overall, the term PMD implies a severe and complex combination of impairments that can negatively affect many aspects of the person's functioning and daily living. Consequently, individuals with PMD are likely to require more intensive personal care and support to improve their personal outcome (Atkin & Lorch, 2014; Lancioni, Basili, & O'Reilly, 2001; Lancioni, Sigafoos, O'Reilly, & Singh, 2013; Nakken & Vlaskamp, 2002; Petry, Maes & Vlaskamp, 2005; Vlaskamp & van der Putten, 2009).

Although the term PMD refers to a heterogeneous condition (Bellamy, Croot, Bush, Berry, & Smith, 2010; Maes, Lambrechts, Hostyn, & Petry, 2007; Nakken & Vlaskamp, 2002), it is generally the case that individuals with PMD will typically present with severe to profound intellectual disability and significant motoric impairments. This combination of intellectual and physical impairment can severely restrict the person's learning and the acquisition and performance of self-care, daily living, academic, social, and recreation/leisure skills. The addition of serious medical problems and possibility of significant impairment of consciousness may complicate the situation. For example, impaired consciousness, which is often manifest by failing to attend to environmental stimulation and fluctuating levels of alertness, can seriously complicate educational and rehabilitation efforts (Arthur, 2003, 2004; Arthur-Kelly, Bochner, Center, & Mok, 2007; Munde, Vlaskamp, Ruijssenaars, & Nakken, 2009). An additional factor complicating educational and rehabilitation efforts is the observation that many such individuals appear to be passive and seemingly under-responsive to environmental stimulation (Arthur, 2003; Arthur-Kelly et al., 2007). Furthermore, many persons with PMD present with very little or no speech and seemingly little understanding of language. The lack of responsivity and limited speech and language skills are likely to severely limit their social interactions with others and engagement in meaningful activity (Arthur, 2004; Atkin & Lorch, 2014; Belva, Matson, Snipes, & Bamburg, 2012; Greathead et al., 2016; Kaiser & Goetz, 1993; Maes et al., 2007; Nakken & Vlaskamp, 2002; Samuel & Pritchard, 2001; Schweigert, 2012; Siegel-Causey, Ernst, & Guess, 1989).

The impairments associated with PMD may arise from various causes, such as (a) genetic disorders (e.g., Rett syndrome), (b) malformations of cortical development (MCDs), (c) antenatal events, or (e) perinatal events (Atkin & Lorch, 2014; Bellamy et al, 2010; Maes et al. 2007; Nakken & Vlaskamp, 2007; Saillour & Chelly, 2016). For example, intellectual disability and motor impairment can result from genetic mutations causing MCDs during the pre-natal phase. Furthermore, infections during the first and second trimesters of pregnancy, or complications during birth where the brain is damaged due to hypoxia, can result in intellectual and physical disabilities (Reddihough & Collins, 2003; Saillour & Chelly, 2016).

One significant challenge for those involved in the care, education, and support of individuals with PMD is the seeming inability of the individual to communicate basic wants and needs (Atkin & Lorch, 2014; Calculator, 1988; Downing & Siegel-Causey, 1988; Greathead et al., 2016; Maes et al., 2007; Nakken & Vlaskamp, 2002). Another significant challenge arises from reduced alertness, responsiveness, and/or engagement. With respect to the latter, it has been noted that individuals with PMD might be able to show subtle signs of alertness, responsiveness, and/or engagement. Various subtle signs indicative of alertness, responsiveness, and/or engagement have been suggested, including various body movements and facial expressions (Atkin & Lorch, 2014; Green & Reid, 1996; Munde et al., 2009). However, these possible subtle indicators also seem to be difficult to identify and interpret due to their fleeting, idiosyncratic, and often highly ambiguous nature (Arthur, 2004; Arthur-Kelly et al., 2007; Greathead et al., 2016). Thus many potential signs of alertness, responsiveness, and/or engagement could go unnoticed or misunderstood and under-interpreted as simple orienting responses or startle reflexes that have no particular social meaning or function for the person (Arthur, 2004; Atkin & Lorch, 2014; Giacino et al., 2002).

As mentioned, the significant communication deficits apparent in persons with PMD acts as a further barrier to engagement whereby carers and teachers often have a limited understanding of the meaning, if any, behind the person's behavioural responses. For example, an individual might display subtle behaviours when presented with non-preferred objects or activities (e.g., dropping the object, looking away, and closing his or her eyes). If the teacher or carer does not recognise these signs, then they are perhaps likely to persist in presenting non-preferred objects and activities to the person, which could lead to frustration and increasing unresponsiveness (Atkin & Lorch, 2014; Meadan, Halle, & Kelly, 2012; Greathead et al., 2016). It would therefore seem crucial to design and implement effective methods of increasing our understanding of the forms and functions of behaviours that a person with PMD might have that indicate engagement and interest as well as behaviours that might indicate disinterest (Atkin & Lorch, 2014; Downing & Siegel-Causey, 1988; Green, Reid, Canipe, & Gardner, 1991; Green & Reid, 1996; Keen, Sigafoos & Woodyatt, 2001; Lancioni et al., 2013; Greathead et al., 2016; Porter, Ouvry, Morgan & Downs, 2001; Sigafoos et al., 2000).

Quality of life for individuals with PMD might thus be improved by seeking to identify activities that are associated with an increase in signs of alertness, responsiveness, and/or engagement and using these activities as the context for implementing specific interventions aimed at enhancing the person's behavioural repertoire. In a study analysing quality of life indicators for individuals with PMD, 76 parents and direct support staff completed questionnaires to determine which of the core quality of life domains were the most imperative for the individuals they cared for, and which aspects of these main domains were the most important to target (Petry et al., 2005). The core quality of life domains, as suggested by Felce and Perry (1995, 1996), included (a) physical well-being, such as mobility and health, (b) material well-being, including financial security and income, (c) social well-being, such as positive relationships and community involvement, (d) development and activities, such as communicating, personal competency and the opportunity to learn new skills, and (e) emotional well-being, such as self-esteem and positive self-concepts. Analysis of the questionnaires indicated that all participants (100%) considered social well-being to the most important domain of quality of life. Next, physical well-being was considered very important (98.5%) and developmental and activity-based well-being (89.5%) was also considered a highly important domain. Within these domains, mobility was considered as the most important factor involved in physical well-being, whereas communication was considered vital in social well-being, and the involvement in activities was considered the most important aspect of the final domain (development and activities). These results suggest that those who care for people with PMD consider mobility, communication, and the ability to participate within activities, to be the three most crucial aspects in promoting a high quality of life for these individuals (Petry et al., 2005). This finding makes sense in that it is these same skills that are often the most impaired in persons with PMD.

Thus interventions that remove barriers for those with PMD and promote engagement in activities and opportunities for development and skill acquisition could positively impact on a person's quality of life. For individuals with PMD however, further significant co-morbidities can act to restrict their ability to interact socially and physically due to severe sensory processing impairment. Thus it is critical to understand the great range of diversity identified in the characteristics and behavioural functioning that may be found within a diagnosis of PMD, so that individualised support and teaching plans can be implemented (Nakken & Vlaskamp, 2007). It is also important to consider how the environment can intensify the restrictions arising from the persons' impairments (Oliver, 1996; WHO: World Disability Report, 2011).

To illustrate the constituents of PMD, consider this example. Awa is a 16-year-old female. She was diagnosed with spastic quadriplegia. She cannot walk, is wheelchair bound, and has limited use of her arms and hands. She requires tube feeding due to poor gastronomy control and functioning. Her spine is curved resulting in an atypical curvature of her neck, which naturally places her head towards her left shoulder. It appears to be very difficult for Awa to lift her head and to sit in an up-right position. She experiences blindness in one eye, and is considered to have a significant hearing impairment. She has also been diagnosed with [profound] intellectual disability. She appears to have widely fluctuating levels of awareness and very low levels of engagement in the classroom. All of this has resulted in her having limited opportunities for social interaction or involvement in classroom activities. She lacks adaptive skills, such as cleaning herself, dressing herself, feeding herself, and independent toileting capabilities such that she is completely reliant upon others for all of her daily self-care and living needs. Due to her high and complex needs, her caregivers and teachers within her [special] education classroom typically limit their interaction with her to times involving feeding and toileting. Awa also has problem behaviours; specifically she will often hit her own head, or bang her hands on the tray table of her wheelchair. Such actions have been interpreted as Awa's way of trying to recruit the teacher's attention. Awa has each of the components that define PMD, including intellectual disability, physical disability, sensory impairment, low levels of engagement, and learning difficulties which will be discussed in the subsequent sections of this chapter.

Thus in order to provide an individual with PMD, such as Awa, with some degree of independent functioning to perhaps improve quality of life, enhancing the individuals existing communication skills might be a beneficial starting point. This thesis aims to evaluate and enhance the communication skills of four adolescents with PMD through (a) identifying existing potential communicative acts and assessing each participants' level of adaptive behaviour functioning, (b) identifying behaviours indicative of alertness and engagement that might indicate a state of motivation for a particular social-sensory activity, (c) evoking consistent pre-linguistic behaviours (PLBs) that might indicate a request for the continuation of, or for more of, a preferred stimulus or activity, and (d) strengthen and enhance these PLBs through microswitch activated speech generating devices (SGDs).

Intellectual Disability

A diagnosis of intellectual disability (ID) requires significantly sub-average intellectual functioning and deficits in adaptive behaviour functioning (Belva & Matson, 2013; Maulik et al, 2011; Nakken & Vlaskamp, 2002; Petry & Maes, 2007; Saillour & Chelly, 2016). The definition of ID from the 11th edition of the American Association of Intellectual and Developmental Disability (AAIDD) states that; ID is characterised by significant deficits implicating intellectual functioning and adaptive behaviour skills, which involves the ability to function independently within society, that manifests before the age of 18 (AAIDD: Schalock et al., 2010). The definition from the latest diagnostic and statistical manual (DSM-5) of the American Psychiatric Association (APA: 2013) states "Intellectual Disability (intellectual developmental disorder) is a disorder with onset during the developmental period that includes both intellectual and adaptive behaviour functioning deficits in conceptual, social, and practical domains" (American Psychiatric Association, 2013, p. 33).

A diagnosis of ID infers that the individual experiences a significant cognitive impairment affecting problem solving skills, reasoning, learning from both experiences and academic instruction, planning, and goal-directed behaviours (American Psychiatric Association, 2013; Atkin & Lorch, 2014; Petry & Maes, 2007; Schalock et al., 2010). According to the DSM-5 severity scale, persons with ID would be expected to perform below the cognitive ability of a 70 score on a standardised intelligence test. For those with a profound intellectual disability, they are assumed to be performing below the cognitive ability of a score of 25 on a standardised intelligence test (American Psychiatric Association, 2013; Atkin & Lorch, 2014; Petry & Maes, 2007). Intelligence is typically measured through standardised IQ tests and clinical or individual assessment, which can be problematic, especially when distinguishing between individuals with a severe or profound ID as it is often difficult to administer IQ tests to these individuals due to the nature of their disability.

The second criteria for a diagnosis of ID relates to impairment in adaptive behaviour functioning. The definition of adaptive behaviour functioning seeks to identify behaviours that individuals are required to perform in order to function independently across various environments, and within social and daily situations (Doll, 1936; Mahoney & Ward, 1979). As adaptive behaviour functioning determines the level of individualised support that a person requires, the severity levels distinguished by IQ levels included in the APA definition directly correspond to adaptive behaviour functioning (American Psychiatric Association, 2013; Belva & Matson, 2013; Belva et al., 2012; Sparrow, Cicchetti & Balla, 2005). Further, deficits are apparent in the inability to behave as an independent and autonomous individual within modern day society in regards to financial security, making complex decisions, and planning for one's own best interests (Matson, Dixon, Matson, & Logan, 2005; Matson, Terlonge, Gonzalez, & Rivet, 2006; Wehmeyer, 2005; Wehmeyer & Schwartz, 1997).

Particular deficits in certain domains of adaptive behaviour have consequences for particular skills required for independent functioning. Specifically, deficits in social skills and daily living skills can negatively impact upon an individual's participation and access to community based interactions and settings (Belva & Matson, 2013; Bruininks, Petry, & Maes, 2007; Thurlow, & Gilman, 1987). Social exclusion can negatively impact upon further adaptive behaviours throughout later development, such as full-time placement in specialised care facilities (Nakken & Vlaskamp, 2002; Petry & Maes, 2007), limited access or opportunity for vocational skill acquisition, and future employment options (Belva & Matson, 2013; Tureck, Matson & Beighley, 2013).

Not only are there likely to be profound deficits in adaptive behaviour functioning among persons with PMD, but such individuals are also likely to exhibit higher rates of maladaptive behaviours, such as stereotypy, aggression, problem behaviours, and self-injurious behaviours (SIB) than typically developing peers (Applegate, Matson & Cherry, 1999; Barnard-Bark et al, 2015; Belva et al, 2012; Matson & Rivet, 2008; Tureck et al., 2013). Impairment in adaptive behaviour and the presence of maladaptive behaviours might lead to social confinement and isolation, restrictions to in-home based care facilities, restrictive activity opportunities, and lower levels of self-concept and perceived autonomy (Bruininks, Thurlow, & Gilman, 1987; Soenen, van Berckelaer-Onnes, & Scholte, 2009; Tureck et al., 2013; Sigafoos, 2000; Wehmeyer, 2005).

There is some consensus in the literature regarding the relation between maladaptive behaviours, and expressive and receptive communication impairment where a lack of functional communication skills leads to the presence of problem behaviours and greater adaptive behavioural deficits (Durand, 1993; Kearney & Healy, 2011; Matson, Boisjoli, & Mahan, 2009; Sigafoos, 2000; Tureck et al., 2013). Indeed as ID increases in severity, the presence of physical disabilities and with the addition of co-morbidities; such as autism spectrum disorder (ASD) a dyad of impairment affecting social communication skills and restricted and repetitive behaviours, the greater the presence of SIB, aggression, stereotypy, and additional adaptive behaviour deficits. These deficits are particularly prevalent in receptive and expressive communication, and daily living skills involving appropriate social skills, planning, and behaviour moderation (Belva & Matson, 2013; Matson & Shoemaker, 2009). In a relevant study, participants with moderate intellectual disability had more difficulty overall with activities of daily living, motor skills, and activities of daily living process skills, where 348 participants with either mild intellectual disability (n = 178) or moderate intellectual disability (n = 170) were assessed using the Assessment of Motor and Process Skills (Kottorp, Bernspång, & Fisher, 2003). Results from this study also supported the finding that as the daily living skills became more complex, the deficits became more apparent. Overall, the literature suggest that the skills required to appropriately participate within society, as compared to looking after oneself, may become too complex to achieve independently for people with ID. Actively participating in a social sense requires adjustable behaviours, mature reactions to situations, and potentially more complex language skills and understanding (Belva & Matson, 2013; Kottorp, Bernspång, & Fisher, 2003; Matson & Shoemaker, 2009). For those who experience lower levels of expressive language skills, limited and restricted physical capabilities, and present with maladaptive behaviours, active community participation may be severely limited or negatively impacted. Maladaptive behaviours, such as SIB, not only produce adverse consequences for community participation, they significantly affect an individual's access to support workers, carers, and their relationships with family members and peers (Applegate et al., 1999; Durand & Carr, 1991; Mirenda, 1997; Tureck et al., 2013). Adaptive behaviour will be discussed in further detail in chapter three.

For those with profound ID, a range of other disabilities or health concerns will often be apparent that further negatively impact adaptive functioning. In 2003, the prevalence of severe to profound intellectual disability was analysed in a large province of Finland (Arvio & Sillanpää, 2003). The authors assessed 461 individuals from the Lammi area in Finland (total population of 341, 227) who were identified as having severe to profound intellectual disability (prevalence rate of 0.13%). Of these 461 individuals, 91.5% experienced from one to six additional impairments with speech related deficits, physical impairment, and epilepsy identified as the most common comorbidities. Common aetiologies of severe and profound ID within this sample were genetic or congenital for approximately 50% of the participants, with Down syndrome and post-asphyxial encephalopathy also being common causes (14%). Motor impairment was observed in 160 of the 461 individuals with 66 of these cases described as presenting with spastic quadriplegia, 43 people presenting with spastic diplegia, 39 with dystonic tetraplegia, seven with spastic hemiplegia, and the remaining five with paraplegia. A total of 27 participants experienced dysmorphic syndromes, with six of these individuals diagnosed with Rett syndrome (Arvio & Sillanpää, 2003). These findings are consistent with previous prevalence rates documented in an earlier study looking at prevalence rates in Finland which reported the prevalence at 0.12% (Stromme & Valvatne, 1998) which showed that those experiencing severe to profound ID will typically coincide with a range of impairment across a variety of functions and skills (Maulik et al., 2011; Oeseburg, Dijkstra, Groothoff, Reijneveld, & Jansen, 2011; Stromme & Valvatne, 1998).

Physical disability

For individuals with PMD, damage to, or an under-developed motor cortex, may be the cause of a severe deficit in physical development and movement (Hadders-Algra, 2008). Commonly this population will experience physical deficits involving multiple areas of their bodies, stunted or abnormal growth of muscles, bones, and tissue, atypical formation of joints, fingers, toes, and limbs, scoliosis, deformities, bone or muscle malformations, and complete immobilisation resulting in the need to use a wheelchair and unable to move freely or to interact with their surroundings (Atkin & Lorch, 2014; Kobe, Mulick, Rash & Martin, 1994; Nakken & Vlaskamp, 2002; Petry & Maes, 2007). In addition to the physical constraints negatively impacting on the completion of everyday tasks, these individuals often experience social seclusion and increased levels of self-injury, immaturity, and are often seen as more passive within their environment (Nakken & Vlaskamp, 2002; Petry & Maes, 2007; Petry, Maes & Vlaskamp, 2005). Motor capabilities during development are important indicators into the integrity of the nervous system, often termed the hallmark measurement of typical development, and is an important aspect of adaptive behaviour in human development (Hadders-Algra, 2008).

One domain that has been researched in relation to providing early indicators of neurodevelopmental disabilities is the development of specific primitive cortical areas responsible for producing and regulating early motor behaviour in young children aged from birth to 12 months (Einspieler & Pretchl, 2005; Hadders-Algra, 2008; Pretchl, 1990). General movements (GMs), refer to the early motor patterns of infants. GMs emerge in the fetus at approximately 8-10 weeks gestation and are seen up until the fifth month post-natal. From birth until approximately 2 months postnatal, these motor patterns occur in both the trunk and limbs and present as a varied sequence of arm, leg, neck, and trunk movements. These GMs are also known as writhing movements (Einspieler, Marschik, & Pretchl, 2008). Abnormality of GMs during this stage seem to correlate with negative consequences for the developing cortex with subsequent negative developmental outcomes with respect to intellectual capacity, motor functioning, and the subsequent diagnoses of developmental disabilities (e.g., autism spectrum disorder or Rett syndrome; Einspieler et al. 2014; Marschik, Soloveichick, Windpassinger, & Einspieler, 2015; Prechtl, 1990). As a result of research within this field, specific neurological impairments and developmental disabilities have been reliably identified based on motor assessments whereby predictions of later intellectual and behavioural outcomes can be established for young children. For instance, cerebral palsy is one physical abnormality that has been identified through early assessment of general movement assessments (Einspieler, Marschik, & Prechtl, 2008; Ferrari et al, 2002).

Cerebral palsy (CP) is a specific type of developmental disability that is often the basis for a PMD diagnosis. CP stems from damage to the motor cortex, which can occur during pre-natal development, during birth, or in the first few months/years post-natal. CP is identified as one of the most prevalent causes of physical impairment in children. The global incidence rate is estimated at approximately 2-2.5 per 1000 live births, as calculated from epidemiological studies from Australia, the UK, Sweden, and the USA (Reddihough & Collins, 2003). An individual with CP will often experience on-going motor control issues of various degrees, dependent upon the severity of the cortex damage, that negatively affects motor control, muscle control, posture, and balance. For those with CP, there are several classification systems relating to (a) muscular tone and control, and (b) affected areas. Spastic CP is regarded as the most common form and manifests in tense contracted muscles. Ataxic CP is characterised by a poor sense of balance resulting in un-coordinated gait, stumbling, and subsequent falls. Athetoid CP is characterised as the constant and uncontrolled motion of the limbs, head, and eyes. These muscular states can be further identified by the degree to which the movement is rigid; where the muscles are tight and resistant to action or movement, or with tremor; where the muscles exhibit an uncontrollable shaking that interferes with coordination. Four main types of CP are characterised based on the specific areas of the body which are affected. Monoplegia CP is classified as affecting only one limb, generally an arm, whereas Hemiplegia affects the arms, legs, and trunk, but only on one side of the body. Diplegia affects either both of the arms, or both of the legs, whereas Quadriplegia affects all four limbs (AAID: Schalock et al., 2010; Bax et al., 2005; Reddihough & Collins, 2003). A diagnosis of CP can negatively impact upon a person's adaptive behaviour as some individuals with a diagnosis of CP will also experience communication and cognitive impairments, perceptual difficulties, and seizure disorder (Bax et al., 2005). Some may also experience varying degrees of sensory impairment; including hearing and vision impairments and impaired spatial perception. Health concerns such as issues with body temperature regulation and bowel functioning can also occur (Petry & Maes, 2007).

Sensory Impairment

An additional type of impairment that may be found in individuals with PMD is severe to profound hearing and/or vision impairment (Brady & Bashinski, 2011; Evenhuis et al., 2001; Maes et al., 2007; Nakken & Vlaskamp, 2002; Schweigert, 2012). Severe to profound hearing and/or vision impairment could further reduce or limit an individual's capacity to learn and engage with their environment (Brady & Bashinski, 2011; Maes et al, 2007; Vlaskamp et al, 2003; Petry & Maes, 2007). Commonly, visual and auditory processing disturbances are implicated for persons with PMD with an estimated prevalence rate range of 2.2% to 26.8% for visual impairment, and 0.0% to 7.1% for hearing impairment (Oeseburg et al., 2011). Further, one Dutch study identified higher rates of combined sensory impairments (approximately 20% of 627 participants) for those younger than 50 years old, and who had multiple disabilities as well more severe to profound ID compared with those who had moderate ID (approximately 3% of participants) (Evenhuis et al., 2001). Sensory impairments are more commonly found in those with ID (Carvill, 2001; Maulik et al., 2011; Oeseburg et al., 2011; Warburg, 2001) and can be overlooked or misdiagnosed due to the severe communication deficit presented by those with profound ID and additional disabilities (Warburg, 2001), perhaps accounting for the large variation between prevalence rates found in the literature (Maulik et al., 2011; Oeseburg et al., 2011).

Visual impairment is defined by deficits in visual acuity and deficits in one's ability to process stimuli within their visual field (van den Broek, Janssen, Van Ramshorst, & Deen, 2006). Acuity involves the ability to process detailed visual stimuli, while visual field involves the range of stimuli processed within each eye's field of vision while the person is focussed on one visual location (Evenhuis & Natzgam: IASSID International Consensus Statement, 1998). A visual impairment can result from ocular dysfunction or damage, or can be the result of cerebral processing deficits (WHO: 2011; van den Broek et al, 2006). Difficulties in assessing those with PMD has resulted in discrepancies with regard to the reported prevalence of visual impairment in this population, however it has been shown that the severity of impairment correlates with both the person's age and severity of disability (Warburg, 2001; van den Broek, 2006). For instance, in a study conducted within a Dutch care facility, 92% of residents diagnosed with PMD were identified as having a visual impairment. Visual impairments for these individuals included deficits in both visual field and acuity, as well as attention and fixation deficits, all of which were found to be more severe in those with more severe disabilities (Evenhuis et al., 2001; van den Broek, 2006). A visual impairment can have further significant implications for social interaction, independence, and effective learning opportunities for persons with PMD as visual stimulation and the use of visual stimuli are often core components involved in teaching and interaction strategies employed by carers, teachers, and therapists (Brady & Bashinski, 2011; Schweigert, 2012).

Along these lines hearing impairment, defined as the partial or total loss of the ability to process auditory stimuli (Evenhuis & Natzgam: IASSID International Consensus Statement, 1998), has significant implications for an individual's ability to function within their immediate environment. Hearing impairment is categorised by the age of onset, whether the impairment occurs bi- or unilaterally, the frequency of tones that are affected, and the severity of the impairment (Evenhuis et al., 2001; Carvill, 2001). Similarly to visual impairments, difficulties arise when attempting to accurately measure the hearing ability of an individual with PMD due in part to the lack of functional communication abilities (Carvill, 2001). Again correlations are identified between hearing impairment and the degree of intellectual disability, the severity of the communication deficit, and additional psychiatric issues (Evenhuis et al., 2001; Carvill, 2001). Combined, a lack of adequate visual and auditory processing for an individual who already experiences an intellectual disability and a severe motor deficit can further limit their capability to interact with their environment, gain control over or access preferred stimuli, interact with others, and experience quality of life (Brady & Bashinski, 2011; Evenhuis et al., 2001; Nakken & Vlaskamp, 2002). Additional to these significant impairments, some individuals may experience an additional diagnosis consistent with a dysmorphic genetic syndrome, such as Rett syndrome.

Rett Syndrome: A Prototypic PMD

In this section, I will provide details on one type of genetic disorder that is related to PMD that is Rett syndrome (RTT). RTT could be viewed as the prototypic example of a PMD. RTT is a neurodevelopmental disorder affecting approximately 1/10,000 females, with little prevalence data available for males due to the sex specific genetic nature of this syndrome (Laurvick et al., 2006; Neul et al., 2010). Genetic testing and research has successfully identified the neurological basis for RTT; a mutation in the MECP2 gene involved in cognitive development. The prognosis for RTT appears to involve a four-step sequential trajectory beginning in the first months of life. Starting around 24 to 36 months of age, children with RTT will generally experience a period of regression during which ambulation skills are lost, purposeful hand use declines, and intellectual disability and communication impairment appear to develop (Hagberg, Goutières, Hanefeld, Rett, & Wilson, 1985; Hagberg & Witt-Engerström, 1987). Eventually, most children with RTT are likely to become unable to walk, unable to talk, and unable to use their hands for any functional activities. They will be dependent upon carers for all of their daily needs and interactions (Byiers, Dimian, & Symons, 2014; Marschik et al., 2014; Marschik, & Einspieler, 2011). After a period of between 3 to 7 years, some of these individuals may present with a variant type of RTT, where they might re-gain some of their previously lost skills; such as regaining some simple speech, some ambulation skills, and some use of their hands. In a typical presentation of RTT, none of these skills will be re-gained however and the child will reach a plateau stage where they do not lose any additional skills, but fail to re-gain any adaptive behaviours or functional abilities (Marschik et al., 2013). As a result, an individual with a diagnosis of RTT typically exhibits poor, or totally absent, ambulatory skills, a lack of purposeful hand use and instead develops intensive continuous hand wringing, marked breath holding, teeth grinding, severe to profound intellectual disability, and an apparent unconventional and pre-symbolic method of communicating (Didden et al., 2010; Hagberg & Witt-Engerström, 1987; Marschik et al., 2014; Marschik, & Einspieler, 2011).

Pre-Linguistic Behaviours

As noted before, limited speech and language development could be seen as characteristic of persons with PMD. This deficit reduces the person's ability to express wants and needs, initiate and maintain social interactions, and more generally become socially close to others and connect with others (Atkin & Lorch, 2014; Bretherton & Bates, 1979; Calculator, 1988; Downing & Siegel-Causey, 1988; Light, 1997) In this way, limited speech and language development could be seen as having a significant negative impact upon quality of life (Beukelman & Mirenda, 2005; Petry & Maes, 2007; Schweigert, 2012; Sigafoos et al., 2006; Warren, Yoder, Gazdag, Kim, & Jones, 1993). Communication can be described as an exchange of information from a speaker to one or more listeners to influence their physical or verbal behaviour (Bates & Dick, 2002; Bretherton & Bates, 1979; Keen, Sigafoos & Woodyatt, 2001; Oller, Eilers, Neal, & Schwartz, 1999; Schweigert, 2012; Skinner, 1957). It requires a dyadic relationship between the speaker and the listener and demands that: (a) the communicative message sent from the speaker is able to be recognised as a meaningful or intentional communicative act by the listener, (b) that the listener acknowledges the speakers message, and responds in the appropriate way, and (c) that the desired outcome for the speaker is achieved (Calculator, 1988; 2002; Arthur-Kelly et al., 2007; Kaiser & Goetz, 1993; Siegel-Causey, Ernst, & Guess, 1989; Sigafoos et al., 2006; Yoder & Warren, 2001).

Despite lacking speech and language, there is evidence to suggest that many individuals with PMD will develop a range of pre-linguistic behaviours (PLBs) to communicate (Atkin & Lorch, 2014; Kaiser & Goetz, 1993; Schweigert, 2012; Siegel-Causey & Bashinski, 1977; Yoder & Feagans, 1988). Furthermore, many persons with PMD seem to rely exclusively upon PLBs to communicate. PLBs are crucial building blocks in the typical trajectory of meaningful communication development in children and are typically observed from birth until the child begins to use speech and/or alternative forms of symbolic communication in meaningful and functional ways (Crais & Ogletree, 2016; Siegel-Causey et al., 1987; Siegel-Causey & Bashinski, 1997; Sigafoos et al., 2000; Yoder & Warren, 2001; Yoder, 1987). The emergence of PLBs, from a developmental perspective, is one of the earliest signals demonstrating a child's communicative intent and that he/she is motivated to communicate (Carter & Iacono, 2002; Keen, Sigafoos, & Woodyatt, 2001; Schweigert, 1996; 2012; Sigafoos et al., 2006; Yoder & Warren, 2001). In order to demonstrate intentional communication, one must demonstrate (a) gestures and/or vocalisations that are combined with coordinated attention directed at an object and a listener, (b) gestures and/or vocalisations that are directed towards a listener, and (c) persistence and/or consistency in the PLB used (Carter & Iacono, 2002; McLean, McLean, Brady, & Etter, 1991; Ogletree, Fischer, & Turowski, 1996; Schweigert, 2012; Yoder & Warren, 2001).

For persons with PMD, PLBs might consist of a range of idiosyncratic body movements and gestures, facial expressions, and the tensing or relaxing of muscles (Atkin & Lorch, 2014; Greathead et al., 2016; Keen et al., 2001; Porter et al., 2001). Issues arise when a learner relies upon these behaviours as their primary communication tool as it can be difficult for a listener to recognise the behaviour as a communication attempt, decipher if the change in physical state is meaningful, and whether the behaviour was intentional or simply a reflex (Arthur, 2003; Crais & Ogletree, 2016; Greathead et al., 2016; Keen et al., 2001; Meadan, Halle & Kelly, 2012; Porter et al., 2001; Sigafoos et al., 2006). There is evidence to support the existence of an inverse relationship between the degree of ID [intellectual disability] and the frequency and clarity of PLBs (Yoder, 1987; Yoder & Feagans, 1988). Thus for those with PMD, the intended meaning of PLBs is often considered ambiguous, hence it can be difficult for a listener to correctly interpret the message, and to then respond in a way that is appropriate. In such circumstances, if an individual is misunderstood, or their potential communicative act goes unnoticed, it may result in an extinction of communication attempts from the learner or escalation to problem behaviours such as SIB or aggression (Applegate et al., 1999; Didden et al., 2012; Durand, 1993; Sigafoos, 2000). PLBs can also become socially stigmatising, especially when the typical trajectory of communication development is not achieved and older individuals continue to rely upon PLBs to communicate (Greathead et al., 2016; Keen et al., 2001; Sigafoos et al., 2006). Further, the acquisition and progression of constructive interaction skills is significantly influenced by the individual's cognitive state, and physical and social environment (Bretherton & Bates, 1979; Schweigert, 2012; Siegel-Causey & Bashinski, 1997). As a result of constantly being misunderstood and rarely achieving the desired affective or social outcome, some individuals may resort to other inappropriate forms of gaining attention or communicating their wants, needs, and preferences. This can lead to increases in self-stimulatory behaviours to occupy or distract the individual, or to provide sensory stimulation in the absence of such interaction (Barnard-Brak et al., 2015; Didden et al., 2010; Petry & Maes, 2007). Stereotypy, or self-stimulatory behaviour is more typically characteristic of those with PMD, compared with typical peers, and defined as behaviours that are repetitive, automatically reinforcing and non-functional in that they appear to serve no conventional purpose (American Psychiatric Association, 1994; 2013; Matson, Minshawi, Gonzalez & Mayville, 2006). Didden et al. (2012) suggests that approximately 50% of those with an ID exhibit one or more identifiable type of stereotypy. These stereotypic behaviours are observed to develop during the early developmental period and persist through to early adulthood (Green, O'Reilly, Sigafoos, 2005). Stereotypy, and the absence of functional means of communicating, has been associated with the subsequent development of more aberrant behaviours involving aggression, problem behaviours, and self-injuring behaviours (SIB) (Barnard-Brak et al., 2015; Durand & Carr, 1991; Guess & Carr, 1991; Nakken & Vlaskamp, 2002; Petry & Maes, 2007; Sturmey & Didden, 2014; Sigafoos, 2000; Tureck et al., 2013).

In a study conducted by Tureck et al. (2013), 45 adults with profound ID living in two state residential care facilities in the USA were separated into two comparison groups of ASD or non ASD, and verbal or non-verbal. Data demonstrating rates of SIB were collected using the ASD-PBA (ASD-Problem Behaviour Adult version) assessment to determine the effect of a co-morbidity of ID, ASD and communication deficit on the rates of SIB. Results from a two way ANOVA indicated that the highest rates of SIB were observed in those with severe ID, ASD, and who were non-verbal, followed by those with ASD and verbal communication skills. A significant effect was demonstrated for verbal skill and rate of SIB, further highlighting the vital role effective communication plays in adaptive behaviour functioning. These findings also have significant implications for social inclusion and community participation as those who lack functional and effective communication skills, and who also display maladaptive behaviours, typically experience social isolation and a lack of independent skills needed to become an active participant within society (Beukelman & Mirenda, 2005; Mirenda, 1997; Nakken & Vlaskamp, 2002; Sigafoos, 2000; Tureck et al., 2013). This inverse relationship between problem behaviours and social and communication skills was specifically addressed in a study conducted by Matson and colleagues (2006). In this study, 120 adults with profound ID were grouped according to the presence of stereotypical behaviours, SIB, a co-morbidity of stereotypy and SIB, or no problem behaviours. The presence of both stereotypy and SIB correlated with the most severe speech and social skill deficits in comparison to the presentation of only SIB, or no problem behaviours at all (Matson et al., 2006).

Specifically, the literature points to correlations between low levels of social interaction and stimulation from teachers or caregivers, and the development of stereotypy (Hall, Oliver, & Murphy, 2001) with further correlations between early stereotypical behaviours acting as social interaction requests or self-stimulation, escalating over time to aggressive or problem behaviours due to a lack of efficacy in achieving a desired outcome (Durand, 1993; Durand & Carr, 1991; Guess, & Carr, 1991; Hall et al., 2001; Sigafoos, 2000).

Clearly, an individual's quality of life and degree of social inclusion is correlated with communication abilities (Kaiser & Goetz, 1992; Schweigert, 2012). Those who struggle to communicate in functional and meaningful ways tend to experience greater social isolation and lack the ability to become an active participant in society. As a result, these individuals will often experience a lower quality of life. Further, individuals are likely to build larger social networks when they possess methods to readily and effectively communicate with others and in turn, be readily and effectively understood (Beukelman & Mirenda, 2005; Calculator, 1988; Calculator & Diaz-Caneja Sela, 2014; Crais & Ogletree, 2016; Keen et al., 2001; Matson et al., 2006; Schweigert, 2012; Sigafoos et al., 2006).

In order to facilitate the development of functional communication, an effective strategy might be to reinforce the PLBs produced by persons with PMD, and tailor potential instructional strategies to match the individual's motivational state (Calculator, 1988; Downing & Siegel-Causey, 1989; Kaiser & Goetz, 1992; Keen et al., 2001; Siegel-Causey & Bashinski, 1997; Sigafoos et al., 2006; Warren & Yoder, 2001). Thus identifying, and validating PLBs and potential communicative repertoire of non-verbal persons seems a logical first step in order to enhance the efficacy of communication intervention; especially in persons with PMD (Downing & Siegel-Causey, 1989; Keen et al., 2001; Schweigert, 2012; Sigafoos et al., 2006).

Levels of Awareness and Alertness

An additional confounding factor that can negatively impact the success of teaching attempts is the fluctuating levels of alertness and awareness often observed in individuals with PMD (Arthur, 2003; Arthur-Kelly et al., 2007; Arthur-Kelly, Foreman, Bennett & Pascoe, 2008; Guess, Siegel-Causey et al., 1990; Guess, Roberts & Rues, 2002; Munde et al., 2009).

Behaviour states were originally described for infants by Wolff (1959) as behavioural and physiological conditions which ranged from sleeping, to being awake, to crying (Wolff, 1959). Behaviour states refer to the organisation of the central nervous system, specifically how the cognitive and physical capabilities of an individual can mediate their ability to respond and make sense of the environment, and how they experience stimulation (Arthur, 2003; Arthur-Kelly et al., 2007; Arthur-Kelly et al., 2008; Helm & Simeonsson, 1989). More recent literature in the field of PMD has favoured more concise definitions involving clear behavioural evidence of self or environmental awareness (Arthur, 2003; 2004; Arthur-Kelly, Bochner, Center, & Mok, 2007; Green et al., 1991; Green & Reid, 1996; Munde et al, 2009). For example a person who is considered to be alert should typically exhibit distinct evidence of self or environmental awareness that is able to be maintained or reproduced under similar circumstances by one or more of the following behaviours: following simple commands, gestural or verbal responses to some level of interaction or question, and some degree of verbalisation or vocalisation (Arthur, 2003; Arthur-Kelly et al., 2008; Guess et al., 1990; Guess et al., 2002). Included within the concept of alertness is the presentation of purposeful behaviour that occur contingent to relevant environmental stimuli, and which are not due to reflexive activity (Arthur, 2003; 2004; Arthur-Kelly et al., 2007). In the literature describing the minimally conscious state (MCS), purposeful behaviour may occur incongruously, but is reproducible or maintained for prolonged periods of time such that it can be differentiated from reflexive behaviour (Giacino et al, 2002). Suggestions of behaviours that qualify as purposeful or meaningful behaviour include: (a) appropriate affective states, such as smiling, that are produced in a response to verbal or visual emotional stimuli, (b) vocalisations or physical gestures that occur contingent to verbal or visual stimuli, (c) reaching for objects that demonstrates a request for the specific object and to which is directed towards the object, (d) manipulating objects to accommodate for their particular size, weight, and shape, and, (e) eye contact or eye gaze directed towards visual stimuli (Carter & Iacono, 2002; Munde et al., 2009; Warren & Yoder, 2001).

Thus for one who experiences behavioural states characterised by fluctuating levels of alertness, awareness of their surroundings, and variable engagement levels, discrepancies arise when deciding whether a presented behaviour was purposeful or simply reflexive

(Arthur, 2003; Greathead et al., 2016). Persons with PMD tend to spend excessive amounts of time in behavioural states characterised by low levels of alertness and engagement in comparison to typical peers or those with less severe disabilities (Arthur, 2003; Arthur-Kelly et al., 2008; Guess et al, 1990; Guess et al., 2002; Munde et al, 2009). Spending more time in these non-engaged or alert states negatively impacts upon the time period where learning opportunities might occur, resulting in a sub-optimal learning or rehabilitation environments for these individuals who also tend to require more intensive and slower paced interactions (Arthur, 2003; Guess et al., 2002). Furthermore, these behavioural states can be difficult to alter in older children or adolescents even with significant intervention efforts (Ault, Guy, Guess, Bashinski, & Roberts, 1995; Guess et al., 2002). Evidence has suggested that assessing behaviour states in persons with PMD can be used to identify variables that evoke optimal behavioural states, and effectively guide educational strategies and intervention plans (Arthur, 2003, 2004; Arthur-Kelly et al., 2007; Guess et al., 2002).

Learning Difficulties

Returning to my example of Awa, who experiences severe to profound ID, profound physical disabilities, sensory impairment, and additional health concerns, basic everyday activities may be difficult. Producing independent actions, engaging in stimuli, interacting with others, alerting someone to her immediate situation or comfort, and engaging and concentrating on tasks may be challenging. Due to these complex limitations and restrictions described, it proves difficult to identify and settle on one effective teaching strategy to enhance functional behaviours and/or skills for someone like Awa. Individuals presenting with PMD are a very heterogeneous group who exhibit varying functional skills and cognitive capabilities (Bellamy et al., 2010; Maes et al., 2007), which poses the first significant issue when trying to identify the most effective educational strategy to teach this population of learners. Strategies and teaching protocols require a high degree of individualised planning and implementing in order to target and teach functional skills that are appropriate and feasible for each unique individual with PMD (Atkin & Lorch, 2014;

Lancioni et al., 2013; Maes et al., 2007; Munde et al., 2009; Nakken & Vlaskamp, 2002, 2007; Petry & Maes, 2007). In a study conducted by Vlaskamp and van der Putten (2009) the use of individualised support programs developed for 23 adults in a residential facility within the Netherlands was analysed through interviews of 41 support staff in relation to each of the client's short and long term goals, how competent the staff felt in implementing the program, the observed efficacy of the program on client characteristics, the effect on creating a collaborative working environment and, the perceived increase or decrease in workload. The majority of the staff reports indicated that although they saw positive effects on their client's behaviours, specifically mood and increased communication skills, and that they felt competent in administering and evaluating the results, it was a common opinion that the staff felt they required more information on the characteristics of their clients with a particular focus placed on the way they communicated (Vlaskamp & van der Putten, 2009). Thus one focus of individualised programs and intervention strategies might be to first obtain, in as much detail as possible, a thorough and detailed inventory of physical and mental capabilities, deficits and potential communicative behaviours and acts that may be meaningful or hold some communicative value to the participants involved. From this, effective instruction programs around those skills already possessed by the individual may be developed to promote constructive interaction, further communication skill development opportunities, and the promotion of adaptive behaviour development such that these individuals may experience a greater quality of life (Lancioni et al., 2002).

Summary

Persons with PMD experience great variance in the range and complexity of both levels of disability and skill strength. Profound ID, severe physical and sensory impairment, fluctuating levels of awareness and a lack of conventional communication skills severely impacts upon adaptive behaviours, independence and the experience of quality of life for these individuals. Creating a highly structured environment, with one on one support from a carer familiar with the individual's typical presentation of behaviours, individuals with these severe and complex disabilities and needs can interact and engage with their environment and reach their optimal human potential. This opportunity can, however be lost due to the lack of appropriate support systems, a lack of a thorough understanding of the learner, and a lack of appropriate technology or effective teaching strategies (Nakken & Vlaskamp, 2007; Samuel & Pritchard, 2001; Vlaskamp & van der Putten, 2009).

A key concept concerning individuals with disabilities from the World Report on Disabilities states that in order to promote human competency in key areas, such as education and social inclusion, we must remove barriers, and promote participation (WHO, 2011). This could, in theory begin with a focus on implementing effective educational strategies based on well-informed evidence based principles that support autonomy and active participation. However determining exactly how to achieve these specified learning objectives serves as potentially the greatest barrier for success in teaching individuals with PMD.

Chapter Two

A Review of Major Instructional Approaches for Persons with PMD

Prior to the 1980s, behavioural studies involving children with PMD often focused on determining whether or not the person's behavioural responses were sensitive to environmental contingencies. That is, whether or not the person's behavioural repertoire included any voluntary or operant responses. An operant response is a behaviour that can is modifiable based on its resulting consequence (Skinner, 1957). If we wish the probability of a behaviour to increase in frequency, or to simply occur again, we can modify the consequence of a particular behaviour through reinforcement (i.e., by providing some preferred or enjoyable stimuli/interaction to the person directing following the response). Likewise if we wish for a behaviour to stop occurring, or to decrease in frequency, we might provide a non-preferred consequence for a particular behaviour (Skinner, 1957). The aim of these early studies was to determine if it was possible to establish functional/environmental control over some aspect of the person's responding via the application of reinforcement, which was often contingent upon an arbitrarily selected response form, such as an arm movement (Brownfield & Keehn, 1966; Fuller, 1949; Rice, McDaniel, Stallings, & Gratz, 1967). The main rationale for these studies was that it was important to try to determine whether or not such individuals could show any evidence of contingency awareness; where they demonstrated an understanding that there was a consequence for their behaviour, and that a relationship existed between their response and the consequential outcome. If so, it would suggest the possibility of learning and rehabilitation and the potential benefit of education, which at the time were not necessarily considered as feasible for people with PMD (Bailey, 1981). Bailey (1981), for example, argued that it was not possible to provide meaningful habilitation to persons with PMD. Instead, programming for such individuals should focus on merely providing care and enriching their environment by providing external stimulation. Some individuals, he argued, might experience some increased ability in simple skills, however it is often difficult to predict who will benefit from specific training, and exactly how to go about training or teaching persons with PMD (Bailey, 1981).

Still, contingency-awareness studies were undertaken to determine whether these individuals could in fact learn from operant-based therapies and if it were possible to identify preferences or establish a behavioural or response repertoire in these individuals (Reid, Phillips, & Green, 1991). Contingency awareness would be evidenced, for example, by changes in the frequency of the response when it was followed by a presumably reinforcing consequences (e.g., food, music) versus when there were no specific consequences programmed for the response (Guess, Benson & Siegel-Causey, 1985; Maes et al., 2007; Marcus & Vollmer, 1996; Schweigert, 2012). Although the results of such studies were often positive in the sense of showing evidence of operant conditioning, few of these studies resulted in the participants learning any meaningful or functional responses (Bailey, 1981; Reid, Phillips, & Green, 1991). Fuller (1949), for example, concluded that even people with the most profound disabilities could learn if taught in a systematic manner, a conclusion based on his study in which he successfully increased the arm movements of a man with PMD by reinforcing each movement with a sugary milk solution delivered to the man's mouth.

Following these early studies, efforts were undertaken that aimed to build on these promising results by targeting more functional responses (Gee, Sailor, & Goetz, 1985; Wacker, Wiggins, Fowler, & Berg, 1988; Wacker, Berg, Wiggins, Muldoon, & Cavanaugh, 1985). In addition to aiming to teach functional skills, research on interventions for persons with PMD has also focused on (a) how to engage persons with PMD in preferred and/or therapeutic and educational activities, (b) how to improve their mood and increase indices of happiness, (c) how to provide appropriate levels and types of stimulation, and (d) how to address/reduce/replace inappropriate behaviours. A range of therapeutic and educational approaches were applied in an attempt to accomplish the broad objectives outlined above. These approaches include the use of multi-sensory environments (Hogg, Cavet, Lambe, &

Smeddle, 2001; Lancioni, Cuvo, & O'Reilly, 2002), an intensive interaction approach (Nind & Hewett, 1988, Nind & Thomas, 2005; Hewitt, 2012), systematic instruction (Healy, 1994; O'Reilly et al., 1992; Sigafoos et al., 2004), enhancing natural gestures (Calculator, 2002, 2015; Calculator, & Diaz-Caneja Sela, 2015), the use of assistive technology (Byiers et al., 2014; Lancioni et al., 2001; Lancioni et al., 2009a; Lancioni et al., 2014; Lancioni et al., 2013), and the behaviour chain interruption strategy (Duker, Kraaykramp, & Visser, 1994; Goetz, Gee, & Sailor, 1985; Hall & Sundberg, 1987). Each of these approaches will be reviewed in terms of (a) quality of the empirical research, (b) efficacy in creating opportunities for active and constructive interactions, and (c) implications of each strategy on the promotion of functional skill development. The general purpose of research in this field is to identify ways in which we, as instructors and researchers, can identify ways to adapt learning environments such that individuals with severe and complex disabilities, such as those with PMD, might be able to actively engage with their environment, interact with others, and have the opportunity to learn new and valuable skills.

Multi-Sensory Environments

Multi-sensory environments (MSE) are rooms designed to provide high levels of sensory stimulation to individuals who might otherwise experience a lack of stimulation or who cannot access preferred stimuli on their own. It is also a place where the aim is to increase the sensory engagement experienced by the individual as well as an area for individuals to relax and enjoy. One common type of MSE is a Snoezelen room. Snoezelen is a Dutch word meaning *Snuffelen;* to smell (to seek out something of interest), and *doezelen;* to doze (Hogg et al., 2001; Lancioni et al., 2002). Originally, the Snoezelen room was designed as an environment for a person to enjoy and to relax in, now these rooms have taken on a therapy-focused approach for individuals with developmental and intellectual disabilities aimed at decreasing maladaptive behaviour while increasing engagement and enjoyment (Botts, Hershfeldt, & Christensen-Sandfort, 2008). Within the Snoezelen room, participants are provided with free access to various types of materials aimed at stimulating the senses.

Materials might include fans, lights, bubbles, soft cushions, textured surfaces, musical instruments, scents, water facilities, and vibrating massagers. Staff trained in the Snoezelen protocol are instructed to passively guide the participants around the room for a fixed period of time without directing the individual's choices of stimulation but rather acting as a mediator to the individuals' experience of the sensory stimulation (Singh et al., 2004). Snoezelen is often aimed at individuals who are diagnosed with an intellectual disability, developmental disability, or PMD, and who engage in problem behaviours. The premise behind the Snoezelen room is that it will offer those with high sensory needs and who engage in stereotypy or problematic sensory seeking behaviours to obtain high levels of sensory stimulation in a safe and appropriate manner/environment, and where the individual chooses the stimuli they wish to engage with and at their own determined pace (Singh et al. 2004; Vlaskamp et al., 2003).

The supposed therapeutic benefits of snoezelen include lowering the frequency and intensity of problem behaviours (Kaplan et al, 2006; Lancioni, et al. 2002). Other studies have focused on increasing positive behavioural states and rates of adaptive behaviours, such as increasing levels of alertness, increasing active participation through independent access to stimulation, and increased social engagement with carers. Additionally, Snoezelen is argued to be an enjoyable and relaxing environment that may be calming for those who feel anxious or become upset in demanding conditions (Cuvo, May & Post, 2001; Singh et al., 2004; Vlaskamp et al., 2003).

In one evaluation of the snoezelen approach, Singh et al. (2004) assessed three groups of 15 individuals before during and after a snoezelen room session. The participants were diagnosed with a combination of mental illness and severe or profound intellectual disability. All participants were actively taking prescription medication for their mental illness and were receiving behavioural interventions for aggression or self-injury, or both. A repeated measures counter-balanced experimental design was implemented where the three groups of participants were rotated through three experimental conditions: (a) ADL (activities of daily living) skills training, (b) Snoezelen, and (c) vocational skills training. Each group spent one hour in each of the three conditions every weekday morning over a 10-week observational period and received various sequences of the conditions. Group 1 received an ABC sequence, Group 2 received a BCA sequence, and Group 3 received a CAB sequence. All aggressive acts (defined as kicking, punching, hitting, and slapping others) and self-injurious behaviours (defined as biting or slapping oneself on any body part and head banging) were recorded as dependent variables with the three conditions acting as the independent variables. Results showed that participants exhibited fewer instances of aggressive and self-injurious behaviours during the Snoezelen condition compared with both the ADL and vocational skills training conditions. The effect of the snoezelen condition appeared to have an observable carryover effect to following sessions in the subsequent condition, regardless of whether this was the vocational skills training or ADL. An additional significant effect of the Snoezelen room was that SIB was significantly lower in the condition directly following the Snoezelen room condition, compared with the condition preceding the Snoezelen condition. Further, research focused on reducing stereotypy in daily living situations following Snoezelen room placement has shown similar carry-over effects (Kaplan et al., 2006).

Contrary to Singh et al. (2004), other studies have demonstrated no therapeutic benefit of MSE-based interventions. Vlaskamp et al. (2003), for example, randomly selected 19 adults out of 62 possible participants, from 15 facilities in the Netherlands who had access to Snoezelen based therapy. Participants, who were described as having PMD, all had pre-determined goals to increase activity levels. Momentary time sampling was utilised to measure the behaviours of both the participants and the staff members during a 30-min Snoezelen session and a subsequent normal living environment observation period. Behavioural measures included being asleep or being un-active or alert, awake but not alert or active, active and self-directed, sensory activity directed at the environment, or sensory and motor activity directed at the environment. The authors found no increase in activity levels for the participants as a result of the Snoezelen room experiences

The discrepant findings of Singh et al. (2004) and Vlaskamp et al. (2003) might reflect the fact that few demands are made of the person in the MSEs, whereas outside of the MSE the person likely experiences more demands to engage in activities that might be less preferred. Thus any therapeutic effect of MSE might simply reflect a relative preference for no demands over demand conditions. A study by Cuvo et al. (2001) suggested that the nature of the demands might impact the behavioural effects of MSEs. This team conducted two studies to analyse the effects of experiencing a Snoezelen room. In the first study, target behaviours (e.g., engagement and stereotyped movements) were recorded in the participant's typical living room before and after a Snoezelen session. In the second study, the target behaviours were analysed in three environments; (a) while participating in an outdoor activity, (b) during a Snoezelen session, and (c) in the participant's typical living room. Results from Study 1 indicated that instances of stereotypy decreased during the Snoezelen session in comparison to the living room environment, while engagement was low during the living room condition, and high during the Snoezelen room session. In Study 2, however, rates of stereotypy were lowest during the outdoor activity condition compared to the other two conditions. Engagement levels were also highest during the outdoor activity compared with Snoezelen and the living room conditions. These findings suggest that when demands are kept similar, then similar outcomes are found when the person is in the MSE and other low-demand environments.

In addition to these studies, several reviews of the effects of Snoezelen have been conducted (Botts et al., 2008; Hogg et al., 2001; Lancioni et al., 2002). Overall, the findings from these reviews suggest that any positive effects of MSEs must be interpreted as preliminary (Hogg et al., 2001) or tentative due to methodological limitations of the studies. Specifically, design flaws were evident in regard to; (a) the lack of experimental rigor and design, (b) the detail of the study procedures and outcome measures, and (c) the great variance in measures including; participant characteristics, comparison conditions, specific target behaviours, and procedures (Botts et al., 2008; Hogg et al., 2001; Lancioni et al., 2002).

Given these limitations, one might conclude that the evidence for positive therapeutic effects from MSE must be viewed as tentative. While MSEs do not seem to present any potential harm to the user, they may not necessarily provide any major therapeutic benefit with respect to increasing adaptive behaviour and reducing problem behaviour over and above what could also be achieved by simply withdrawing demands or presenting the person with preferred sources of stimulation. In addition to the study design flaws noted above, issues arise when ascertaining exactly what types of stimulation are offered or provided in these rooms. Often stimuli are offered to individuals with PMD under the premise that they are in fact preferred or enjoyed, but MSE materials often seem to be selected without any assessment of the person's preferences (Botts et al., 2008). In addition, the behaviours required to manipulate these materials might be outside of the physical capabilities of the individual (Vlaskamp et al., 2003). Due to the lack of independence and complete reliance upon others for all interaction, it can become challenging to firstly engage an individual in an activity that they prefer or enjoy, and then to assess or monitor their affect during the activity to establish whether or not that activity and those materials are in fact something that the person wants to use and/or finds reinforcing.

Intensive Interaction

Originally developed by Nind and Hewitt (1988), Intensive Interaction (II) approaches are designed to elicit and enhance communication and social skills in individuals with PMD and other significant developmental disabilities such as ASD. This approach aims to engage individuals in a one-on-one interaction that focuses on increasing the person's levels of alertness, and providing sensory and social stimulation. Examples of sensory and social stimulation might include the use of a fan within a game, or playing a game with a textured ball or soft toy. The central component to this approach is the notion that any communicative behaviour exhibited by the individual, such as an idiosyncratic gesture or vocalisation, should be interpreted as conveying a meaningful message for that individual (Nakken, & Vlaskamp, 2009; Nind, & Hewett, 2005, 2012). II supposedly enhances the fundamentals of communication (Nind & Hewett, 1988) in a positive and sensitive manner during an intensive interaction session where the trainer and learner enjoy an interaction that targets: increasing attention span and concentration, the ability to learn and follow sequences of activities, turn taking and exchanges of behaviour and vocalisations, the use of appropriate eye gaze, facial expression, physical contact, understanding non-verbal communication including idiosyncratic behaviours, and maintaining and regulating arousal levels (Hewett, 2007; Nind & Hewett, 2005, 2012; Nind & Thomas, 2005).

The approach requires carers to act as sensitive, consistent, and engaged communication partners who follow the lead of the learner in a demonstrative way as opposed to directing the interaction (Barber, 2007; Nind, & Hewett, 2005, 2012). This strategy seeks to enhance the teacher-learner relationship by adopting patterns of early caregiver-infant social interactions. By using these positive social exchanges following a watch, join, imitate, elaborate formula, II aims to increase communicative attempts, frequencies, and levels of social engagement through five core objectives: (a) creation of interactive activities that are pleasing to the person, (b) increasing the level of engagement and sensitivity of the staff when interacting with the person, (c) embedding specific teaching and prompting procedures, such as pausing and modelling, within the fun activity, (d) increasing the sensitivity of the carer to communicative attempts or perceived attempts from the individual, and (e) providing clear and consistent responses contingent upon a response from the person (Nind, 1996; Nind & Hewett, 2012). Further, II seeks to increase the variance in interactive capacity of individuals with PMD (Barber, 2007; Nind & Thomas, 2005).

Several studies have explored the use of II as an intervention for children with PMD. Firth et al. (2008) for example, studied the perspectives and experiences of 29 care staff (25 women) recruited from four in-home residential settings in North England. Staff members attended training over five days where video modelling was used to teach the instructional techniques associated with II. Following the training, staff received weekly visits from a trainer who provided feedback. The study adopted a thematic qualitative analysis approach, involving pre-and post-interviews with staff regarding the level of client responsivity attributed to the II sessions. The results were mixed in that staff perceptions of the II effects ranged from very effective and helpful, to being ineffective and essentially similar to what they were doing before. This study is limited, however, because data collection was based on the perceptions of those who had implemented the strategy, and how they felt the clients receiving the intervention had responded.

In another relevant study, Watson and Fisher (1997) observed sessions of II sessions conducted with six children with PMD. The authors reported that the children displayed higher frequencies and more elaborate communication skills during the II sessions in comparison to skills reportedly present on a standardised measure of language development. Additionally, the authors noted that during II sessions, the teachers frequently identified and responded to the learner's communicative attempts (Watson & Fisher, 1997). These results suggest that by adopting a more rigorous experimental design and reporting on measurement outcomes based upon direct observational data, instead of basing the reliability and efficacy of such procedures on the perceptions of trainers, more accurate and reliable outcomes can be established.

In another study, Zeedyk, Caldwell and Davies (2009) examined increases in social behaviours of 10 adults after receiving II. The first 10 II sessions were analysed to record the frequency of four social behaviours: (a) eye gaze, (b) body orientation to an interaction partner, (c) proximity to a social interaction partner, and (d) emotional valence. Results demonstrated that all participants exhibited increases in at least two of these behaviours. Increases in the behavioural measures occurred from the first 3 to 14 min of each II session. From these results, the authors concluded that II was successful in rapidly increasing appropriate social skills in adults with PMD (Zeedyk et al., 2009).

Overall, the evidence from studies implementing II are limited in that few studies have demonstrated positive results stemming from rigorous experimental designs. However, several elements from this approach warrant further investigation. For example, increasing carer responsiveness to persons with PMD during communication attempts would seem to enhance social communicative interactions, strengthen communication responses, and reduce social isolation for these individuals. Further, the establishment of a more sensitive carer would seem to provide a more intensive and responsive environment for the individual, where they may experience greater instances of constructive interaction and achieve higher engagement levels.

Systematic Instruction

Systematic instruction (SI) refers to a method of instruction where a skill or performance deficit is identified, and a desired response is broken down into discrete steps and taught to an individual using specific procedures implemented in a clear and consistent manner (Snell, 1987). SI involves certain procedures including modelling, prompting and reinforcement schedules. Modelling is often required for those with PMD where a new more complex skill is taught, and requires the trainer to visually and/or physically demonstrate the desired response. Prompting involves the use of verbal cues, gestural cues, graduated guidance, hand-over-hand instruction, and time delay procedures to enhance and maximise a learner's independent performance. Prompt hierarchies are often altered over time as the learner develops proficiency in the desired skill or behavioural response. For instance, if a most-to-least prompt hierarchy was employed during the initial stages of intervention; where the trainer would physically guide the learner to correctly perform the skill, this prompt would be systematically faded over time such that the learner would independently produce the response following only a verbal cue. Prompting also involves time delay or response delays where a fixed period of time is allocated for the learner to respond following an initial cue. This can also be increased or decreased over time depending on the learners responding and also seeks to maximise independent responding from learners. A further critical component in SI is the feedback provided from the trainer in response to the learner's behaviour, implemented through reinforcement schedules. When the strengthening of a skill is targeted through intervention, reinforcement should be contingent upon a target response. When problem behaviours, or inappropriate forms of communication are targeted to decrease, reinforcement should be contingent upon the replacement behaviours, or offered at fixed intervals where the un-wanted behaviour is absent (Cohen & Lynch, 1996; Browder & Cooper-Duffy, 2003; Snell, 1987).

SI results in the opportunity for quantifiable performance based data collection and precise and reliable data analysis. It can also allow for opportunities to program for generalisation and maintenance. Additionally, procedures implemented repetitively and continuously over a certain timeframe can lead to faster skill acquisition, especially for those with PMD and developmental disabilities (Downing & Siegel-Causey, 1988; Kennedy, 2005; O'Reilly et al., 1992; Sigafoos, 1999; Sigafoos et al., 2004; Snell, 1987). As summarised from Lancioni et al. (2013), four common empirically validated components, or steps of this approach, are often incorporated into instructional strategies when teaching individuals with PMD and other disabilities. These include: (a) the creation of structured opportunities for the execution of a target response, (b) specific response prompting strategies, such as graduated guidance, (c) systematically fading the response prompting strategies, and (d) providing meaningful reinforcement contingent upon a target response (Lancioni et al., 2013).

Maes et al. (2007) reviewed 16 studies adopting SI to teach persons with PMD physical and material well-being, emotional well-being, social interactions, choice-making, and personal development. The authors concluded that those studies demonstrating the most functional and successful outcomes adopted systematic strategies and robust experimental designs. Methodological flaws and inconsistent inter-observer agreement and inter-rater reliability scores limited the strength of many of the reviewed studies. Further, maintenance was not always reported or included within the studies. It appears that the state of empirical research into the effective use of SI for individuals with PMD is limited, perhaps due to the complexity and challenges faced by researchers and clinicians when attempting to design and implement high quality services and support for this population (Maes et al., 2007). Still there are further studies that have reported success in using SI to teach a range of functional skills to persons with PMD.

Healy (1994), for example, implemented SI to increase the frequency of conversational initiations and appropriate social responses for one 17-year-old adolescent male with cerebral palsy, severe ID, and no speech. A multiple baseline across activities design was implemented to measure the young man's social and conversational skills to his teachers, his peers, and school staff across three activities: morning tea, lunch time, and group activities. He was taught via SI procedures to activate a scan-wolf (a speech-generating device: SGD), equipped with synthesised speech software that was activated through touching line-drawings representing short phrases. Once a line drawing was selected, the associated synthesised speech out-put was produced. Results suggest that the teaching procedures adopted within the study were effective in increasing the participant's social and conversational skills, and responses during morning tea time and during group activities. He demonstrated some discrimination where he appeared to prefer to initiate conversations and respond to others during these two conditions (morning tea and group activities), as opposed to during the lunchtime condition. A unique aspect identified in this study was the opportunity of choice for the young man to socially engage with others when and where he preferred, highlighting the importance of context when developing and implementing systematically instructed responses.

Additional studies have aimed to increase social skills in persons with PMD using SI. Carter and Hughes (2005), reviewed 26 studies specifically targeting social engagement in persons with intellectual disabilities and non-disabled peers. Studies in the review were critically evaluated in terms of the student characteristics, interaction settings, measures of social interaction, observation and experimental designs, and generalisation. Findings suggest that for adolescents with ID and other disabilities, SI training in conjunction with support-based training that included adapting the social environment, was effective in increasing social skills. In fact, almost all of the participants within these 26 studies demonstrated increases in the targeted social skills.

SI has also been used to develop adaptive behaviour skills and to increase instances of self-determination in persons with PMD. Gee, Graham, Sailor and Goetz (1995), taught four students with PMD adaptive skills within specified routines within their general education setting and in the community. Specific activities were selected for each participant, considered appropriate to promote the participant's adaptive behaviour development, with familiar routines comprised of particular steps requiring specific motor, sensory, social or communicative responses in order to complete each routine. A multiple baseline across skills design was adopted to teach participants from four to five discrete adaptive skills required within their particular routine. During intervention, antecedent prompting strategies and time delay were utilised to promote independent responding alongside the natural cues provided by the routine where a behaviour was required in order to complete the routine. Results of this study were positive in that all four participants were able to reach a pre-determined skill proficiency following intervention for target skills. These results suggest this method, of embedding instruction into typical routines naturally requiring specific adaptive skills, was a successful teaching approach. This study further highlights the importance of adapting performance levels for those with multiple disabilities such that they are still able to interact and engage within a typical environment, but are not required or demanded to match their peers performance levels. An additional finding from this study indicated generalisation effects were demonstrated where fewer trials were required for the participants to reach proficiency for each subsequent skill taught (Gee et al., 1995).

In another study effectively using SI, Sigafoos et al. (2005) taught three adults with intellectual disability and low adaptive behaviour skills to make microwave popcorn, a favoured snack, using SI and video-modelling. The full performance of making popcorn in the microwave was taught using partial task instruction where the full performance was segmented into 10 steps. Each step was taught to participants explicitly whereby they first watched a video segment of one step, and then were immediately given the opportunity to perform the step of the task. This study differed from previous research in that videos of each step were recorded from the point of view of the individual performing the task, and partial instructional techniques were used to increase the number of practice trials each participant received. Following the completion of the 10 steps, the natural reinforcement of eating the prepared popcorn was both functional and relevant to the entire process as now these individuals could independently make their own preferred snack, and the popcorn could only be eaten following the exact and precise implementation of all required steps (Sigafoos et al., 2005).

Further studies have focused on training classroom teachers to adopt SI strategies into their daily teaching routines. O'Reilly et al. (1992) taught two pre-service special education teachers to use SI within their daily teaching routines. This study analysed the effect of immediate or delayed supervision support on the ability of the teachers in the appropriate use of positive reinforcement and the use of systematic instructional prompting techniques. Immediate feedback was identified as the most effective method of training for both teachers where they reached high levels of proficiency in reinforcement contingencies and prompting strategies. These successful results were further generalised to additional classrooms and were maintained four weeks following the removal of the supervision (O'Reilly et al., 1992).

In another relevant study, Horrocks and Morgan (2011) taught teachers, using video modelling, live modelling, and feedback techniques, to first implement preference and motor skills assessments and then teach their students using specific systematic procedures. These procedures, involving graduated guidance, a least-to-most or most-to-least prompting hierarchy, and time delay, were taught in the format of a multiple baseline across participant (teacher) design. Results indicated significant improvement in the accuracy and efficacy of implementation for each teacher following training, and increased levels of responsiveness and independent target responding in the students receiving the systematic instruction (Horrocks & Morgan, 2011).

A broad range of studies implementing systematic instructional techniques have focused on teaching particular communication skills to individuals with PMD. Functional communication skills are especially relevant for those with PMD as their primary method of communicating often involves ambiguous and non-conventional forms. Thus they are largely unable to independently gain access to preferred or desired stimuli through physically or communicatively obtaining items, and rely upon others for all interactions and access to stimuli. The goal of communication interventions for these individuals is often to replace non-conventional behaviours likely to be misunderstood by listeners, with more readily understood and appropriate forms of communication (Downing & Siegel-Causey, 1988; Iacono, Carter, & Hook, 1998; Sigafoos et al., 2004). Functional communication skills would enable these individuals to request for desired items in a conventional and efficient manner (Beukelman & Mirenda, 2005; Beukelman, Light, & Reichle, 2002; Lancioni et al., 2013; Schlosser & Sigafoos, 2002).

Considerations for effective methods in designing and implementing communication interventions for people with PMD were described by Sigafoos et al. (2004). First, an important initial step is to evaluate the individuals existing pre-linguistic skills to identify their specific communicative forms and functions. These communicative forms and functions should then be identified by all involved parties as behaviours that require targeting for intervention, and a new specific measurable and quantifiable definition of a replacement behaviour should be formulated. The new communicative form must be within the target individual's repertoire, should be easily acquired, and an efficient response to produce. Instruction should then occur during times when the individual is motivated to communicate, matching those times when the original behaviour was produced. Instruction should involve many repetitions to strengthen the new communicative response and to enhance the learning process. Further, intervention should use appropriate and effective instructional techniques, so that only the new response occurs consistently and can then be reinforced. And lastly, the new response should be consistently reinforced to strengthen and maintain the independent use of the new more appropriate communicative form (Sigafoos et al., 2004).

In a relevant case study conducted by Sigafoos et al. (2004), functional and socially appropriate forms of rejecting were taught to one young boy with PMD. The young boy reportedly used inappropriate vocal behaviours (crying and whining) to reject non-preferred food items during mealtimes. The new conventional and socially appropriate behaviour of using the manual sign for 'No' was considered a feasible replacement behaviour as it was within the boy's motor repertoire and considered an easy behaviour to physically prompt. The boy's mother identified 10 food items, which were consistently rejected by the boy, and these items were dispersed throughout a typical mealtime to encourage the practice of the new skill. Differential reinforcement was utilised to enhance the efficacy of the new targeted response where only the manual sign for 'No' resulted in the immediate withdrawal of the non-preferred food item. Errorless learning was utilised during the first few trials to ensure that the boy experienced the new contingency, and prompting was gradually faded by increasing the response time delay following the presentation of the non-preferred item. Results suggest that the boy began to independently and consistently adopt the new manual sign to reject non-preferred items and maintained this new conventional communicative form for three months following intervention.

Overall, SI appears to be an effective teaching strategy for teaching a range of adaptive behaviours (Cater & Hughes, 2005; Gee et al., 1995; Healy, 1994; Sigafoos et al., 2005). Teachers can learn to implement SI within classrooms (Horrocks et al., 2011; O'Reilly et al., 1992), and SI has been successfully applied to teach a range of functional communication skills (Healy, 1994; Sigafoos et al., 2004; Snell, 1987). Effective use of SI appears to depend to some extent on the existing skills of the individual prior to intervention, but in some cases, it might be more effective to strengthen an individual's pre-existing communicative behaviour, instead of replacing such behaviours (Calculator, 1988; Downing & Siegel-Causey, 1988).

This is an especially important consideration when working with individuals who experience PMD whereby teaching a new response might not be feasible.

Targeting Communication

To aide individuals with PMD in developing a more effective communicative method, and to enable their carers, teachers and families to better understand their communicative attempts, several communication intervention approaches or pathways might be explored. To begin, as mentioned previously, it might be useful to examine the existing pre-linguistic behaviours (PLBs) exhibited by the individual, and assess the communicative function, if any, of these PLBs. Three core inextricably linked intervention pathways include the (a) interpretive pathway, (b) the enhancement pathway, and (c) the replacement pathway (Downing & Siegel-Causey, 1988; Sigafoos et al., 2006). The interpretive pathway is the entry point, where individuals who rely upon PLBs would begin. A listener 'interprets' the behaviour of the communicator, deciphers the presumed intended meaning of the behaviour, and responds accordingly (Calculator, 1988; Downing & Siegel-Causey, 1988; Iacono, Carter, & Hook, 1998; Ogletree et al., 1996; Porter et al., 2001; Reichle, 1997; Schweigert, 2012). Issues can arise when a communication partner misinterprets the communicative behaviour to mean something else and responds in a way contrary to the communicator's desire, or over interprets the behaviour as conveying an intentional communicative message (Greathead et al., 2016; Kaiser & Goetz, 1993; Porter et al., 2001). Typically, an individual whose communication attempt is dismissed as carrying intentional meaning may give up on attempting further communicative interactions (Didden et al., 2010; Mirenda, 1997; Sigafoos et al., 2006). An individual whose communicative attempt is misunderstood might instead escalate to problematic forms of communication (Didden et al., 2010; Durand & Carr, 1991; Durand 1991; Mirenda, 1997). An inverse relationship between communication skills and frequency and severity of problem behaviours has been suggested (Sigafoos, 2000), particularly in those with PMD (Barnard-Brak et al., 2015; Belva et al., 2012; Durand & Carr, 1991; Matson et al., 2011; Matson & Rivet, 2008; Tureck et al., 2013).

In order for these interpreted behaviours to qualify as communicative, it would seem useful to have them occurring under consistent social circumstances, and maintained by the resulting listener's response (Kaiser & Goetz, 1993; Siegel-Causey et al., 1987; Schweigert, 2012). To achieve this, the interpretive pathway focuses on ensuring that all communication partners identify and respond appropriately and consistently to PLBs, as if they were intentional communicative acts (Calculator, 1988, 2002; Carter & Iacono, 2002; Schweigert, 2012; Siegel-Causey & Bashinski, 1997; Sigafoos et al., 2006). In order to consistently identify and respond to a particular PLB, all parties involved need to have a concrete system which provides details on the behaviour, what to look out for, and what response is appropriate (Carter & Iacono, 2002; Keen et al., 2001; Schweigert, 2012; Sigafoos et al., 2006). To achieve this, the enhancement and/or the replacement pathway might be investigated for individuals who lack functional communication skills. For those with PMD, as mentioned before, it might be more appropriate to follow the enhancement pathway as opposed to the replacement pathway where existing skills of the communicator might be enhanced, avoiding intervention programs that aim to replace the communicators existing methods with more conventional forms (Downing & Siegel-Causey, 1988; Ogletree et al., 1996; Schweigert, 2012; Sigafoos et al., 2006).

Alternative and augmentative communication (AAC) systems are often used to replace or enhance functional communication in individuals with significant communication deficits. These individuals tend to be considered non-verbal in that they use minimal speech to communicate on a daily basis (Beukelman & Mirenda, 2005). AAC systems can replace verbal communication with symbols and picture representations of words or messages (picture exchange system), symbolic communication forms (manual sign language), or software loaded onto portable electronic devices allowing the production of synthesised speech out-put through a selection of a graphic symbol (SGD: speech generating device). The literature evaluating these systems demonstrate substantial support for the use of these systems in providing non-verbal individuals with an effective and functional means by which to communicate (Beukelman & Mirenda, 2005). However, these systems do require a certain level of fine motor proficiency in order to select, pick up, and hand over a picture card (picture exchange), create a symbol using one's hands/fingers (manual sign), or to select a graphic symbol on the screen of an electronic device (SGD). Due to this, AAC options tend to be inappropriate for those with profound physical impairments. Thus alternative strategies aimed at enhancing functional communication are required for this population of learners.

Enhanced Natural Gestures

In 2002, Calculator developed an intervention program to enhance the use of natural gestures, or PLBs for communicative purposes. The main idea behind Enhanced Natural Gestures (ENGs) is the premise that individuals, even with the most complex disabilities often seem capable of producing PLBs that carry some communicative meaning and that these behaviours can be shaped and strengthened to form purposeful, intentional communication (Calculator, 1988, 2002; Calculator & Diaz-Caneja Sela, 2014). To be considered a viable candidate for ENGs, Calculator (2002) suggested that participants meet six criteria: (a) a diagnosis of severe to profound ID, (b) communication skills equivalent to a typical 6 month old, (c) varied success with prior AAC use, (d) limited motor skills excluding manual sign language training, (e) limited cognitive ability excluding abstract or symbolic communication forms, and (f) some evidence that the participant is already able to produce some intentional and meaningful natural gestures.

To date the ENG intervention strategy has largely focused on children with Angelman Syndrome (AS); a genetic disorder characterised by severe ID, communication and physical impairment, seizure disorder, and significant uncontrollable levels of arousal (involving frequent laughter and heightened excitability). However, Calculator (2002) noted that this strategy might also be effective for other individuals with various physical disabilities and intellectual or developmental disabilities, including those with PMD. Similarly to those with PMD, persons with AS tend to communicate using natural gestures and other non-symbolic forms of communication that are often deemed non-functional due to the ambiguity of these gestures to un-familiar communication partners. Additionally, sign language for this population is often problematic as the required motor skills and cognitive demands might be too complex for some individuals. ENGs were thus developed as an alternative communication option to manual signing and other symbolic communication systems. ENGs build upon the individual's pre-existing gesture repertoire, thus reducing the intensity of teaching or training, and are based on both the level of cognitive and motor skills possessed by the individual. In addition to strengthening this natural response, communication partners are trained to recognise these gestures, and consistently respond in an appropriate manner (Calculator, 1988; 2002). The theory behind the ENG intervention protocol is similar to the critical component of the interpretive pathway outlined by Sigafoos et al. (2006), where the listener's response is critical to the strengthening and functional use of that PLB (Iacono & Carter, 2002; Ogletree et al., 1996).

Calculator and Diaz-Caneja Sela (2014) evaluated an ENG approach with three participants diagnosed with AS. In this study, two target ENGs were selected for each participant and training followed a quasi-experimental design to assess participants' use of ENGs over a 12-week period. Familiar staff of the participants were used as instructors to strengthen and shape the existing communicative behaviours observed in each participant. Event recording data collection procedures were used to record the frequency of target responses. Following the conclusion of training, the ENG-ARF (ENG- Acceptability Rating Form) was used to evaluate the instructor's perceptions of the ENG procedures. The ENG-ARF is a socially validated tool to evaluate the (a) effectiveness, (b) willingness, (c) reasonableness, (d) disadvantages, (e) negative side effects, and (f) anticipated outcomes of the program using Likert scale ratings (Calculator, 2002). The results demonstrated an increase in spontaneous use of ENGs for each of the three participants over the 12-week period. Additionally, each student was able to learn and produce their target ENGs quickly and with apparent ease, strengthening the premise that ENGs are accurately matched to the user's cognitive and motor capabilities (Calculator & Diaz-Caneja Sela, 2014).

In a follow-up study, Calculator (2015) carried out a parent training intervention to further evaluate the ENG program as an effective communication strategy for use in the home and community settings. Again a quasi-experimental design was used to determine if the ENG strategy could be taught to 18 parents and used effectively in a home and/or community setting. The perceptions of the ENG program from the parents and assigned Speech Language Pathologists (SLPs) regarding the communicative outcome for the children was analysed through both quantitative (Likert scale ratings) and qualitative measures (interviews). Parents were trained, and supported by their associated SLP to implement the teaching program aimed to enhance three of their child's natural gestures to communicate simple wants and needs within the home or community environment. To evaluate the efficacy of the program, the ENG-ARF was used, as similarly used in the 2014 study. This was provided online and the parents completed it independently. Additionally, Goal Attainment Scaling (GAS) was used to measure the changes in communication for each participant, as due to the intervention. GAS provides a numerical rating of changes in pre-selected goals. In this study, the parents and SLPs were provided with four predetermined ENG goals covering possible outcomes. Each goal had four attainment levels based on percentage correct and level of prompting. The intervention adopted a least-to-most prompting hierarchy, which correlated with specific scores on the GAS. Results suggest that this program was deemed effective by the majority of the parents who observed an increase in their child's use of their individually selected ENGs. Many parents involved in this training program noted that ENGs could be very effective when used in conjunction with their child's additional AAC systems; especially when their AAC system was not readily available. However, limitations were apparent in this study; first no inter-observer agreement or formal procedural integrity checks were carried out on the collected data. As this program was based on measures from (a) use of ENGs, and (b) questionnaires from parents, these outcomes must be interpreted with caution as parent bias and expectations of success may have had a significant impact on the outcomes reported. Additionally, as this study adopted a B-only design where only one condition was assessed, a functional relationship could not be established. Thus these results cannot be suggested as due only to the training program. Instead maturation or the increased engagement with the parent or SLP may have influenced the apparent increase in ENG use observed by parents.

Overall, the studies evaluating ENGs for individuals is limited to those diagnosed with AS. Further, these studies adopt pre-experimental B-designs that lack experimental rigor. Regardless, assessing an individual's natural repertoire of communicative gestures, strengthening these responses, and ensuring the appropriate response is produced by communication partners during an exchange may be a useful teaching strategy for individuals with PMD (Ogletree et al., 1996; Reichle, 1997; Schweigert, 2012; Sigafoos et al., 2006; Sigafoos et al., 2000), a finding consistent with procedures used in II (Nind & Hewett, 2012). Additionally, the use of ENGs may help to bridge the discrepancies identified between an individual's communication abilities, and those abilities required by society in order for communication to be deemed appropriate (Calculator, 1994; Calculator & Diaz-Caneja Sela, 2014). However, as stated by Calculator (2015) these communication strategies are perhaps best augmented with effective AAC options, such that the natural gestures of children may be enhanced and supported with additional functional communication modes. For persons with PMD, traditional AAC modes requiring fine touch or imitation skills and specific levels of alertness and engagement tend to be beyond the capabilities and skill level observed in this population of learners (Lancioni et al., 2001; Lancioni et al., 2013). An approach adopting assistive technology that aligns with the theory behind the instruction of ENGs might be one effective way of enhancing and providing further clarity to natural communicative gestures for those with PMD.

Assistive Technology

Assistive technology is designed to remove barriers imposed on an individual by their disability or impairment. For those with PMD, the use of assistive technology can offer an opportunity to become an active participant within their environment through the use of behavioural responses, or natural gestures, that already exist within their repertoire (Calculator, 1988; Lancioni et al., 2013; Lancioni, Singh, O'Reilly, Sigafoos, & Oliva, 2014; Roche et al., 2015; Stasolla et al., 2015; Schweigert & Rowland, 1992).

A microswitch is a type of assistive technology that is designed to enable individuals with minimal motor skills to produce functional responses that are feasible within their existing motor repertoire. Responses of this type might enable them to have a positive impact on their immediate environment through active participation, the control of specific stimulation, and constructive engagement within their immediate context (Lancioni et al., 2001; Lancioni et al., 2009a, Lancioni et al., 2013). As a result of the complex and profound disabilities persons with PMD endure, response skills and abilities tend to be limited making them appear largely passive, seemingly disengaged, often completely dependent upon others for all daily living requirements, and ultimately socially isolated (Lancioni et al., 2001; Lancioni et al., 2008b). Microswitches are designed to increase levels of active participation, engage the user to exert control over environmental stimulation, and have the opportunity to achieve social goals (Lancioni et al., 2008b, 2008c). Microswitches are designed to be easily activated through an available or feasible motor movement possessed by the person, such as by being pressed by an arm or hand, a leg movement, an upward movement of a knee, or the miniscule upward movement of the eyebrows or eyelids (Lancioni, et al., 2001, 2006; Lancioni et al., 2008b, 2008c). Microswitches can be effective tools in translating motor behaviour into functional active responses when motor skills already present within the user's repertoire are targeted for intervention, as opposed to attempting to teach a new motor behaviour in order to activate the microswitch (Lancioni et al., 2013; Schweigert & Rowland, 1992). By capturing a feasible motor movement already possessed by the learner, microswitches might be a more appropriate option for those with limited physical skills as opposed to other AAC options, as discussed earlier in this chapter.

Microswitch technology has documented efficacy in increasing functional skills and creating opportunities to increase self-determination and promote adaptive behaviour in individuals with PMD (Lancioni et al., 2004). Specifically, research has focused on enabling individuals to control preferred environmental stimulation (Kennedy & Haring, 1993; Lancioni et al., 2006a; Singh et al., 2004; Warren et al., 1990), and requesting social interaction (Lancioni, 2008b, 2008c; Lancioni et al., 2009a, 2009c). Microswitch technology has also been used effectively in increasing leisure occupation in persons with PMD (Lancioni et al., 2014), enhancing and promoting ambulation skills (Stasolla & Caffo, 2013), posture (Lancioni et al., 2004; Lancioni et al., 2007), and reducing maladaptive behaviours such as mouthing objects (Lancioni et al., 2007). For example, a pressure-sensor microswitch might be a large round switch that upon pressing, with a certain amount of specified force, might produce some a reinforcing recorded verbal message, reinforcing or preferred music or audio stimulation, or be linked with an SGD to produce a synthesised spoken message (i.e., "*please play with me")* to gain access to a preferred or reinforcing activity*.* Alternatively a motion-detecting microswitch might be 'activated' via an individual moving their body, an arm, or a leg, within a certain distance near switch sensor so that an infra-red beam of light is 'broken', thus triggering the direct production of reinforcing audio stimuli, or again be linked with an SGD to produce a clear synthesised spoken message to access a preferred activity or reinforcement (Lancioni et al., 2013).

In a review of microswitch interventions for increasing adaptive behaviours in children with multiple and developmental disabilities, Stasolla et al. (2015) discuss the educational outcomes of 35 studies conducted in the last 15 years (from 2000- 2015) regarding microswitch set-ups, the specific adaptive behaviours targeted, increasing self-determined responding, indices of happiness and efficacy of functional communication skills (Stasolla et al., 2015). Overall, this review indicated positive effects of microswitch-based intervention programs for individuals with PMD across all measures, however several limitations were also highlighted. Namely the lack of generalisation and maintenance phases, the use of inappropriate technology, and motor responses that were either poorly matched to the demand of the microswitch, and/or unable to be easily performed by the learner (Stasolla et al., 2015).

Another relevant review, conducted by Roche et al. (2015: see appendix B), analysed 18 studies that targeted self-determined responding through microswitch based interventions. The studies were grouped into three classes of self-determined behaviour: (a) requesting preferred stimuli, (b) choosing between stimuli, and (c) requesting social interaction. Again the outcome from this review suggested that microswitch technology can provide an effective method for those with PMD to exert some degree of control over their immediate environment, and produce self-determined responses that may have a positive impact upon their overall quality of life (Roche et al., 2015).

Results from both reviews noted the critical importance of appropriately matching a microswitch to a learner's existing motor skill level and motivational state when designing and implementing microswitch-based interventions, where studies indicating negative outcomes or intervention failures tended to mismatch the microswitch set-up and target response with the learner. Both reviews and the substantial body of work conducted in the field of microswitch interventions for persons with PMD demonstrate positive implications for both the learners and staff/carers when pre-existing skills and motivational states of learners are considered (Roche et al., 2015; Stasolla et al., 2015).

What is unique about these behavioural interventions is the ability to translate minimal motor movements into functional acts. For example; in 2006, Lancioni et al. devised a microswitch to capture the up-ward movement of two boys' eye-lid response in order to provide them with a way of controlling the presentation of preferred environmental stimulation. Due to the severity of the participants' physical disabilities, the eye-lid movement was considered the only feasible response the researchers could target. This study is one of many which highlights the notion that microswitch technology can enable those with PMD to exert some control over environmental stimuli, when they do not have the personal ability to do so on their own (Holburn, 2004; Lancioni et al., 2006; Lancioni et al., 2013), again providing another useful instructional strategy that may well help to bridge the discrepancy between an individual's communicative abilities, and those communicative skills deemed acceptable and competent by society's standards (Calculator, 2002; Lancioni et al., 2013; Reichle, 1997; Roche et al., 2015; Stasolla et al., 2015).

Microswitch-based interventions have demonstrated additional successes in enhancing adaptive behaviour and increase indices of happiness in girls with Rett syndrome. Stasolla and Caffo (2013) taught two females, aged 12 and 17 years old, to request preferred stimuli using a wobble microswitch, and to promote ambulation using an optic sensor using a multiple probe across behaviour experimental design. In addition to these adaptive skills, the study also looked at reducing stereotypy (hand washing and body rocking) and indices of happiness associated with acquisition and proficiency with the two microswitches. Results indicated that both participants' microswitch responses increased following intervention, and these high levels of switch responses were maintained during the third intervention phase, where both switch responses were used alternately. Additionally, both participants showed decreases in stereotypy and increased indices of happiness.

Microswitch technology has additionally been combined with aided AAC modes, such as speech generating devices (SGDs), which produce synthesised speech output for those without functional speech (Lancioni et al., 2001; Lancioni et al., 2014; Lancioni et al., 2009a; 2009c Lancioni et al., 2008b; 2008c). SGDs can enable a user to produce a spoken response without actually possessing the ability to speak, allowing a consistent and readily understood communication option. Substantial research has identified SGD-based communication options as an effective and socially valid functional communication tool for those with developmental disabilities and speech impairment (Lancioni et al., 2002; Lancioni et al., 2014; Rispoli et al., 2010). An SGD might be activated by a microswitch through a blue-tooth connection, or by directly plugging into a microswitch. With the appropriate SGD software loaded onto a chosen device, the press of a microswitch can act to select a symbol or communicative message that is available on the screen of the device (i.e., on the screen of an iPad for example) at the correct time. The use of SGD's in combination with microswitches provides a clear synthesised spoken message and could allow the user an opportunity to extend their communicative capability by including multiple messages, or accessing leisure content such as music, videos, or the internet (Lancioni et al., 2001; Lancioni et al., 2014; Lancioni et al., 2013; Rispoli et al., 2010). In this way, an SGD can become an accessible communication option, providing a conventional and an advanced symbolic method of communicating, for those who otherwise would not be able to physically operate an SGD on their own (Lancioni et al., 2001). .

Lancioni et al. (2008b, 2008c) for example, taught two participants in the first study, and three participants in the second, to activate microswitches and SGD to access desired environmental stimuli and request social interaction from carers. Both studies adopted modified multiple probe experimental designs where the microswitches were taught for the purpose of controlling desired environmental stimuli, followed by the introduction of the SGD to request social interaction. Following this, both the microswitch and the microswitch-activated SGD were available for use, allowing the participants to choose between the stimuli or social interaction. By the end of intervention, all participants from both studies had gained proficiency in operating the microswitches and the SGD to request and obtain sensory stimuli and social contact (Lancioni et al., 2008b; 2008c). Further, Lancioni and colleagues (2009a; 2009c) conducted two studies where 11 adolescents with PMD were again taught to control desired environmental stimulation and access social contact using a microswitch activated SGD.

Thus promising evidence exists documenting the successful outcomes of assistive technology, particularly microswitch-activated SGD technology, in improving adaptive behaviour functioning and skill development for persons with PMD (Lancioni et al., 2014; Lancioni et al., 2013). Empirical research in this literature provides instructional procedures demonstrating successful outcomes, however due to the heterogeneity that exists within this population of learners, individualisation in regards to the design of such teaching programs is warranted.

Individualised Support Programs

It has been said that for "…people without disabilities technology makes things easier, but for people with disabilities technology makes things possible" (Bryant et al., 2010, p 203). Just as specific AAC modes, such as sign language or symbolic systems, are carefully selected and matched to the skills of a non-verbal individual to promote the development of functional communication skills, so too should the assistive technology for the person with PMD to enhance effective functional communication (Lancioni et al., 2014; Stasolla et al., 2015). Therefore, the extent to which any type of technology makes something possible for a person with a disability will likely depend to some extent on whether the technology is appropriately suited to the person's physical, sensory, and cognitive abilities. In some cases, it may mean having to adapt off-the-shelf technology so that it can be operated by the person given his/her physical and/or sensory impairments. Such adaptations are likely to require a high degree of individualisation. A microswitch solution that works for one individual might not be appropriate for another, even when those individuals have similar characteristics. Still, there are several design principles that would seem to have some general relevance to the adaptation of technology for people with disabilities which focus on the concept of cognitive artifacts.

Cognitive artifacts are man-made objects or items developed for the purpose of enhancing and/or facilitating human performance (Norman, 2013). Examples of cognitive artifacts can be low-tech and as simple as a shopping list, which when used in the intended way can enhance our performance without actually enhancing our personal memory ability. Further, more high tech cognitive artifacts could include specific assistive technology, such as an automatic wheelchair, that can enable an individual to access their environment and enhance their transportation ability, without increasing their personal ability to move around. Cognitive artifacts can be viewed from a system or a personal view point and create an alternative focus depending on which view point is evaluated. A cognitive artifact viewed from a systems perspective analyses the user and the artifact as a whole. From this perspective one can understand the benefit for the individual in using the cognitive artifact to achieve the end result. From a personal view point, the user can see that the artifact has in-fact altered the original task, enabling them to enhance their performance. For example; consider an individual with PMD who uses gestures to communicate and a microswitch-activated SGD is identified and matched to their existing gestural repertoire in order to provide a functional method of communication. The microswitch-activated SGD would be identified as the cognitive artifact and would reduce the physical and intellectual limitation experienced by the individual by providing them with a spoken communicative message, where they might otherwise be unable to produce the message on their own. If viewing this artifact from a systems view-point, the person plus the microswitch-activated SGD results in the enhanced communication performance of the individual. From a personal view-point, the motor response acting on the microswitch results in the communicative outcome from the SGD, where the task for the individual has been altered (i.e., an existing motor response is now enabling, or enhancing, their communication).

The design of a cognitive artifact greatly influences the usability of that artifact. For example, discoverability refers to the clarity of perceived actions and functions that are possible of an artifact, and how easily it may be activated or utilised. Often users require a cue or ‘invitation’ to identify and draw their attention to the artifact. In order to accomplish discoverability, specific principles involving feedback and affordance, need to be adhered to. Feedback refers to the reaction from the device the user receives following a response to essentially alert them that their response has been recognised, or that their response was correct. These can be in the form of sensory stimulation (i.e., a vibration from a handheld device), a highlighted icon, a flashing icon (to indicate that you have selected the icon), or some auditory stimulation like a bell or synthesised voice message. Affordance refers to the range of possible actions or activities that are available to act on the artifact, which subsequently influences the extent to which the user understands how an artifact may be used (Norman, 2013).

When considering PMD persons who might benefit from using specific assistive technology or cognitive artifacts, increasing the persons' capability to use any given type of technology for common purposes (e.g., using an iPad to access entertainment/music videos) may mean teaching them how to use existing technology. When the disability is associated with cognitive impairment, effective teaching may require the need for systematic instruction (SI) based on well-established principles of learning, as previously discussed. For example, a person with a sensory impairment or severe language deficit may not only benefit from an alternative/adapted way to access content on an iPad, but he or she might also require systematic instruction on how the use that technology for specific purposes (accessing leisure content). To this end, rehabilitation professionals may find it helpful to refer to successful examples of adapting technology and teaching individuals with specific types of disabilities to use the newly configured technology following individualised teaching procedures. Such examples are only necessary of course in cases where it can be shown that the person was in fact unable to effectively use off-the-shelf technology after what seems to be the more typical (show and tell) instructional procedures. For those with PMD, this is often the case and teaching strategies involving these individuals demands highly individualised and systematic teaching procedures to enhance intervention efficacy (Gee et al., 1991; Nakken & Vlaskamp, 2002; Snell, 1987). One effective method which incorporates systematic instructional procedures under a naturalistic teaching approach is the interrupted behaviour chain (IBC) procedure (Hall & Sundberg, 1987).

Interrupted Behaviour Chain (IBC) Procedure

Previous studies adopting the IBC procedure have demonstrated success in teaching functional communication skills to individuals with developmental disability (Carter & Grunsell, 2001; Duker et al., 1994; Gee et al., 1991; Hall & Sundberg, 1987). The IBC procedure involves a naturalistic teaching approach adopting systematic interruptions to a familiar, or taught, routine. These interruptions become the opportunity for instruction (Carter & Grunsell, 2000; Duker, Kraaykramp, & Visser, 1994; Halle, 1986; Hall & Sundberg, 1987). This procedure reduces a simple task into discrete steps that can be systematically taught and quantifiably measured for performance accuracy (Carter & Grunsell, 2000; Hall & Sundberg, 1987; Sigafoos et al., 2005). Distinguishing features of the IBC procedure require the target participant be actively engaged in a task or activity that is interrupted by the trainer, and that a specific communicative response is required from the learner in order for the remaining steps to be performed (Hall & Sundberg, 1987; Shafer, 1994). By interrupting an activity or stimuli the learner is actively engaged with, the reinforcing value of the activity is momentarily altered where the individual will likely be highly motivated to produce a requesting response to reinstate the reinforcer (Halle, 1987; Skinner, 1957). In an adapted stimulus interruption method, a communicative response from the learner would enable the reinstatement or continuation of an interrupted activity or access to highly motivating stimuli without the requirement for subsequent steps to be completed (Duker et al., 1994; Hall & Sundberg, 1987).

This strategy has been implemented to teach functional skills for individuals with ID and multiple disabilities such as cooking a meal (Sigafoos et al., 2005), and requesting for specific items or actions in order to complete a desired activity or task (Carter & Grunsell, 2000; Gee et al., 1991; Gee et al., 1995; Goetz, Gee, & Sailor, 1985). Specifically, IBC procedures were used to elicit requesting in individuals with PMD to complete making toast and washing dishes (Goetz, Gee, & Sailor, 1985), and brushing ones teeth and engaging in a ball play activity (Hunt, Goetz, Alwell, & Sailor, 1985).

A study which successfully combined the effective teaching procedures involved in stimulus and behaviour interruption chains, and assistive technology was implemented by Gee et al. (1991). In this study, three students with profound intellectual, sensory, and physical disabilities were taught to activate a ‘call buzzer’ to request during a stimulus interruption. Intervention was implemented according to a multiple baseline across response design with additional generalisation phases to different contexts for each participant. During intervention, participants were taught, using increasing time delay and most-to-least prompting techniques, to request the continuation of a social interaction or for the re-establishment of a routine to which they were partly involved in. Results indicated that all three participants were able to consistently use the call buzzer to request during the interruption, and these skills were generalised to novel contexts (Gee et al., 1991). Similarly, generalisation was demonstrated in Hunt et al. (1986) where three participants were able to respond correctly across at least two untaught chains involving novel behaviour sequences.

The interruption of a routine or activity has demonstrated efficacy in increasing functional requesting in individuals with PMD but has also reported effects on spontaneous communication skills in individuals instructed in this procedure (Hall & Sundberg, 1987; Hunt & Goetz, 1988; Romer & Schoenberg, 1991; Shafer, 1994). This effect was illustrated in a study conducted by Romer and Schoenberg (1991), where resident care staff working with two individuals with multiple disabilities were instructed in the implementation of an IBC procedure to enhance the participants' requesting behaviours. Staff underwent a short training workshop and received initial support from the trainers during the first few trails of intervention. Results indicated that the participants' requesting behaviours increased during the successful staff implementation of the intervention procedures. Further, one participant demonstrated significant increases in spontaneous communication skills during the intervention period (Romer & Schoenberg, 1991). Thus the IBC procedure has demonstrated efficacy in promoting highly motivational contexts under which functional communication skills, spontaneous communication, and skills that are able to be generalised across new behaviour sequences, might be taught (Gee et al., 1991; Hunt et al., 1986; Hunt & Goetz, 1988; Romer & Schoenberg, 1991). The IBC procedure has proven to be a flexible teaching approach that can be individualised to suit the needs and elicit responses from learners with multiple and complex communication needs and personal abilities. The required communication response from learners can be simple or complex, as determined by the pre-existing skills of the learner, and the routine or activity that is interrupted can also be as simple or as complex as is appropriate for the personal ability of the learner. Thus this approach, in combination with assistive technology such as microswitch-activated SGDs, might provide a feasible teaching option for those with PMD.

Summary

Teaching strategies and intervention programs can be difficult to implement and design for individuals with PMD due to the severe and complex nature of the topography of disability and heterogeneous nature of this population. The variance observed in intellectual capabilities, physical skills, sensory impairment, and additional health needs results in fluctuating levels of awareness, a lack of independence and control, lower levels of engagement and interaction with their carers and environment, and often a lower quality of life (Atkin & Lorch, 2016; Lancioni et al., 2013; Nakken & Vlaskamp, 2007). Harder still, these persons tend to lack conventional methods of communicating, instead relying upon pre-linguistic forms of communication that are often ambiguous and difficult to interpret (Kaiser & Goetz, 1993; Ogletree et al., 1996; Schweigert, 2012; Siegel-Causey et al., 1987). Further, the intended meaning of these PLBs can often be misunderstood or overlooked due to a lack of understanding from communication partners (Carter & Iacono, 2002; Meadan et al., 2012). As a result, these individuals are often misunderstood and socially isolated. The combination of these factors upon the person with PMD results in few opportunities for the effective learning of new skills and quality social interactions (Atkin & Lorch, 2016; Calculator, 1988; Gee et al., 1991; Kaiser & Goetz, 1993; Keen et al., 2001; Maes et al., 2007; Nakken & Vlaskamp, 2002; Reichle, 1997; Schweigert, 2012; Sigafoos, 2000).

Research is, however, promising. Educational methods, such as Snoezelen and II, adopt positive interactive approaches which aim to identify the behavioural states of persons with PMD, create greater instances of positive reaction and responsivity between the PMD person and therapist/carer, and create environments where the individual feels comfortable, calm, and can access stimuli or wants without escalating to more problematic behaviours (Nind &

Hewett, 1988; 2012; Singh et al., 2004). Although aspects of these approaches are helpful in addressing fluctuating behavioural states and low levels of engagement in persons with PMD, studies focused on Snoezelen and II are limited. The few studies that have been published tend to demonstrate methodological limitations and report varying outcome measures largely based on trainers' perceptions as opposed to quantifiable data. Further, these approaches do not appear to specifically target functional skills training for persons with PMD nor employ reliable procedures addressing preferences or ways to enhance active participation. Rather, they provide environments where interaction and active participation are encouraged. Still, measuring an individual's behavioural state and adopting a more sensitive approach to communication attempts in persons with PMD seem to be useful strategies to adopt.

Studies adopting SI appear to be successful in effectively teaching a wide range of adaptive skills to persons with PMD and have been incorporated into other educational approaches for this population. The procedures involved in programs teaching ENGs, the use of microswitch technology, and IBC strategies incorporate key elements identified in the literature using SI for persons with PMD to either enhance or replace existing non-conventional communication forms, including: (a) assessing and validating the learners PLBs and functions, (b) either enhancing this existing PLB, or identifying another existing skill within the learners repertoire that could be taught as a replacement behaviour, (c) identifying stimuli or activities that the learner is highly motivated to access or to continue, (d) adopting step by step instruction, prompting, time delay, and differential reinforcement procedures to enhance or replace the learners PLB such that a more conventional or readily understood communication method can be developed (Calculator, 1988, 2002; Gee et al., 1991; Goetz et al., 1985; Lancioni et al., 2013; Maes et al., 2007; Schweigert, 2012; Sigafoos et al., 2006; Snell, 1987). In general, it is suggested that independent responding from an individual with PMD acts to increase indices of happiness, levels of engagement, and may positively impact upon the person's quality of life (Lancioni et al., 2002; Lancioni et al., 2013). Therefore, an intervention that enhances the learners existing communicative behaviour with the use of assistive technology that requires the active participation of the learner is preferable over programs that seek to increase stimulation levels through sensory rooms or interactions (Calculator, 1988; Kaiser & Goetz, 1993; Lancioni et al., 2002; Maes et al., 2007; Schweigert, 2012).

Purpose of the Present Studies

Persons with PMD can and do communicate and participate in social communication interactions, even when using non-conventional forms of communication. Further it is often the listener's inability to comprehend or correctly interpret or recognise the individual's communicative attempt that limits their communicative competency (Kaiser & Goetz, 1993; Meadan et al., 2012; Ogletree et al., 1996; Schweigert, 2012). The focus of this research is to identify potential communicative acts and consistent natural gestures in four participants with PMD such that effective individualised intervention programs, aimed at enhancing functional communication skills, can be designed and implemented. In order to ensure the best possible instructional program for individuals with PMD, it might be helpful to identify four key elements, adapted from the literature regarding potential communicative and PLBs (Bretherton & Bates, 1979; Kaiser & Goetz, 1993; Schweigert, 2012; Siegel-Causey & Bashinski, 1997; Siegel-Causey, Ernst, & Guess, 1987; Sigafoos et al., 2000; Sigafoos et al., 2006), that ask: (a) does the person demonstrate an intent to communicate?, (b) does the person exhibit consistent forms of communication to express a request for a reinforcing stimulus?, (c) is the communicative form meaningful and easily produced by the person? and, (d) is this communicative form socially appropriate and readily understood by others? if not, could it be enhanced or replaced?. Additionally, meaningful assessment that provides information regarding adaptive skills and potential communicative acts are critical to creating a comprehensive inventory of skills and deficits in individuals with PMD. The evaluation of behavioural states in those with PMD is also important to assess as fluctuating levels of alertness and engagement can significantly impact on the ability to learn and maintain new skills. By collating this assessment data and addressing the four questions above, individualised and specific communication interventions might be developed that create opportunity to enhance functional communication skills for individuals with PMD through the use of assistive technology.

Research Questions

The overall question of this thesis asks; *how do four individuals with PMD communicate, and in what way might their communication be enhanced through assistive technology and individualised systematic teaching approaches?* This question is addressed in four research studies which seek to answer the following research questions.

1. To what extent do the four participants within this research study communicate using prelinguistic behaviours (PLBs)? And what are the particular forms and functions of these behaviours?
2. Is it possible to identify conditions under which these same participants are able to demonstrate behaviours consistent with happiness and high levels of alertness and engagement?
3. To what extent are these four participants able to demonstrate meaningful and consistent PLBs to request further access to reinforcing stimuli? And is there an accurate way to evoke these behaviours and validate the communicative intent of these behaviours?
4. Is there a systematic instructional procedure that might effectively enhance these PLBs? And, if so, could these PLBs be augmented with the use of microswitch technology such that they become more readily understood by communication partners?

The following six chapters of this thesis attempt to answer these four questions and provides a comprehensive assessment and intervention package that might enable persons with PMD the opportunity to actively engage with their environment, interact with others, and have the opportunity to learn new and valuable skills. First, assessment data from the Inventory of Potential Communication Acts (IPCA: Sigafoos et al., 2000) provides an inventory of potential communication forms and functions of each participant, and the Vineland Adaptive Behavior Scales (Sparrow et al., 2005) will provide detailed information regarding each participants adaptive behaviour profile. In the following chapter, a direct analysis of behaviour states during a social interaction and an alone condition provides a demonstration of the behavioural states indicative of alertness and engagement of each participant, and how they behave when alone. The results from this direct assessment aim to determine potential indicators of motivation and a precise and comprehensive knowledge of behavioural indications of happiness, engagement and awareness exhibited by each participant. The fifth chapter discusses the implementation of a systematic instructional approach using adapted IBC procedures to evoke consistent PLBs and directly validate these PLBs that are produced as a way of reinstating or gaining access to preferred stimuli. Lastly, this thesis will combine the identified behavioural states optimal for learning, engagement, and participation, to strengthen and enhance the PLBs of three of the four participants. These individualised case studies aim to create opportunities to systematically enhance and strengthen the participant's existing PLBs using microswitch-operated SGDs and SI procedures. The final chapter provides an overview of the major findings from this thesis to further discuss the implications for both the participants from this research and their teachers and caregivers. Future considerations for the implementation of comprehensive communication intervention programs that could be individualised and successfully implemented to enhance communication skills for persons with PMD are discussed.

Chapter Three

Study One: Assessing Adaptive Behaviour and Potential Communication Acts

One purpose of behavioral and educational assessment is to obtain detailed information about a person's level of functioning, such as their abilities with respect to the communication, socialization and motor skills domains (Beukelman & Mirenda, 2005; Karan, DonAroma, Bruder & Roberts, 2010; Salvia, Ysseldyke, & Bolt, 2012). It is also important to identify specific areas of adaptive behaviour limitations or deficit and the degree to which any particular deficit limits the person's participation. Assessment might also be used to (a) identify how an individual reacts to particular situations or sources of stimulation, and (b) document behaviours that might indicate the person's level of engagement, awareness and alertness (Arthur-Kelly et al., 2007; Lancioni et al., 2011). Assessment could also be directed towards identifying changes in these behavioral indicators of alertness/awareness in relation to differing types of environmental stimulation/circumstances (Calculator, 1988; Ounsted, Osborn, Sleigh, & Good, 1979; Karan et al., 2010). This could be useful for determining if there are certain types of environmental stimulation or particular circumstances that are associated with greater levels of engagement, alertness and awareness. If so, this assessment information might reveal what types of stimulation evokes more active engagement or alertness in the person and thus these circumstances might represent optimal conditions for teaching, as the person would presumably be more alert and engaged, and thus perhaps more responsive to instruction (Arthur, 2003; Arthur-Kelly et al., 2007; Green & Reid, 1996; Green et al., 1997).

In this respect, behavioural and educational assessments might help parents, teachers, and therapists design and implement individualised intervention programs to enhance and strengthen the person's skills as well as increase their level of engagement (Beukelman & Mirenda, 2005; Lancioni et al., 2001; Mirenda et al., 1990). To obtain a representative sample of the individual's level of ability, assessments that are capable of providing an indication of the person's performance with respect to typical tasks, environments and circumstances need to be undertaken (Karan et al., 2010). This is one meaning of the term authentic assessment (Bagnato, 2007; Bagnato, McLean, Macy & Neisworth, 2011; Choate & Evans, 1992). An authentic assessment is perhaps more likely to provide an accurate (valid) sample of the person's skills and reactions to differing types of environmental stimulation and specific circumstances (Bagnato, 2007; Bagnato et al., 2011; Beukelman & Mirenda, 2005; Choate & Evans, 1992; Karan et al., 2010). For example, if certain activities appear to evoke greater levels of engagement or alertness, it is possible that the types of stimulation occurring in those activities are preferred and reinforcing (Green & Reid, 1996). Thus, the person might be more motivated to learn in the context of activities that evoke greater levels of alertness or engagement. Incorporating teaching procedures into such activities may be one way to increase the person's engagement and strengthen, enhance and/or teach new behaviours, such as enhancing the person's communication skills that function as a request for the continuation of that particular activity (Gee et al., 1991; Goetz et al., 1985; Hall & Sundberg, 1987). In this way, various types of assessment data could be useful for designing programs aimed at increasing engagement/alertness and strengthening, enhancing and/or teaching new skills. Increasing engagement/alertness, developing specific skill areas (such as enhancing a person's natural gestures) could represent important educational priorities for students with varied and complex disabilities, such as those with PMD (Arthur-Kelly et al., 2007; Calculator, 1988; Lancioni et al., 2013).

Adaptive Behaviour

Prior to 1959, the main type of assessment that was considered most important when assessing individuals with intellectual disabilities was the standardised intelligence test (Klein-Parris, Clermont-Michel & O'Neil, 1986). Often intelligence tests used for young children were administered to adults with intellectual and multiple disabilities as they were presumed to be functioning within this age range (Sternberg & Adams, 1982). These tests, however, often failed to provide an accurate representation of the skill level and specific areas of adaptive behavioural strengths or deficits. Thus IQ tests did not provide a full representation of the person's abilities and educational needs. In addition, such tests were often of limited use with respect to designing educational programs. During the 1950s, it became apparent that a more comprehensive assessment approach was needed. For example, it became increasingly recognised that assessments were needed to address environmental factors and how individuals interact with their immediate context, as such information might provide a broader representation of the person and their capabilities within their daily life (Mahoney & Ward, 1979; Sternberg & Adams, 1982). Assessing behaviour within typical environments provides information across a range of contexts and can provide a more thorough and accurate representation of actual behaviour. Together, these factors might allow for a more effective intervention approach under which new skills can be taught (Karan et al., 2010; Kraijer, 2000).

In 1959 the proposed definition of intellectual disability was altered to incorporate this new more representative focus of adaptive behaviour functioning. For example, The American Association on Mental Retardation (AAMR), which is now referred to as The American Association on Intellectual and Developmental Disability (AAIDD: 2013), included the term 'adaptive behaviour impairment' in addition to limited intellectual ability in the diagnosis of intellectual disability (AAMR, 1959; Klein-Parris, Clermont-Michel & O'Neil, 1986). Adaptive behaviour is a broad term that seeks to define behaviours that individuals are required to perform in order to function effectively across various environments and within social and daily situations (Ditterline, Banner, Oakland, & Becton, 2008; Doll, 1935; Heber, 1959; Mahoney & Ward, 1979; Sparrow, Cicchetti, & Balla, 1984; 2005). In biological terms, adaptive behaviour demands the organism adapt or alter their behaviour in response to a change in their environment, such that they are able to produce a response appropriate to this altered environment or change in environmental stimuli (Ashby, 2013). Adaptive behaviour in educational and psychological terms refers to personal competence relating to a range of skill domains (e.g., communication, social, motor, self-care, and daily living skills) as well as coping with environmental demands, and developing greater independent functioning within society as they mature to adulthood (AAMR: 1959; AAIDD: 2013; Belva, & Matson, 2013; Bruininks, Thurlow, & Gilman, 1987; Nakken & Vlaskamp, 2002, Petry & Maes, 2007).

The concept of adaptive behaviour has been categorised into 10 core competencies highlighting specific skills required for adaptive functioning. These include: communication, self-care, social skills, community-involvement (or ability to access), self-direction (self-independence), awareness and ability to regulate ones' health, functional academic skills, independent home living, leisure skills and access, and economical independence (AAMR, 1992, 2002 AAIDD: 2013). Adaptive skills are conceptualized as being influenced by the various environments and stimuli that the person encounters. These skills progress and expand during development as we become progressively exposed to an ever changing environment with more complex situational demands. Adaptive behaviour is also influenced by different social environments and situations, and by the various expectations due to these people and places (Bruininks et al., 1987; Doll, 1935, 1965; Mahoney & Ward, 1979). Adaptive behaviour concepts have also been incorporated into more general terms relating to personal or general competence amongst people. For example, general competence as described in the Greenspan model (Greenspan & Driscoll, 1997) includes the following; (a) physical competence in both motor skills and physiological functioning, (b) affective competence, (c) social and practical competence for daily functioning, and (d) academic or intelligence competence.

Deficits in adaptive behaviour can have negative consequences for an individual as these can affect many aspects of their daily functioning. Deficits in adaptive behaviour functioning are a defining characteristic of intellectual and other developmental disabilities (Balboni, Pedrabissi, Molteni, & Villa, 2001; Ditterline et al., 2008). Specifically, deficits in social skills and daily living skills can negatively impact upon an individual's participation and access to community based interactions and settings (Belva & Matson, 2013; Gresham & Elliot, 1987; Tassé et al., 2012). Social exclusion can negatively impact upon further adaptive behaviours throughout later development such as full-time placement in specialised care facilities (Gresham & Elliot, 1987; Nakken & Vlaskamp, 2002; Petry & Maes, 2007), and limited access or opportunity for vocational skill acquisition and future employment options (Belva & Matson, 2013; Tureck et al., 2013). Problem behaviours and stereotypical behaviours are found to be more prevalent in individuals with intellectual disabilities compared with typically developing peers (Applegate et al., 1999; Matson & Shoemaker, 2009; Mirenda, 1997; Petry & Maes, 2007). Self-injurious behaviour (SIB), for instance, is found in higher rates amongst those with severe to profound intellectual disabilities (Didden et al., 2012; Schroeder et al. 1997) with a greater prevalence of SIB observed in association with low levels of specific adaptive behaviour abilities, such as self-care skills, daily living skills, motor skills, and social and communication skills (Durand, 1993; Durand & Carr, 1991; Matson, Anderson, & Bamburg, 2000; Mirenda, 1997; Sigafoos, 2000). Further, evidence suggests that problem behaviour, such as aggression and SIB, often appears during the early developmental years of children with developmental disabilities, and such behavior often persists through to adulthood with its most severe presentation around adolescence (Green, O'Reilly, Itchon, & Sigafoos, 2005). Thus limitations or impairments that negatively impact upon any one of the 10 core competencies can drastically affect the independent functioning of the person within their daily life (Atkin & Lorch, 2016; Belva & Matson, 2013; Sparrow et al., 2005; Tassé et al., 2012).

Assessing Adaptive Behaviour

Assessments that accurately measured the strengths and weaknesses of an individual's adaptive behaviour profile could be seen as potentially helpful tools for classifying and diagnosing various intellectual and developmental disabilities. They also provided relevant target goals that held real functional value in increasing quality of life and independence for those who lacked specific self-help, communication, or competency skills (Klien-Parris et al., 1986). Adaptive behaviour for PMD individuals includes all aspects of daily functioning and one deficit in one domain of functioning can have significant consequences for various other domains of functioning, resulting in a profound adaptive deficit across multiple skills (Belva & Matson, 2013; Balboni et al., 2001; LeBlanc et al., 1999). When devising intervention or teaching goals for those with PMD in particular, it is crucial to take into the account the impact of the level of intellectual functioning of the individual as there may be a limit to the expectations of those experiencing severe to profound ID in their ability to function independently (Kaiser & Goetz, 1993; Goetz, Gee, & Sailor, 1985; Schweigert, 2012). Hence the need for extensive and thorough pre-assessment of both the strengths and weaknesses to determine which skills are most necessary for the individual to gain some independence, and which skills and intervention goals are feasible and appropriate.

Doll (1935, 1965) was the original advocate for the vital role adaptive behaviour functioning played in the 'cognitive deficiency' he observed in individuals with diagnoses of mental retardation. He identified eight distinct categories, deemed essential for adaptive functioning, and defined these as: (a) self-help general, (b) self-help dressing, (c) self-help eating, (d) communication, (e) self-direction, (f) socialisation, (g) locomotion, and (h) occupation. These categories combined to form the original Vineland Social Maturity Scales (Vineland Social Maturity Scales; Doll, 1936), which marked the official beginning of the measurement of adaptive behaviour functioning. An early study involving the assessment of adaptive behaviour was conducted by Gould (1977). In this study, 41 children with moderate ID were compared with 15 children with both ID and PDD (including autism) using three assessment tools. The Vineland Social Maturity Scales (VSMS: Doll, 1935) was used to assess the children's social skills, language abilities, and activities of daily living (ADL). Results indicated that differences in the functioning of the children emerged, specifically children with PDD scored lower in the language and social skill domain compared to the ID group. These findings provided early evidence to support differential diagnoses between ID and autism based on the greater language and social deficits of the children with ID and PDD/autism (Gould, 1977). Information of this type helped pave the way for further differential diagnoses and the delineation of various levels of adaptive functioning in children with developmental and intellectual disabilities.

The second edition of the Vineland Adaptive Behavior Scales (Vineland™-II: Sparrow et al., 2005) was the second revision of the original Vineland SMS (Doll, 1936). The first revision, the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984) was published in 1984 (survey and expanded forms) and 1985 (classroom edition). The Vineland™-II is a questionnaire based assessment comprised of 244 items covering an individual's development of personal independence and social responsibility. This assessment gathers information about frequencies of day-to-day activities necessary to take care of oneself and to get along with others where an informant indicates the occurrence of specific behaviours using a four point Likert scale from 0 (never) to 3 (always).

The Vineland™-II covers four behavioural domains; communication, daily living skills, socialisation, and motor skills. These domains are then further divided into sub-domains to more specifically isolate particular areas of adaptive behaviour deficit. The communication domain, for example, is divided into (a) receptive communication, (b) expressive communication, and (c) written communication. The daily living skills domain is divided into (a) personal, (b) domestic, and (c) community. The socialisation domain is divided into (a) interpersonal skills, (b) play and leisure skills, and (c) coping skills. Lastly, the motor domain is divided into two sub-domains; (a) gross motor skills and (b) fine motor skills. Information gained from specific questions relating to each of these sub-domains translates into a Vineland score, an overall adaptive level (low, moderate, high), and an age equivalency score presented in years: months, which is intended to give as an indication of the individual's level of functioning. Results of the Vineland™-II correlate with standard age equivalent scores based on norms calculated from a sample of over 3,000 typically developing individuals. The sum of the sub-domains translates into an overall domain score for communication, daily living skills, socialisation, and motor skills. There are four forms of the Vineland™-II, two using information obtained in a semi-structured interview with a parent or caregiver (2005) and two using a rating form completed by a teacher or parent/caregiver (2006). More recently an updated version of the Vineland was released in 2016, Vineland™-III (Sparrow, Cicchetti, & Saulnier, 2016), which includes an online tool to automatically analyse the assessment results and produce the corresponding domain scores and specific age equivalency scores. Further, this new version includes updated normative data and new checklist items to more effectively identify an individual's range of adaptive behaviour functioning. In the newly revised Vineland™-III, the motor skills domain is now optional, and there is an opportunity for interviewees to fill out a briefer form as opposed to answering all of the questions for all four core domains. At the time that I began this research this updated version was not available, and so for the purpose of this thesis I have had to use the previous version, that is the Vineland™-II.

A relevant study adopting the Vineland™-II assessed individuals with multiple physical and sensory disabilities and who were grouped based on the presence or absence of a clinical diagnosis of epilepsy. Multiple assessments were used to compare the degree and frequencies of problem behaviours, and the level of social skills and adaptive behaviours between the two groups. In the first phase, 212 adults with epilepsy and additional disabilities were compared to 141 age matched individuals without epilepsy on the functions of problem behaviours using the Questions About Behavioural Functioning (QABF: Matson & Vollmer, 1995). In the second phase the social skills and adaptive functioning of 353 adults with epilepsy, profound ID and additional impairments were compared to 353 age matched adults with mild to profound ID and no epilepsy. The overall results of this study demonstrates that problem behaviours were maintained by similar antecedents for those with and without epilepsy, and that those adults with epilepsy and other disabilities exhibit greater social skill and adaptive functioning deficits compared to those without epilepsy (Matson, Bamburg, Mayville, & Khan, 1999).

In a more recent study, Belva and Matson (2013) assessed 204 non-verbal adults (106 male, 98 females) aged from 27 to 85 years old with severe to profound ID. The Vineland™-

II was used to identify significant differences in (a) age and (b) severity of intellectual disability in relation to the specific domain of daily living skills. This domain is segmented into three sub-domains; personal, domestic, and community and covers functioning such as: 'drying oneself with a towel after bathing', 'answers the telephone at appropriate times', 'understands a basic functioning of money', and 'crosses a street in a safe and appropriate manner', amongst other items pertaining to independent living. Statistical analyses were conducted to evaluate the differences amongst those with profound or severe ID, and the effect age had on individual's scores across the three subdomains. Results indicated that those with profound ID scored higher on items within the personal sub-domain, in comparison to the domestic, with the lowest scores found in the community subdomain. Further, more complex skills, such as those requiring pre-planning to gather materials in order to fix or alter something, or those items that required the handling of money, were rarely endorsed. These skills, and others included in the community and domestic sub-domains of the Vineland™-II, often require higher cognitive capabilities such as goal planning and strategic thinking, as well as complex communication and comprehension skills, all skills that are often severely lacking or negatively affected in individuals with profound ID (Belva & Matson, 2013; Tassé et al., 2012).

The Vineland™-II has also been used in comparison studies where it is rated alongside other adaptive behaviour assessments to evaluate, for example, the content validity of particular adaptive behaviours in individuals with multiple disabilities. Gresham and Elliot (1987) compared assessments analysing social skills and adaptive behaviour functioning to identify the most effective and valid tools to measure social skills and social competence. The Vineland™-II was compared to the AAMD Adaptive Behaviour Scale (ABS: Lambert, Windmiller, Tharinger, & Cole, 1981) to establish how much emphasis is placed on social competence and the validity of the contents when incorporated into a wider adaptive behaviour assessment. Results of this comparison indicate that although the Vineland™-II included a high level of social skill content validity, the data obtained from this assessment was considered less refined in comparison to specific data from the ABS. Hence the Vineland™-II should be implemented in combination with additional direct measures and observational data. Additionally, the Vineland™-II has been identified as less sensitive to specific changes or developments in adaptive behaviour across domains due to the basal and relatively low ceiling effects, and is found to have a lower sensitivity for those over the age of seven years old when assessing motor skills (Carter et al., 1998; Sparrow et al., 2005).

Despite these limitations, the Vineland™-II is still regarded as an accurate and reliable assessment of general adaptive behaviour functioning with good reliability coefficients for internal consistency and high test-retest scores (Sparrow et al., 2005). The Vineland™-II is one of the most common assessment tools used to reliably identify strengths and weaknesses across the four adaptive functioning domains of communication, daily living skills, socialisation, and motor skills. Furthermore, it is recommended that interventions and specific behavioural or teaching strategies should be informed by adaptive behaviour levels and assessments for individuals with developmental disabilities, intellectual disability, or any type of disability that negatively impacts upon their adaptive skills (American Psychiatric Association, 2013; Carter et al., 1998; Schalock et al., 2010). Thus information obtained through the Vineland™-II could be used to direct intervention targeting specific adaptive skills that will enable individuals to function in a more independent way, gain some level of control over their immediate environment, increase social and daily living skills, and may positively impact upon their quality of life. One area of adaptive behaviour that is considered an important and feasible starting point for those with PMD is communication (Atkin & Lorch, 2014; Calculator, 1988, 2002; Gee et al., 1991; Goetz et al., 1985; Kaiser & Goetz, 1993; Lancioni et al., 2002; Lancioni et al., 2013; Nakken & Vlaskamp, 2002; Schweigert, 2012).

Assessing Communication

In typical speech-language development, infants are reported to first produce early pre-linguistic vocalisations to convey basic needs, wants, and to interact with others during face-to-face interactions (Oller, Eilers, Neal, & Schwatrz, 1999; Tager-Flusberg & Caronna, 2007).

These vocal behaviours progress, becoming more clearly articulated and complex until the infant reaches the babbling phase where canonical babbling, comprised of consonants and vowel sound combinations, begin to emerge (Oller et al., 1999; Tager-Flusberg & Caronna, 2007). From around the second year of life, typically developing children will begin to use first words, and rapidly progress to multi-word combinations (Oller et al., 1999). Many individuals with profound ID, genetic syndromes, and those with PMD, appear to remain at the pre-linguistic phase of communication, and rarely develop more complex and sophisticated communicative forms, such as speech (Atkin & Lorch, 2014; Beukelman & Mirenda, 2005; Maes et al., 2007; Nakken & Vlaskamp, 2002; Ogletree et al., 1996; Siegel-Causey, Ernst, & Guess, 1989). Deciphering the intended message and responding to these communicative attempts in the appropriate way is often very difficult and, in some cases, impossible to identify if the message was interpreted in the correct and appropriate way (Atkin & Lorch, 2016; Greathead et al., 2016; Meadan et al., 2012; Petry & Maes, 2007; Porter et al., 2001). In such circumstances, if an individual is misunderstood or their potential communicative act goes unnoticed, it may result in an extinction of communication attempts from the learner or perhaps escalation to problem behavior, such as a tantrum. Further, for people with PMD who rely upon non-conventional forms of communication, the acquiescence effect is often observed where a response from an individual is assumed to be positive or affirming rather than contradictory (Grove et al., 1999; Porter et al., 2001; Siegelman, Budd, Spanhel, & Schoenrock, 1981). Thus it becomes crucial to develop a thorough understanding of potential communicative attempts and the individual's context in which they are attempting to communicate, such that these responses can be recognised and the correct meaning can be attached to their specific signals (Greathead et al., 2016; Porter et al., 2001; Schweigert, 2012; Sigafoos et al., 2006; Ware, 1997).

Data suggest that individuals with PMD may engage in specific behaviours in reaction to, or to obtain, certain stimuli, or to indicate discomfort or protest a situation or interaction (Arthur, 2003; Arthur-Kelly et al., 2007; Atkin & Lorch, 2016; Downing & Siegel-Causey, 1988; Siegel-Causey, Ernst, & Guess, 1989; Sigafoos & Dempsey, 1992). There is also evidence to suggest that these individuals have the potential to communicate yet are often limited in being effective communicators due to the often the idiosyncratic and non-conventional methods that they often have to rely on when attempting to communicate (Atkin & Lorch, 2014; Kaiser & Goetz, 1993; Lancioni et al., 2013). Thus what limits these individuals is not necessarily a lack of intent to communicate, but the lack of conventional communication skills or communication skills that are rather inconsistent (Arthur-Kelly et al., 2007; Atkin & Lorch, 2016; Grove et al., 1999; Nakken & Vlaskamp, 2002; Porter et al., 2001; Schweigert, 2012).

Thus communication plays a significant role across multiple domains of adaptive behaviour. Communication is considered a fundamental basis of social interaction in humans and is the primary means by which we are able to actively participate in society (Ferguson, 1994; Kaiser & Goetz, 1993). Social skills require communication, where particular behaviours deemed necessary for adequate social functioning in individuals with ID include: verbal skills, initiating interactions with another, communicating, emotional understanding and flexibility, and conversational skills (Gresham & Elliot, 1987; Porter et al., 2001; Sigafoos et al., 2006; Ware, 1997). And, as previously discussed, an inverse relationship exists where communication deficits are correlated with increased rates and severity of SIB (Sigafoos, 2000; Tureck et al., 2013).

When designing and implementing interventions that target or focus on increasing the specific communication aspect of adaptive behaviour functioning, it is suggested to begin with behaviours that are; (a) appropriate for the learner whereby the response is within the learner's repertoire, (b) meaningful for the learner such that learning and/or proficiency can be obtained, and (c) able to increase some level of independence in interacting with others or their environment (Calculator, 1988; 2002; Maes et al., 2007; Reichle, 1997; Ware, 1997). Effective communication interventions not only require the learner to acquire new skills, but that the environment is equipped to encourage and enhance communication opportunity, and communication partners are more able to consistently respond in an appropriate way (Calculator, 1988; 2002; Iacono et al., 1998; Meadan et al., 2012; Reichle, 1997; Schweigert, 2012). Thus to more accurately determine communication goals for individuals with PMD, it would be necessary to include assessments identifying pre-existing communicative skills or behaviours displayed by the individual, prior to any intervention or training, so that all requirements can be fulfilled.

Assessing Potential Communicative Acts

That one is attempting to communicate could be viewed as an inference that underpins many human interactions (Kaiser & Goetz, 1993; Reichle, 1997). In general, even the most subtle or simple action or reaction produced by an individual within a social context harbor some communicative intent. Thus even when behaviours are produced without a clear intentional function, it is likely that aspects of these behaviours will be interpreted by listeners as carrying some potential communicative meaning, largely due to the interactive context and our social patterns and expectations (Beukelman & Mirenda, 2005; Braddock et al., 2015; Sigafoos et al., 2006). During exchanges, meaning can often be applied to ambiguous or idiosyncratic behaviours produced by those who lack symbolic communication forms, under circumstances where a communicative response is expected. In this way, a response typical of an individual during particular situations might be labelled as 'enjoyment', or as 'something he does to tell us that he is bored' for example. Thus when we are unsure of the exact function or meaning of a behavioural response, we tend to assign potential meaning, and subsequently respond in a way that acknowledges that meaning as if the behavioural was a functional communicative act. If this behaviour is then consistently responded to in such a way, it may be strengthened and consistently produced under those circumstances whereby it begins to take on that particular assigned meaning (Braddock et al., 2015; Calculator, 1988; Iacono et al., 1998; Keen et al., 2001; Reichle, 1997; Sigafoos et al., 2006; Sigafoos et al., 2000).

Research has however demonstrated discrepancies in the assignment of intention to potential communicative behaviours, and their intended function across different communication partners. In a study conducted by Meadan et al. (2012) videos of three children with ASD and expressive language deficits were judged by 24 raters who were either familiar with (knew the child) or unfamiliar with the child. The sample also included professionals (had some formal understanding of communication development) and non-professionals. Video clips of the children were edited to show specific behaviours that functioned as requests and rejecting responses for preferred and no-preferred stimuli, respectively. Viewers were asked to identify whether the observed behaviours were produced as intentional communicative acts, and the potential function of each behaviour. As anticipated, familiar-professional adults were more accurate in identifying the correct function for behaviours indicative of requesting and rejecting, and were more confident in assigning intentionality to particular behaviours than were non-familiar, non-professional adults. Further, these results indicated that requesting behaviours were more accurately identified overall in comparison to rejecting responses, and that the assigned function of a behaviour can differ between communication partners and raters. Thus the interpretations assigned to a child's communication behaviours by familiar and unfamiliar communication partners may play a significant role in the development and persistence of communicative attempts. A behaviour that goes unnoticed or is misunderstood is unlikely to be strengthened or enhanced and vice versa. Also, unfamiliar communication partners tend to overlook or find it difficult to identify behaviours that are communicative, this may be particularly relevant for rejecting behaviours as often idiosyncratic and non-conventional forms are used for this function (Meadan et al., 2012; Sigafoos et al., 2000; Sigafoos et al., 2006). Therefore, prior to assigning meaning to potential communicative acts, the individual's repertoire of specific behaviours produced during opportunities requiring a communicative response should be assessed, in order to facilitate the interpretation of the function of that response (Atkin & Lorch, 2014; Beukelman & Mirenda, 2005; Kaiser & Goetz, 1993; Meadan et al., 2012; Sigafoos et al., 2006). The more precise and specific an assessment, the easier it should be to identify and define target behaviours for intervention (Ditterline et al., 2008; Klien-Paris et al., 1986).

One assessment, designed specifically to identify the potential communicative acts of individuals with severe communication impairment, as well as those with physical and developmental disabilities, is the Inventory of Potential Communicative Acts (IPCA: Sigafoos, Woodyatt, Keen, Tait, Ticker et al., 2000). Originally created following pilot data and empirical testing involving 30 children, the IPCA has now been used to identify the potential communicative acts of many individuals across a wide range of developmental and physical disabilities including those with ASD, Rett syndrome, Angelman syndrome, and Fragile X syndrome (Braddock et al., 2015; Bartl-Pokorny et al., 2013; Didden et al., 2010; Marschik et al., 2013; Marschik et al., 2014; Sigafoos, Woodyatt, Tucker, Roberts-Pennell & Pittendreigh, 2000). The IPCA is a questionnaire designed to be completed by the parents, caregivers, teachers and therapists of children with developmental and additional disabilities. It comprises 53 questions covering 10 pragmatic functions covering typical communication used in everyday contexts (Keen, Woodyatt & Sigafoos, 2001; Sigafoos et al., 2000). These pragmatic functions include: 1. Social convention (greetings, social responding), 2. Attention to oneself (accessing the attention of other), 3. Rejecting unwanted items, or protesting, 4. Requesting access to a desired object or stimulus, 5. Requesting an action or assistance, 6. Requesting clarification or information, 7. Commenting, 8. Choosing between stimuli or activities, 9. Indicating an answer to a question, and 10. Imitating a simple behaviour (Sigafoos et al., 2000). The primary aim of the IPCA is to identify an inventory of specific behaviours displayed by children with disabilities when faced with an opportunity to communicate. For example, the specific behaviour a child exhibits when he or she wants a drink, indicates they are feeling happy, or demonstrates that they do not wish an activity to continue (Sigafoos et al., 2000). Thus from this assessment, both the forms and the functions of potential communicative behaviours can be collected and assessed and may be one way of systematically validating the communication forms and functions of individuals with PMD.

In a study conducted by Didden et al. (2010) 120 children and adults with diagnoses of Rett Syndrome were assessed to identify particular forms and functions of observable potential communicative acts. Females diagnosed with Rett syndrome often display idiosyncratic forms of communication that are often misunderstood or dismissed as communication attempts due to their ambiguity and non-conventional manner. The IPCA (Sigafoos et al., 2000) was administered to informants familiar with the participants to identify their repertoire of potential communication acts in order to identify what, if any, behaviours each of the participants consistently used to communicate. Results from Didden et al. (2010) identified two specific potential communicative acts common across all participants that were eye gaze and eye contact. Identified communicative functions for these behaviours included requesting, choosing between stimuli and social conventions including commenting and answering questions (Didden et al., 2010). Further, Marschik et al. (2013) compared three children's potential communicative forms and functions through retrospective video analysis and the IPCA to compare the number and complexity of potential communicative behaviours for one girl with classical RTT, the persevered variant presentation (RTT-PSV) and one typically developing toddler. Results indicated that the typically developing toddler displayed the most comprehensive and complex repertoire of pre-linguistic behaviours in comparison to the participant with classical RTT who displayed the most limited communicative repertoire at 24 months. Overall, the three profiles indicated that the child with RTT-PSV and the typically developing toddler had an increasing number of communicative functions over the course of the analysis in comparison to the female later diagnosed with classic RTT, adding further insight into the delineation of the pre-regression period for those later diagnosed with PSV and classical RTT (Marschik et al., 2013).

Similarly to those with Rett syndrome, persons with PMD arising from other causes will often produce gross body movements that are highly ambiguous in nature, and may communicate in more reactive ways rather than in functional or meaningful ways by adopting pre-linguistic idiosyncratic and non-conventional forms. This does not however dictate that they lack the capability to communicate in meaningful ways to preferred or to adverse stimuli. In fact research identifying preferences and the literature focusing on behavioural states suggests the contrary; that there are distinct patterns of response topographies and communicative behaviours that may hold a range of functions for those with the most disabling and complex conditions (Arthur, 2003; Arthur-Kelly et al., 2007; Atkin & Lorch, 2014; Calculator, 1988; 2002; Greathead et al., 2016).

Recently, the IPCA was validated in three studies identifying the communicative forms and functions of 10 children with developmental disabilities. In this research project, the IPCA was administered to the parents and teachers of each participant, and results from each informant and communicative environment was compared. Next, the identified communicative forms and functions were assessed within a clinical environment to evaluate the reliability of the IPCA. Results indicated that the children all used similar behaviours to communicate specific functions, and that these behaviours were used consistently across communication partners and settings. Further, the validity of the IPCA was demonstrated in that reports from the parents, teachers, and the clinical observations were consistent, suggesting that either informant source will provide reliable information regarding the forms and functions of a child's inventory of potential communication acts (Stevens, 2015).

Thus administering the IPCA may be a helpful way of accurately identifying potential communicative acts and reliably isolating their specific function such that structured teaching opportunities to strengthen these behaviours might be possible. This may in turn promote greater interaction and active engagement from those with PMD, allow their carers, therapists and teachers to more accurately understand and interpret their communicative behaviours, and positively impact upon their quality of life.

Assessing Specific Target Behaviours for Intervention

In addition to obtaining extensive information regarding an individual's entire communicative repertoire, it might also be useful to identify specific skills to target for intervention purposes. To identify these particular intervention targets more specific behavioural assessments are warranted. One indirect measure of behaviour profiles is the Behaviour Indication Assessment Scales (BIAS; Sigafoos et al., 2006). This assessment is designed to supplement information collected through the IPCA by providing the frequencies of specific behaviours relating to gaining attention, requesting preferred items and activities, and rejecting non-preferred items and activities in non-verbal individuals. From this assessment, behaviours that are appropriate, but occur at low frequencies can be strengthened or enhanced through intervention. Alternatively, behaviours that are non-conventional or inappropriate can be targeted and reduced. The BIAS is comprised of 10 questions, segmented into three parts; part A covers behaviours and situations where the individual recruits attention, part B covers behaviours situations where the individual demonstrates requests for preferred items and activities, and part C involves behaviours and situations where the individual might protest or reject unwanted stimuli and activities. Interviewees rate the individuals' frequency of particular behaviours on a checklist using a 4-point Likert scale selecting between; Never (0), Sometimes (1), Often (2) or Always (3). Thus the BIAS strengthens and validates certain sections of the data obtained through the IPCA covering requesting, rejecting and recruiting attention. The BIAS might be seen as a method of continuously and efficiently measuring and monitoring the progress of individuals with disabilities as it is a quick and straightforward assessment of particular behaviours and their relative frequency that could be directly targeted in intervention. For instance, where an individual might 'sometimes' reach, touch, or grab for a preferred item, this communicative function could be strengthened or enhanced such that the individual reaches an intervention goal where they 'always' reach, touch, or grab for a preferred item, thereby producing a more consistent and clear behaviour indicative of a potential request. Alternatively, if an individual is reported to 'always' use problem behaviours to recruit or sustain attention, this behaviour could be reduced and replaced with another more conventional and appropriate communicative behaviour indicating that they wish an interaction to continue.

Thus pre-assessment is both a crucial and valuable first step in the design and implementation of behavioural intervention aimed at increasing adaptive behaviour and, in particular, communicative skills of individuals with PMD. This chapter therefore reports on three assessments conducted for four adolescents with PMD recruited for participation in this PhD project. The Vineland Adaptive Behaviour Scales (Vineland™ II; Sparrow et al., 2005), The Inventory of Potential Communicative Acts (IPCA; Sigafoos et al. 2000), and the Behaviour Indication Assessment Scales (BIAS; Sigafoos et al., 2006). The four participants attended the same school and were based within the same day classroom, thus each assessment was completed by the participant's head teacher who was able to confidently provide detailed information regarding adaptive behaviour skill levels, a thorough repertoire of potential pre-linguistic communicative behaviours, and specific behavioural capabilities of the four students. As she saw each participant during every school day, she was considered an appropriate and confident interviewee whom had vast knowledge of each participant, and very able to provide precise and detailed information regarding each student's adaptive and communication skills. The purpose of this study was to address the research question; to what extent do the four participants within this research study communicate using prelinguistic behaviours (PLBs)? And if so, what are the particular forms and functions of these behaviours?

This type of assessment information is critical for teachers, carers, and clinicians so that: (a) specific areas of strength and weakness within their student's/client's adaptive behaviour functioning profile can be identified, (b) the students/clients potential communicative behavioural repertoire might be recorded in detail and misunderstood or misinterpreted communicative messages might be more clearly understood and agreed upon, and (c) that specific and consistent forms of communicative behaviours indicating a request for, or the rejection of, particular stimuli might be identified and targeted for intervention purposes (Nakken & Vlaskamp, 2002; Petry & Maes, 2007; Porter et al., 2001; Sigafoos et al., 2006; Sigafoos et al., 2000).

Method

Ethical Approval

The participants' parents granted consent to allow their child to be involved in the study, which had been approved by the relevant university ethics committee. Consent was also obtained from the classroom teachers and school principal (Reference 21119, See Appendix A).

Participants

For the purpose of this research, local schools that included students with PMD were contacted via email to participate. Local schools located within 40 kms from Wellington city were chosen due to time restraints and travel costs. Four participants, aged from 16-19 years old, were identified. All four initially attended the same special education school. The school was specifically designed to accommodate the needs and complex requirements of individuals with PMD. All four participants attended classrooms staffed with one head special education teacher and two support teacher aides. The classroom teacher nominated four students who were considered the least responsive, most passive, and most difficult to engage and motivate

Thomas

Thomas was an 18 year old male with a diagnosis of profound intellectual disability, severe physical disability (quadriplegia), severe visual impairment (Left eye: detached retina with limited vision, Right eye: extreme short vision), photosensitivity, tactile resistant, possible craniofacial syndrome, and was gastrostomy dependent. Thomas was non-ambulatory, due to his severe physical disability, and therefore used a wheelchair. However, he would spend approximately an hour everyday out of his wheelchair, on the ground, where he could shuffle around the classroom on his bottom. Thomas had one word that he used frequently in both the correct and incorrect context; "*Hi*". He would say this word seemingly to greet others when prompted, but he would also say this word at various unprompted times throughout his school day. Thomas had some use of his arms and some purposeful use of his hands (e.g., he could reach out and touch objects placed on the tray table of his wheelchair) He was also known to be able to grab and shake toys that made noises, throw balls and reach out for the individual who was talking to him. Thomas also engaged in multiple stereotyped movements and SIBs, such as leg rubbing, rubbing his stomach and his head, hitting his chin and/or his head, and tapping on his wheelchair tray table.

Blake

Blake was a 17-year-old male with a diagnosis of profound intellectual disability and clinical epilepsy, based on medical information provided by the school. He had very little communication ability and was considered non-verbal (the teacher noted the he could say "*come on*" and "*K k k k*"). Blake was able to walk, but he was unsteady on his feet. In terms of fine motor control, he had little purposeful hand movements, although he could reach and grab larger objects, such as cups and snacks, but he tended to wait until offered items before reaching for them. Additionally Blake engaged in maladaptive behaviours such as putting his hands down his trousers, and hitting his legs or his head. Blake would vocalise loudly when left alone and often chewed on items. Blake could feed himself food items that did not require external tools (fork or spoon) and would spend some of his leisure time at school outside walking around the playground.

Josie

Josie was a 16 year old female who had a diagnosis of Rett syndrome, scoliosis, profound intellectual disability, and long Q.T syndrome. Josie has no functional speech and no purposeful hand movements. Josie engaged in hand wringing, hyperventilation, and marked breath holding. She would often grind her teeth and vocalise throughout the duration of her school day, but reportedly could make eye contact when interacting with her teachers. Josie began the study by attending every session in her wheelchair. However, over time, Josie seemed to show some improved ambulation skills, and so this was encouraged by the school staff by allowing her increasing time periods out of her wheelchair. She was unable to independently get up from her wheelchair, but she was capable of walking around the classroom and to sit in a chair with assistance.

Anna

Anna was a 19 year old female with a diagnosis of cerebral palsy (specifically; spastic quadriplegia with a right hemiplegia), ventriculomegaly hydrocephalus, epilepsy, and had cerebral vision impairment. Anna was tube fed, completely wheelchair bound and experienced seizures on a near daily basis. Anna spent most of her day asleep in her wheelchair and was often difficult to wake and engage with. Anna could move her head from side to side to orient to her name (sometimes) and to sounds.

Informant

The classroom teacher for the four participants acted as the interviewee for all three assessments. She was the head teacher within the classroom where all four participants were students. She had known each of the participants for approximately three years.

Materials

Second Edition, Vineland Adaptive Behaviour Scales. The first assessment used the Second Edition of the Vineland Adaptive Behaviour Scales (Vineland™-II: Sparrow et al., 2005). This is an interview-based questionnaire protocol covering four adaptive behaviour domains: communication, daily living skills, socialisation, and motor skills. Skills in these domains are further organised into a number of sub-domains with varying numbers of items on each sub-domain (Sparrow, Cicchetti, & Balla, 2005). Questions within the Vineland™-II are answered based on frequencies of observable behaviours on a scale ranging from 0 (never), to 1 (rarely), or 2 (often). Parents, caregivers, or familiar adults are eligible to be informants for an individual if they have known the individual for more than six months and who are very familiar with their typical behavioural topographies (refer to page 78 for further detail). Examples of the types of questions asked within the Vineland™-II include: "Follows one-two-word instructions" (extracted from the receptive communication sub-domain), "Can speak own name" (extracted from the expressive communication sub-domain), "Can spell own name correctly" (extracted from the written communication sub-domain), "Can hold pencil in pincer grasp correctly" (extracted from the fine motor sub-domain). Results of the Vineland™-II correlate with standard age equivalent scores based on norms calculated from a sample of over 3,000 typically developing individuals. The Vineland™-II is acceptable for use within research as a reliable and validated assessment for adaptive behaviour level functioning (Sparrow, Cicchetti, & Balla, 2005).

Inventory of Potential Communicative Acts (IPCA). The Inventory of Potential Communicative Acts (IPCA: Sigafoos et al., 2000) is a semi-structured interview-based assessment implemented to obtain information on the potential communication acts observed in children with severe communication impairment and additional physical or developmental disabilities. The IPCA covers 10 pragmatic functions concerning typical daily events that may warrant a communicative response (refer to page 86 for further detail). The purpose of this assessment is to obtain an inventory of specific and meaningful acts observed within an individual's behavioural repertoire that potentially hold communicative meaning for the non-verbal person. See Appendix B for an example of the IPCA (re-printed with permission from J. Sigafoos).

Behaviour Indication Assessment Scale. The Behaviour Indication Assessment Scale (BIAS: Sigafoos et al., 2006) is an assessment tool that is intended to provide supplementary information to support assessment information gathered using the IPCA and more specifically highlights isolated manding behaviours relating to positive and negative reinforcement in similarly non-verbal persons (refer to page 89 for further detail). See Appendix C for an example of the BIAS (re-printed with permission from J. Sigafoos). The BIAS consists of a total of ten questions divided into three parts: part A involves behaviours observed pertaining to the function of gaining or maintaining attention, part B involves behaviours indicative of a request for objects and activities, and part C involves behaviours used to reject and protest unwanted items and activities. Within parts A, B, and C, 13 examples of specific behaviours are listed for the informants to rank by frequency using a Likert scale from 0 (never) to 3 (always). This assessment is designed to supplement information gained from the IPCA and provides further in-depth information regarding an individual's communication profile.

Procedures

Each assessment was completed in a one-on-one interview format between the author and the informant. The interview was conducted in the classroom setting. Each assessment took from 30 to 40 min for each participant.

Results

Results from the Vineland™-II, the IPCA and the BIAS are presented in the tables presented next as well as in the narrative text for each participant.

Vineland™-II

Results from the Vineland™-II were calculated based on each participant's raw scores, which corresponds to (a) a Vineland scale score, (b) an adaptive level, and (c) an age equivalency score (presented in years: months) for each sub-domain of the scale. The table below shows each participants sub-domain age equivalency score shown in years: months for each of the behavioural domains.

The results from the Vineland™-II are then described for each participant in the form of: (a) sub-domain raw scores, (b) the overall adaptive level for that particular sub-domain, and (c) the age equivalency measure for each sub-domain. Overall the general adaptive level deficit was classified as profound for all four participants as all scores for each sub-domain were scored as less than nine on the adaptive level index.

Table 1.1: Vineland Results

	Communication			Daily Living			Socialisation			Motor	
	Receptive	Expressive	Written	Personal	Domestic	Community	Intra-personal	Play & Leisure	Coping	Gross	Fine
Blake	1:1	0:9	1:10	1:8	0:7	<0:1	<0:1	0:7	<0:1	1:8	1:5
Thomas	1:2	0:9	1:10	<0:1	<0:1	<0:1	2:4	0:8	<0:1	0:7	0:7
Josie	0:11	0:3	1:10	1:3	0:7	<0:1	0:5	0:6	0:10	0:10	0:3
Anna	<0:1	<0:1	1:10	0:1	0:7	<0:1	<0:1	<0:1	<0:1	0:1	0:1

Table 1.1: Age equivalency scores (in years:months) across the 11 sub-domains for the participants Blake, Thomas, Josie and Anna as calculated from the Vineland Adaptive Behaviour Scales, Second Edition (Vineland™-II: Sparrow, Cicchetti, & Balla, 2005).

Thomas

In the Communication domain standard score, Thomas scored 34. In the receptive sub-domain, Thomas had a raw score of 13, which corresponded to a low adaptive level and an age equivalency of 1:2 (years: months) as shown in table 1.1. In the expressive sub-domain, Thomas's raw score was 14, his adaptive level was low, and his age equivalency was 0:9. In the final sub-domain of communication; written, Thomas's raw score was 0, corresponding to a low adaptive level and equivalent to 1:10. In the Daily living skills domain standard score, Thomas scored 25. In the personal sub-domain, Thomas had a raw score of 0, which corresponded to a low adaptive level and an age equivalency of <0:1 (years: months). In the domestic sub-domain, Thomas's raw score was 1, his adaptive level was low, and his age equivalency was <0:1. In the final sub-domain of daily living skills; community, Thomas's raw score was 0, corresponding to a low adaptive level and equivalent to <0:1. In the Socialisation domain standard score, Thomas scored 42. In the interpersonal relationships sub-domain, Thomas had a raw score of 36, which corresponded to a low adaptive level and an age equivalency of 2:4 (years: months). In the play and leisure sub-domain, Thomas's raw score was 7, his adaptive level was low, and his age equivalency was 0:8. In the final sub-domain of daily living skills; coping, Thomas's raw score was 0, corresponding to a low adaptive level and equivalent to <0:1. In the Motor skills domain, Thomas's standard score was 34. In the gross motor sub-domain, Thomas's raw score was 10, corresponding to a low adaptive level and an age equivalency of 0:7. In the second sub-domain, fine motor skills, Thomas's raw score was 9, corresponding to a low adaptive level and an age equivalency of 0:7.

Blake

In the Communication domain standard score, Blake scored 28. Blake had a raw score of 12 in the receptive sub-domain, which corresponded to a low adaptive level and an age equivalency of 1:1 (years: months) as shown in table 1.1. In the expressive sub-domain, Blake's raw score was 15, his adaptive level was low, and his age equivalency was 0:9. In the final sub-domain of communication; written, Blake's raw score was 0, corresponding to a low adaptive level and equivalent to 1:10. In the Daily living skills domain standard score, Blake scored 25. In the personal sub-domain, Blake had a raw score of 18, which corresponded to a low adaptive level and an age equivalency of 1:8 (years: months). In the domestic sub-domain, Blake's raw score was 0, his adaptive level was low, and his age equivalency was 0:7. In the final sub-domain of daily living skills; community, Blake's raw score was 0, corresponding to a low adaptive level and equivalent to <0:1. In the Socialisation domain standard score, Blake scored 23. In the interpersonal relationships sub-domain, Blake had a raw score of 0, which corresponded to a low adaptive level and an age equivalency of <0:1 (years: months). In the play and leisure sub-domain, Blake's raw score was 6, his adaptive level was low, and his age equivalency was 0:7. In the final sub-domain of daily living skills; coping, Blake's raw score was 0, corresponding to a low adaptive level and equivalent to <0:1. In the Motor skills domain, Blake's domain standard score was 54. In the gross motor sub-domain, Blake's raw score was 47, corresponding to a low adaptive level and an age equivalency of 1:8. In the second sub-domain, fine motor skills, Blake's raw score was 17, corresponding to a low adaptive level and an age equivalency of 1:5.

Josie

In the Communication domain standard score, Josie scored 28. In the receptive sub-domain, Josie had a raw score of 10, which corresponded to a low adaptive level and an age equivalency of 0:11 (years: months) as shown in table 1.1. In the expressive sub-domain, Josie's raw score was 7, her adaptive level was low, and her age equivalency was 0:3. In the final sub-domain of communication; written, Josie's raw score was 0, corresponding to a low adaptive level and equivalent to 1:10. For the Daily living skills domain standard score, Josie received 25. In the personal sub-domain, Josie had a raw score of 13, which corresponded to a low adaptive level and an age equivalency of 1:3 (years: months). In the domestic sub-domain, Josie's raw score was 0, her adaptive level was low, and her age equivalency was 0:7. In the final sub-domain of daily living skills; community, Josie's raw score was 0, corresponding to a low adaptive level and equivalent to <0:1. In the Socialisation domain standard score, Josie scored 34. In the interpersonal relationships sub-domain, Josie had a raw score of 16, which corresponded to a low adaptive level and an age equivalency of 0:5 (years: months). In the play and leisure sub-domain, Josie's raw score was 5, her adaptive level was low, and her age equivalency was 0:6. In the final sub-domain of daily living skills; coping, Josie's raw score was 0, corresponding to a low adaptive level and equivalent to 0:10. In the final Motor skills domain, Josie's standard score was 31. In the gross motor sub-domain, Josie's raw score was 22, corresponding to a low adaptive level and an age equivalency of 0:10. In the second sub-domain, fine motor skills, Josie's raw score was 1, corresponding to a low adaptive level and an age equivalency of 0:3.

Anna

In the Communication domain standard score, Anna's score was 26. In the receptive sub-domain, Anna had a raw score of 3, which corresponded to a low adaptive level and an age equivalency of <0:1 (years: months) as shown in table 1.1. In the expressive sub-domain, Anna's raw score was 1, her adaptive level was low, and her age equivalency was <0:1. In the final sub-domain of communication; written, Anna's raw score was 0, corresponding to a low adaptive level and equivalent to 1:10. In the Daily living skills domain standard score, Anna scored 25. In the personal sub-domain, Anna had a raw score of 2, which corresponded to a low adaptive level and an age equivalency of 0:1 (years: months). In the domestic sub-domain, Anna's raw score was 0, her adaptive level was low, and her age equivalency was 0:7. In the final sub-domain of daily living skills; community, Anna's raw score was 0, corresponding to a low adaptive level and equivalent to <0:1. For the Socialisation domain standard score, Anna's score was 32. In the interpersonal relationships sub-domain, Anna had a raw score of 5, which corresponded to a low adaptive level and an age equivalency of <0:1 (years: months). In the play and leisure sub-domain, Anna's raw score was 0, her adaptive level was low, and her age equivalency was <0:1. In the final sub-domain of daily living skills; coping, Anna's raw score was 0, corresponding to a low adaptive level and equivalent to <0:1. In the final domain, Motor skills, Anna's standard score was 25. In the gross motor sub-domain, Anna's raw score was 2, corresponding to a low adaptive level and an age equivalency of 0:1. In the second sub-domain, fine motor skills, Anna's raw score was 0, corresponding to a low adaptive level and an age equivalency of 0:1.

IPCA

Thomas

Table 1.2 displays the distribution of behaviour types reported for Thomas across the communicative functions of the IPCA. Thomas' distribution of behaviours shows that he demonstrated the highest proportion of behaviours for the commenting function (27 different behaviours), the rejecting function (13 different behaviours), and the attention to self function (12 different behaviours). Of the 27 behavioural forms Thomas used for commenting, 37% were vocalisations, and 26% were body movements. Of the 13 behavioural forms used for rejecting, 30.7% were vocalisations, 23.1% were body movements, 23.1% were problem behaviours, and 23.1% were reported as other. Of the 12 behavioural forms used for attention to self, 41.7% were body movements and 33.3% were vocalisations. Overall, Thomas used body movements across eight of the communicative functions, and vocalisations for seven of the communicative functions.

Table 1.7 displays the IPCA data for Thomas. Overall, Thomas's inventory of potential communicate acts obtained from the IPCA indicated that he had a total of 33 discrete behaviours were observed to cover a range of potential communicative functions. The specific behaviours identified in the IPCA are described for each communicative function below.

Behaviours used in the social convention: To greet others, Thomas would use speech and say “Hi”. To respond to his own name he would gaze towards the caller, engage in eye contact, and use speech.

Behaviours used to gain attention: Thomas would dribble, make noises, vocalise, wriggle in his wheelchair and use speech. To gain comfort he would take someone’s hand, and to experience a cuddle he would take someone’s hand or reach for them. To show off, Thomas would giggle, stop breathing, display animated facial expressions, and wiggle around in his wheelchair.

Behaviours used to reject/protest: To reject or protest a routine he would yell, to protest doing something or something he did not like he would sit back in his wheelchair and thrash around. To protest someone taking an item from him, Thomas would yell and wriggle in his wheelchair. To protest towards an adult, he would wait and yell, and other behaviours he might display included crying, dribbling, gagging and vomiting.

Behaviours used to request: To request objects, Thomas would move in his wheelchair, make noises and vocalise. To request more of something, he would vocalise and make noises, and to access toys he wanted when he was out of his wheelchair, Thomas would bum shuffle towards the item.

Behaviours used to respond: To respond to actions, Thomas would move his arms and move around in his wheelchair when his clothes were being changed, and he would move in his wheelchair and yell if he wished to be near something.

Behaviours used to comment: To indicate that he was happy, Thomas would clap his hands, smile, giggle, dribble, move in his wheelchair, and rub his head. To show he was sad, he would cry, vomit, gag, and yell. To show he was bored, Thomas would sleep or throw toys and to show he found something funny he would giggle, move in his wheelchair, move his arms and smile. To indicate he was frightened, Thomas would move his arms, cry, sit back and move in his wheelchair, and yell. If Thomas was tired he would sleep, if he was in pain he would cry and yell, and to show that he was angry, he would hit his chin, vocalise and move in his wheelchair.

Behaviours used to choose between stimuli: To choose between two or more stimuli, Thomas would reach for his preferred item, or move around in his wheelchair and when he was on the floor, he would bum-shuffle towards his desired stimuli.

Behaviours used to react: To react to a question or verbal language, Thomas would engage in eye contact, or take someone's hand. To answer yes, he would smile and engage in eye contact, and to answer no, he would push the person and/or stimuli away.

Behaviours used to imitate: To imitate speech, Thomas would use speech ("Hi"), to imitate yes he would laugh, and would imitate other conventions with kissing.

Blake

Table 1.3 displays the distribution of Blake's behaviours across the communicative functions of the IPCA. Blake's distribution of behaviours shows that he demonstrated the highest proportion of behaviours for the commenting function (14 different behaviours) and the attention to self function (9 different behaviours). Of the 14 behavioural forms Blake used for commenting, 43% of these were vocalisations, and 21.4% were body movements. Of the nine behavioural forms Blake used for attention to self, 44.4% of these were body movements, 44.4% were vocalisations, and 11.1% were facial movements. Overall, Blake used body movements across seven of the communicative functions and vocalisations across six of the communicative functions.

Table 1. 6 displays Blake's IPCA data. Overall, Blake's results from the IPCA indicated that he had a limited communicative profile where a total of 26 discrete behaviours were observed to cover a range of potential communicative functions. The specific behaviours identified in the IPCA are described for each communicative function below.

Behaviours used in the social convention: Blake would make excited noises, look towards an individual, orient towards an individual, and stop what he was doing to greet or respond to his own name in the social convention.

Behaviours used to obtain attention: Blake would bang his hands on the table, make noises and shout. He might run towards someone if he required comfort, and would run, shout, smile and laugh if he was showing off in-front of others.

Behaviours used for rejecting/protesting: To reject an unwanted activity, Blake would move away, pull back from the activity, or shout. To reject an item that he disliked, Blake would push the item away and would look around, make noises, and vocalise to protest an item being taken away from him.

Behaviours used for requesting: To specifically request an object, Blake would bang his hands on the table, vocalise, and make noises. He would bang his hands on the table make noises and take an item of food that he wanted, and would make noises and take an item that he wanted more of.

Behaviours used for commenting: Blake's behaviours were as follows in regards to commenting; when he was happy, he made noises, yelled, when he was sad, he would look towards an individual, walk around and vocalise. When Blake was bored, he would discard an item and fall asleep, he would quieten down and slow down when he was in pain, sleep when he was tired, and would shout and vocalise when he was angry.

Behaviours used to choose between stimuli: To choose between two or more items Blake would reach out, or bang on the table when he wanted a particular item. To start an activity, he would stop what he was doing.

Behaviours used to react: Blake would make eye contact, noises, orient towards a stimulus and smile in demonstration of a reaction to some external stimuli.

Table 1.2: The percentage of behaviour types used by Thomas for each communicative function

Behaviour Type	Social convention	Attention to self	Rejecting	Requesting	Requesting actions	Requesting info	Answering	Choice making	Commenting	Imitation
Body movements	50%	41.7%	23.1%	33.3%	75%	-	20%	100%	26%	-
Face movements	-	8.3%	-	-	-	-	20%	-	3.7%	-
Eye movements	-	-	-	-	-	-	40%	-	-	-
Gestures	-	-	-	-	-	-	20%	-	3.7%	33.3%
Vocalisations	50%	33.3%	30.7%	66.7%	25%	-	-	-	37%	66.7%
Symbolic	-	-	-	-	-	-	-	-	-	-
Stereotypic	-	-	-	-	-	-	-	-	3.7%	-
Problem	-	8.3%	23.1%	-	-	-	-	-	11.1%	-
Other	-	8.3%	23.1%	-	-	-	-	-	14.8%	-
Total Behaviours	4	12	13	6	4	0	5	3	27	3

Communicative Functions (column headings); Behaviour Type (row headings)

Table 1.2: The distribution of behaviour types across communicative functions as reported in the IPCA for Thomas

Table 1.3: The percentage of behaviour types used by Blake for each communicative function

Communicative Functions

Behaviour Type		Social convention	Attention to self	Rejecting	Requesting	Requesting actions	Requesting info	Answering	Choice making	Commenting	Imitation
	Body movements	25%	44.44%	57.1%	37.5%	-	-	25%	33.3%	21.4%	-
	Face movements	-	11.11%	-	-	-	-	25%	-	-	-
	Eye movements	25%	-	-	-	-	-	25%	-	7.1%	-
	Gestures	-	-	-	-	-	-	-	33.3%	7.1%	-
	Vocalisations	37.50%	44.44%	42.9%	62.5%	-	-	25%	-	43%	-
	Symbolic	-	-	-	-	-	-	-	-	-	-
	Stereotypic	-	-	-	-	-	-	-	-	-	-
	Problem	-	-	-	-	-	-	-	-	-	-
	Other	12.50%	-	-	-	-	-	-	33.3%	21.4%	-
	Total Behaviours	8	9	7	8	0	0	4	3	14	0

Table 1.3: The distribution of behaviour types across communicative functions as reported in the IPCA for Blake.

Josie

Table 1.4 displays the distribution of behaviour types reported for Josie across the communicative functions of the IPCA. Josie's distribution of behaviours shows that she demonstrated the highest proportion of behaviours for the commenting function (16 different behaviours), rejecting function (11 different behaviours), and attention to self function (9 different behaviours). Of the 16 behavioural forms used for commenting, 56.25% were vocalisations, and 12.5% were eye movements. Of the 11 behavioural forms used for rejecting, 45.5% were vocalisations, and 27.3% were body movements. Of the nine behaviour forms used for attention to self, 77.8% were vocalisations, and 22.2% were body movements. Overall, Josie used body movements across six of the communicative functions, vocalisations across five of the communicative functions, and eye movements across six of the communicative functions.

Table 1.8 displays the IPCA data for Josie. Overall, Josie's inventory of potential communicate acts obtained from the IPCA indicated that she had a limited communicative profile where a total of 24 discrete behaviours were observed to cover a range of potential communicative functions. The specific behaviours identified in the IPCA are described for each communicative function below.

Behaviours used in the social convention: Josie would engage in eye contact, gazing, and would smile to greet others. She would look towards and use eye contact to farewell someone, and would smile, look towards and engage in eye contact to respond to her name.

Behaviours used to gain attention: To gain attention to herself, Josie would grizzle, make noises, vocalise, and whine. To obtain comfort she vocalise, make noises that were high pitched, and to obtain a cuddle she would back-up to an adult or sit on someone's knee.

Behaviours used to reject/protest: To reject or protest doing something, Josie would cry, vocalise, whine, or pull away, and would grizzle, pull away and make noises to indicate there was something she disliked. To protest the removal of stimuli she would gaze towards it, and would engage in increased hand-wringing, gazing and would lean towards an adult to protest their actions.

Behaviours used to request: To request an object, Josie would make noises and vocalise and to request more of a stimulus, she would call out, vocalise, and make noises. To request music or TV, Josie would lean towards or move towards the source, or would engage in eye contact. To request the toilet, she would vocalise and make high-pitched noises, and to request the closeness of someone, she would walk towards them.

Behaviours used to comment: To comment that she was happy, Josie would smile, rock her body and would use eye contact. To show she was sad, she would cry and increase the intensity of her hand wringing. To show she was bored she would sleep, and would cry when frightened. To show she found something funny, Josie would laugh and use eye contact. To indicate she was in pain, Josie would cry, produce high-pitched noises, make noises and vocalise. To indicate she was tired she would sleep and would cry and vocalise to show she was angry. Other behaviours included in this section involved her grinding her teeth.

Behaviours used to choose between stimuli: To choose between two or more items, Josie would reach or take an item, and to demonstrate she wanted something she would lean towards, walk towards, gaze or use eye contact. She show she wanted something to start she would pull away.

*Behaviours used to answe*r: To react to verbal language Josie would smile, gaze and use eye contact.

Anna

Table 1.5 displays the distribution of behaviour types reported for Anna across the communicative functions of the IPCA. Anna's distribution of behaviours shows that she demonstrated the highest proportion of behaviours for the social convention function (9 different behaviours), and the commenting function (6 different behaviours). Of the nine behavioural forms used for social convention, 77.8% were eye movements, and 22.2% were body movements. Of the six behaviours used for commenting, 33.3% were face movements, 16.7% were body movements, 16.7% were eye movements, 16.7% were vocalisations, and 16.7% were reported as other. Overall, Anna used body movements across four of the communicative functions, and eye movements across three of the communicative functions.

Table 1.9 displays the IPCA data for Anna. Overall, Anna's inventory of potential communicate acts obtained from the IPCA indicated that she had a limited communicative profile where a total of 14 discrete behaviours were observed to cover a range of potential communicative functions. The specific behaviours identified in the IPCA are described for each communicative function below.

Behaviours used in the social convention: Anna would greet others using eye contact, eye movements and glances, and to farewell others she would glance at them and move her eyes. To respond to her name, Anna would move her head, glance, orient towards the person, and move her eyes.

Behaviours used to gain attention: To gain attention to herself, Anna would stretch her arms and make noises.

Behaviours used to reject/protest: To reject something she did not like she would pull a face.

Behaviours used to comment: To indicate she was happy, Anna would smile, use eye gaze, and would wriggle in her wheelchair. To show she was sad she would cry, and would smile to show something was funny. Anna would sleep if she was tired.

Behaviours used to react: Anna would react to answer someone by turning her head, and moving her eyes.

Table 1.4: The percentage of behaviour types used by Josie for each communicative function

		Communicative Functions									
		Social convention	Attention to self	Rejecting	Requesting	Requesting actions	Requesting info	Answering	Choice making	Commenting	Imitation
Behaviour Type	Body movements	-	22.2%	27.3%	25%	33.3%	-	-	71.4%	6.25%	-
	Face movements	25%	-	-	-	-	-	33.3%	-	6.25%	-
	Eye movements	75%	-	18.2%	12.5%	-	-	66.7%	28.6%	12.5%	-
	Gestures	-	-	-	-	-	-	-	-	-	-
	Vocalisations	-	77.8%	45.5%	62.5%	66.7%	-	-	-	56.25%	-
	Symbolic	-	-	-	-	-	-	-	-	-	-
	Stereotypic	-	-	9%	-	-	-	-	-	6.25%	-
	Problem	-	-	-	-	-	-	-	-	-	-
	Other	-	-	-	-	-	-	-	-	12.5%	-
	Total Behaviours	8	9	11	8	3	0	3	7	16	0

Table 1.4: The distribution of behaviour types across communicative functions as reported in the IPCA for Josie

Table 1.5: The percentage of behaviour types used by Anna for each communicative function

Behaviour Type	Social convention	Attention to self	Rejecting	Requesting	Requesting actions	Requesting info	Answering	Choice making	Commenting	Imitation
	Communicative Functions									
Body movements	22.2%	50%	-	-	-	-	50%	-	16.7%	-
Face movements	-	-	100%	-	-	-	-	-	33.3%	-
Eye movements	77.8%	-	-	-	-	-	50%	-	16.7%	-
Gestures	-	-	-	-	-	-	-	-	-	-
Vocalisations	-	50%	-	-	-	-	-	-	16.7%	-
Symbolic	-	-	-	-	-	-	-	-	-	-
Stereotypic	-	-	-	-	-	-	-	-	-	-
Problem	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	16.7%	-
Total Behaviours	9	2	1	0	0	0	2	0	6	0

Table 1.5: The distribution of behaviour types across communicative functions as reported in the IPCA for Anna

Table 1.6: IPCA data chart for Thomas

	Communicative Function																																																	
	Social convention				attention to self					reject/protest						request object					request action					request info			comment									CM				answer				imitate					
	greet	farewell	name	other	get attention	comfort	cuddle	shows off	other	routine	do	dislike	take	adult	other	object	food	more	TV or music	other	dress	game	toilet	near	other	clarification	info	other	happy	sad	bored	funny	fright	pain	angry	tired	other	2 or more	wants	start	other	reacts	yes	no	other	speech	yes	no	shrug	point	other
Behaviours																																																			
animated face								■																																											
arm movement																					■											■	■																		
bang hands																																																			
bum shuffle																				■																			■												
clap hands																													■																						
crying															■															■			■	■																	
dribbling					■										■														■																						
eye contact			■																																							■	■								
gagging															■															■																					
gaze towards you			■			■																																													
giggle								■																					■			■																			
heavy breathing								■																																											
hit chin																																			■																
kissing																																																			■
laugh																													■																		■				
movement in WC																■					■			■					■			■	■		■			■													
noises					■											■		■																																	
push away																																												■							
reaching							■																															■													
rub head																													■																						
sit back in WC											■	■																					■																		
sleep					■																										■					■															
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stop breathing								■																																											
take						■																																													
take your hand						■	■																																			■									
thrash around											■	■																																							
throw toy																															■																				
vocalise					■											■		■																	■																
vomit															■															■																					
wait														■																																					
wriggle in WC					■			■					■																																						
Yelling										■			■	■										■						■			■	■																	

Table 1.7: IPCA data chart for Blake

	Communicative Functions																																																		
	Social convention				attention to self					reject/protest						request object					request action					request info			comment									CM				answer				imitate					
	greet	farewell	name	other	get attention	comfort	cuddle	shows off	other	routine	do	dislike	take	adult	other	object	food	more	TV or music	other	dress	game	toilet	near	other	clarification	info	other	happy	sad	bored	funny	fright	pain	angry	tired	other	2 or more	wants	start	other	reacts	yes	no	other	speech	yes	no	shrug	point	other
Behaviours																																																			
bang hands on table					■											■	■																																		
bang on item																																							■												
discard item																															■																				
excited noises	■																																																		
Eye contact																																										■									
galloping								■																																											
look towards		■	■																											■																					
laugh								■																								■																			
look around													■																																						
move away											■																																								
noises	■	■			■								■			■	■	■											■													■									
orient towards			■																																							■									
pull back											■																																								
push away												■																																							
quieten																																		■																	
run						■		■																								■																			
reach																																						■													
stop what doing			■																																					■											
shout					■			■			■																								■																
smile								■																																		■									
sleep																															■					■															
slow down																																		■																	
take item																	■	■																																	
vocalise													■			■	■													■					■																
walk	■																																																		
walk towards																														■																					
yell																													■																						

Table 1.8: IPCA data chart for Josie

	Communicative Functions																			
	Social convention				attention to self					reject/protest						request object				
	greet	farewell	name	other	get attention	comfort	cuddle	shows off	other	routine	do	dislike	take	adult	other	object	food	more	TV or music	other
Behaviours																				
back up to an adult							■													
call out																		■		
cry											■									
eye contact	■	■	■																■	
gazing	■												■	■						
grind her teeth																				
grizzle					■							■								
hand wringing increase														■						
high pitch noise						■														
laugh																				
lean towards														■					■	
look towards		■	■																	
move her body																				
move toward																			■	
noises					■	■						■				■		■		
pull away											■	■								
reaching																				
rocking																				
sit on knee							■													
sleep																				
smile	■		■																	
take item																				
vocalise					■	■					■					■		■		
walk																				
whine					■						■									

	Communicative Functions																														
	request action					request info			comment									CM				answer				imitate					
	dress	game	toilet	near	other	clarification	info	other	happy	sad	bored	funny	fright	pain	angry	tired	other	2 or more	wants	start	other	reacts	yes	no	other	speech	yes	no	shrug	point	other
Behaviours																															
back up to an adult																															
call out																															
cry										■			■	■	■																
eye contact									■			■							■			■									
gazing																			■			■									
grind her teeth																	■														
grizzle																															
hand wringing increase										■																					
high pitch noise			■											■																	
laugh												■																			
lean towards																			■												
look towards																															
move her body																															
move toward																															
noises														■																	
pull away																				■											
reaching																		■													
rocking									■																						
sit on knee																															
sleep											■					■															
smile									■													■									
take item																		■													
vocalise			■											■	■																
walk				■															■												
whine																															

Table 1.9: IPCA data table for Anna

	Communicative Functions																																																		
	Social convention				attention to self					reject/protest						request object					request action					request info			comment									CM				answer				imitate					
	greet	farewell	name	other	get attention	comfort	cuddle	shows off	other	routine	do	dislike	take	adult	other	object	food	more	TV or music	other	dress	game	toilet	near	other	clarification	info	other	happy	sad	bored	funny	fright	pain	angry	tired	other	2 or more	wants	start	other	reacts	yes	no	other	speech	yes	no	shrug	point	other
Behaviours																																																			
arm movement																																																			
arm stretch					■																																														
cry																														■																					
eye contact	■																																																		
eye movement	■	■	■																																							■									
gaze																													■																						
glance	■	■	■																																																
head turning																																										■									
move head			■																																																
noises					■																																														
orient			■																																																
pull face												■																																							
sleeping																																				■															
smile																													■			■																			
wriggle																													■																						

BIAS

Thomas

The table below shows the specific behaviours produced by Thomas and the associated functions in relation to gaining attention, requesting preferred items or activities, and rejecting unwanted items or the participation in activities.

Table 1.10: Thomas's results from the BIAS displaying behaviours used for each of the communicative functions.

	Communicative Functions		
Behaviours	**Attention**	**Request**	**Reject**
Problem behaviours	×	×	×
Intentional eye gaze	×	×	☐
Vocalising	×	×	×
Reach, touch, grab	×	×	×
Move body	×	×	×
Guide another's' hand	×	×	×
Point with finger	×	×	☐
Use electronic device	×	×	☐

×= present; ☐ = absent

Table 1.10 demonstrates that Thomas displayed several specific behaviours indicative of particular communicative functions across parts A, B, and C.

Part A Attention: Thomas would sometimes use an electronic device, and would often (a) use problem behaviours, (b) move his body, (c) reach, touch or grab the person, and (d) guide another's hand or lead a person somewhere. Thomas would always make noises and intentionally use his eye gaze. To indicate that he wished to retain another's attention or to continue an interaction, Thomas would sometimes point with his index finger, and would often (a) use problem behaviours, (b) intentionally use his eyes, (c) move his body, (d) reach, touch or grab, and (e) guide another's hand or lead them somewhere. He would always make sounds or noises.

Part B Requesting: When Thomas wanted access to a preferred item he would sometimes (a) use problem behaviours, (b) intentionally use his eyes, (c) point with his index finger, and (d) use an electronic device. He would often (a) move his body, (b) reach, touch, or grab the item, and (c) guide another's hand or lead them somewhere. Thomas would always make sounds or noises. To let someone know when he wished to participate in an activity or do something Thomas would sometimes (a) use problem behaviours and (b) guide another's hand or lead them towards the activity. He would often (a) make noises, (b) move his body, and (c) reach, touch, or grab. To indicate that he wanted more of a preferred item, Thomas would sometimes use problem behaviours and guide another. He would often (a) make noises, (b) move his body, and (c) reach, touch or grab the item. To indicate he wished an activity to continue, Thomas would sometimes use problem behaviours and guide another person's hand. He would often (a) make noises, (b) move his body, and (c) reach, touch, or grab.

Part C rejecting/protesting: When Thomas rejected an item he would sometimes use problem behaviours and guide another's hand. Often he would (a) make noises, (b) move his body, and (c) reach, touch, or grab. To protest the beginning of an activity, Thomas would sometimes use problem behaviours and guide another person's hand. He would often (a) make noises, (b) move his body, and (c) reach, touch, or grab. To let others know that he was finished or that he has had enough of a particular item Thomas would sometimes (a) use problem behaviours, (b) guide another's hand, and (c) reach, touch, or grab. He would often make noises and move his body. To let others know that he did not want attention or to continue an interaction, Thomas would sometimes use problem behaviours and reach, touch or grab. Often, he would make noises and move his body.

Blake

The table below shows the specific behaviours produced by Blake and the associated functions in relation to gaining attention, requesting preferred items or activities, and rejecting unwanted items or the participation in activities.

Table 1.11: Blake's results from the BIAS displaying behaviours used for each of the communicative functions.

	Communicative Functions		
Behaviours	**Attention**	**Request**	**Reject**
Problem behaviours	□	□	×
Intentional eye gaze	×	×	□
Vocalising	×	×	×
Reach, touch, grab	×	×	×
Move body	×	×	×

×= present; □ = absent

Table 1.11 demonstrates that Blake displayed several specific behaviours indicative of particular communicative functions across parts A, B, and C.

Part A Attention: Blake would sometimes use his eye gaze intentionally, and move his body, and would often make sounds or noises. To let others know he wished to continue to have their attention or to continue an interaction, Blake would sometimes make sounds or noises and reach, touch, or grab for the person.

Part B Requesting: When Blake wanted access to a preferred item, he would often make sounds or noises and reach, touch or grab for the item. To let others know that he wished to participate in an activity or to do something, Blake would sometimes (a) move his body and (b) engage in an alternative behaviour of moving to the door to go outside. Often he would make sounds or noises. To indicate that he wished to have more of preferred item, Blake would sometimes use his eye gaze intentionally and move his body, often make sounds or noises, and always reach, touch or grab for the item. To let others know that he wished an activity to continue, Blake would sometimes reach, touch or grab, and often made sounds or noises.

Part C Rejecting/Protesting: When Blake rejected an unwanted item, he would sometimes (a) make sounds or noises, (b) move his body, and (c) reach, touch or grab. To protest participation in an activity, Blake would sometimes move his body and reach, touch or grab, and often make sounds or noises. To indicate that he had finished with an item or had enough of an activity Blake would sometimes (a) make sounds or noises, (b) move his body, (c) reach, touch or grab, and (d) use an alternative behaviour where he would spit unwanted food out. To let others know that he did not want their attention or did not wish to continue an interaction, Blake would sometimes make sounds or noises and move his body.

Josie

The table below shows the specific behaviours produced by Josie and the associated functions in relation to gaining attention, requesting preferred items or activities, and rejecting unwanted items or the participation in activities.

Table 1.12: Josie's results from the BIAS displaying behaviours used for each of the communicative functions.

	Communicative Functions		
Behaviours	**Attention**	**Request**	**Reject**
Problem behaviours	□	□	×
Intentional eye gaze	×	×	×
Vocalising	×	×	×
Reach, touch, grab	□	×	□
Move body	×	×	×
Facial expression	×	×	□

×= present; □ = absent

Table 1.12 demonstrates that Josie displayed several specific behaviours indicative of particular communicative functions across parts A, B, and C.

Part A attention: To gain someone's attention, Josie would sometimes use her eyes intentionally, and would often (a) make noises, and (b) move her body. To indicate that she wished to continue to have attention or to continue an interaction with another, Josie would sometimes (a) make noises, (b) use her eyes intentionally, (c) make a distinctive facial expression, such as a frown, and (d) move her body.

Part B requesting: Josie would let others know that she wanted access to a preferred object by sometimes (a) moving her body and (b) reaching or touching the item. Often, Josie would make noises. To let others know that she wanted to do something, like an activity, Josie would sometimes (a) use her eyes intentionally, and (b) reach or touch the stimuli. She would often move her body, and would always make noises. To indicate that she wanted more of a preferred object, Josie would sometimes move her body. To let someone know that she wished a preferred activity to continue, Josie would sometimes (a) make noises, (b) use her eyes intentionally, (c) make a distinctive facial expression, and (d) move her body. Additionally, she would often engage in an alternative behaviour of increasing the intensity of her hand wringing.

Part C rejecting: Josie would reject items sometimes by intentionally using her eye gaze. To protest the beginning of an activity, she would sometimes make noises and move her body. To let others know that she was finished or that she has had enough of a particular item, Josie would sometimes move her body, and often make noises. To indicate that she did not want attention or that she did not wish to interact, Josie would sometimes move her body, and would often grind her teeth.

Anna

The table below shows the specific behaviours produced by Anna and the associated functions in relation to gaining attention, requesting preferred items or activities, and rejecting unwanted items or the participation in activities.

Table 1.13: Anna's results from the BIAS displaying behaviours used for each of the communicative functions.

	Communicative Functions		
Behaviours	**Attention**	**Request**	**Reject**
Problem behaviours	☐	×	☐
Intentional eye gaze	☐	×	×
Vocalising	×	×	☐
Reach, touch, grab	☐	×	☐

Move body	×	×	□
Facial expression	□	×	×

×= present; □ = absent

Table 1.13 demonstrates that Anna rarely displayed consistent behaviours across functions in parts A and C, and was not observed to clearly display any of the behaviours pertaining to a request for preferred objects or activities.

Part A attention: In order to gain another's attention, she would sometimes (a) make noises or sounds, and (b) move her body. In order to continue to have another's attention or to further continue an interaction, Anna would sometimes (a) make noises or sounds, and (b) move her body.

Part C rejecting/protesting: To reject an unwanted item, Anna would often make a distinctive facial expression, such as a frown or disgusted look, and to indicate that she no longer wished to interact or have another's attention, she would sometimes use her eye gaze in an intentional way.

Discussion

Results from the three assessments reported here may aid in identifying a feasible starting point from which potential intervention programs targeting functional skills could be developed for Blake, Thomas, Josie and Anna. Results from the Vineland™-II, the IPCA, and the BIAS provide detailed information regarding the adaptive behaviour functioning of the four participants in addition to their potential communicative acts, and specific requesting and rejecting behaviours that they reportedly used.

All four participants scored low across all domains in the Vineland™-II with an overall adaptive functioning indicating a profound deficit. This indicates that each of the participants experience severe limitations in expressive and receptive communication skills, a severe lack of independence in daily living skills and socialisation, deficits in community participation and profound gross and fine motor limitations. Adaptive behaviour equivalency scores fell below the age of two years for all participants across all domains and sub-domains, except for Thomas in the inter-personal domain where his age equivalency score was two years, four months. Domains that were particularly limited were communication and daily living skills where all four participants scored within the severe profound deficit range. Receptive language was scored around the equivalent of 12 months for Thomas, Blake and Josie and less than one month for Anna. Expressive communication was scored equivalent to nine months for Thomas and Blake, three months for Josie, and less than one month for Anna, with no written skills demonstrated for any of the four participants. In the daily living domain, in particular the domestic and community sub-domains, age equivalency scores fell well below two years and for Anna were equivalent to less than one year in comparison to the normative data. The implications of these findings for each participant for their involvement in daily social interactions, physical autonomy, expressive and receptive communication skills, and their constructive engagement within their immediate environment, is severely limited. These individuals are considered unable to independently execute simple daily self-care tasks, physically participate in activities or interactions, socialise in age appropriate ways, communicate using conventional and effective methods, and are therefore considered completely reliant on their teacher and in-class carers for all daily needs, wants, and interactions. The low adaptive levels identified in these individuals is consistent with previous reports of adaptive levels in persons with multiple disabilities and, in particular, are consistent with the low scores on the communication and the domestic and community sub-domains of daily living skills (Belva & Matson, 2013; Greenspan & Driscoll, 1997; Gresham & Elliot, 1987; Tureck et al., 2013).

A potential limitation of the Vineland™-II is the relatively high basal levels, where distinctions in individuals who are considered low-functioning are unable to be identified. For example, Anna, who displayed the most profound and apparent fluctuating levels of alertness and engagement, had the most severe physical impairment where she was not able to hold her head up independently, move her arms or hands to perform a functional act, and was unable to move her legs independently, scored less than one year old across most domains of the Vineland™-II. In comparison Thomas, who was considered as more socially responsive and interactive, had a greater physical competency where he could throw balls, hold onto toys, reach for desired items, push items or people away, and imitate actions such as clapping, and presented slightly higher age equivalency scores across the adaptive sub-domains. The differences in functioning between these two is not easily identified when simply evaluating the overall scores of each domain and, perhaps due to the high basal levels of each domain, both of these participants are categorised as functioning in the severe to profound adaptive behaviour impairment range. This presents one limitation in the sensitivity of this assessment instrument when attempting to identify particular deficits and strengths in the heterogeneous population of persons with PMD.

Results from the IPCA suggest that although each participant's repertoire of potential communication acts were restricted, they were each able to produce various behavioural forms to indicate communicative functions. For example, Blake, Thomas, and Josie each displayed certain behaviours to greet and respond to their name, reject and protest unwanted items or activities, request certain preferred objects and stimuli, request more, choose between stimuli, and indicate simple emotions like happiness and anger. Only one participant (Thomas) was able to use any type of verbal language ("Hi"), the other three participants appeared to lack any verbal communicative skills. The majority of these behaviours indicative of these specific communicative functions were described by the informant as gross body or facial movements, vocalisations, whining, or emotional responses like crying or smiling. Thus, these responses, although recognised by the informant, might appear as ambiguous and considered non-conventional forms of communicating these simple pragmatic functions. Anna, who was considered to have severely fluctuating levels of awareness and was often asleep or very drowsy during the day, displayed a very limited inventory of potential communicative acts. Particularly eye movement, eye gaze, and slight head turning and head orientation served as her primary means of communicating, again non-conventional and highly ambiguous forms of communicating. In some sections of the

IPCA, the teacher reported that in some instances she was not sure exactly how the individual communicated or what exactly some of their behaviours were meant to convey.

The data presenting the distribution of behaviour types across communicative functions demonstrates that the most common behaviour form reported for these four participants was body movements, with vocalisations being the second most common behaviour form used for Blake, Thomas and Josie. These behaviours were used across communicative functions where body movements were reportedly used by Blake for 18 different functions, and vocalisations for 22 different communicative functions. Thomas was reported to use body movements for 24 different communicative functions, and vocalisations for 27 functions. Josie reportedly used body movements for a total of 14 different functions, vocalisations for 21 different functions, and eye movements for nine different functions. Anna was reported to use body movements for five functions and eye movements for nine different communicative functions. Across these communicative functions, the distribution of behaviours were similar for all four participants. The highest number of behaviours used by Blake were for the (a) commenting function, and (b) attention to self function. For Thomas and Josie, the highest number of behaviours used were for the (a) commenting function, (b) rejecting/protesting function, and (c) attention to self function. The top two functions Anna demonstrated the highest number of behaviours were for the (a) social convention function, and (b) the commenting function. The top three communicative functions; commenting, rejecting/protesting, and attention to self, could be viewed as reactive and relatively basic communicative functions in comparison to some of the other functions included within the IPCA for which less behaviours were identified. The ability to communicate within the commenting function requires a learner to indicate, for example, that they are feeling happy, sad, angry or bored. These are typically behaviours that are produced in reaction to environmental circumstances, instead of active communicative responses with the aim to gain functional outcomes. Rejecting and protesting behaviours are considered a basic manding behaviour demonstrating that a learner can discriminate between preferred and non-preferred stimuli, and can demonstrate a negative reaction to environmental stimuli. Additionally, the function of drawing attention to oneself could be viewed as a primary way of accessing basic needs like comfort and touch from others. Thus these three communicative functions appear to demonstrate basic and more reactive forms of communication as opposed to active and functional forms that might enable positive outcomes for these participants. Furthermore, the reliance upon ambiguous and reactive forms of communication could provide greater opportunities for more aberrant behaviours to develop (Didden et al., 2014; Durand, 1993; Durand & Carr, 1991; Keen et al., 2001; Mirenda, 1997; Sigafoos, 2000; Tureck et al., 2013).

Previous research analysing the IPCA for individuals with ASD, RTT and other types of developmental disabilities similarly identified severe restrictions in the number of behavioural forms to indicate a range of communicative functions (Didden et al., 2010; Marschik et al., 2013; Marschik et al., 2014; Sigafoos et al., 2000; Sigafoos, Woodyatt, Tucker et al., 2000b). In particular, functions within the social context and requesting desired stimuli were typically communicated using pre-linguistic vocalisations and gross body movements (Bartl-Pokorny et al., 2013; Didden et al., 2010; Marschik et al., 2013; Sigafoos, et al., 2000). Similarly, three of the four individuals with PMD wholly relied upon gross body movements and vocalisations to communicate pragmatic functions such as; orienting to their name, drawing attention to themselves, requesting stimuli, and rejecting/protesting activities or stimuli. Only one participant (Thomas) used speech to (a) direct attention to himself, (b) greet another, (c) respond to his name being called, and (d) to imitate someone else's speech. Thus for all four of the participants body movements and vocalisations were used more frequently in comparison to other more advanced forms of communication, such as gestures or symbolic forms, across all forms and for all functions of communication. These data demonstrate that all four participants exhibited limited behaviours for requesting functions; thus requesting might be one function that is (a) overlooked by the informant, hence she was unable to describe how each participant requested, (b) the participants did not have the repertoire of behaviours to specifically request under the various conditions and for multiple stimuli, or (c) the participants had a small number of behaviours that were used across requests for multiple stimuli. A more thorough description of the manding behaviours of these participants are thus further assessed in the BIAS. Furthermore, none of the four participants' demonstrated potential communicative acts to request information and only Thomas was reported to imitate behaviours and speech, both of which could be considered as more complex communication forms. Thus without any intervention or instruction to enhance or progress the existing communication skills exhibited by these participants, they may continue to experience daily life whereby they are misunderstood, unable to clearly and conventionally express themselves, and lack a consistent tool to control aspects of their immediate environment, which may affect, or continue to affect, their quality of life.

Results from the BIAS supplemented the information gained from the IPCA by reporting on frequencies of requesting and rejecting behaviours used by each participant. Across the three communicative functions of gaining attention, requesting and rejecting/protesting, participants tended to display similar behaviours, a similar finding reported in the IPCA. Specifically, Blake reportedly used the same behaviours across all conditions relating to gaining attention and requesting preferred items and activities. Problem behaviours were only observed to occur during rejecting/protesting. Similarly, Thomas used the same behaviours during conditions of attention and requesting, with a smaller repertoire of behaviours used to reject/protest. Problem behaviours, including stereotypy, were used across all communicative functions. Josie used intentional eye gaze, un-specified vocalising and body movement consistently for all three functions, and only reportedly used stereotypy to reject/protest. Anna was reported to display a very limited number and frequency of behaviours across the attention and rejecting/protesting functions, and showed no behaviours to request preferred items or activities. Again, these particular behaviours would be difficult to interpret as a demand for attention, a request for a preferred item, the continuation of an activity, or an indication that they wished an activity to stop or an item to be removed as specific behaviours served several communicative functions. However, this assessment does demonstrate that three of the four participants had existing behaviours they used in a consistent manner that appeared to function as requests.

These results are important for two reasons; first there are several specific behaviours identified as behaviours indicative of a request for an item, or for more of a preferred item. These requesting behaviours provide a feasible starting point in the process of identifying targets for functional communication training to strengthen the clarity of these existing gestures, and to increase the success of these somewhat ambiguous communicative attempts. Second, many of the behaviours observed to indicate a request for a preferred item or for a desired activity to continue were also found to function as a rejection or to protest an activity or interaction. This finding might support the rationale for the further direct identification of environments under which the participants demonstrate discrepancies in behaviours when engaged with preferred stimuli and display behaviours indicative of enjoyment or happiness, and under environments where they display behaviours indicative of boredom or frustration. Thus it may be possible to determine if there are environments or particular stimuli that elicit behavioural states consistent with indicators of motivation, happiness and engagement which could then be re-created for functional communication training.

Several limitations in the methodology of this study are apparent that limit the external validity of these results. As only four participants were involved in these assessments, the types of data reported cannot be generalised to the greater population of those with PMD, and thus similar conclusions regarding the communicative potential of others with PMD cannot be extended. Further assessment involving a greater sample of individuals with PMD would more reliably confirm the presence of restricted communicative repertoires and low adaptive functioning identified in this study. Additionally, the reliability of these results is limited in that only one informant, the head teacher of all four participants, completed all three of the assessments. In a study conducted by Voelker, Shore, Hakim-Larson, & Bruner (1997), teacher ratings of adaptive skills were compared with the mother, or primary caregiver, of 59 children with multiple disabilities. Results indicated that the teacher scored the children, on average, higher than the parent on global and specific adaptive behaviour domains, suggesting that potential differences in informants from different environments offer varying knowledge regarding behavioural functioning (Voelker et al., 1997). Thus future research applying the IPCA, for instance, could assess the consensus between more and less familiar informants of target participants to further analyse the functionality, consistency, and ambiguity of the person's communicative attempts. Further, to strengthen this study, additional assessment to specifically identify levels of alertness, engagement, and motor skills are warranted to provide a more elaborate understanding of the skills, deficits, and behavioural states of these individuals.

Nonetheless for the scope of this thesis, these data provide some practical insight into each participant's overall adaptive functioning across specific domains including communication, daily self-help skills, socialisation, and motor skills. A detailed inventory of potential acts was established for all four participants and a further analysis of specific communicative skills regarding manding behaviours was identified. This information was collected from an individual who had spent considerable time with each individual and who drew on her knowledge of these behaviours from her experience of these adolescents during their daily school routines, thus all information provided covers a broad range of times, days, and various school based activities including community outings, baking, leisure time, eating situations, cleaning, and social interactions.

From these findings it appears that multiple and meaningful assessments are critical in providing a thorough and precise overall picture of the learner with PMD and to identify specific skills and deficits within their functioning. Had only the Vineland™-II been administered, the communication skills of all four participants would not have exceeded that expected from a 6-month old infant with no disability. The IPCA and BIAS provided valuable information detailing the inventory of potential communicative acts, the precise behavioural forms used by each participants, and the particular functions of communication for which these behaviours were used during communication opportunities. Thus the use of multiple assessments can provide a greater understanding of a learner and isolate more specific intervention targets to enhance and strengthen adaptive behaviour functioning for persons with PMD (Klien-Parris et al., 1986; Siegel-Causey & Bashinski, 1997).

Chapter Four

Study Two: Assessing Behavioural States of Alertness and Engagement

Of particular concern when assessing individuals with PMD for the design of educational interventions is the common occurrence of fluctuating levels of awareness and engagement that can have significant implications for adaptive responding, a crucial factor involved in optimal learning (Arthur, 2003; Arthur-Kelly et al., 2007; Guess et al., 1990; Mattie & Kozen, 2007). Fluctuating levels of alertness in these individuals is significant for two main reasons; firstly, carers and those who support persons with PMD often have difficulty in identifying expressions of alertness or awareness in those with PMD due to the severity of their disability and the heterogeneous characteristics of individuals within this population. In particular, the lack of conventional communicative abilities and reliance on pre-linguistic behaviours can often lead to staff misunderstanding or dismissing communicative attempts made by a person with PMD (Atkin & Lorch, 2014; Calculator, 1988; Carter & Iacono, 2002; Greathead et al., 2016). Secondly, persons with PMD tend to spend excessive amounts of time in behavioural states characterised by low levels of alertness in comparison to typical peers or those with less severe disabilities (Guess et al, 1990; Guess et al., 2002; Munde et al, 2009), a behavioural state recognised as significantly counter-productive to learning and developing new skills and increasing adaptive responding (Arthur, 2003; Mattie & Kozen, 2007). Thus by spending more time in these non-engaged or alert states, the time period where learning opportunities might occur are restricted to short time frames, resulting in a sub-optimal learning or rehabilitation environments for these individuals who typically require more intensive and slower paced interactions (Arthur, 2003; Guess et al., 2002).

Fluctuating Behaviour States

Fluctuating behavioural states, from that of high levels of alertness to that of low levels, make consistent and thorough assessment and instructional attempts difficult (Gee et al., 1991; Goetz et al., 1985). Furthermore for older individuals, these behavioural states can be difficult to alter even with significant intervention efforts (Ault et al., 1995; Guess et al., 2002). Therefore, assessing behaviour states in persons with PMD could be an effective method to identify variables that evoke these sub-optimal behavioural states considered counter-productive to learning, and help to direct teaching strategies and intervention plans (Arthur, 2003, 2004; Arthur-Kelly et al., 2007; Arthur-Kelly et al., 2008; Greathead et al., 2016; Guess et al., 2002).

In a study conducted by Guess et al. (1990) the behaviour states of 50 students with PMD, ranging from 1:8 (years: months) to 21 years of age, were analysed in two studies. Firstly, 20 classroom based observation sessions were carried out to specifically identify various behavioural states observed in the participants to determine available periods of their day where learning opportunities could be presented. This study focused on levels of alertness (where participants had their eyes open and appeared to demonstrate some level of awareness to their environmental situation through eye gaze direction), and engagement. Engagement was operationally defined as 'Alert-active' and included: (a) contact with another person or object via an interaction or through manipulation, (b) body movements either directed towards a wanted stimulus, or away from an unwanted stimulus, and (c) auditory, visual, or tactile interactive patterns exhibited with motor movements (Guess et al., 1990; Guess, Roberts, & Rues, 2002). The alert-active, or engaged behaviour state, is considered critical for effective learning whereas behaviour states where the participant is not demonstrating behaviours aligned with that of alter or engaged are considered sub-optimal learning states (Guess et al., 2002). Results from this indicated that during 42% of the school day, the students were observed to be in a sub-optimal behavioural state with very low levels of engagement and alertness, leaving just over half of their school day available for effective learning opportunities. Further, in their second study authors found that based on the analysis of each participant's medical and behavioural information, their behavioural states corresponded with particular characteristics and conditions. Overall, the significance of behavioural states, especially levels of engagement and alertness, were found to have significant implications for learning opportunities and capacity in individuals with PMD (Guess et al., 1990).

Assessing Behaviour States

Given that it is arguably an important educational goal to increase levels of alertness and engagement, it would seem important to investigate procedures for assessing indicators of possible engagement in individuals with PMD. One approach to doing this might be to look for changes in behaviour under different conditions that would presumably evoke different levels of engagement (e.g., alone versus social-leisure interaction). Any behaviours that occur more frequently in a social-leisure interaction versus an alone condition, for example, might be indicative of greater engagement. Information on the types of behaviours that might evoke behaviours consistent with signs of engagement could, in turn, be useful to educators (Ault et al., 1995; Green & Reid, 1996). For example, educators could then increase the person's exposure to engaging activities, which might in turn increase the person's happiness and overall quality of life. In addition, educators might use engaging activities as the context for instruction as it is presumed that the student would perhaps be more motivated to learn new skills in the context of activities that "engage" them.

There has been some work along these lines. Green and Reid (1996), for example, sought to determine if individuals with PMD showed any indices of happiness (e.g., smiling, laughing, and engaging in eye contact) and whether the frequency of such indices varied in relation to the person being offered various types of stimuli. While the aim of this assessment was to identify preferred versus non-preferred stimuli, the results of the study indicated that certain stimuli evoked greater increases in indices of happiness than others. These stimuli were therefore considered to be the preferred choice for use in an intervention. The intervention consisted of increasing/enabling access to the preferred stimuli, which resulted in increased expressions of indices of happiness for three of the four participants.

In another relevant study, Davis, Young, Cherry, Dahman, and Rehfeldt (2004) also assessed indices of happiness in three adults (aged 31 to 45 years) with profound intellectual disability and physical impairment. A multi-element design was used to assess the effects of three conditions on the frequency of indices of happiness. The three conditions were: (a) typical classroom practice with the stimuli offered chosen by a staff member, (b) offering preferred stimuli in addition to social interaction from a trainer, and (c) social interaction from a trainer in the absence of any stimuli. The results showed offering preferred items plus providing social interaction was associated with significant increases in indications of happiness than any of the other conditions.

The results of Green and Reid (1996) and Davis et al. (2004) suggest a potentially useful method for identifying conditions associated with more or less indices of happiness. Information of this type could be useful as it may enable carers, therapists, and educators to create environments that are more likely to make the person happy and thus improve the person's overall quality of life. As persons with PMD typically communicate various affective states and convey emotional well-being through gross motor responses (Atkin & Lorch, 2014; Arthur-Kelly et al., 2007; Lancioni et al., 2001; Nakken & Vlaskamp, 2007), these results also highlight the idea that these alterations in their physical state, where happiness is indicated, may provide knowledge into preferences, social interactive capabilities, and abilities involved in comprehending environmental and social contingencies; all significant behavioural considerations when designing and implementing educational and intervention strategies (Arthur, 2003; Arthur-Kelly et al., 2007; Ault et al., 1995; Green et al., 1991; Green & Reid, 1996; Green et al., 1997; Guess et al., 2002; Mattie & Kozen, 2007).

Assessing Engagement

In addition to undertaking assessments to identify indices happiness, it would also seem potentially important to identify indices of engagement. Lancioni, O'Reilly, Campodonico, and Mantini (2002) aimed to assess engagement and indices of happiness in four adults with PMD. Using a multiple baseline across participants design, these researchers defined and recorded a number of engagement and happiness indices under several conditions. Specifically during baseline session, three to four common items used during regular daily activities for each participant was available to interact with for all four participants. During these sessions, the experimenter would mediate a physical interaction with these items two or three times per session. During the subsequent stimulation phase, seven items were chosen to be particularly stimulating for each participant based on previous observations and reports from staff. These items were systematically presented to each participant for approximately 1-1.5 min segments if the item appeared to elicit positive engagement or indicators of enjoyment from the participant. If not, the item was presented for approximately 20-s before being removed. The presentation of items systematically alternated across sessions and observations of positive engagement and indices of happiness were recorded. The data indicated that positive engagement increased substantially for all four participants while a slight increase in levels of positive engagement were observed for two of the four participants. In addition, indices of positive engagement did not always occur in association with indices of happiness, suggesting that some individuals might be displaying signs of engagement without showing overt signs of happiness (Lancioni et al., 2002).

The focus of the present study was to determine whether levels of alertness and engagement, based on the operational definition of these behaviour states from Guess et al. (1990) and Guess et al. (2002), would vary in four adolescents with PMD across two conditions, (a) during a social-leisure activity versus (b) when the person was left alone. Results from this study will address the research question; is it possible to identify conditions under which the participants with PMD are able to demonstrate behaviours consistent with high levels of alertness and engagement? As these individuals often possess severely limited intellectual capabilities and can often appear to be unengaged and unresponsive to their environment and environmental stimuli, or show very subtle signs of engagement and responsiveness, the intent of this study was to determine if there were any behaviours that were more or less likely to occur in the social interaction condition versus the alone condition. As described in the literature, it is of great importance to identify the variables that lead to states of alertness and engagement, and variables that also lead to less responsive states that are sub-optimal for learning, such that those variables inducing high levels of alertness and engagement might be created to provide opportunities for learning. It was hypothesised that any behaviours observed more frequently during the social-leisure interaction condition might be indicative of engagement and greater levels of alertness. Increased indices of happiness during the social-leisure interaction condition might also suggest that engagement in the social-leisure interaction was reinforcing, or that this condition was motivating for the participants.

Method

Participants

The participants were the same two males and two female adolescents, ranging from 16 to 20 years of age, from whom the pre-assessment data (Chapter Three) was collected.

Settings, Sessions, and Context

All sessions were implemented by the first author (interaction partner) in the participants' classrooms or in a resource or clinical room at the school. These rooms were alternated due to availability and had artwork on the walls, windows, and may have included from one to three additional teachers. Prior to the beginning of a session, the interaction partner informed each participant, as they were wheeled to the allocated room, that they were "going to do some interacting with me!". Participants were seated with the communication partner standing within view of the iPad to ensure it would film the session with as much accuracy and precision as possible.. Sessions lasted approximately 10 min.

Interaction Partner

All sessions were conducted by the author of this thesis, who acted as the interaction partner and implemented all steps of the assessment. The interaction partner was responsible for recording and analysing all of the video data collected from this study however, 30% of the videos were independently coded by a second observed (who was a PhD student) to obtain data in inter-observer agreement (IOA) and procedural integrity.

Materials

IPad®. An iPad-mini® loaded with iOS7 capability was used to video record all of the sessions. Two leisure items were utilised during the social interaction (SI) condition.

Simon Game. The Simon Game®, is a sensory toy that consists of a black plastic ring with four coloured segments (red, blue, green, and orange). When one of the colours is touched, it produces a noise. This game requires the user to follow a pattern by watching a light pattern, and then replicating the pattern by selecting the correct colours in the correct order.

Handheld vibrating massager. The hand held vibrating massager was the second sensory stimuli used in the present study.

Both of these sensory materials were used in conjunction with social interaction from the interaction partner who spoke to the participant continually during sessions of the social-leisure interaction condition (e.g., *Oh look what I've got, shall we have a turn?, I will massage Josie's arm!, Is this fun?, Can Thomas touch the blue bit?, Anna! Look what I've got!*).

Definition and Recording of Target Behaviours

The target behaviours were (a) eyes open, (b) eye gaze, (c) orienting to the toy and/or trainer, (d) smile/laugh, (e) reaching, (f) vocalising, and (g) SIB and/or stereotypy. Eyes open was defined as any instance where the participants' eyes were clearly open, eye gaze was defined as any instance where the participant's eye gaze was directed at the interaction partner's face and appeared to be looking into their eyes. This was a difficult behaviour to accurately code for as neither observer could be 100% certain that participants were engaged in direct eye contact, however when the participant's eyes were directed at the interactive partner's face, we could be almost certain. These two behaviours, eyes open and eye gaze, could indicate that the participant was alert. Orienting was defined as any instance where the participant moved their body and face towards the interaction partner and/or the stimulus, and also included whenever the participant directed their eye gaze towards the interactive partners actions and/or stimulus. These behaviours could indicate that the participant was engaged with the trainer and/or stimulus, and in conjunction with eyes open and eye gaze, could represent a behaviour state suggesting that the participant was motivated by the condition. Smiling and/or laughing was combined together and was defined as any instance where the participant clearly smiled and/or laughed. Smiling and laughing was based largely on smiling and laughing in typical non-disabled individuals. Reaching was defined as any instance where the participant clearly and with intention moved their arm/hand towards the stimulus and/or interaction partner, or in the direction of the stimulus and/or interaction partner. Vocalising was defined as any instance where the participant produced a vocalisation that did not include yawning or sneezing. SIB and/or stereotypy was defined individually for each participant. For Blake, SIB and/ or stereotypy was defined as any instance where Blake had either of his hands in his pants, or when he hit his own head, his own arm, or any other body part. For Thomas, SIB and/or stereotypy was defined as any instance where Thomas rubbed his head, hit his chin, rubbed his legs together, tapped his tray table, or scratched his stomach. For Josie, SIB and/or stereotypy was defined as any instance where she wrung her hands together, or held her breath and breathed out after a prolonged time (identified as heavy breathing). Anna did not display any SIB and/or stereotypical behaviours. A behaviour was recorded as observed if during the 10 s observation interval the behaviour had been displayed by the participant. If the behaviour had not occurred within the 10 s interval, a non-occurrence was recorded.

Video Coding of Responses

Each session was recorded and later viewed by the interaction partner (thesis author). Videos were micro analysed and the presence of the target behaviours occurring during the 10-s time intervals for each 2.5min part (four parts in total, comprised one 10-min session) was recorded. Largely behaviours fell into one of the targeted responses outlined above however, some of the behaviours described were not able to be observed during the alone condition (eye gaze, orienting towards the trainer and/or stimulus, and reaching for the trainer and/or stimulus). These behaviours were still included regardless of this as during the social-interaction condition, they may indicate that the participant was engaged and alert, and may be suggestive of an interaction, or particular variables, that were motivating or reinforcing for the participants. Additional behaviours such as vegetative noises (coughing, yawning, and sneezing) or reflexive movements (stretching) were not included within the analysis. A second independent viewer analysed 30% of the videos to code for inter-observer agreement (IOA) and procedural integrity (PI).

Procedures

Each participant participated in sessions that lasted about 600 s (10 min). These 10 min sessions were comprised of four parts, each of which lasted about 2.5 min. During the first part, the participant received the social-leisure interaction condition. Following this, each participant was observed during the Alone condition for 2.5 min. This same sequence was then repeated to complete the session. Each participant received eight sessions and thus a total of 16 exposures to the social-leisure condition and 16 exposures to the alone condition.

Social-Leisure Interaction Condition

During the social leisure interaction condition, the interaction partner attempted to engage the participant with the Simon game or provided a vibration massage. The interaction partner also provided social interaction in the form of smiling, touching, talking to the participant, and gently prompting the participant to engage with the materials (i.e., assisting the participant in touching the panels on the Simon game or holding the massager).

Alone Condition

During the alone condition, the interaction partner removed access to the stimulus (toy), moved about 2 m away and did not interact with the participant in any way. The interaction partner was careful not to make eye contact. The other adults in the room were asked not to interact with the participant.

Inter-observer Agreement

All of the videotapes were coded by the author (interaction partner) and an independent observer (a PhD student) coded six of the 2.5 min social-leisure conditions and six of the 2.5 min alone conditions for each participant (i.e., 3 sessions in total; 37% of all sessions). This student received training by watching two 2.5min sequences with the author. During this time, the author and the student discussed the different behaviours seen in the videos, and what each behaviour would be coded as. Following this, both the author and student watched another two 2.5min sequences and coded these videos independently. This was then followed by a discussion in regards to their agreements and disagreements. This was sufficient to obtain a high level of agreement between the two coders, as determined by the author. An agreement between the two coders was scored if each had recorded that a target behaviour had either occurred or not occurred within the 10-s interval with a 2-s discrepancy allowed for timing differences. For example, if the independent observer had recorded that smiling had occurred during nine time intervals, and the primary coder (interaction partner) recorded that smiling had occurred at eight of these same intervals, but not at the ninth interval, this would indicate one disagreement in the coding scheme. Inter-observer agreement (IOA) was calculated using the formula: Agreements/(Agreements + Disagreements) x 100% and was rounded to nearest whole number. IOA for Thomas was from 80% to 90% (average was 86%), IOA for Blake was calculated from 80% to 91% (average was 85%), IOA for Josie was from 85% to 99% (average was 90%), and IOA for Anna was 80%. Overall calculations of IOA for all four participants were from 80% to 90% (average was 85%).

Results

Across the eight sessions, that is 16 Social-Interaction and 16 Alone conditions, each participant was observed for a total of 80 minutes- 480 10-s intervals (240 intervals per condition). For each participant, a summary of the percentage of observation intervals, in which each of the target behaviours was recorded as having occurred, are presented in the figures below and discussed.

Thomas

Figure 1.1 shows the percentage of intervals Thomas engaged in each of the target behaviours. During the Social Interaction condition, Thomas had his eyes open during 99.2% of the intervals, directed his eye gaze towards the interaction partner during 28.4% of the intervals, oriented towards the interaction partner and/or toy during 80.4% of the intervals, smiled and/or laughed during 65.4% of the intervals, vocalised during 24.2% of the intervals, reached for the stimulus during 49.2% of the intervals, and engaged in SIB and/or stereotypy during 42.1% of the intervals. During the alone condition, Thomas had his eyes open during 90% of the intervals, smiled and/or laughed during 3.3% of the intervals, vocalised during 26.7% of the intervals, and engaged in SIB and/or stereotypy during 70% of the intervals.

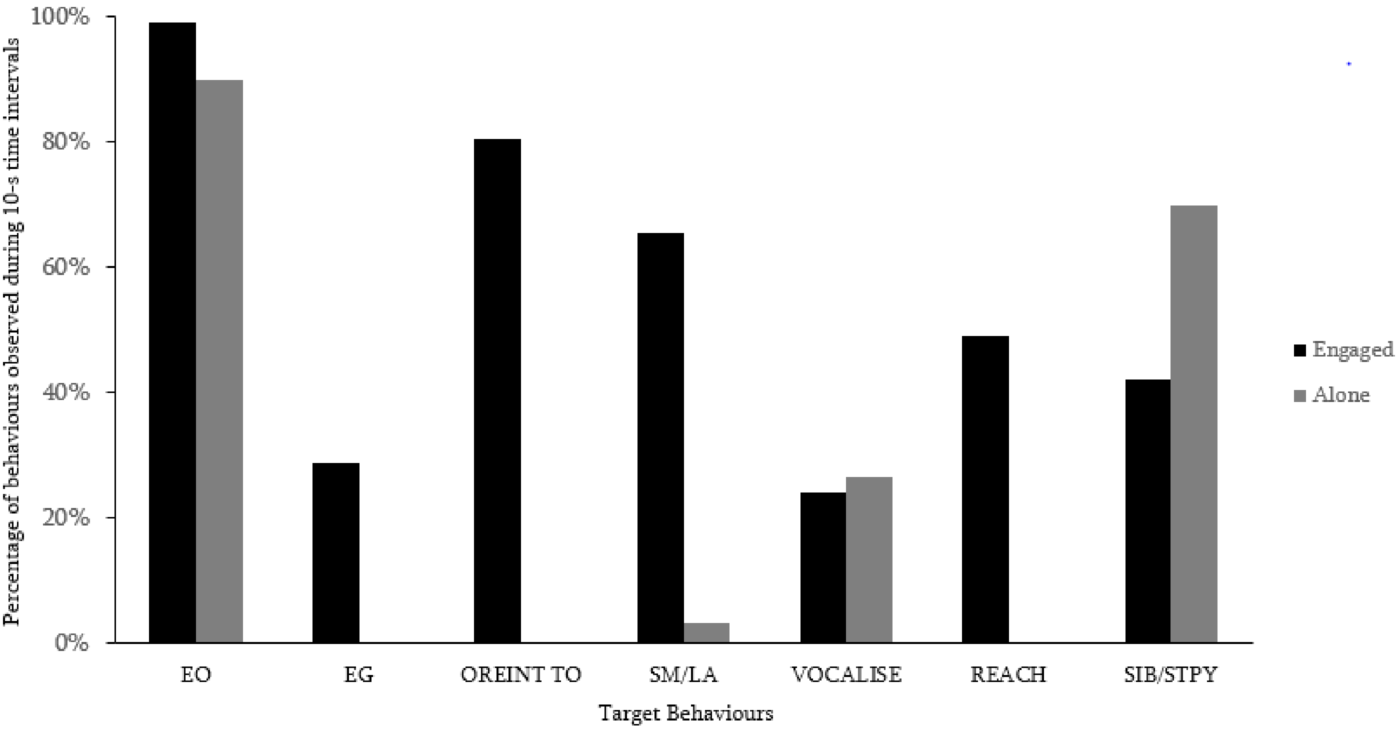

Figure 1.1: The percentage of behaviours observed from Thomas during the 10-s time intervals during the alone and social interaction conditions. Specific behaviours coded: EO- eyes open, EG- eye gaze directed towards the interaction partner/stimuli, Orient To- turning body and face towards interaction partner/stimuli, SM/LA- smile and/or laughing, Vocalise- instances where vocalising had occurred, Reach- where the participant reached towards the interaction partner/stimuli, and SIB/STPY- instances of stereotypy and/or self-injuring behaviours.

Blake

Figure 1.2 show the percentage of intervals Blake engaged in each target behaviours. During the Social Interaction condition, eyes open was observed during 99.6% of the intervals, he directed his eye gaze towards the interaction partner during 4.2% of the intervals, and he was orientated towards the interaction partner and/or leisure item during 84.6% of the intervals. He was also observed to have smiled and/or laughed during 19.2% of intervals, while vocalisations were recorded during 53.3% of the intervals. Reaching was observed during 70.4% of the intervals and SIB and/or stereotypy was observed during 42.5% of the intervals. During the Alone condition, Blake had his eyes open during 88.8% of the intervals, he smiled and/or laughed during 6.7% of intervals, vocalised during 65.4% of intervals, and he engaged in SIB and/or stereotypy during 86.7% of the intervals.

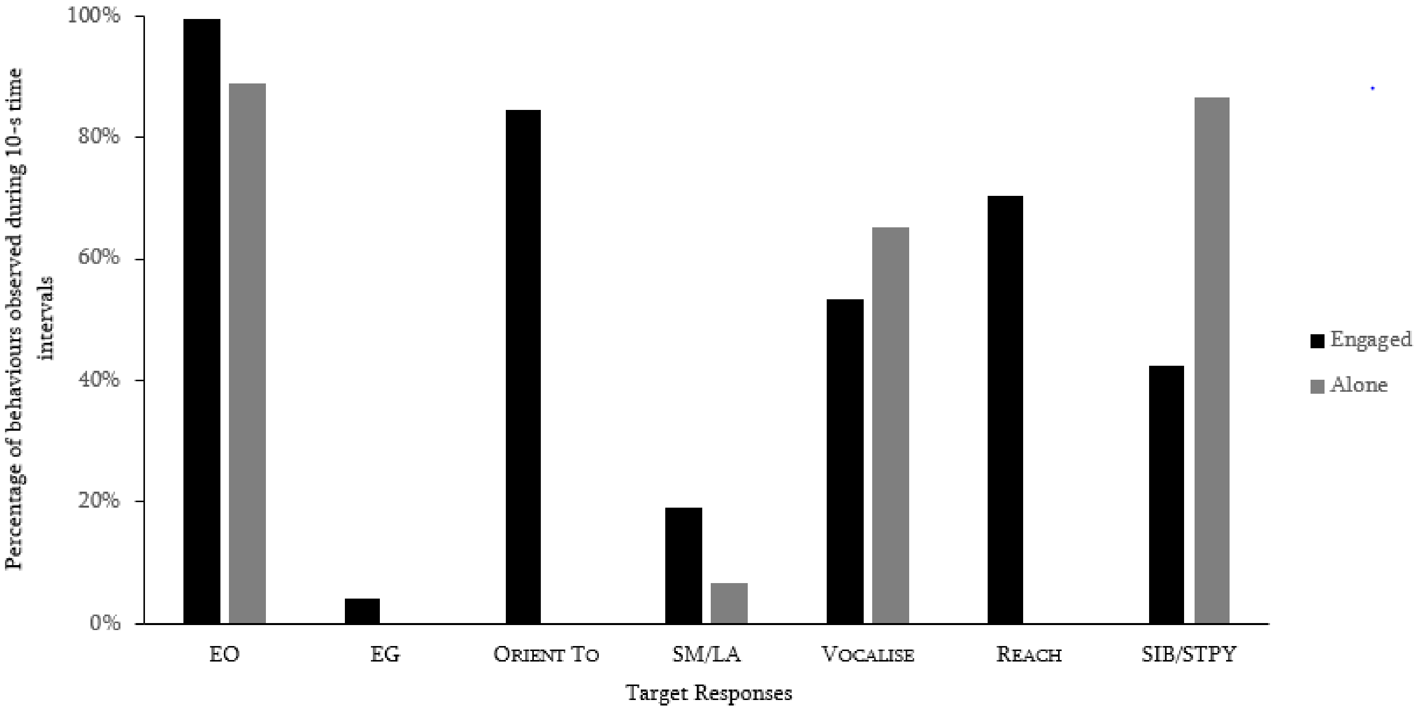

Figure 1.2: The percentage of behaviours observed from Blake during the 10-s time intervals during the alone and social interaction conditions. Specific behaviours coded: EO- eyes open, EG- eye gaze directed towards the interaction partner/stimuli, Orient To-turning body and face towards interaction partner/stimuli, SM/LA- smile and/or laughing, Vocalise- instances where vocalising had occurred, Reach- where the participant reached towards the interaction partner/stimuli, and SIB/STPY- instances of stereotypy and/or self-injuring behaviours.

Josie

Figure 1.3 shows the percentage of intervals Josie engaged in each of the target behaviours. During the social interaction condition, Josie had her eyes open during 100% of the intervals, directed her eye gaze towards the interaction partner during 75.8% of the intervals, oriented towards the interaction partner and/or toy during 88.3% of the intervals, smiled and/or laughed during 25.4% of the intervals, vocalised during 11.7% of the intervals, reached for the stimuli during 0% of the intervals, and engaged in SIB and/or stereotypy during 77.9% of the intervals. During the alone condition Josie had her eyes open during 99.6% of the intervals, smiled and laughed during 6.7% of the intervals, vocalised during 17.1% of the intervals, and engaged in SIB and/or stereotypy during 74.2% of the intervals.

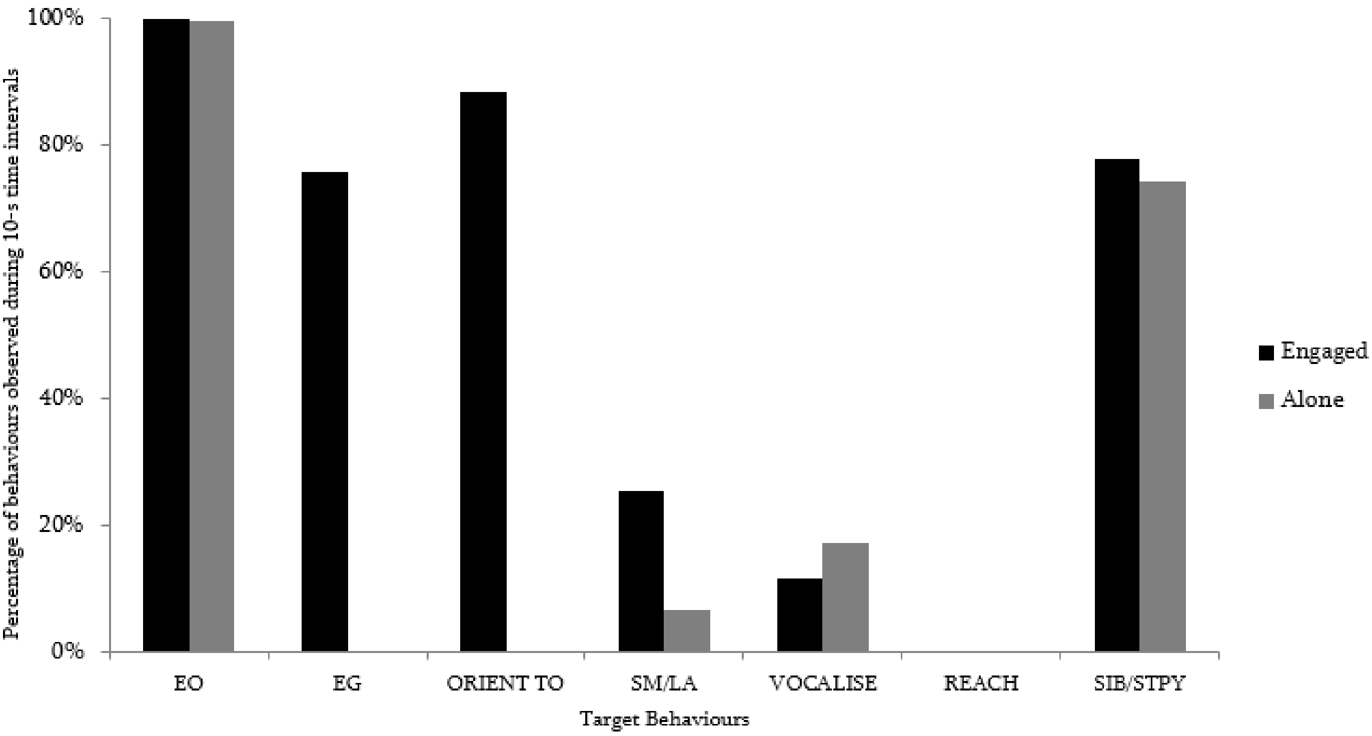

Figure 1.3: The percentage of behaviours observed from Josie during the 10-s time intervals during the alone and social interaction conditions. Specific behaviours coded: EO- eyes open, EG- eye gaze directed towards the interaction partner/stimuli, Orient To- turning body and face towards interaction partner/stimuli, SM/LA- smile and/or laughing, Vocalise- instances where vocalising had occurred, Reach- where the participant reached

towards the interaction partner/stimuli, and SIB/STPY- instances of stereotypy and/or self-injuring behaviours.

Anna

Figure 1.4 shows the percentage of intervals Anna engaged in each of the target behaviours. During the SI condition, Anna had her eyes open during 98% of the intervals, directed her eye gaze towards the interaction partner during 12.5% of the intervals, oriented towards the interaction partner and/or toy during 63.8% of the intervals, smiled and/or laughed during 3.8% of the intervals, vocalised during 2.5% of the intervals, and reached for the stimuli during 1.7% of the intervals. During the alone condition, Anna had her eyes open during 67% of the intervals, smiled and/or laughed during 3.3% of the intervals, and vocalised during 2.9% of the intervals. Anna did not engage in SIB and/or stereotypy.

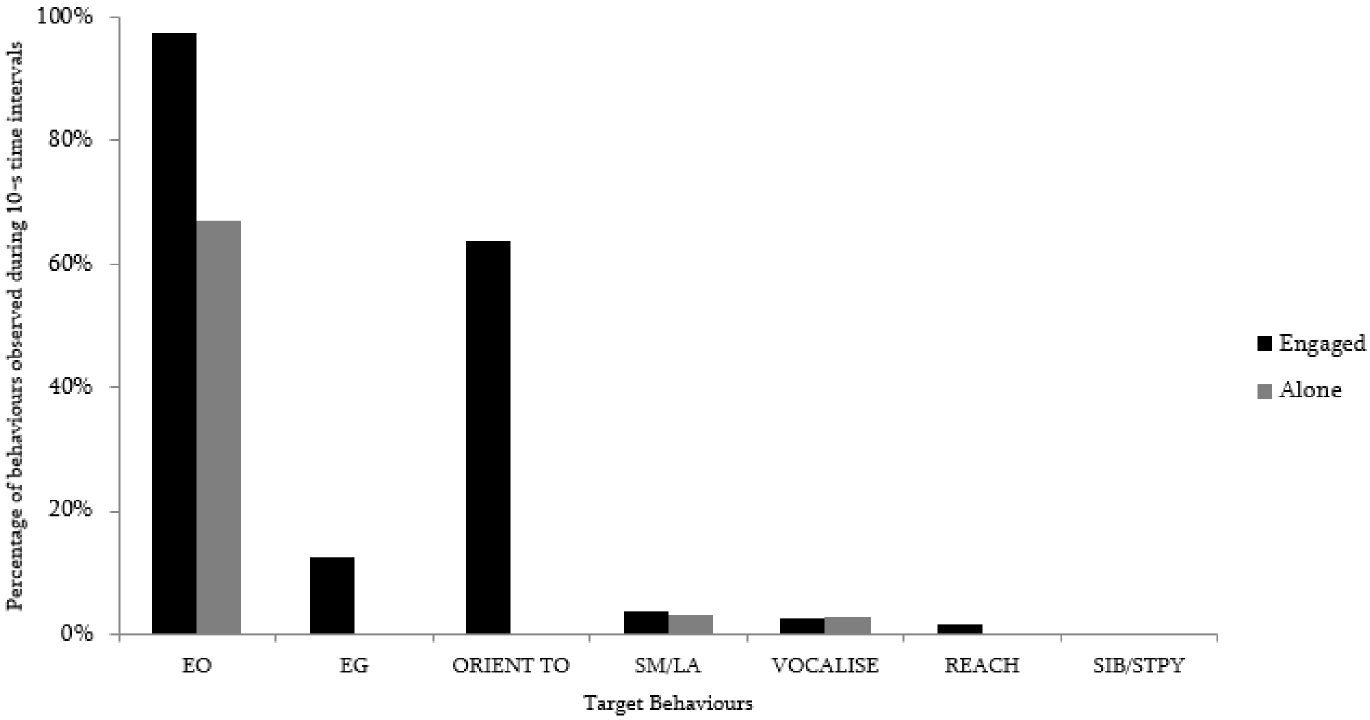

Figure 1.4: The percentage of behaviours observed from Anna during the 10-s time intervals during the alone and social interaction conditions. Specific behaviours coded: EO- eyes open, EG- eye gaze directed towards the interaction partner/stimuli, Orient To-

turning body and face towards interaction partner/stimuli, SM/LA- smile and/or laughing, Vocalise- instances where vocalising had occurred, Reach- where the participant reached towards the interaction partner/stimuli, and SIB/STPY- instances of stereotypy and/or self-injuring behaviours.

Discussion

The present study aimed to identify behaviours indicative of alertness and engagement in four adolescents with PMD during times when they were alone versus times when they were involved in a social-leisure interaction. Results from this study suggest that the procedures used were effective in showcasing different levels of alertness, potential states of engagement, and potentially positive and negative affect in these four participants. In general, participants engaged in higher frequencies of vocalizations and SIB and/or stereotypy during the alone condition, and laughed, smiled, directed eye gaze, oriented towards the interaction partner and reached for the stimulus, during the engaged condition.

Specifically, results from this study indicate that seven identified behaviours that were common to the four participants held several communicative functions. When the participants' eyes were open, it appeared that the participant had some level of awareness of their immediate environment, and were aware of the interaction with the interaction partner and may suggest that they were alert, in accordance with criteria for a state of alertness defined in Guess et al. (1990). A common behaviour seen across all four of the participants was orienting towards the interaction partner and/or the stimuli. Combined with reaching for the stimulus and eye-gaze, these behaviours may be indicative of engagement and joint attention for these participants, where they shared a common interest with the interaction partner (the stimulus) and were engaged in both the stimulus (reaching and body orientation) and the interaction partner (eyes open and directed eye gaze). Further, all four participants engaged in smiling and laughing more frequently during the social interaction condition compared to the alone condition. These behaviours are therefore assumed to indicate that the participants were happy to engage with the interaction partner, and may have been expressing enjoyment or indicating that the interaction was motivating. This is supported through the lower frequency of laughing and smiling during the alone condition.

SIB and stereotypy often occurred at slightly higher frequencies during the alone condition, particularly for Blake and Thomas, suggesting that during this condition these behaviours might indicate (a) frustration, (b) distress, and (c) a request for attention or more social interaction. Stereotypy was however seen across both the engaged and alone conditions and could also be a sign of being very excited and overwhelmed or very upset/angry/frustrated. There is existing evidence that SIB and stereotypy are more automatically maintained in persons with ID and PMD, such that it would be expected that these behaviours would occur under all conditions for those that demonstrate and engage in these behaviours (Applegate et al., 1999; Durand & Carr, 1991). Along these lines, for Thomas, Blake, and Josie it is not surprising that they exhibited high rates of these behaviours during both the alone and interaction condition. Specifically, Josie's stereotypy which involved hand wringing and hyperventilation (or atypical breathing patterns) are core behavioural characteristics of her neurodevelopmental disability (Rett syndrome). Therefore it is not surprising that these behaviours were evident throughout both conditions. However, the frequency of this behaviour was seen slightly less in the alone condition compared to the engaged condition, where she engaged in stereotypy during 74.2% when alone compared to 77.9% when engaged.

Additionally, vocalising was not significantly greater in frequency for any of the participants during either of the conditions and was seen in conjunction with multiple other behaviours. For Thomas and Josie, vocalising was slightly more frequent during the alone condition, thus it might be indicative of a request for more social attention or further engagement from the trainer. However, as the difference across the two conditions was slight, it is difficult to determine exactly what function this behaviour had. For Blake however vocalising might have served multiple communication purposes and be maintained by several environmental factors as opposed to simply requesting attention or interaction as he engaged in vocalisations during 53.3% of opportunities during the engaged condition, and 65.4% of opportunities during the alone condition, a higher frequency in general across both conditions in comparison to the other participants. Thus vocalising for Blake may have been maintained by several factors including; (a) requesting more stimulation, (b) requesting more attention from the interaction partner or, (c) to entertain himself in the absence of stimulation.

The present findings are consistent with results reported in Davis et al. (2004) in that the combination of social interaction with a tangible stimulus resulted in increased frequencies of behaviours indicating engagement and apparent happiness in individuals with PMD. Further, a key conclusion reported in Lancioni et al. (2002) highlighted the importance of combining positive engagement and happiness indicators in participants to provide a more accurate description of interest and preference for stimuli in these individuals, as opposed to coding happiness or positive engagement in isolation (Lancioni et al, 2002). Indicators in the present study of positive engagement and happiness during the social interaction condition, including open eyes, eye gaze, orienting to the interaction partner and/or stimulus, and smiling and laughing, align with behaviours indicative of interest-excitement and enjoyment, consistent with theories describing the fundamental basis behind motivation (Csikszentmihalyi, 1975; Deci & Ryan, 1985; Izard, 1977) and affirmation in studies investigating signalling behaviours in persons with PMD (Atkin & Lorch, 2014). Therefore in accordance with previous research, the method utilised within the present study was effective in identifying several behaviours, indicative of alertness, engagement, and potential indices of happiness that when coded and analysed together, might provide evidence that these participants were motivated during the social interaction condition. It is of critical importance that for individuals with fluctuating levels of alertness, engagement, and for those who experience 'sub-optimal' behavioural states for learning, variables that either evoke behaviours consistent with demonstrations of motivation, or those that lead to drowsy or low levels of alertness and engagement, are identified such that variables and conditions promoting more positive behaviour states can be re-created. Conditions under which high levels of motivation are observed might aide in the process to identify a potential context in which to provide further instruction, or optimal behavioural states during which effective learning can occur (Goetz et al., 1985; Guess et al., 2002).

Despite these positive findings, several limitations were identified. The external validity of these findings are restricted as only four participants were involved in this study, and the data specifically illustrates behaviours that are unique to each individual. Although there was evidence of overlap in some behaviours of participants when demonstrating engagement and happiness, for instance Blake, Josie, and Thomas smiled/ laughed more frequently in the engaged condition, Thomas and Blake both displayed reaching behaviours when engaged, and all four participants oriented towards the interaction partner and/or toy with both body movement and eye gaze in the engaged condition, the small sample size limits the generality of these data to the wider population of individuals with PMD. Further, each behaviour was recorded as 'had occurred' if it was observed at any time during each of the 10 s time intervals. Although 10 s time intervals are small time frames, the occurrence of behaviours could be seen as occurring more frequently than they had in reality, as if a participant had produced a short vocalisation for 2 s of the ten second time interval, it was recorded as occurring. This may have obscured the data by providing an inflated picture of the rates of these behaviours, a common limitation encountered when adopting this type of data coding (Kennedy, 2005). Further, inter-rater reliability was conducted on only 37% of sessions. To ensure this method of data coding was more reliable a larger number of sessions could have been coded. Due to the time consuming nature of this coding however, only this sample of videos was able to be analysed by a second observer. More importantly, it must be acknowledged that comparisons for 'eye gaze', 'reaching', and 'orienting towards the interaction partner/stimulus' cannot be compared across the two conditions as these behaviours were unable to be reliably and accurately coded during the alone condition. Even though these behaviours are important to note within the results, their frequencies are stated and not used in comparable terms with the alone condition.

Regardless, these results provide an effective method of identifying engagement, alertness, and happiness in four individuals with PMD. Specifically, the video analysis of behaviours observed in ten second time intervals across two different conditions has provided extensive evidence of specific behaviours in four individuals (a total of 80 minutes of footage across 4 months), providing a large body of individual data on unique aspects of these individuals' states of positive affect and engagement levels. This study adds to the body of literature suggesting that both social interaction and tangible stimuli can increase indices of happiness and engagement in individuals with PMD. The combination of social interaction with sensory stimuli, and then the comparison of this with the starkly contrasted condition of being left alone, allowed for differences in behaviours to be observed. These differences across these two conditions might suggest that the participants were more motivated to express their happiness and engagement with the trainer and stimulus during the social interaction condition. Motivation indicators can be a very helpful way of identifying opportunities to provide instruction for simple communicative skills; such as requesting the continuation of a highly motivating task or interaction. By identifying the specific conditions under which an individual displays signs indicative of positive engagement, or under which the person displays signs of motivation, carers, therapists, and teachers might then be able to increase the frequency of these conditions, and use such circumstances as optimal teaching opportunities to implement interventions targeting specific adaptive skills for these individuals.

Chapter Five

Study Three: Assessment of PLBs Evoked by the Interruption of Social-Interaction/Sensory Stimulation

Perhaps the greatest challenge for those responsible for providing an appropriate education to students with PMD is the fact that many such students appear to have a very limited ability to effectively communicate wants, needs, and preferences, at least through the use of conventional communication forms. This apparent limitation with respect to conventional forms of communication could lead to problematic behaviour or passivity/learned helplessness (Guess, Benson & Siegel-Causey, 1985; Guess et al., 1990; Maes et al., 2007; Marcus & Vollmer, 1996). Individuals with PMD do however often appear to show prelinguistic behaviours (PLBs) that could represent intentional forms of communication and/or which could also indicate active engagement, awareness and/or responsiveness to social interaction and/or sensory stimulation. PLBs might include informal body movements, facial expressions, and other non-symbolic or unconventional forms (Atkin & Lorch, 2016; Siegel-Causey & Bashinski, 1997; Siegel-Causey et al., 1989; Sigafoos et al., 2006). However, the communicative intent, if any, of PLBs is often difficult to identify and interpret due to their fleeting, idiosyncratic and often highly ambiguous nature of the PLBs observed in persons with PMD. In addition, even when PLBs can be reliably identified, it is possible that these actions are not forms of intentional communication or indicators of engagement, awareness and/or responsiveness, but rather such forms might simply represent orienting responses or startle reflexes that have no particular intentional meaning or operant function (Arthur, 2003; Arthur-Kelly et al., 2007; Giacino et al., 2002). Thus in order for the person with PMD to be understood, and for carers, teachers and therapists to know how to be most responsive to the person so as to develop and enhance that person's communication abilities, it would seem important to attempt some type of assessment aimed at identifying any specific PLBs and the meaning, if any, of these responses (Carter & Iacono, 2002; Kaiser & Goetz, 1993; Schweigert, 2012). It would seem particularly important to attempt to determine if PLBs are serving any particular communication function for the person.

Communication can be generally described as a reciprocal process in which there is an exchange of information between a speaker and a listener (Beukelman & Mirenda, 2005; Keen et al., 2001; Oller et al., 1999; Skinner, 1957). Effective communication could then be seen as involving or requiring a dyadic relationship between the speaker and the listener where clear and consistent communicative attempts are correctly interpreted by a communication partner. Functional communication, at least from the perspective of special education, has generally been considered in terms of the specific messages, purposes, or intents that the speaker is attempting to convey to the listener. The specific messages, purposes, or intents are functional in the sense that they are directed at enabling the speaker to express some want or need, such as requesting access to preferred or needed objects or activities and rejecting non-preferred objects or activities (Iacono et al., 1998; Reichle, York, & Sigafoos, 1991; Schweigert, 2012; Siegel-Causey & Bashinski, 1997).

For persons with PMD, conveying recognisable and meaningful messages can be challenging as their repertoire of available responses that might be used for effective and functional communication purposes are often very limited. This could result in a large number of instances where these individuals will miss out on desired outcomes because communication partners might be unable to reliably detect or correctly respond to the person's unconventional communicative attempts (Carter & Iacono, 2002; Kaiser & Goetz, 1993; Ogletree, Fischer, & Turowski, 1996; Schweigert, 2012).

As many persons with PMD appear to rely upon PLBs to convey communicative messages to listeners, and these behaviours tend to manifest in the form of idiosyncratic gestures and body movements, such acts might be identified as communicative in one setting, but completely inappropriate or misunderstood within another (Atkin & Lorch, 2014; Greathead et al., 2016; Kaiser & Goetz, 1993; Nakken & Vlaskamp, 2002; Petry & Maes, 2007; Sigafoos et al., 2006). In some situations, it can be difficult for the listener to recognise a PLB as a communication attempt, decipher if the change in physical state is meaningful, and determine whether the behaviour was an intentional act of communication or a more basic orienting response, sensory reaction, or reflexive response to some type of environmental stimulation (Arthur, 2003; Arthur-Kelly et al., 2007; Carter & Iacono, 2002; Meadan et al., 2012; Schweigert, 1996; 2012). This may result in the listener assigning no meaning to the PLB or assigning the wrong meaning to a PLB. Both possibilities could have additional negative consequences. As mentioned before, problem behaviour, such as aggression and SIB have been linked to an inability of persons with developmental disabilities to effectively communication basic functions, such as requesting attention (Applegate et al., 1999; Didden et al., 2010Durand & Carr, 1991; Durand, 1993; Mirenda, 1997; Sigafoos, 2000; Tureck et al., 2013).

Communication has been suggested to be a fundamental component of meaningful social interaction in humans and one of the primary means by which individuals obtain membership into society (Ferguson, 1994; Kaiser & Goetz, 1993). Therefore those who struggle to communicate in functional and meaningful ways may also tend to have a higher risk of experiencing greater social isolation and lack opportunities to become active participants in society. As a result, these individuals might also experience a lower quality of life (Lancioni et al., 2001; Sigafoos et al., 2006). The enhancement of effective and age-appropriate forms of communication may help to include these individuals within society (Sigafoos et al., 2006), and may result in more successful communication attempts where they are more able to achieve desired outcomes through readily understood methods of communication (Atkin & Lorch, 2014; Greathead et al., 2016).

Validating the Communication Function of PLBs

In Chapter Three, pre-assessments were conducted to identify general level of adaptive behaviour functioning and specific potential communicative acts or potential PLBs in four participants with PMD. Following these assessments, it is important to validate the specific PLBs identified or nominated in Chapter Three to determine; (a) if these PLBs are in fact occurring in contexts that would suggest they are in fact functioning as acts of communication and, (b) the extent to which the person exhibits these PLBs consistently when an opportunity to express the presumed communicative function of the PLB arises. Assessment data of this type could be useful in planning an intervention aimed at enhancing the effectiveness of any such PLBs for functional communication purposes (Bretherton & Bates, 1979; Kaiser & Goetz, 1993; Schweigert, 1996, 2012; Siegel-Causey et al., 1989; Sigafoos et al., 2000; Sigafoos et al., 2006).

One potentially important component to consider when designing an intervention plan might be to begin by collecting a better understanding of the person's strengths and areas of educational need, including the extent to which the person's communication repertoire includes behaviours that have the potential to become effective means of functional communication (Meadan et al., 2012; Siegel-Causey & Bashinski, 1997). These findings may aide in the planning process when designing and implementing interventions aimed at strengthening and/or enhancing the existing PLBs that might have communication potential (Calculator, 1988; Carter & Iacono, 2002; Petry & Maes, 2007; Schweigert, 2012).

The literature into the behavioural states of individuals with PMD, suggests that the demonstration of indices of engagement and positive affect (e.g., orienting to the stimulus, looking at the stimulus, reaching for the stimulus, smiling, and laughing) during the presentation of a particular stimulus or during social interaction with another person, suggests the individual finds the stimulation reinforcing and could thus be taught to engage in some type of communication request to re-instate that stimulation when it is temporarily interrupted (Green & Reid, 1996; Gee et al., 1991; Goetz et al., 1985). Studies evaluating interruptions in the flow of purposeful behaviour have also found increases in more naturalistic communicative responding, such as spontaneous communication and the generalisation of skills across settings and activities (Hunt et al., 1986; Hunt & Goetz, 1988; Romer & Schoenberg, 1991). Thus interrupting a reinforcing stimulus could be used to create the want or need for a communicative request and this could then be the occasion in which any PLBs that are forms of requesting might be evoked. Such contexts could also represent an opportunity to enhance the evoked PLB (Goetz, Schuler & Sailor, 1983; Goetz et al., 1985; Hunt et al., 1986; Reichle, 1997).

Using a Stimulus Interruption Procedure to Assess and Evoke PLBs

It is important that activities used in teaching strategies for individuals with PMD take into account the sensory and physical limitations of the person, such that the demands of the activity can be met, and the person can participate fully in the activity while experiencing success (Atkin & Lorch, 2014; Nakken & Vlaskamp, 2002; Petry & Maes, 2007; Siegel-Causey & Bashinski, 1997). One evidence-based approach to reliably validate potential communicative acts is to implement a stimulus interruption or interrupted behaviour procedure (IBC). With this procedure, the intent is to create the need for communication by interrupting a preferred/reinforcing activity (Hall & Sundberg, 1987; Gee et al., 1991; Hunt et al., 1986; Sigafoos et al., 2005).

For example, in an interrupted behaviour procedure, one step of a behavioural chain is manipulated such that the process cannot be completed until a behaviour or request has been actioned by the learner. In previous research, manipulations have included; requiring the learner to locate a missing piece of information or stimuli (find the spoon), asking a specific question (Where is the spoon?), providing a missing word or sentence (spoon), or requesting or rejecting (Can I please have a spoon?. Not a fork, but a spoon). Following the correct response, the remaining steps of the chain can be completed leading to reinforcement for the person (e.g., using the spoon to eat the ice-cream). Previous studies have demonstrated successful results using this teaching strategy to create the need for communication from individuals with autism and/or intellectual disability (Carter & Grunsell, 2001; Gee et al., 199; Hall & Sundberg, 1987; Hunt et al., 1986; Roberts-Pennell & Sigafoos, 1999; Romer & Schoenberg, 1991; Sigafoos & Littlewood, 1999; Sigafoos et al., 2005).

Several studies have investigated this approach with individuals with PMD. Goetz, Gee and Sailor (1985), for example, taught two adolescent boys, aged 12 and 14 years old, to produce functional requests during an IBC procedure using a picture-based communication system. Both boys experienced profound ID and were non-verbal. Three novel pictures necessary for the completion of three corresponding functional tasks were targeted in a multiple-baseline across responses design. For example, one of the tasks involved one participant locating and pointing to a target symbol to request a piece of bread in order to complete the subsequent steps in making a piece of toast. Each behaviour chain for the two participants was chosen and evaluated based on two factors:

(a) the consistency of attempts to complete the chain (i.e., motivation to complete the change), and (b) the degree of distress observed in the participants during the interruptions. According to the authors, a prescribed level of each behaviour indicated a high level of motivation to complete the behaviour chain, thus an effective context, under which instruction could be implemented, was identified. Results of this study showed positive results for both boys in that they quickly gained proficiency in using the picture-based communication system to make the required request when the behaviour chain was interrupted (Goetz et al., 1985).

Positive results from such studies appear to depend on ensuring that: (a) the required response is appropriate and feasible for the individual to perform, such as being within the person's physical capabilities, (b) the interruption is discrete and clear, and (c) the motivational state of the learner is appropriately matched to the task such that the completion of the behaviour chain, or access to the reinforcement out-weighs the response effort required (Gee et al., 1991; Goetz et al., 1983; Hunt & Goetz, 1988). A failure to meet these criteria might hinder teaching perhaps due to the repeated failure, lack of motivation, or use of interruptions that evoke interfering problem behaviour. Capturing and matching a learner's motivational level for successful instruction are not only critical for successful teaching outcomes, but also to maintain a learner's attention, engagement and alertness. Fluctuating levels of engagement and alertness in those with PMD can make implementing consistent and thorough assessment and instructional attempts difficult (Goetz et al., 1985; Goetz et al., 1983; Hunt et al., 1986). Hence the need for highly motivating and stimulating interactions and teaching programs.

The IBC strategy may be one effective way to validate PLBs that have been suggested as being present in the communication repertoire of a person with PMD. By creating conditions that create a need for the person to request continuation of a reinforcing activity, it might be possible to reliably evoke PLBs that do in fact function as a request and thus be in a better position to strengthen and enhance those PLBs (Goetz, et al., 1985; Reichle, 1997).

The present study aimed to make use of a stimulus interruption procedure in an attempt to evoke PLBs related to requesting and thereby possibly validating the communicative function of the behaviours. Results from this study addresses the research question, to what extent are these four participants able to demonstrate meaningful and consistent PLBs to request further access to reinforcing stimuli? And is there an accurate way to evoke these behaviours and validate the communicative intent of these behaviours?

The participants were the same four adolescents with PMD described in Study One and Study Two. The specific PLBs that were of interest were identified from the IPCA assessment conducted in Study One. That is, the aim was to determine if any type of pre-linguistic requesting response would occur when the need to request was created by interrupting preferred activities/access to stimuli, so that a social interaction be reinstated (Thomas), or so that access could be continued (Blake, Josie and Anna). Furthermore, the present study aimed to identify stimuli that, when interrupted, would be consistently associated with high levels of behaviours that were previously (Study Two) identified as promoting increased indices of engagement and alertness.

Method

Participants

The participants were Thomas, Blake, Josie and Anna as described in Chapters Three and Four.

Settings, Sessions, and Context

Sessions were implemented in the participants' classrooms or in a resource or clinical room at the school. The location of sessions varied due to room availability, but all sessions were conducted in quiet school rooms that had artwork on the walls, windows, and may have included from one to three additional teachers. Prior to the beginning of a session, the interaction partner informed each participant, as they were wheeled to the allocated room, that they were "going to do some interacting with me!". Participants were seated (Thomas, Blake and Anna) or allowed to move freely around the room (Josie) with the communication partner standing within view of the iPad to ensure it would film the session with as much accuracy and precision as possible. Each participant received 20 assessment sessions. All of the sessions were videotaped and lasted approximately 5-mins. Each participant experienced two to three sessions per day, depending upon availability. Sessions were conducted one to two times per week over a period of approximately six weeks (again depending upon their availability). An interruption trial began when the communication partner provided access/interacted with the participant for 1-2 min. This was then interrupted for 20 s and then reinstated for a further 1-2 min. This entire sequence required approximately 5 min. The entire 5-min sequence constituted one session.

Communication Partner

The author of this thesis acted as the communication partner and conducted all of the 20 sessions, implemented all of the procedural steps during each session, and provided all social interactions and sensory stimulation to participants during the sessions. The communication partner was responsible for recording and analysing all of the video data collected from this study however, 30% of the videos were independently coded by a second observer (who was a PhD student) to obtain data in inter-observer agreement (IOA) and procedural integrity.

Materials

An iPad-mini® loaded with iOS7 capability was used to video record all of the sessions. During Blake's sessions, a small bowl filled with preferred snacks (potato chips) were used as the preferred type of sensory stimulation. During Thomas's sessions, a handheld vibrating massager was used as the preferred type of sensory stimulation. During Josie's sessions, her highly preferred band was played on a CD player in her classroom, and during Anna's sessions, a handheld device playing specific Māori songs was used as the preferred type of sensory stimulation. The selection of these types of sensory stimulation was based on direct assessment data (from Study Two) and in-direct allocation from the participant's teachers.

Definition and Recording of Target Behaviours

Target behaviours included: (a) look at (communication partner), (b) smile/laugh, (c) reaching, (d) vocalising, and (e) SIB and/or stereotypy. During Josie's sessions, additional behaviours were recorded. These included: (a) orienting/moving to the stimuli and/or interaction partner, (b) staying the same location, (c) Hand wringing/teeth grinding (her unique form of stereotypy), (d) walk away, and (e) turn away. For Anna, the additional behaviour of 'move head' (toward the communication partner) was also included. Specifically, 'look at' was defined as any instance where the participant's eye gaze was directed at the communication partner's face and appeared to be looking at her. Smiling and/or laughing was combined together and was defined as any instance where the participant clearly smiled and/or laughed. Reaching was defined as any instance where the participant moved their arm/hand towards the stimulus as if trying to reach for that stimulus item. Vocalising was defined as any instance where the participant produced speech-like sounds or vocalisations. Yawning, sneezing and other such noises were excluded. SIB and/or stereotypy was defined individually for each participant. For Blake, SIB and/or stereotypy was defined as any instance where Blake had either of his hands down the front of his pants, or when he hit his own head, his own arm, or any other body part. For Thomas, SIB and/or stereotypy was defined as any instance where Thomas rubbed his head, hit his chin, rubbed his legs together, tapped his tray table, or scratched his stomach. For Josie, orienting/moving was defined as any instance where she moved towards, leaned towards, or moved directly towards the communication partner during an interruption. Staying was recorded if Josie remained in the same location as she had been prior to the interruption. Walking away was recorded if Josie walked out of view of the iPad (used to film the sessions) during an interruption and turn away was recorded if Josie turned away from the communication partner during an interruption. Josie's stereotypy was more clearly defined as any instance where she was heard grinding her teeth and/or wringing her hands. For Anna the additional behaviour of 'move head' was included as she was not observed to 'orient' her entire body towards the communication partner/stimulus, rather she would move her head in the direction of the communication partner. Anna was not observed engaging in any SIB or stereotypy. The presence of a behaviour was recorded if at least one instance occurred during any of the 20-s interruptions that occurred within a session. Furthermore a behaviour was considered consistent if it occurred during 75% or more of the sessions.

Video Coding of Responses

Each session was recorded and later viewed by the communication partner (thesis author). Videos were micro analysed and any behaviour occurring during the 20-s interruption in preferred stimuli was recorded. Largely behaviours fell into one of the targeted responses outlined above. Additional behaviours such as vegetative noises (coughing, yawning, and sneezing) or reflexive movements (stretching) were not included within the analysis. A second independent viewer analysed 30% of the videos to code for inter-observer agreement (IOA) and procedural integrity (PI).

Procedural Overview

A stimulus interruption strategy was implemented to create opportunities for each of the four participants to produce a communicative response to indicate 'more' when a preferred stimuli or a social interaction was interrupted. These stimulus interruptions were implemented using a discrete trial format where one interruption occurred per session. To start the session, the communication partner would engage with the participant for approximately 1-2 min and then interrupt the interaction for 20-s. Following the 20-s interruption, the social interaction/sensory stimulation was reinstated for another 1-2 mins.

Thomas

During Thomas's trials, the communication partner engaged in a social interaction; speaking to Thomas, laughing, asking questions, and also playing with Thomas using a preferred toy item; a hand held massager. After providing Thomas with approximately 1-2 minutes of play and social interaction, the communication partner would stop the interaction, step away from Thomas with the massager held towards Thomas and say; *"Let me know if you want more".* The communication partner then waited for approximately 20 s until stepping back towards Thomas saying, *"You can have more"* whereby the social interaction and toy play was re-established. During the 20 s response delay any observed behaviour from Thomas was recorded including; vocalisations, reaching, smiling, body orienting, and stereotypy. If Thomas reached out for the massager and managed to grab the massager, he was allowed to take it with the added verbal praise from the communication partner *"Good reaching Thomas!"*. Happiness indicators such as vocalising, smiling, and laughing were also recorded.

Blake

During Blake's trials, the communication partner offered him chips one at a time from a blue plastic bowl that was visible to Blake for the entirety of the session. After providing Blake with approximately five chips, given to him one at a time over a time period of approximately 2 min, the communication partner would interrupt the flow of chips, and holding the chips up in front of Blake would say; *"Let me know if you some want more"*. The communication partner then waited for 20-s to create an opportunity for Blake to respond. After this 20-s interval, the communication partner said, *"You can have more"* and gave Blake access to the snacks once again. During the 20-s response delay any observed behaviour from Blake was later recorded including; vocalisations, reaching, smiling, body orienting, and stereotypy.

Josie

During Josie's trials, the communication partner played her preferred music from a table top stereo that played compact discs. After providing Josie with approximately 1-2 minutes of music the communication partner would interrupt the song by pushing pause and saying; *"Let me know if you want more"*. The communication partner then waited for approximately 20 s until re-playing the music and saying, *"You can have more"*. During the 20 s response delay any observed behaviour from Josie was later recorded including; vocalisations, forward body leaning, smiling, body orienting, and stereotypy. Happiness indicators such as vocalising, smiling, and laughing were also recorded.

Anna

During Anna's trials, the communication partner played her preferred music from a hand held music device. After providing Anna with approximately 1-2 minutes of music the communication partner would interrupt the song by pushing pause and, holding the music device up in front of Anna, would say; *"Let me know if you want more".* The communication partner then waited for approximately 20 s until re-playing the music and saying, *"You can have more".* During the 20 s response delay any observed behaviour from Anna was later recorded including; vocalisations, any head turning or movement, body orienting, and eye gaze. Happiness indicators such as vocalising, smiling, and laughing were also recorded.

Inter-observer Agreement

All of the videotapes were coded by the author (communication partner) and an independent observer (a PhD student) coded 30%, i.e., six of the 20 sessions that were conducted for each participant. This student received training by watching one session with the author. During this time, the author and the student discussed the different behaviours seen in the video, and what each behaviour would be coded as. Following this, both the author and student watched another 5min session and coded this video independently. This was then followed by a discussion in regards to their agreements and disagreements. This was sufficient to obtain a high level of agreement between the two coders, as determined by the author. An agreement between the two coders was scored if each had recorded that a particular behaviour had either occurred or not occurred within the 20-s interruption intervals. IOA was calculated using the formula: Agreements/(Agreements + Disagreements) x 100%. IOA for Blake was 100%, for Thomas was 78.5% (range from 67.7 to 100), for Josie was 78.3% (range from 50% to 100%), and for Anna was 100%.

Procedural Integrity

All of the videotapes were coded by the author (communication partner) and an independent observer (same PhD student as above) coded 30% of the sessions for each participant. An agreement on procedural integrity between the two coders was scored if the independent observer recorded that all procedural steps were implemented in the correct order and in the correct way, with a 3-s discrepancy allowed. In this study, the procedures were the same for all four participants and involved the following five steps.

1. Communication partner sits next to/stands next to the participant to begin a session. The required materials are located within view of the participant, but out of reach.
2. A session begins when the communication partner engages with/offers the stimuli to/plays the stimuli to the participant for 2.5 min and provides social stimuli to each participant (such as rubbing their arms, dancing around, clapping, talking and laughing).
3. The communication partner interrupts the stimuli/interaction and says: "Let me know if you want some more". The communication partner then waits for approximately 20 s.
4. Following the 20-s interruption, the stimulus/interaction is reinstated. Procedures were slightly different for Blake and Thomas in that if they reached and grabbed a hold of their stimuli (potato chips or the hand held massager) during the interruption, the communication partner would immediately offer Blake the chip, and re-engage with Thomas with the handheld massager.

Procedural integrity checks were calculated as 100% for all four participants.

Results

The series of four tables presented below show the percentage of 20-s interruption intervals during which each participant was observed to have engaged in the target behaviours.

Thomas

Table 2.1: The percentage of 20-s interruptions during which each target behaviour from Thomas was observed.

Target Behaviours				
Reach	Vocalise	Smile/laugh	Look at	SIB/STPY
80%	60%	50%	20%	35%

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The results for Thomas show his most consistent behaviour produced during the 20-s interruptions was reaching, which occurred during 80% of the interruptions. Other consistent behaviours included vocalising which were observed during 60% of the interruptions, and smiling and/or laughing during 50% of the interruptions. Thomas looked at the communication partner during 20% of the interruptions and engaged in SIB and/or stereotypy during 35% of the interruptions.

Blake

Table 2.2: The percentage of 20-s interruptions during which each target behaviour from Blake was observed.

Target Behaviours				
Reach	Vocalise	Smile/laugh	Look at	SIB/STPY
95%	55%	30%	0	0

The results from Blake's sessions show the most consistent behaviour observed during the 20-s stimulus interruptions was reaching, which occurred during 95% of the 20 interruptions. Blake also vocalised and smiled and/or laughed during 55% and 30% of the interruptions respectively.

Josie

Table 2.3: The percentage of 20-s interruptions during which each target behaviour from Josie was observed.

Target Behaviours						
Orient to	Stayed	Vocalise	Look at	HW/TG	Walk away	Turn away
60%	30%	25%	35%	90%	15%	15%

The results for Josie show that her most consistent behaviour observed during the stimulus interruption procedure was Hand wringing and teeth grinding (HW/TG) was observed during 90% of the interruptions. The second most consistent behaviour observed from Josie was orienting towards the trainer and/or to the stimulus. This behaviour was observed during 60% of the interruptions. Other behaviours observed during the interruptions were looking at the trainer and remaining in one location. These occurred during 35% and 30% of the interruptions, respectively.

Anna

Table 2.4: The percentage of 20-s interruptions during which each target behaviour from Anna was observed.

Target Behaviours			
Move head	Vocalise	Smile/laugh	Look at
15%	0%	10%	35%

Results for Anna show that her most consistent behaviour observed during the interruptions was directing her eye gaze towards the communication partner which occurred during 35% of the interruptions. Her second most consistent behaviour was moving her head in the direction of the communication partner which occurred during 15% of the interruptions. Anna also demonstrated smiling and/or laughing during 10% of the interruptions.

Discussion

Three of the four participants demonstrated consistent use of at least one target behaviour during the interruptions. Consistent use of a behaviour was defined as any behaviour that was observed during 75% or more of the interruptions. The most consistently observed behaviours for Blake and Thomas was reaching. For Josie, an orienting response was most consistently observed and unfortunately, no consistent behaviours were observed for Anna.

Blake, for example, showed a reaching response during 95% of the interruptions. This could indicate that reaching represented an attempt by Blake to re-instate or regain access to the preferred stimulus (i.e., the potato chips). Thomas also showed a high percentage of reaching (80%) during the interruptions. This response could also indicate an attempt by Thomas to re-instate the social-sensory interaction with the communication partner, and suggests that reaching for Thomas might be a way of requesting. The consistency of reaching for Blake and Thomas might indicate that reaching for these two boys conveyed the potential communicative function of “I want more”. Furthermore, results from Study One (Chapter Three) align with this finding as these two participants were observed to ‘often’ reach to indicate a request for a preferred item, to access preferred activities, or to communicate that they wished an activity or interaction to continue.

Josie often oriented towards the trainer, or oriented towards the stereo during the pause in her preferred music. These responses were collated within the data table as ‘orienting’ and were the most consistent behavioural response observed form Josie during the stimulus interruption procedure occurring during 60% of the interruptions. This could indicate that orienting towards a preferred item could represent an attempt by Josie to reinstate access to her preferred reinforcement, and that orienting conveyed the potential communication function of ‘I want more’. However this behaviour was not observed as consistently as those demonstrated by Thomas and Blake and was not observed to occur during more than 75% of the interruptions. Furthermore, Josie displayed a wider range of behaviours during the interruptions in comparison to the boys, indicating that she might benefit from an intervention that (a) increases the consistency of her behaviour that occurs most often (orienting), and (b) increases the clarity of this behaviour such that she will orient directly towards one communication partner during an interruption. These results were also consistent with the results from Study One (Chapter Three) where Josie was reported to orient towards and lean into stimuli that she wished to engage with or to indicate a request for more.

Anna’s most consistent behaviour was directing her eye gaze towards the communication partner which occurred during 35% of the interruptions. This response was not always very clear form the video footage and was difficult to determine as an intentional response due to her fluctuating levels of responsiveness and alertness. As this response was only observed during 35% of the interruptions, it did not demonstrate a consistent response indicating a request for more of her preferred stimuli. This may have been due to her deteriorating health and the subsequent increase in medication that left her very drowsy, with significant fluctuations in her levels of alertness and responsiveness. The stimuli used may not have been a strong enough reinforcer for Anna, thus the response effort required may not have been outweighed by access to music. Furthermore, she may not possess a behavioural response that can be produced consistently, thus simply waited until the music was played again. Anna may have also required an increased number of opportunities to understand the behavioural contingency used in this assessment, as she may have failed to grasp the idea that she was required to respond. These findings also align with the results from Study One where Anna requesting behaviours were reportedly absent from Anna's repertoire of potential communicative acts.

These procedures appeared to effectively evoke one PLB at a high level of consistency during interruptions to preferred stimuli for two participants, and a less consistent, but dominant response for one participant. The PLB most highly evoked from these interruptions might therefore be interpreted as a communicative act functioning as the learner's method to re-instate the social interaction/sensory stimulation. In this way, the most consistent PLB produced during the interruptions may be considered a functional request for more. Intervention could focus on enhancing and strengthening this PLB such that communication partners might be able to detect and respond appropriately to these communicative acts. By interrupting the flow of purposeful behaviour, in these cases interrupting access to preferred stimuli or a social interaction, opportunities were created for participants to demonstrate consistent behaviours that appeared to indicate a high level of motivation and an intent to communicate. Previous studies have adopted similar procedures whereby the interruption becomes the context for instruction in new skills or the refinement of non-conventional or ambiguous behaviours (Gee et al., 1991; Gee et al., 1995; Goetz et al., 1983; Hunt et al., 1986). The studies using similar interruption procedures highlight the need for communication partners to understand the meaning or intention behind a potential communicative act, prior to strengthening or enhancing it. This will ensure that the correct PLB is used for the correct outcome (Carter & Iacono, 2002; Greathead et al., 2016; Sailor et al., 1988; Sigafoos et al., 2006).

As observed in a recent study conducted by Meadan et al. (2012), communication attempts can be misinterpreted by particular communication partners depending on their relationship and familiarity with the speaker. Listeners who have no formal understanding of PLBs or who are unfamiliar with the communicator, tend to overlook behaviours with an intended communicative function, and misinterpret behaviours indicating requests for stimuli, or behaviours intended to reject unwanted stimuli. Issues can also arise when a learner communicates within different contexts or in terms of novel stimuli. Thus listener responsivity plays a significant role in communication development and becomes a critical consideration when designing and implementing effective communication interventions (Atkin & Lorch, 2014; Greathead et al., 2016; Meadan et al., 2012; Reichle, 1997; Sigafoos et al., 2006). Furthermore, in a study conducted by Carter and Iacono (2002), professional judgements of intentional communication behaviours were evaluated in videos of children with typical development, Down syndrome, and children with PMD. The results from the professional judgements, 20 special education teachers and 19 Speech language therapists, showed discrepancies in assigning intention to behaviours when compared with researchers who followed published criteria for intentional communicative acts. Professionals tended to over-assign intentional meaning to behaviours compared with researchers, and the two groups of professionals often overlooked the criteria for intentionality. This calls into question the reliability and accuracy of professionals when observing and responding to children with disabilities. Assessing intentional communicative behaviours, in particular for those with PMD, can offer valuable insight into the motivational state of learners and facilitate the precise and relevant selection of communication goals. A significant component of successful communication interventions require a clear understanding of communicative intention and validation of the function of identified PLBs. This might enable the construction of an instructional program that allows for the best possible outcomes for the learner (Ogletree et al., 1996; Siegel-Causey & Bashinski, 1997).

For Blake and Thomas, an appropriate and feasible response to regain access to their preferred stimuli/interaction was identified, and activities where the motivational states of each participant was appropriately matched to the task, such that they produced responses indicating that they wished to gain further access to the reinforcer. Josie produced two particular behaviours, orienting towards the trainer and orienting towards the stereo, on a somewhat consistent basis. These behaviours appeared to be meaningful for her in re-instating her preferred stimuli. Further, these orienting responses were within her behavioural repertoire, and appeared to be her way of indicating she was motivated to re-gain access to the music. A strength of this technique in validating communicative attempts from these participants is that essentially, the participants themselves choose their individual communicative responses, as opposed to being allocated a response from a therapist or teacher. This ensures that the chosen response is both a feasible response and meaningful to the learner. Further, by first in-directly assessing specific requesting behaviours (Study One, Chapter Three) and now validating these responses, we can assume with some confidence that the behaviours evoked during the interruptions do function as a request for more of a preferred stimulus, or for the continuation of an interaction. Thus the implications of these findings for Blake and Thomas are that the reaching behaviours validated as requests can be targeted in a new instructional based study where assistive technology can be used to enhance their PLBs and provide a more detectable readily understood communicative response. For Josie, the next step might involve strengthening her existing response such that it becomes more refined and consistent.

One particular limitation from this study that may have impacted upon the results was the method of data collection. Although video recording can often be a reliable way to micro-analyse specific behaviours, especially isolating and coding subtle behaviours that require intensive scrutiny, this method can also limit the behaviours able to be coded. For example, due to the video set-up, it was impossible to record eye contact, and specific behaviours when the participant had turned to the side, or had turned away from the camera. This may have been remedied with additional cameras, and/or an additional assistant who could have filmed the sessions more accurately. Due to this, IOA was sometimes challenging as some of the subtle behaviours were difficult for an unfamiliar observer to record. Still, IOA ranged from 78% to 100%. It was also apparent that for those participants who demonstrated more ambiguous behaviours (Thomas and Josie), IOA was lower in comparison to Blake who produced a very clear and consistent response, and Anna who displayed few behaviours during the interruptions. This supports the argument that more subtle or ambiguous PLBs produced by communicators are often more readily identified by familiar communication partners in comparison to other unfamiliar listeners (Carter & Iacono, 2002; Meadan et al., 2012). A further limitation of this approach was that the behaviours presented by the participants outside of the interruptions were not analysed. Thus these participants could well have been producing their specific behaviours consistently throughout the entire session during times where they received access to their reinforcement. This is particularly relevant for Anna as her eye gaze towards the communication partner was not consistently observed during the interruptions, and may well have been a reflexive response. Further, it should be noted that when assessing or evaluating the skills or behaviours of persons with PMD, their behavioural states and learning abilities should be taken into account as these can significantly increase the time taken to learn behavioural contingencies. Fluctuating levels of both awareness and engagement can significantly impact upon the time it takes to provide precise and thorough assessment and implement intervention procedures (Goetz et al., 1985). Thus in the present study, these considerations should have been taken into account for Anna, so that more time was allocated to the implementation of her procedures in order to more effectively and accurately capture and maintain her motivation and attention.

In spite of these limitations, this simple and straightforward stimulus interruption procedure appeared to create a practical method of promoting constructive engagement and interactive behaviours from the participants towards the trainer by invoking a consistent PLB that may indicate a ‘request’ or indicate that they wish to gain further access to their desired reinforcement. It has also provided a simple way of validating the intended meaning and function behind the somewhat ambiguous yet consistent PLBs demonstrated by three of the four participants. This procedure might therefore offer a viable method to enhance these PLBs and provide an opportunity to increase their detectability by using assistive technology (Siegel-Causey & Bashinski, 1997). Assistive technology involving microswitches and Speech Generating Devices (SGDs) might allow for a more naturalistic spoken request that is more easily understood by communication partners, and thus is more likely to be detected and responded to in an appropriate way (Calculator, 1988; Lancioni et al., 2001; Lancioni et al., 2013; Schweigert, 2012).

Based on the results from this study, three individualised communication interventions in the form of three Case Studies were designed for Thomas, Blake and Josie. Unfortunately, due to the lack of a consistent PLB and apparent lack of contingency awareness, a communication intervention was not implemented for Anna. Furthermore, Anna's health began to deteriorate during the end of the present study where the frequency of her seizures increased, resulting in an increase in her medication. Her teachers became apprehensive in regards to the implementation of a communication intervention for Anna, thus it was decided to continue with only Thomas, Blake and Josie.

Adapted Approaches to Intervention

As previously described, systematic instruction incorporating behavioural principles appear to be effective methods to teach functional skills to individuals with PMD (Lancioni et al., 2011; Schweigert, 2012). There is substantial evidence to suggest that such applied behavioural principles may be effective for this population of learners, and that these learners can respond positively to alternating treatment designs, differential reinforcement schedules, and systematic manipulations of variables (Lancioni et al., 2013; Roche et al., 2015; Sobsey & Reichle, 1989; Stasolla et al., 2015).

Issues arose in the present thesis following the completion of this study (Study three) where some unexpected behaviours were observed. Specifically, (a) low levels of responding was observed for Blake, and (b) unanticipated responses were observed for

Thomas and Josie. These outcomes resulted in the modification of procedures and a new pre-experimental intervention approach for their three respective case studies.

Firstly, Thomas was observed to produce additional activations of his microswitch outside of the interruptions that were created as an opportunity for Thomas to use his microswitch to functionally request the continuation of the interaction. This indicated that he (a) was potentially not using the microswitch as a functional communication tool, or (b) he enjoyed the speech out-put that resulted from a microswitch-activated SGD response. Thus instead of teaching Thomas a microswitch response, and then continuing to implement additional phases of intervention where the consequence of the microswitch was manipulated, to identify the function of Thomas' microswitch use, a second phase was implemented to identify the function of Thomas' additional activations.

The low levels of responding observed during an initial intervention procedure resulted in the author having to alter the prompt hierarchy within this first intervention study for Blake. This resulted in 12 sessions where alternative prompting strategies were implemented in an attempt to increase Blake's frequency of independent microswitch activations shifting from (a) errorless prompting (reaching was immediately re-directed to a prompted microswitch activation), to (b) least-to-most prompting, to provide Blake with greater opportunity to independently activate the microswitch, to finally (c) highlighting the microswitch during the stimulus interruptions. Unfortunately these procedural modifications did not increase Blake's independent use of his microswitch, thus a pre-experimental approach was adopted for his final case study.

The unanticipated response from Josie prompted the altered focus of her intervention to that of strengthening her existing PLB, as opposed to enhancing her PLB with the microswitch. This approach adopted a B-only design and manipulated the response delay time-frame in order to strengthen her approach and orienting response towards the communication partner during the timed interruptions in her preferred stimuli.

Due to these unanticipated results, the rigorous experimental designs that had been planned originally were compromised, and pre-experimental approaches were instead implemented for the following three case studies for Thomas, Blake, and Josie. This decision was based on two important considerations; (a) I had to take what the learners were giving me and individualise each case study approach to capture each participants PLB, and (b) provide a communication intervention that would still enhance each participant's communication skills in both a meaningful and beneficial way.

Chapter Six

Case Study One: Enhancing Thomas's Communication Skills

During Study Two (Chapter Four), Thomas demonstrated differences in the rates of specific behaviours that were recorded during the two conditions assessed. Thomas engaged in a number of behaviours more frequently during the stimulus-interaction condition and these were interpreted as being indicative of potential signs of awareness and engagement. During the alone condition, in contrast, the general pattern of behaviour observed was different (i.e., lower levels of engagement behaviour) and this pattern might be interpreted as being indicative of boredom and perhaps also frustration. These findings are important in suggesting that to successfully engage Thomas would require providing a relatively high level of social and sensory stimulation. In contrast, when he was left alone, he showed lower levels of alertness or engagement and appeared to be bored and frustrated. During these alone conditions, Thomas also engaged in higher frequencies of stereotypy and SIB that might indicate that these behaviours were automatically reinforced and used as a distraction or non-social entertainment in the absence of any social attention or interaction (Durand & Carr, 1991; Durand, 1993). This suggests that he was aware of and sensitive to the differences with respect to the two assessment conditions. These results could indicate that Thomas was able to demonstrate social awareness where he adapted his behaviour from that of being alert and engaged in activities with the communication partner, to engaging in stereotypical behaviour when he was alone.

During Study Three (Chapter Five) Thomas demonstrated reaching behaviours that appeared to indicate that he wanted to re-engage with the communication partner and/or that he wanted the interrupted social interaction and sensory stimulation activity to be continued. This was demonstrated in the 20 stimulus interruptions in that during these interruptions Thomas reached for the stimulus and/or communication partner during 80% of the interruptions. These results suggest that the social interaction and sensory stimulation activity was a highly motivating activity for Thomas, and that he had the capacity to produce consistent PLBs to request the reinstatement of this activity. As mentioned in the previous chapter, demonstrations of consistent behavioural responses and the intent to communicate in order to regain access to a highly motivating stimulus could be seen as a critical component for the success of communication interventions, especially for individuals with PMD who rely upon PLBs to communicate (Gee et al., 1991; Gee et al., 1995; Kaiser & Goetz, 1993; Schweigert, 2012).

In addition to providing a seemingly effectively way of identifying the form and possible function of PLBs, the assessment procedures used in Studies Two and Three appeared to be effective in verifying that the social interaction/sensory stimulation provided, and interruptions in these assessment tasks, represented a type of preferred and perhaps also reinforcing activity for Thomas. Based on this assumption, the use of a handheld vibrating massager was chosen as the stimulus with the highest potential reinforcing value for Thomas because: (a) he displayed the most consistent signs of engagement during Study Two when this stimulus was used, and (b) he consistently reached for this item when it was offered to him during the interruptions associated with Study Three. From these findings, it was reasoned that Thomas would likely be highly motivated to continue the social interaction and sensory stimulation activity and might also display an appropriate means of communicating this that could later be strengthened and enhanced. During the social interaction and sensory stimulation activity Thomas frequently appeared to be: (a) engaged and alert, (b) displaying signs of happiness by laughing and smiling, (c) actively engaging with the communication partner through orientating his body and eye gaze towards the Communication partner, and (d) actively reaching for the Communication partner and stimuli during times when social interaction and sensory stimulation were interrupted. Thus interruption of this activity could provide an effective context for the present chapter's attempt to strengthen and enhance Thomas' existing PLB of reaching.

It is also important to note that Thomas also engaged in some problematic forms of behaviour. From Study Two such forms were most often observed when he was alone. However, from Study One, such forms were also reported to occur when his attempts to request or re-instate a desired activity was not successful in that his communication partners did not respond to his apparent communicative attempts. This suggested the need to enhance his existing PLB through the use of assistive technology that might enable him to produce a more naturalistic response that is readily identifiable and correctly interpreted by his communication partners. This may in turn reduce Thomas' tendency to escalate to more problematic behaviours because he would be more consistently understood and achieve functional outcomes.

Based on the data from Studies One, Two, and Three and the analysis or interpretation of these findings described above, it seemed reasonable to pursue an intervention approach (this chapter) aimed at strengthening and enhancing Thomas' existing PLB, such that he would learn to apply his existing communication form (i.e., reaching) so as to engage in what could be seen as a more advanced developmentally, more symbolic, and more readily understood response (i.e., activating a SGD). To achieve this enhancement, it was decided to make use of the stimulus interruption procedure that was used during Study Three (Chapter Five), as this was viewed as an effective method for creating opportunities for enhancing his existing PLB. As noted previously, this procedure has prior success in teaching individuals with PMD functional communication (Hunt et al., 1986; Gee et al., 1991; Gee et al., 1995; Goetz et al., 1985). Additionally, microswitches linked with SGDs, as previously discussed in this thesis, have been successfully applied to promote functional communication in persons with PMD by enhancing existing motor movements or natural gestures, and translating these into synthesised spoken messages via the SGD synthesised speech out-put (Lancioni et al., 2001; Lancioni et al., 2014; Lancioni et al., 2013; Roche et al., 2015; Stasolla et al., 2015).

Therefore by interrupting a highly motivating activity, and instructing Thomas to activate a microswitch linked SGD to provide synthesised speech out-put, Thomas' existing PLB might be enhanced to produce a more naturalistic communicative request that is easily understood by his communication partners. The purpose of the present study was to address the research question: Will the use of the stimulus interruption procedure and systematic instruction be effective in enhancing Thomas' PLB that was validated in Study Three? That is, would these procedures be effective in augmenting his existing PBL (i.e., reaching) with the use of microswitch technology? In the present study, the aim was to teach Thomas to use a microswitch activated SGD to request for the continuation of social interaction and sensory stimulation.

Method

Participant

Thomas was a 19-year-old male who had PMD. A thorough description of Thomas was provided in Chapter One.

Sessions, Settings and Context

Thomas received one session per day, from one to two times per week depending on his attendance at school. All sessions occurred in Thomas' classroom or in a resource or clinical room at his school. The room in which the intervention was provided changed from day to day due to availability issues. However, the use of different rooms was seen as a way of programming for generalisation across settings. Sessions lasted for approximately 10 min and involved a social interaction and sensory stimulation activity during which the communication partner engaged with Thomas. Four interruptions, using the same procedures as reported in Study Three, were implemented during each 10-min sessions.

Communication Partner

All sessions were conducted by the author of this thesis, who acted as the communication partner and implemented all steps of the intervention procedures.

Materials

Two iPad-minis®, both loaded with iOS7 capability were used in this study. One of the iPads was used to video record all of the sessions. The second was loaded with speech generating software, GoTalk®, and was connected to a pressure switch via a wireless Bluetooth connection. The GoTalk speech generating program could be customised to produce individualised speech out-put. For Thomas, the synthesised message produced was *"Please play with me"*.

Microswitch: A pressure sensor microswitch, was used for Thomas. The switch was a highly sensitive round red coloured microswitch called an iPad wireless switch #1164 from the Enabling devices company (www.enablingdevices.com). Activations of the switch would produce voice out-put from the iPad loaded with the GoTalk app via a wireless Bluetooth connection.

Handheld massager: A hand-held vibrating massager was used in conjunction with social interaction for Thomas as this combination appeared to be highly motivating for Thomas.

Response Definitions and Data collection

A correct (independent) requesting response was recorded when Thomas activated the microswitch within 20 s of an interruption, following the communication partner's verbal cue; "Thomas, Let me know what you want". A prompted response was recorded when Thomas did not respond by activating the microswitch within the 20-s timeframe. In such cases, Thomas was prompted to press the microswitch using a physical, gestural, and/or second verbal prompt delivered by the communication partner (see *Procedures*). Additional switch activations were recorded when Thomas activated the microswitch during times outside of the 20-s interruption timeframe. Additional switch activations were only included if Thomas pushed the switch with his hand or arm, and was looking at the switch. Microswitch activations were not recorded if Thomas accidentally hit the switch with his elbow or forearm when engaging with the communication partner. This was an important distinction as the microswitch was located on Thomas' tray table of his wheelchair and he would occasionally bump the microswitch with his elbow or arm while interacting with the communication partner.

Evaluation Approach

To evaluate the effects of the intervention procedures that were intended to increase Thomas' correct responses (i.e., independent use of his microswitch during the 20-s interruption), two conditions were assessed. First, four interruptions to the social interaction and sensory stimulation activity were implemented during each 10-min session with one interruption scheduled approximately every 2.5 min. Data were collected on the percentage of interruptions during which a correct response (i.e., independent switch activation) occurred within 20-s of the start of the interruption trial.

An increase in the percentage of correct responses (i.e., independent switch activations that occurred within the 20 s window of opportunity) across sessions would suggest that Thomas was learning to use the microswitch to make a functional request and that he was learning to do so at the right time.

However, during the course of the first few intervention sessions, Thomas was observed to also activate the microswitch during times outside of these interruptions. Consequently, a second phase was added to the intervention evaluation. During this second phase there were no interruptions built into the social interaction and sensory stimulation activity. This second phase was designed as a way of checking to determine if his use of the SGD was functioning as a request for re-instatement of the social interaction and sensory stimulation. A high frequency of switch activations when there was no interruption, and hence no need to "request" continuation, would indicate that the intervention was not effective in teaching Thomas to use the SGD as a tool for communication exclusively at the right time. Instead, high rates of switch activations during this phase could suggest the switch was being used to produce sensory stimulation in the form of the speech output. In contrast, lower rates of switch activations during this phase when no interruptions occurred, might suggest that Thomas had acquired discriminated use of a new communicative requesting response. In this way, it would be possible to determine if the increase in the percentage of correct microswitch activations during interruptions was due simply to an overall increase in responding for direct stimulation, rather than communication, purposes. Based on the results of this second (no interruption) phase, a third and final phase was conducted as part of Thomas' intervention. In this final phase, the interruption procedure was re-instated to strengthen Thomas' use of the SGD for requesting continuation of social interaction/sensory stimulation.

Procedures

Overview. The intervention programme for Thomas aimed to teach him to press the microswitch and activate the SGD when social interaction and sensory stimulation was interrupted. The intervention involved providing social interaction and sensory stimulation and then providing interruption trials similar to those used in Study Three. In addition to the stimulus interruption procedure, the teaching procedures involved the use of time delay, a least-to-most prompt hierarchy, and contingent reinforcement. The dependent variables were (a) the percentage of interruptions with a correct response (i.e., independent switch activation within 20-s of the interruption), and (b) the number of switch activations that occurred outside of the 20-s interruption interval.

First intervention phase. During the first interruption phase, Thomas was seated in his wheelchair facing an iPad which video-recorded him. On a low table beside him, the second iPad, connected to the microswitch, was open to the correct page in the GoTalk app and acted as the SGD. The microswitch was placed on his wheelchair tray within his reach. Before every session, Thomas received five practice trials where he was prompted to push the microswitch with his hand. Prompting consisted of the communication partner first saying, *"Thomas, push the switch",* followed by the implementation of the least-to-most prompt hierarchy where the communication partner would point to the switch, and then physically prompt Thomas to push the switch if he had not done so independently. Following this, the communication partner began timing the 10-min session. The communication partner engaged continuously with Thomas through social interaction and used the hand held massager to massage Thomas's arms and neck. During the activity, she would also place the massager on his tray table to create funny buzzing noises. After approximately 2.5 min, the communication partner paused the interaction and said; *"Let me know what you want".* A 20-s response delay was then implemented during which the communication partner stepped back from Thomas and held the massager in-front of him, but out of reach. During this pause, a correct response (i.e., independent microswitch activation) was recorded if Thomas independently pushed the microswitch within this 20-s time delay so as to produce the synthesised speech output. Following an independent activation, the communication partner immediately responded with *"I will play with you!"* and then reinstated the interaction. If no SGD response occurred with the 20-s response delay, Thomas was prompted to press the microswitch. Prompting consisted of the communication partner providing a verbal prompt ("Thomas, let me know what you want") while also gesturing towards the microswitch. If this did not recruit a microswitch response within about 10 s, then the communication partner physically prompted Thomas to push the microswitch. If Thomas reached for the massager and/or the communication partner, his hand was immediately re-directed to the microswitch and he was physically prompted to push the microswitch. A session lasted approximately 10 min with a total of four interruptions of the interaction implemented per session (i.e., one interruption approximately every 2.5 min).

No interruption phase. During the no interruption phase, Thomas received social interaction and the sensory stimulation with the handheld massager for a total of 10 min. During this time there were no interruptions to the social interaction and the sensory stimulation activity. The number of microswitch activations was recorded, but any such activations had no social consequences (i.e., the communication partner ignored these).

Second intervention phase. Procedures were the same as during the first interruption phase.

Inter-observer Agreement

All of the videotapes were coded by the author (communication partner) and an independent observer (PhD student) coded 30% of the sessions for Thomas. This student received training by watching one session with the author. During this time, the author and the student discussed the different behaviours seen in the video, and what each behaviour would be coded as. Following this, both the author and student watched another session and coded this video independently. This was then followed by a discussion in regards to their agreements and disagreements. This was sufficient to obtain a high level of agreement between the two coders, as determined by the author. An agreement between the two coders was scored if each had recorded that a correct response (i.e., an independent switch activation) had either occurred or not occurred within the 20-s interval. IOA was calculated using the formula: agreements/(agreements + disagreements) x 100. IOA ranged from 50% to 100% (average was 87.5%). IOA was also calculated for the additional switch activations by comparing the total number of additional activations recorded by each observer. This was also done for 30% of the sessions. IOA on additional switch activations was calculated using the formula: Smaller number/larger number x 100%. The resulting percentages of agreement, rounded to nearest whole number, ranged from 57% to 86% (average was with 81%). Sessions with relatively lower percentages of agreement (i.e., 50%, 57%) occurred when the absolute number of correct responses or additional switch activations was relatively low and thus any differences between the two observers resulted in disproportionately deflating the percentage agreement.

Procedural Integrity

An independent observer coded 30% of the sessions for Thomas to check if all procedural steps had been implemented correctly according to the steps below, and had been carried out in the correct order, with a 3-s discrepancy allowed for specific timing of procedures. The procedural steps were:

1. Communication partner stands near to Thomas with the microswitch located on his tray-table, linked with a nearby iPad, opened to the correct page.
2. Communication partner engages with Thomas for approximately 2.5-min by massaging his arms/back, talking and laughing with him, counting, and playing games.
3. Communication partner pauses the interaction, steps back from Thomas, and provides verbal cue: “Let me know what you want?”
4. Communication partner pauses for 20-s. During the interruption, if Thomas makes no response, the specific prompting hierarchy implemented. If independent response, interaction immediately reinstated.
5. Social and tangible interaction reinstated for approximately 2.5-min. Repeat steps 2-5 for a total of four interruptions per each 10-min session.

PI was calculated using the formula: total number of correctly implemented steps/total number of steps implemented x 100. PI was calculated at 100% for Thomas' sessions.

Results

The results of the evaluation approach implemented to enhance Thomas's communication skills are presented in the figure below as the percentage of independent microswitch activations per interruption during each session, and the frequency of additional activations per session, across the three phases. As shown in Figure 2.1, during the first interruption phase, Thomas showed an increasing percentage of correct responses over sessions. He reached the 75% correct level during the fourth session and maintained this high level over the final three sessions of this phase. However, there were an average of 15.7 additional activations per session in this phase. This finding prompted a move to a second (no interruption) phase. During his first session of the no interruption phase, Thomas produced four additional switch activations and during the next two sessions he produced zero and six additional switch activations. This decrease in additional switch activations is in contrast to the previous phase and as these frequencies were lower than 10 additional activations, a decision was made to return to the use of the interruption procedure in a final phase. During this final phase, Thomas was consistently at or above 75% for percent of correct, responses (except during the second session). During this final phase he averaged 6.4 additional activations per session.

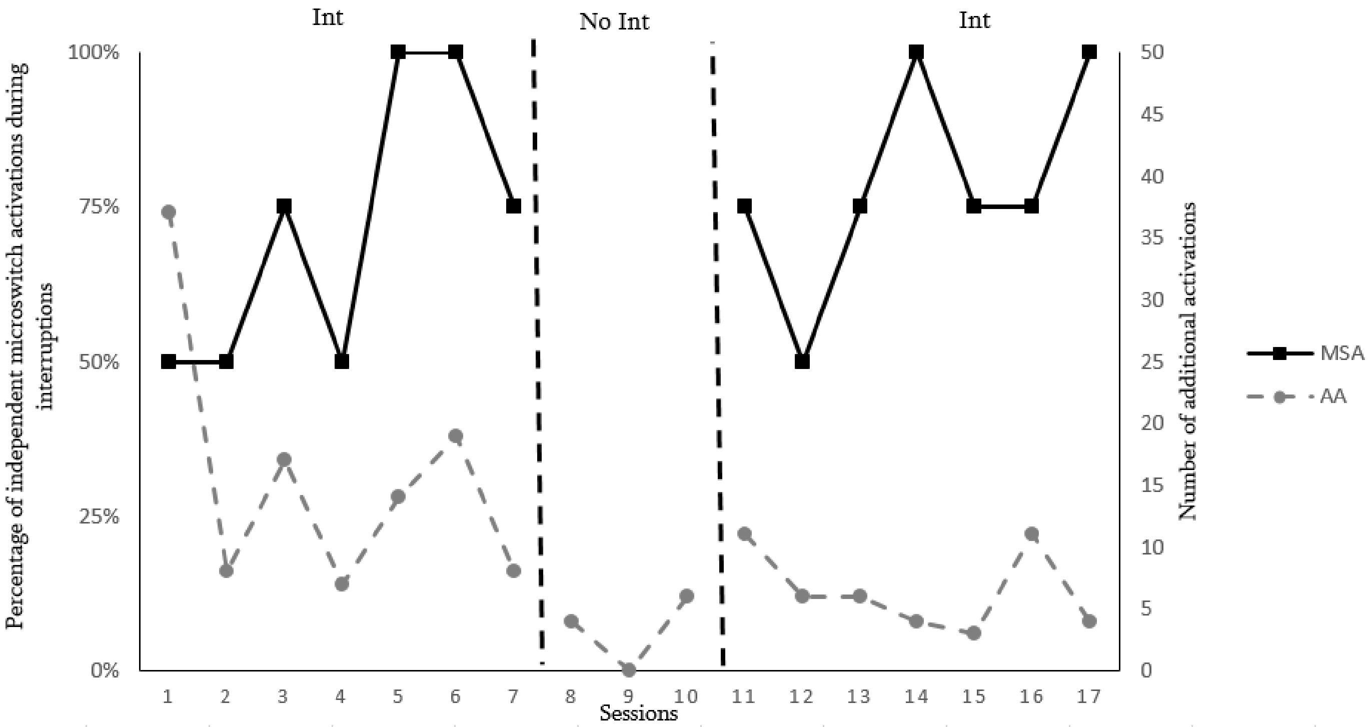

Figure 2.1: On the left axis is scaled the percentage of correct, independent microswitch activations (MSA) that occurred within 20 s of an interruption across the three phases: On the right axis is scaled the number of Additional Activations (AA) made by Thomas outside of the 20-s stimulus interruption trials.

Discussion

The purpose of the present study was to address the research question: Will the use of the stimulus interruption procedure and systematic instruction be effective in enhancing Thomas' PLB that was validated in Study Three? That is, would these procedures be effective in enhancing his existing PBL (i.e., reaching) by teaching him to reach for and activate the microswitch, which in turn activated the SGD and led to the communication partner re-instating the social interaction and sensory stimulation activity. The intervention aim was to teach Thomas to use a microswitch activated SGD to request for the continuation of social interaction and sensory stimulation activity instead of just reaching for the communication partner or reaching for the massager. The results of the evaluation of this intervention approach with Thomas suggested that it was effective in teaching him to use the microswitch-based SGD to request continuation of the social interaction and sensory stimulation activity. This is evidenced by increases in the percentage of correct responses (i.e., independent microswitch activations) over sessions during the interruption phases and a relatively lower level of additional activations during the no interruption phase. These findings suggest the systematic instructional procedures were effective in promoting functional use of the SGD as a means of communicating a request.

The results are consistent with previous studies that have adopted interrupted strategies and systematic instructional procedures to teach communication skills to individuals with developmental and physical disabilities (Gee et al., 1991; Gee et al., 1995; Goetz et al., 1985). Rapid acquisition rates are often hypothesised to be due to the highly motivating context under which instruction is implemented, that is the interruption strategy is considered to be an effective way to create the need for communication (Gee et al., 1991; Goetz et al., 1985). In addition to using well-established interrupted strategies and systematic instruction procedures, the microswitch technology could also be seen as a simple yet highly effective communication mode for Thomas as it was activated using a similar response form that he previously displayed in Study Three when the social interaction and sensory stimulation activity was interrupted (i.e., reaching). This might account for Thomas' rapid acquisition of correct, independent requesting in this study (Lancioni et al., 2014; Lancioni et al., 2013; Roche et al., 2015; Stasolla et al., 2015).

These successful results are likely due to the interruption procedures which effectively created a highly motivating context where the need for communication was generated. Interrupting the social interaction, sensory stimulation activity appeared to be an effective context for teaching and motivating Thomas to communicate. As Study Three showed, Thomas would engage in PLBs when the interaction was interrupted. This PLB of reaching was produced seemingly as a way of indicating a desire to reinstate the interaction. Additionally, the new microswitch activated SGD response was similar in form to his existing reaching response and so intervention could be seen as focused on adapting or enhancing this existing communicative form into a slightly different form (i.e., reaching for an object versus reaching out and touching the microswitch). The enhancement consisted of making the response perhaps more advanced developmentally and perhaps also more readily interpreted by communication partners (Carr, Austin, Britton, Kellum, & Bailey, 1999; Lancioni et al., 2002). The decision to enhance in this way could be seen as advancing Thomas' existing level of communication to a form that would likely be considered more sophisticated and perhaps also more socially appropriate. By enhancing his reaching response, Thomas' requests would likely be more detectable for communication partners due to the synthesised speech out-put from the microswitch activating the SGD. Evidence from Lancioni suggests that people using such technology to communicate are seen as more socially adept and can interact in a more constructive manner with their environment (Lancioni et al., 2001; Lancioni et al., 2002; Lancioni et al., 2009a). Thus the use of the SGD and microswitch technology might have enhanced his social image among communication partners.

However, these results must be interpreted with caution. The lack of a rigorous experimental design means we cannot be sure the intervention procedures were responsible for Thomas' increase in microswitch use. The presence of additional activations were also not completely absent from any of the phases during intervention. These could indicate that Thomas was just pressing the microswitch to hear the synthesised speech out-put from the SGD, or that he enjoyed the act of pressing the microswitch instead of using it to make intentional communicative requests. The continued presence of additional activations could also mean that he failed to learn when a request was necessary and was simply pushing the switch because it was accessible. If the former, then this would be consistent with Sobsey and Reichle (1989). These authors were interested in evaluating the effect of the buzzing noise (from activating the microswitch) on the frequency of microswitch activations. In this study, three boys and three girls, described as having multiple disabilities, were instructed to activate a microswitch to request attention. An alternating treatments experimental design was implemented to assess the purpose of the participant's microswitch activations by alternating four conditions following a microswitch activation: (a) buzzing noise only, (b) attention only (no buzzing noise), (c) buzzing noise and attention, and (d) no buzzing noise or attention. Results suggested that microswitch activation frequencies were highest during the buzzing plus attention conditions followed by the attention only, the buzzing noise only, and finally the no buzzing nor attention condition. During this study, microswitch activations were still observed during the buzzing only condition, which means that some microswitch activations might function as a form of gaining stimulation (i.e., tactile or auditory [hearing the noise]) rather than as an act of intentional requesting, at least for some of the time. If the latter then it means there could be value in an additional intervention aimed at teaching discriminated requesting, as suggested by Reichle, York, and Sigafoos (1991). This might be attempted by first maintaining the correspondence between Thomas' request and the subsequent reinforcing stimulus he had asked for. One approach to maintain correspondence might be to offer Thomas two stimuli upon a request: his requested stimuli, and a distractor stimuli that is either another toy or an un-related item. If Thomas is then able to indicate towards the requested item it might suggest that his correspondence between his requests and his desired outcome have been strengthened and may demonstrate that he is able to discriminate between desired and non-desired stimuli. A second phase could involve providing Thomas with the wrong stimulus following a request, or offering a non-preferred stimulus following a request. In these scenarios, if Thomas again tried to request his original desired stimulus using the microswitch, it might indicate that he was in-fact using the microswitch as a functional communication tool to gain access to his original desired stimulus (Reichle, Rogers, & Barrett, 1984; Reichle, Sigafoos, & Pichè, 1989; Reichle et al., 1991; Sigafoos & Dempsey, 1992; Sigafoos & Roberts-Pennell, 1999).

The present evaluation design was used because the main purpose of the intervention was to enhance Thomas' communication skills using microswitch activated SGD technology. Results from Studies One, Two, and Three appeared to show that Thomas already had a viable means of requesting preferred stimuli, however this response was often misunderstood or misinterpreted as a communicative attempt by listeners. This miscommunication often resulted in Thomas escalating to more problematic behaviours. Further, Thomas's PLB could be viewed as a less advanced mode of communication, socially unacceptable and ambiguous. Therefore, the present intervention was conducted to enhance this existing form by linking his reaching response to activating a microswitch activated SGD to produce a synthesised spoken message, which would provide a more appropriate and readily understood communication response for communication partners to detect and respond to. Further, the activation of an SGD and the production of synthesised speech out-put would be perhaps a more acceptable response in situations when reaching was not possible, or his response was incorrectly interpreted by communication partners.

Although this intervention could be considered preliminary research for Thomas, there is some indication that he was able to learn the contingency and produce differentiated microswitch responding during the intervention. This was demonstrated in the last interruption phase where his average number of additional microswitch activations decreased from that recorded during the first interruption phase (from 15.7 to 6.4 additional activations), and he produced high rates (above 75%) of correct independent microswitch activations. This provides some evidence that Thomas was using the microswitch intentionally to produce a functional communicative request. As discussed, behaviours that are consistent and produced under highly motivating circumstances are often considered intentional acts. Furthermore, Yoder and Warren (2001) suggest that intentional communication also requires the speaker to orient their body towards a listener, and gaze towards the listener, all behaviours Thomas engaged in during microswitch activations. Furthermore, generalisation of independent microswitch use was demonstrated by Thomas because during intervention the location of instruction changed due to room availability. Thus Thomas demonstrated the ability to use this technology across various classroom settings.

The use of the stimulus interruption procedure, an adapted version of the interrupted behaviour chain procedure, proved an effective method under which to create opportunities for systematic instruction. As shown in the data, Thomas responded positively to these instructional procedures. Therefore a more elaborate behaviour chain could be targeted in future teaching programs for Thomas where he could be instructed to carry out more complex tasks, or initiate a request to begin a behaviour chain or social interaction. Further, the enhancing of Thomas' natural gesture with assistive technology allowed for his existing communicative form that was feasible and meaningful for him, to be effectively translated into a more easily understood synthesised spoken message. In line with the Enhanced Natural Gesture Theory (ENG: discussed in Chapter Two), future research could focus on further strengthening and enhancing additional natural communicative gestures demonstrated by Thomas to build up a more functional exchange and response repertoire to foster more social and constructive interactions (Calculator, 1988; 2002). Additionally, future goals for Thomas could extend his use of this assistive technology. Thomas was able to quickly understand the reinforcement contingency and reached proficiency in independent microswitch activations with only a few sessions, thus future research with Thomas could incorporate additional microswitch combinations with multiple messages, such as rejecting non-preferred stimuli. This could enable Thomas to make choices between stimuli, or initiate social interactions with additional communication partners. Further, additional research could replicate the intervention procedures and design to determine whether this teaching approach could benefit larger sample sizes of individuals with PMD in order to address the lack of external validity of this intervention approach.

Following the completion of intervention, the author returned to the classroom to discuss the findings from the three assessments and the final case study for Thomas. In this meeting, the author provided a report covering (a) the purpose of the research, (b) the findings form the IPCA and the Vineland, (c) the findings, and potential outcomes for Thomas, in regards to the second study assessing alertness and engagement, and (d) the results of study three and his final case study. During this meeting, a selection of short video clips from Thomas' case study were shown to the teachers. During this we discussed Thomas' various methods of communication, what his behaviours appeared to show, and how he demonstrated high levels of alertness and engagement during the one-on-one interaction with me. Future ideas to progress Thomas' communication were discussed and his teachers and the school were given a copy of the report.

In summary, these data suggest that Thomas' existing communication form of requesting was successfully enhanced using a stimulus interruption procedure and a microswitch activated SGD. Furthermore, this response was translated into a synthesised spoken message that may be easier for his communication partners to detect, interpret, and respond appropriately to.

Chapter Seven

Case Study Two: Enhancing Blake's Communication Skills

The findings from Study Two (Chapter Four) indicated differences in the rates of behaviours exhibited by Blake under the two conditions assessed. During the social-interaction conditions, Blake displayed behaviours considered indicative of engagement and happiness. Alternatively, during the alone conditions Blake demonstrated behaviours that potentially indicated that he was bored or frustrated. He would often fall asleep, vocalise loudly, and engage in stereotypy and SIB during the alone condition. These findings suggest that engagement could be evoked by the social interaction and sensory stimulation activity. These findings also suggest Blake was sensitive to the differences in the two conditions, and was able to adapt his behaviour depending upon his social circumstance. This assessment also demonstrated that Blake might have found the social interaction and sensory stimulation activity to be reinforcing, preferred and enjoyable in that during the activity he frequently was observed to be laughing, smiling and vocalising. In contrast, he did not appear to enjoy the alone condition as during this he showed stereotypy, falling asleep, and lowered alertness.

During Study Three (Chapter Five) Blake demonstrated the PLB of reaching consistently during the interruptions, suggesting that this PLB was in fact a form of requesting that he wanted more access to the preferred snack. Over the 20 interruption trials conducted in Study Three Blake showed the PLB of reaching during 95% of the interruptions. These results suggest that accessing this snack item was highly motivating for Blake, and that he had the capacity to produce the reaching response consistently and that this response most likely functioned as a communicative request for more. The consistency of reaching during interruptions suggest that Blake did have an intent to communicate. Intent to communicate might be seen as an important construct in that it would seem to indicate that the learner has an understanding of the contingency that exists between their behaviours, and the consequences of those behaviours (Carter & Iacono, 2002; Crais & Ogletree, 2016; Kaiser & Goetz, 1993; Schweigert, 2012; Sigafoos et al., 2006). A learner who demonstrates an intent to communicate may be more likely to be successful in developing more advanced symbolic means of functional communication (Kaiser & Goetz, 1993; Schweigert, 2012; Yoder & Warren, 2001).

The findings from Studies Two and Three overall suggest that the procedures used were effective in the identification of a preferred stimulus for Blake, and in identifying behaviours indicative of communicative intent. Therefore, interrupting access to potato chips was chosen as the intervention context for Blake given the aim to strengthen and enhance his existing prelinguistic form of requesting more.

The purpose of this current study was to enhance his PLB of reaching by teaching him to reach out and activate a microswitch, which in turn activated a SGD. To achieve this, a responsive interaction condition was devised for Blake which included the creation of a highly motivating communication environment, limited physical prompting, and access to his highly motivating snack item contingent on a correct response (i.e., independently using a microswitch based SGD) when access to a seemingly preferred stimulus was temporarily interrupted. Interruption of access to a preferred stimulus could be seen as a type of naturalistic teaching procedure. In addition to this, Blake's intervention plan also aimed to evaluate a response interaction approach in which there would be limited use of prompting or cueing. This decision was made because Study Three showed Blake would consistently reach only during the interruption and therefore in the present study it was anticipated that he would be highly likely to reach for the microswitch when it was in reach, but the preferred snacks were out of reach.

Responsive interaction is a naturalistic teaching procedure designed to elicit functional communication in children with developmental disabilities using limited prompting, maximising the learner's motivation to communicate, and instructing communication partners to be sensitive and responsive to the learners communicative attempts (Kaiser et al., 1996; Yoder et al., 1995; see also Chapter Two). In a responsive interaction condition, the environment of instruction is manipulated to increase the likelihood of the learner needing to communicate, for example, pretending to misunderstand a communicative gesture when standing in the kitchen next to the sink. A learner might point to the tap in order to request a drink, and the communication partner would use time delay, and models to prompt a functional communicative act such as a clear gesture, a vocalisation, or a word approximation for ‘drink’. Responsive interaction conditions have proven success in individuals who experience developmental or intellectual disabilities where the development of speech or functional communication is impaired and require a naturalistic approach to enhancing communication (Kaiser et al., 1996; Mahoney & Powell, 1988; Yoder et al., 1995). Due to the naturalistic approach, this type of intervention can be easily implemented within a classroom or home environment with simple procedures for teachers and parents to follow (Kaiser et al., 1996). In fact, literature suggests that communication interventions should take place within environments where the communicator is motivated and required to communicate in a functional manner, thus classroom based naturalistic interventions are encouraged (Yoder et al., 1995). In the present study, the original responsive interaction model was adapted where no modelling of the correct response was provided. Instead, to enhance Blake’s communication skills this adapted responsive interaction condition included: (a) manipulations of the environment where Blake’s preferred snack was out of reach and inaccessible, (b) a communication partner who was sensitive and responsive to communication attempts, (c) an initial communication cue, and (d) access to preferred reinforcement contingent upon a microswitch response during a 5-min timed period. By providing Blake with the antecedent to request using the microswitch to access more of the snack, he could request when he was motivated to do so. In this way, Blake could only receive his preferred item contingent on independent and active participation.

As validated in Study Three, Blake already had a viable means of requesting preferred stimuli. This response was however considered a response that could be enhanced by linking it to a SGD via the microswitch technology. Reaching out and activating a microswitch-based response would enhance his PLB of reaching in that it would (a) serve the same communicative function, (b) require the same effort, and (c) could be seen as perhaps more symbolic, advanced and conventional. Furthermore, as Blake was a very passive and somewhat often seemingly unresponsive individual, an intervention to promote engagement and constructive interaction with his communication partners seemed beneficial. The purpose of the present study was to address the research question: Will a stimulus interruption approach with a responsive interaction component and systematic instructional procedures be effective in enhancing Blake's PLB of reaching. A three phase evaluation approach was implemented to assess the effects of the intervention on Blake's use of a microswitch-activated SGD to request access to his preferred snack item when access to the snacks was interrupted.

Method

Participant

Blake was a 20-year-old male. A thorough description of Blake was provided in Chapter Three.

Sessions, Setting, and Context

Blake received from one to two sessions per day, depending upon his attendance at school. Sessions were 5 min in duration and occurred within Blake's classroom or resource room at his school. The room in which the intervention was provided in changed due to availability issues. However, the use of different rooms was seen as a way of programming for generalisation across settings.

Sessions occurred within Blake's classroom or within a resource or clinical room at his school that was quiet. Often these rooms had to be changed during this study due to availability. Sessions were conducted in the context of a snack activity during which Blake had access to potato chips while also receiving social interaction provided by the communication partner. This involved the communication partner talking to him, asking him questions, mimicking his vocalisations, singing to him, and physically engaging with him by clapping his hands or touching his shoulder.

Communication Partner

All sessions were conducted by the author of this thesis, who acted as the communication partner and implemented all steps of the intervention procedures.

Materials

iPads. Two iPad-minis®, both loaded with iOS7 capability were used in this study. One of the iPads was used to video record all of the sessions, and the second was loaded with the speech generating software, GoTalk®, and was connected to a pressure microswitch via a wireless Bluetooth connection. The GoTalk speech generating program could be customised to produce individualised speech out-put. For Blake, the synthesised message produced from the SGD via a microswitch press was *"More Please".*

Microswitch: One highly sensitive round red coloured pressure microswitch called an iPad wireless switch #1164 was used in the present study (the same switch as used for Thomas in the previous case study). Activations of the switch would produce voice out-put from the iPad loaded with the GoTalk app via a wireless Bluetooth connection.

Salted Potato chips: A bowl full of salted potato chips acted as Blake's preferred stimuli which he requested to gain further access to.

Response Definitions and Data Collection

During the first, no prompting phase, a correct response was recorded and reinforced (see *Procedures*) whenever Blake either reached for the snack directly or pressed the microswitch to activate the SGD. The number of reaching and SGD responses was recorded for each 5-min session. During the prompted phase, the number of correct responses were recorded and defined as occurring only when Blake independently pressed the microswitch to activate the SGD during the 5-min sessions. Reaching was considered as an incorrect response and was not reinforced during this phase. During the final, no prompting phase, both reaching and microswitch activations were recorded and reinforced as correct responses.

Evaluation Approach

Blake's intervention was evaluated in a three phase design that examined the effects of the intervention on the frequency of reaching and microswitch activations. The three phases were an initial no prompting phase during which both reaching and microswitch use were reinforced to determine which response he would consistently use. After this, the second phase involved prompting microswitch use and no longer reinforcing reaching in an effort to strengthen the use of the microswitch-based requesting form. After this, a final third phase was implemented in which prompting of microswitch use was discontinued in an effort to promote and strengthen independent use of the microswitch-based requesting form.

Procedures

No prompting phase. During this phase, Blake was seated at a table with the communication partner. The bowl of chips was placed in-front of him but out of reach. The two iPads were located on the table, one recording him and the other open to the correct page on the GoTalk app (acting as the SGD). The microswitch was located directly in-front of him within arm's reach. Before every session, Blake received one chip and a verbal cue directing his attention to the bowl of chips and the microswitch with the communication partner saying; *"Blake, if you want some more, push the switch".* The 5-min session then began. During these sessions, if Blake reached for the chip or activated the microswitch, he was reinforced by being given a potato chip. Both reaches and microswitch activations were accepted as correct responses and were reinforced and recorded. No other prompting procedures were used during this phase.

Prompting phase. During this phase, Blake was seated at the table with the communication partner with the same set-up of materials present in-front of him as during the previous phase. The procedures during this phase were similar to those during the previous phase, except that reaching was no longer reinforced. Instead Blake was only reinforced when he used the microswitch to activate the speech out-put. If he reached for a chip, he was then prompted to press the microswitch. Prompting consisted of the communication partner physically re-directing his hand to the microswitch. Both independent and prompted microswitch activations were reinforced with access to the chips. During these sessions Blake also received verbal praise following prompted and independent responses.

No prompting phase. During the final phase the procedures were identical to those implemented in the first no prompting phase.

Inter-observer Agreement

All of the videotapes were coded by the first author (communication partner) and an independent observer (PhD student) coded 30% of the sessions for Blake. This student received training by watching one session with the author. During this time, the author and the student discussed the different behaviours seen in the video, and what each behaviour would be coded as. Following this, both the author and student watched another session and coded this video independently. This was then followed by a discussion in regards to their agreements and disagreements. This was sufficient to obtain a high level of agreement between the two coders, as determined by the author. An agreement between the two coders was scored if each had recorded that an independent microswitch activation or a reach had occurred during each 5-min session. IOA was calculated using the formula: Agreements/(Agreements + Disagreements) x 100%. IOA was calculated for Blake as from 50% to 100% (average was 90%).

Procedural Integrity

All of the videotapes were coded by the first author and an independent observer coded 30% of the sessions for Blake. An agreement between the two coders was scored if the independent observer recorded that all procedural steps were implemented in the correct order and in the correct way, with a 3 s discrepancy allowed. The procedures used in this intervention were systematically implemented following these steps:

1. Communication partner sits next to Blake with the microswitch located on the table, linked with a nearby iPad, opened to the correct page.
2. Communication partner offers Blake one chip. Communication partner waits for Blake to finish the chip, then holds up the microswitch and provides verbal cue: "Blake, if you want more, push the switch"
3. Communication partner starts timing the 5-min session and records the number of reaches and microswitch activations that occur.
4. In the no prompting the phase, the communication partner reinforces each reach and/or microswitch activation response by giving Blake another potato chip.
5. In the prompting phase, if Blake reaches for the chip, the communication partner prompts Blake to press the microswitch by re-directing his hand to the microswitch. Blake immediately receives snacks following activation of the microswitch.

PI was calculated using the formula: Total number of correctly implemented steps/total number of steps implemented x 100%. PI was calculated at 100% for Blake's sessions.

Results

The results of the intervention implemented to enhance Blake's communication skills are presented in the figure below. Figure 2.2 displays the frequency of reaching and microswitch activations across sessions during each phase of the intervention. During the first three sessions of the first phase, Blake reached for the preferred item once during each of the sessions, and independently hit the microswitch a maximum of two times per session. During the 10 sessions when microswitch use was prompted, Blake's frequency of reaching decreased as the number of independent microswitch activations increased from one during the first session, to three in the fifth session. Over the remaining five sessions, Blake pushed the microswitch an average of 4.6 times per 5-min session. During the last no prompt phase, Blake maintained a high frequency of microswitch activations across the three sessions resulting in nine switch activations during the first two sessions, and 12 switch activations during the final session. The frequency of Blake's reaching averaged two reaches per each 5-min session during this final phase.

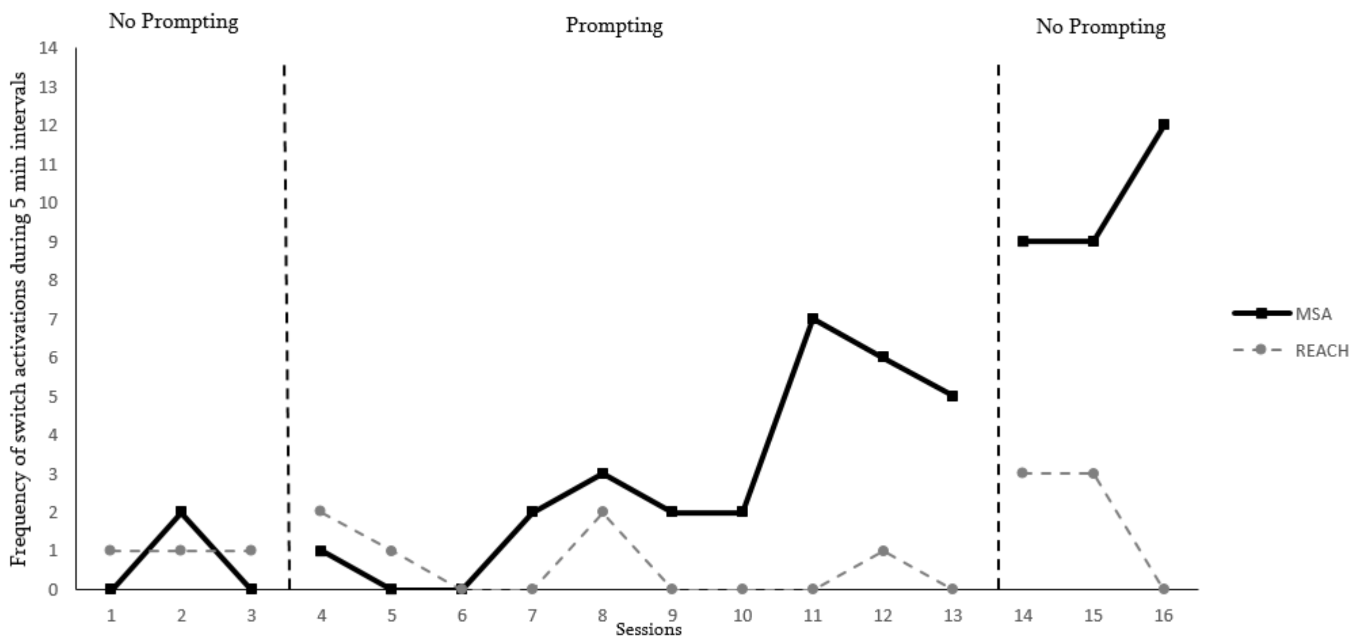

Figure 2.2: The Y-axis represents the frequency of independent switch activations (MSA) and reaching (REACH) during each session across the three intervention phases.

Discussion

The purpose of the present study was to evaluate the effects of three intervention phases on Blake's use of an existing PLB and a new enhanced requesting form, which was to activate a microswitch-based SGD. Results of this intervention show increases in Blake's average rate of independent microswitch activations from less than one (0.7) during the first no prompting phase to almost three (2.8) responses per session during the subsequent prompting phase. High rates of the enhanced response form were maintained during the final no prompting phase where his average microswitch response was 10 per session. These findings suggest the systematic instructional procedures implemented in this intervention evaluation were effective in increasing the frequency of independent microswitch activated SGD requests for Blake. Additionally, differential responding increased during the last phase where Blake activated the microswitch more frequently than he reached for the snack item, suggests that he may have learned to use the microswitch as a functional communication tool.

The data during the first no prompting phase may be indicating that Blake lacked the motivation and need to communicate, resulting in his low levels of responding and apparent passitivity. These findings align with literature demonstrating the importance of contingency based interventions for those with PMD. Frequent and continuous access to reinforcement, or non-contingent access, can reduce a learner's motivation to actively participate within a learning or instructional environment. The reduction of a connection between a behaviour and its consequence can often lead to a state of learned helplessness in individuals with PMD, which may manifest as passitivity, non-engagement, and low levels of arousal or alertness (Arthur, 2003; Guess et al., 1990; Maes et al., 2007; Marcus & Vollmer, 1996). For Blake, a 20-year old male who has not experienced any such intervention before, it is perhaps not surprising that he exhibited low levels of alertness, engagement and appeared passive and largely unresponsive during the initial intervention sessions.

Alternatively, research has demonstrated fast acquisition rates of independent microswitch use when a highly motivating situation is identified, and a need to communicate is created (Kaiser & Goetz, 1993; Lancioni et al., 2001; Schweigert, 2012; Wacker et al., 1990). Further, when the correspondence between the request from a learner and the subsequent access to the requested stimuli is matched, acquisition of a requesting response is often rapid (Beukelman & Mirenda, 2005; Reichle et al., 1991). Furthermore, responsive interaction approaches have been effectively used in conjunction with systematic teaching procedures in communication interventions in previous literature (Yoder et al., 1995). As well as providing a more naturalistic instructional context, responsive interaction conditions can be established within classrooms and with a range of individuals with varying skills and deficits (Kaiser et al., 1996; Mahoney & Powell, 1988; Yoder et al., 1995). As the intervention progressed, Blake appeared to grasp the contingency where microswitch activations gained him access to the reinforcer. Simultaneously his reaching response decreased. These findings suggest that the prompting procedures were effective in strengthening Blake's differentiated responding and may indicate that Blake's microswitch responses were intentional acts of communication (Yoder & Warren, 2001; Schweigert, 2012).

This evaluation approach is limited by the sequential design which lacked experimental rigor and did not include any long term follow-up. The low levels of responding seen during the first no prompting phase suggested that Blake was not motivated to communicate. This resulted in the compromise of potentially implementing a more rigorous experimental design, as was originally planned. Instead, an evaluation approach involving two additional phases was implemented to assess the effects of the responsive interaction and prompting procedures on Blake's microswitch use. Further, both the external and internal validity of this study are restricted because only one participant received instruction, and there were no systematic replications of these results, thus these seemingly positive data must be interpreted with caution.

Results from Studies Two and Three suggested that Blake already had a viable means of requesting preferred stimuli. However, Blake's reaching gesture could be viewed as perhaps a less advanced mode of communication and less socially acceptable than would be expected of an adolescent of his age. Therefore, the present intervention was conducted to enhance his existing communicative form by linking his reaching response to a microswitch-based SGD. This enhanced form could be seen as a more readily understood communication response. Further, the activation of an SGD and the production of synthesised speech out-put would be perhaps a more acceptable and consistent response in situations when reaching was not possible or appropriate. A microswitch-based communicative response is also seen as a more conventional and appropriate form of communicating (Carr et al., 1999; Lancioni et al., 2002). Additionally, generalisation of independent microswitch use was demonstrated by Blake as during intervention, the location of instruction changed due to room availability. Thus Blake was able to use this technology across various settings within his school.

These results could be seen as offering a preliminary demonstration of a potentially useful method of instruction where the communication skills of an individual with PMD, with an existing and consistent PLB, could be enhanced. This approach could be implemented within the context of a classroom as it does not require any technical behavioural strategies or training manuals. It requires a communication partner to wait and implement a prompting hierarchy in order to facilitate differential responding and increased use of assistive technology. Future research could expand Blake's microswitch use for additional communicative purposes within his classroom where he could be instructed to appropriately reject undesired stimuli using a second microswitch. Information obtained through the IPCA and BIAS (from Study One, Chapter Three) indicate that Blake had several existing forms of rejecting, such as pushing unwanted items away from him, which could also be considered a socially inappropriate form of communication. Adopting instructional techniques, such as the wrong item format where non-preferred items are offered to learners whereby they are instructed, under these highly motivating states, to appropriately reject the items (Sigafoos & Dempsey, 1992), could be effective in extending Blake's use of functional communication (Reichle et al., 1991; Sigafoos & Roberts-Pennell, 1999).

Following the completion of intervention, the author returned to the classroom to discuss the findings from the three assessments and the final case study for Blake. In this meeting, the author provided a report covering (a) the purpose of the research, (b) the findings form the IPCA and the Vineland, (c) the findings, and potential outcomes for Blake, in regards to the second study assessing alertness and engagement, and (d) the results of study three and his final case study. During this meeting, a selection of short video clips from Blake's case study were shown to his Teachers and we discussed ways in which the interaction appeared to help increase Blake's engagement and alertness, and his apparent joy in engaging in the task. Future ideas to maintain these high levels of alertness and engagement for Blake were discussed and the Teachers and the school were given a paper copy of the report.

In summary, these data suggest that the instructional procedures used in this three phase study were effective in enhancing Blake's communication skills. This was demonstrated by the increasing frequency of independent microswitch activated SGD request during intervention. High frequencies of responding were maintained during the final no prompting phase, suggesting that Blake was using the microswitch as a functional communication tool to gain access to his preferred stimuli. The use of the microswitch and SGD provides Blake with a conventional and socially appropriate method of communicating with both familiar and unfamiliar communication partners. Overall and most importantly, Blake appeared to increase his levels of engagement and enjoyment during the intervention as directly observed by the communication partner.

Chapter Eight

Case Study Three: Enhancing Josie's Communication Skills

The findings from Study Two (Chapter Four) showed differences in the rate of behaviours exhibited by Josie in the two conditions assessed. In the conditions involving social interaction and sensory stimulation, Josie displayed higher rates of particular behaviours that were interpreted as being indicative of potential signs of alertness, engagement, and potential indices of happiness. During the alone conditions, in contrast, Josie demonstrated lower rates of particular behaviours and higher rates of behaviours that were interpreted as indicating non-engagement, such as higher rates of stereotypy and SIB. Stereotypy for Josie involved her loudly grinding her teeth, holding her breath and wringing her hands. However it is important to note that stereotypy was in fact observed across both conditions, suggesting that this behaviour is likely automatically reinforced for Josie. In addition, these behaviours are key characteristics of Rett syndrome (RTT; Hagberg & Witt-Engerström, 1987; Neul et al., 2010). These results suggest that Josie demonstrated some degree of sensitivity to the differences in the two conditions and that her behaviour changed depending on the social and environmental circumstances impinging upon her. This could, in turn, indicate that Josie had some understanding or awareness of her environment and some level of contingency awareness. During the social interaction and sensory stimulation condition, Josie would often orient her body and face towards the communication partner. She would also often smile and laugh more frequently compared to the alone conditions where she would close her eyes, vocalise, and engage in stereotypy. These results suggest that interacting with the communication partner and engaging with sensory stimulation might have been motivating or reinforcing for Josie.

During Study Three (Chapter Five), Josie engaged in stereotypy most consistently. However, two orienting behaviours were the next most consistent behaviours produced during the stimulus-interruption intervals that appeared to indicate that she wanted the interrupted sensory stimulation to be continued. She would orient towards the stereo where the music was being played from and/or she would orient towards the trainer during the interruptions. In this study, Josie experienced 20 trials during which the social interaction/musical stimulation was interrupted. Data from these trials showed that Josie consistently oriented towards the trainer and/or towards the stereo during 60% of the interruptions. This result suggests that the interaction with the communication partner and the sensory stimulation might have been highly motivating for Josie, and that she was attempting to communicate using a body movement (PLB). The presumed function of this PLB was to request the reinstatement of the music/social interaction. However, this PLB (orienting towards the communication partner and/or towards the stereo) that was evoked during Study Three was not as consistently observed as the PLBs (reaching) demonstrated by Thomas and Blake. Therefore, it was reasoned that Josie might benefit from an intervention programme that aimed to strengthen her existing PLB so that it could be made to occur more consistently.

The procedures used in Studies Two and Three appeared to suggest that social interaction and music represented preferred sources of stimuli that might also function as reinforcers for using her existing PLB of orienting towards or moving towards the communication partner or the stereo. Based on this assumption, the intervention reported in this chapter made use of interruptions to music to create opportunities to strengthen Josie's PLB of orienting towards or moving towards the communication partner or the stereo. In addition, as with Thomas and Blake, another aim was to see if Josie could also activate a microswitch linked to a SGD to request more music.

As demonstrated in the case studies of Blake (Chapter Six) and Thomas (Chapter Seven), the stimulus interruption procedures used with them appeared to be an effective and simple method of strengthening and enhancing PLBs and so it was logical to presume that this same approach might be useful for strengthening Josie's PLB, which was re-defined as orientating towards a specific location, to request the reinstatement of the seemingly preferred musical stimulus. The procedures used for Blake and Thomas appeared successful in that both boys' targeted PLBs increased during their intervention. As mentioned before a number of studies have demonstrated success in teaching individuals with PMD to make requests using stimulus interruption procedures (Gee et al., 1991; Gee et al., 1995).

Furthermore, Calculator (1988, 2002) discussed ways in which natural gestures (or PLBs) of individuals with communication deficits and physical disabilities might be strengthened and enhanced. His ENG protocol, as previously reviewed in Chapter Two, includes elements of systematic instruction, such as time delay procedures, contingent reinforcement, and altering the environment such that opportunities for communication are increased and extended.

In addition to identifying strategies to strengthen natural gestures or PLBs of individuals with PMD, the use of assistive technology can be used to enhance PLBs (Lancioni et al., 2014; Lancioni et al., 2013; Stasolla et al., 2015). Microswitch technology has been investigated specifically for instruction in girls with RTT (Byiers, Dimian, & Symons, 2014; Stasolla & Caffo, 2013). Stasolla and Caffo (2013) taught two females aged 12 and 17 years old to request preferred stimuli using a wobble microswitch. Results indicated that both participants' microswitch responses increased with intervention. They also reported a decrease in the frequency of stereotypy observed in the girls and increases in indices of happiness. More recently three females diagnosed with Rett syndrome were taught to use a microswitch-activated SGD to request preferred stimuli using systematic instruction (Byiers et al., 2014). Results of this study indicated a positive outcome where all three participants learned to independently activate their microswitches to request more of a preferred stimulus. Therefore, microswitch technology might be viable type of assistive technology to enhance the existing communication skills of girls with RTT and, although Josie had limited functional use of her hands, the way in which she oriented and moved in-towards the trainer/stimulus suggested that a microswitch may have been an appropriate assistive technology mode to enhance her communication skills.

The purpose of the present study evaluated an intervention approach to strengthen and enhance Josie's PLB. The intervention approach included interrupting music to create opportunities for Josie to use her existing PLB, which would then be reinforced by reinstatement of the music. In addition, Josie was also prompted to use a microswitch-based SGD that produced a requesting response. By strengthening her existing PLB (of orienting) and then also prompting use of the microswitch, the intent was to determine if Josie would become more consistent in using her PLB and more independent in activating the SGD.

Method

Participant

Josie was a 16-year old-female who had PMD and Rett syndrome. A thorough description of Josie was provided in Study One.

Settings, Sessions, and Context

Sessions occurred within Josie's classroom only as there were no other rooms available within her new school within which the study could be implemented. Each session lasted approximately 10 min. Josie received between one and three sessions per week, depending upon her availability. Often there were between four to six other students present in the room in addition to three support teachers. Josie would begin by being helped out of her wheelchair, so that she was free to walk around the classroom during each session.

Communication Partner

All sessions were conducted by the author of this thesis, who acted as the communication partner and implemented all steps of the intervention procedures.

Materials

iPads. Two iPad-minis®, both loaded with iOS7 capability were used in this study. One of the iPads was used to video record all of the sessions, and the second was loaded with the speech generating software, GoTalk®. This second iPad was connected to a pressure microswitch via a wireless Bluetooth connection. The GoTalk speech generating program could be customised to produce individualised speech output. For Josie the synthesised message was "*More music please"*. During sessions the second iPad was open to the correct screen in the GoTalk app displaying the correct message. Upon a microswitch activation, the message on the iPad screen would be selected and the synthesised speech out-put was produced.

Microswitch. One microswitch was used in the present study. The switch was a highly sensitive round red coloured pressure switch called an iPad wireless switch #1164 from a company named Enabling devices (www.enablingdevices.com). The highly sensitive pressure switch could be activated by a light touch or tap from a hand, elbow, or fingers on the top surface. Activations of the switch would produce voice out-put from the iPad loaded with the GoTalk app via a wireless Bluetooth connection.

Music. During Josie's sessions, a CD player was used to play her preferred music, The Mavericks. In addition to the music, social interaction was provided by the communication partner during all sessions. Social interaction consisted of the communication partner talking to Josie, dancing to the music, touching her, and smiling and laughing throughout the 10 min sessions.

Response Definitions and Data Collection

An independent/correct *orienting/approach* was recorded if Josie: (a) oriented her body towards the communication partner, (b) directed her face and eye gaze to the communication partner's face, and (c) approached the partner and stereo within the specified time frame after a stimulus interruption. A correct/independent *microswitch response* was recorded if Josie: (a) activated the microswitch within the specified time frame following a stimulus interruption, and (b) did so without receiving any physical or gestural prompt from the communication partner. An incorrect/prompted response was recorded if any of the above criteria were not met during the stimulus interruption procedure.

Evaluation Approach

In the present study, the frequency of correct orienting/approach and microswitch responses was recorded for each session and graphed across sessions by plotting the cumulative frequency of these two responses. Increases in the cumulative frequency of orienting/approach over successive sessions would provide some evidence that the intervention was being successful in strengthening Josie's existing PLB of orienting and approaching. Similarly, increases in the cumulative frequency of microswitch activations over successive sessions would provide some evidence that the intervention was successful in enhancing this PLB by adding the microswitch response to that existing form. Three phases were implemented with different time delay procedures applied to strengthen Josie's PLB and promote independent microswitch activations.

Procedures

No prompting phase. During the no prompting phase, Josie stood near the stereo where her seemingly preferred music CD was inserted. The communication partner stood beside her, holding the microswitch. On a table beside them, the iPad was placed, open to the correct page on the GoTalk app and acted as the SGD. On a nearby table, the additional iPad was placed in a location so as to video record the session. During the 10-min session, the communication partner played the CD and interacted with Josie by talking to her, touching her arms, and dancing to the music with her. After approximately 2.5 mins of continuous music, the communication partner paused the CD and the social interaction and said; *"Let me know if you want some more".* A 20-s response delay was implemented during which the communication partner stood close to the stereo with the microswitch. During this pause, any correct and independent microswitch activation was recorded if Josie pushed the microswitch within this time delay. Following a correct response, the trainer would immediately re-play the CD. If Josie oriented towards the trainer, but did not activate the microswitch, the communication partner waited until the 20-s response time was up, and then re-started the CD.

First prompting phase. During the first prompting phase, Josie and the communication partner stood near the stereo with the iPads and the microswitch in the same location as during the first no prompting phase. A 20-s time delay was implemented following a stimulus interruption. The communication partner stood beside the stereo and waited for a total of 20-s. During this time, if Josie approached the communication partner, the communication partner waited until the 20-s time delay was up, and then implemented a least-to-most prompting hierarchy to prompt microswitch use. This involved the communication partner repeating the verbal prompt and gesturing towards the microswitch. If Josie still did not activate the microswitch, the communication partner would then physically assist Josie to press the microswitch by pushing her hands down upon the top of the switch. Following a prompted response, the music was immediately re-instated and Josie received verbal praise. If Josie independently activated the microswitch following an orienting response and within the 20-s period, the music was immediately re-instated and she received verbal praise. In this way, orienting towards the trainer and any microswitch response (independent or prompted) was reinforced with the reinstatement of the music and verbal praise. Each session lasted for approximately 10 min and included four stimulus interruptions.

Second prompting phase. During the second prompting phase, the communication partner waited until Josie oriented towards her, and then paused for 3-s before prompting a microswitch activation. These sessions lasted approximately 10 min, but included 8 interruptions, with one interruption occurring approximately every 60-s. This change was made to increase the frequency of communication opportunities in an aim to promote acquisition of the microswitch response. Again, orienting towards the trainer and any microswitch response (independent or prompted) from Josie was reinforced with music and verbal praise.

Inter-observer Agreement

All of the videotapes were coded by the author (communication partner) and an independent observer (PhD student) coded videos from 30% of the sessions across each of the three phases. This student received training by watching one session with the author. During this time, the author and the student discussed the different behaviours seen in the video, and what each behaviour would be coded as. Following this, both the author and student watched another session and coded this video independently. This was then followed by a discussion in regards to their agreements and disagreements. This was sufficient to obtain a high level of agreement between the two coders, as determined by the author. An agreement between the two coders was scored if both had recorded that a correct response had either occurred or not occurred within the interruption interval. IOA was calculated using the formula: Agreements/(Agreements + Disagreements) x

100% and rounded to the nearest whole number. IOA ranged from 75% to 100% (average was 97%).

Procedural Integrity

All of the videotapes were coded by the first author and an independent observer coded 30% of the sessions. An agreement between the two coders was scored if the independent observer recorded that all procedural steps were implemented in the correct order and in the correct way, with a 3-s discrepancy allowed. Procedural steps included:

1. Communication partner stands near the stereo holding the microswitch, engages with Josie while CD plays for approximately 2.5 min (First two phases) or 1-min (last phase).
2. Communication partner interrupts/pauses the CD and says: "Josie, let me know if you want some more".
3. Communication partner waits for 20-s (first two phases), or until Josie orients towards her (last phase).
4. Following Josie correctly orienting towards communication partner, if she does not press microswitch within 20-s (first two phases), the communication partner re-instates the music (first phase), or implements the least-to-most prompt hierarchy for a microswitch activation (second phase), or if Josie does not press microswitch within 3-s of orienting (last phase), the communication partner physically prompts a microswitch activation.
5. Following the interruption trial, the communication partner re-instates the music regardless of independent/prompted microswitch response.
6. Repeat for four interruptions per 10-min session (first two phases), and eight interruptions per 10-min session (last phase).

PI was calculated using the formula: total number of correctly implemented steps/total number of steps implemented x 100. PI was 100%.

Results

The figure below shows the number of orienting/approach responses and correct/independent microswitch activations across the three phases of the intervention.

During the first session, Josie oriented towards the communication partner during three of the interruptions, and then did not orient/approach during any of the eight interruptions conducted in the next two sessions. In this first phase, she never activated the microswitch across the 12 total interruptions. In the next phase, Josie's orienting/approach response increased across the four sessions and she also independently activated the microswitch a total of three times. During the final phase, Josie's orienting/approach response occurred consistently during the interruptions that were implemented in the final three sessions, and she independently activated the microswitch once during this final phase. In total, over 10 sessions, Josie oriented towards/approached the communication partner and stereo 34 times, and independently activated the switch a total of five times.

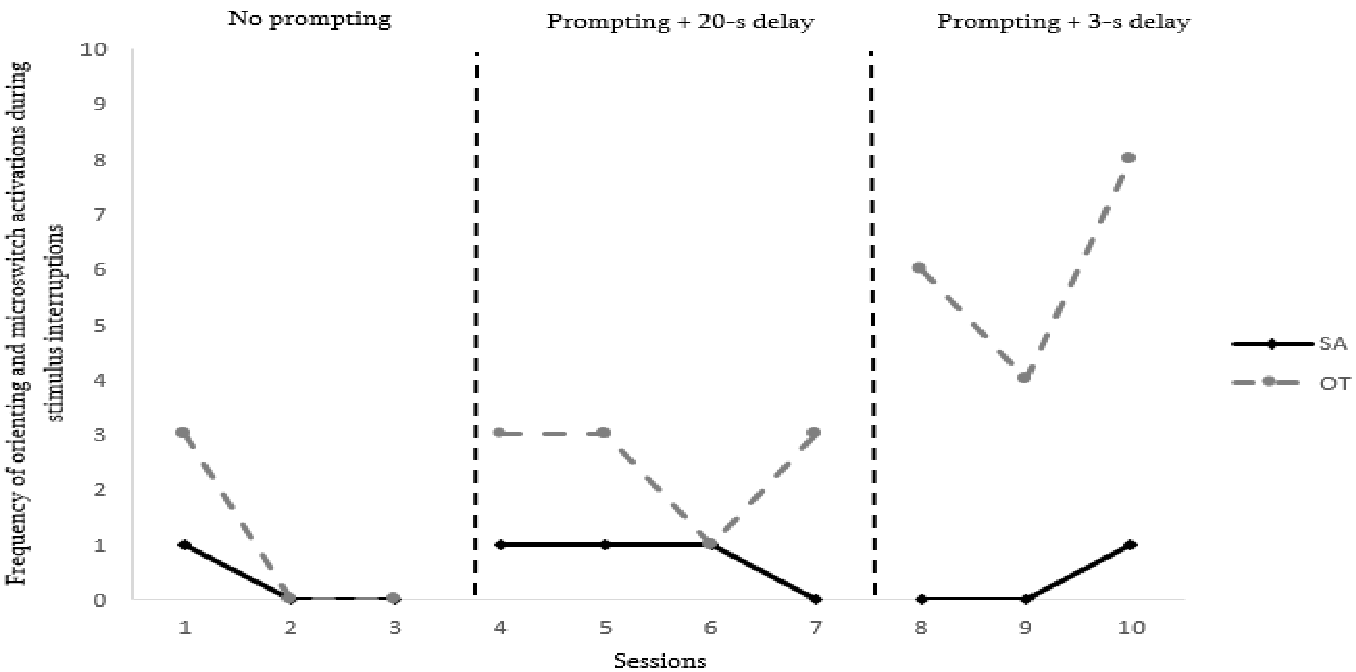

Figure 2.3: The frequency of Josie's orienting towards (OT) the communication partner and independent microswitch activations (SA) across the three phases of intervention.

Discussion

The aim of this intervention was to strengthen Josie's existing PLB of orienting towards and approaching the communication partner, and to enhance this response by adding the microswitch response into her PLB. In the last phase, the communication partner attempted to further strengthen and enhance her PLB by providing more frequent communication opportunities, and also by decreasing the time delay between the orienting response and the prompting of a microswitch response. During this phase, Josie's orienting response was occurring consistently, suggesting that these procedures were effective in strengthening Josie's existing PLB to request more of a seemingly preferred stimulus. The intervention did not however lead to any change in her microswitch use, suggesting that the procedures did not enhance her PLB by adding the microswitch response.

The overall results of this study were interesting as Josie's PLB increased in consistency and, as demonstrated in Study Three, the chosen context for intervention appeared to be motivating for Josie. Thus it was hypothesised that she would continue to orient towards and approach, and that she might then also learn to add in the microswitch response to form a new enhanced form for requesting the re-instatement of the music. While previous studies have reported successful use of microswitch technology as a requesting behaviour of girls with RTT (Byiers et al., 2014; Stasolla & Caffo, 2013), these studies were not aimed at enhancing an existing PLB by adding in a new microswitch response. This could be one reason why Josie did not show any increase in microswitch use over the 10 sessions of this study.

In a review conducted by Sigafoos et al. (2009), nine studies that implemented communication interventions to individuals with Rett syndrome were analysed. Studies were evaluated according to participant characteristics, targeted skills and procedures implemented, intervention outcomes and certainty of evidence. Due to methodological flaws in the majority of studies, the certainty of evidence was considered inconclusive for eight of the nine studies and therefore the authors concluded that there was a lack of strong experimental evidence to support effective communication intervention outcomes for individuals with Rett syndrome. However, they did note that perhaps identifying a motor response within a learner's repertoire, and enhancing this response through the use of simple technology, such as microswitches, may have some benefit (Sigafoos et al., 2009). Throughout the present intervention, Josie demonstrated consistent behaviours during the stimulus interruptions that suggested she had an intent to communicate, and that she appeared to be motivated to have a preferred stimulus (music and social interaction) re-instated. During intervention, Josie would consistently use her PLB (i.e., orienting towards/approaching the communication partner) regardless of who else was present in the room. This suggests a level of discrimination. In addition, she began to display this approach behaviour very quickly after the initial interruption suggesting that the behaviour was intentionally used to get the communication partner to stop the interruption, and replay the music. The intervention procedures were however, unsuccessful in enhancing Josie's PLB with microswitch use. This is disappointing but the overall outcome for orienting/approach could be seen as having some benefit. Indeed, Calculator (1988; 2002) suggested that any appropriate form of communication, such as a PLB, should be strengthened by creating opportunities and reinforcing these acts consistently. This was in fact what the present intervention appeared to have involved. Use of the microswitch would have enhanced Josie's communication development, but the lack of increase here should not detract from the seemingly effective strengthening of her existing PLB.

The results from this intervention with respect to lack of acquisition of the microswitch response may be due to several limitations of the current approach. It is possible that the microswitch response was not appropriate for Josie, due to her having RTT, which is associated with lack of purposeful hand use. Perhaps the response of pressing the microswitch may have been too physically challenging for her. Had there been access to more advanced or sensitive technology, such as alternative microswitches that could detect her body movement of approach, then her existing PLB might have been "technologically" enhanced. In addition, during the intervention, Josie was free to wander around her classroom, and once she had oriented towards the trainer, she may not have grasped that a further step (i.e., pressing the microswitch) was required. Thus the two-step requirement may have been too advanced for Josie. Furthermore, Josie's approaches may have simply been well timed approaches to the right communication partner, and not actually used by her as a means of intending to communicate a request for more. Time restrictions also significantly limited the duration and number of sessions conducted with Josie. Specifically, the lack of opportunity to offer further trials for instruction, and limited opportunities to alter the intervention procedures impacted upon these results. It is possible that more intervention or some modification to the intervention procedures would have resulted in Josie learning to use the microswitch. Further restrictions were placed on the days available for Josie to be a part of this study, the times during the available days she was free to participate, and the amount of absences Josie experienced during the latter part of this study.

Still, the intervention did appear to help strengthen Josie's use of an existing PLB that is orienting towards and approaching the communication partner. However, the effects of intervention on the use of the orienting/approach PLB is not entirely convincing due to the lack of a proper experimental design. Instead, I evaluated the effects of the intervention using a simple teaching-only design in which there were three sequential phases. This evaluation approach is perhaps best described as pre-experimental. The evaluation of the intervention is also limited due to lack of maintenance and generalisation data. Future research for Josie might include access to more advanced microswitch technology, such as a motion detecting sensor, which might match Josie's PLB of orienting towards the communication partner more appropriately and be a more successful approach. Additionally, if given further opportunities to practice this skill across a longer time frame, Josie may well have progressed to independent microswitch responding, thus an increased number of opportunities might further enhance Josie's communication skills. Furthermore, to determine whether her existing PLB of orienting towards one specific communication partner was consistent and an intentional communicative act, it would be necessary to assess her discriminant response between two or more adults who could be positioned near the stereo to act as distractors. If Josie continued to interact and orient toward the target communication partner, this might strengthen the argument for her intentional response and her ability to discriminate between target communication partners.

Given the aim to strengthen and enhance Josie's PLB, the results do seem to suggest that the intervention procedures produced a strengthening effect of the PLB or at least created effective opportunities for her to use that existing response to exert some degree of control over the environment. This could be seen as important in its own right. The fact that Josie consistently oriented towards and approached the communication partner very soon after the music was interrupted suggest that this PLB represented intentional communication in her part. Intentional communicative acts are a core component of successful communication interventions. So critical is intentionality that some argue more advanced or complex communication forms cannot be taught in its absence. Once intentional communication has been established, a strong foundation for more advanced conventional communication skills may be taught (Schweigert, 2012). It is possible that by participating in this thesis, Josie was helped in a small way towards having a strong foundation for communicating successfully with others.

Following the completion of intervention, the author returned to the classroom to discuss the findings from the three assessments and the final case study for Josie. In this meeting, the author provided a report covering (a) the purpose of the research, (b) the findings form the IPCA and the Vineland, (c) the findings, and potential outcomes for Josie, in regards to the second study assessing alertness and engagement, and (d) the results of study three and her final case study. The author explained why Josie's case study was different to that of the original plan and ideas were discussed as to why Josie did not appear to independently press the microswitch, and other ways in which the microswitch could be used more effectively to enhance her PLB. The teachers also contributed some of their ideas for engaging more with Josie, and showed me their switch which, when pressed, immediately played a short segment of music for Josie. They informed me that she had pressed this switch a few times, and I gave them some ideas for how to continue using this switch. Following this meeting, the school and the teachers were given copies of the report for future reference.

Chapter 9

General Discussion

The four general purposes of this research were to (a) assess adaptive behaviour functioning, including the communication forms and functions of four adolescents with PMD, (b) determine the extent to which social interaction/sensory stimulation would evoke PLBs and other behaviours that might be indicative of engagement in and preference for social interaction/sensory stimulation, (c) determine if brief interruption of seemingly preferred sources of simulation would reliably evoke PLBs that might be functioning as communicative requests for reinstatement of that activity, and (d) make use of that assessment information to design an intervention aimed at strengthening and enhancing PLBs that appeared to function as communicative requesting responses.

Four studies were undertaken. Study One, involving the use of three assessment protocols, was implemented to address the first research question. Study Two sought to identify whether provision of social interaction and sensory stimulation would result in an increase in the types of adaptive and communicative behaviours indicative of alertness, engagement, and motivation/preference. Study Three built upon the results of Study Two by focusing on whether an interruption of social interaction and sensory stimulation would evoke specific PLBs, which might thus represent PLBs related to requesting continuation of the social interaction and sensory stimulation. Finally, the three case studies (Chapters Six, Seven and Eight) aimed to evaluate if the PLBs most consistently observed during the interruptions of Study Three could be strengthened and enhanced using individualised teaching programmes for Thomas, Blake and Josie.

The Assessment Protocols

In this thesis, both standardised and informal observation-based assessment protocols were administered/conducted. In addition to providing data relevant to the main purposes of the study, these assessment data could also be seen as providing an in-depth picture of the participants' existing behavioural strengths, existing communication forms and functions, and whether specific [requesting] communication forms could be reliably evoked using a stimulus interruption procedure, which could then become the context for intervention aimed at strengthening and enhancing these forms of prelinguistic requesting.

Klien-Parris et al. (1986) discussed the importance of undertaking a meaningful assessment of individuals' existing abilities. Meaningful assessments are those that accurately describe and identify existing skills/abilities and the conditions under which these skills and abilities are reliably produced. This information may enable parents and teachers to form a reasonable hypothesis regarding the function or purpose of the person's existing skills and abilities. This in turn may enable parents and teachers to set intervention goals and design teaching strategies/interventions aimed at strengthening and enhancing the person's existing repertoire (Klien-Parris et al., 1986; Schweigert, 2012; Siegel-Causey & Bashinski, 1997).

Data were collected in the first study using the second edition of the Vineland Adaptive Behaviour Scales (Vineland™ II: Sparrow et al., 2005), the Inventory of Potential Communicative Acts (IPCA: Sigafoos et al., 2000), and the Behaviour Indication Assessment Scale (BIAS: Sigafoos, Butterfield & Arthur-Kelly, 2006). This combination of assessment protocols provided a detailed and comprehensive picture of each participant's adaptive behavioural repertoire, including a picture of their [reported] PLBs, specifically the person's existing forms of PLBs and the presumed communicative functions of these forms.

The main findings from the assessments completed in Study One suggested that while each participant demonstrated significant deficits in adaptive behaviour functioning, each was also reported to use certain prelinguistic forms that reportedly served specific communicative functions for that person. More specifically, results from the Vineland™ II indicate that all four participants' scores indicated a level of adaptive behaviour functioning representative of a profound deficit. This suggests that across the four major domains of Communication, Daily living, Socialisation, and Motor Skills, these individuals required high levels of intensive support and were reliant upon their carers for all daily tasks and social interaction. Data from the Vineland™ II would also suggest that the participants had limited development of expressive or receptive communication skills in that their age equivalency scores in these domains never exceeded the types of communication skills that typically develop at approximately 6 months of age in children without any type of disability.

Despite their limited expressive and receptive communication development, results of the IPCA assessment indicated that the teacher perceived that the participants were using a range of PLBs to communicate. A dominant finding from the results of the IPCA showed that all four participants were reported by the teacher to be demonstrating an apparent reliance upon prelinguistic communicative acts rather than symbolic or speech-based communicative forms, with the majority of these forms represented through body movements and vocalisations. Additionally, these participants were reported by the teacher to be demonstrating a restricted inventory of communicative forms where many behaviours were used for multiple functions, particularly for responding, and requesting and rejecting stimuli. These findings suggest that these participants were reported by the teacher to be engaging in a relatively small number of prelinguistic behaviours, but that these behaviours were often interpreted as serving multiple communicative functions.

These results are consistent with a number of studies reporting the development and use of PLBs for children and individuals with PMD, even in the absence of early communication milestones and the progression of more complex symbolic communication (Atkin & Lorch, 2014; Bretherton & Bates, 1979; Ogletree et al., 1996; Schweigert, 2012; Siegel-Causey & Bashinski, 1997; Sigafoos et al., 2006; Yoder & Feagans, 1988). Pre-symbolic communication acts, including physical acts such as reaching for desired objects or pushing unwanted items away, are often interpreted as serving a functional communication purpose by communication partners, and are thus reinforced as if these were indeed functional communicative acts where an item reached for is retrieved and offered, and the stimuli that is pushed away is removed. In this way, these ambiguous behaviours might be strengthened and become functional PLBs that serve as communicative acts (Warren et al., 1993; Yoder & Feagans, 1988).

For those with PMD who do not progress past this PLB stage to develop more complex symbolic forms of communication, these behaviours can function as effective methods of communication if enhanced. As these behaviours can often be ambiguous, enhancing such behaviours might involve (a) shaping the behaviour to become more direct or discrete, (b) strengthening the behaviour such that it is produced more consistently, or (c) augmenting the response with assistive technology (Calculator, 1988; Ogletree et al., 1996; Schweigert, 2012; Sigafoos et al., 2006). Identifying PLBs, using an assessment such as the IPCA, may enable communication partners to more easily recognise and hence respond to an individual's communicative attempts (Braddock et al., 2015; Ogletree et al., 1996; Schweigert, 2012; Siegel-Causey et al., 1989; Sigafoos et al., 2006). The findings from the IPCA could also be seen as perhaps providing some insight into the child's communicative intentions or motivations. At a more practical level, the results of an IPCA-type assessment may point to PLBs that could be targeted for intervention aimed at strengthening and/or enhancing PLB.

However, the IPCA results are teacher reports and it is possible that the teacher was over-interpreting or mis-interpreting the meaning of the student's PLBs. Still, the IPCA data were considered useful for helping to gain an initial picture of some possible communication forms and functions in the students' repertoires. If the communication function, of a PLB could in fact be verified (as was attempted in Study Three), then this information would seem useful for the goal of strengthening and enhancing the participants' PLBs as was attempted in Study Four.

Assessment of Alertness, Engagement, and Motivating variables

In addition to attempting to verify the communication function of PLBs as was attempted in Study Three, an attempt was also made in Study Two to identify whether providing social interaction and sensory stimulation would evoke indices of alertness, engagement, alertness and motivation (Dillon & Carr, 2007; Green et al., 1991; Green & Reid, 1996). If so, it would suggest that the social interaction and sensory stimulation condition might represent a preferred activity that could then be used as the context for assessing whether there were any PLBs related to requesting (Study Three) and, if so, then providing an intervention aimed at strengthening and enhancing any such PLBs related to requesting (Goetz et al., 1985; Gee et al., 1991; Gee et al., 1995; Schweigert, 2012). The decision was made to focus on requesting behaviours for several reasons. Firstly, requesting is one of the earliest functions of communication to develop in young children that directly provides a functional method of gaining access to, or obtaining stimuli that is wanted, needed or preferred (Beukelman & Mirenda, 2005; Gee et al., 1991; Reichle et al., 1991; Schlosser & Sigafoos, 2002). This communicative function was reportedly limited in all four participants as reported in the IPCA. Further, requesting is a basic way of achieving functional outcomes for early communicators where they become able to exert some degree of control over their immediate environment. Requests for preferred stimuli also provides an indication that the early communicator has an awareness of behavioural contingencies where he or she understands that their behaviour can impact upon a listener's behaviour (Cannella et al., 2005; Kaiser & Goetz, 1993; Gee et al., 1991; Schweigert, 2012).

At a more theoretical level, Study Two could be seen as an attempt to more generally examine whether two conditions differing in the amount and type of stimulation would influence the participants' general behavioural state. This was viewed as useful information not only to determine if the social interaction and sensory stimulation condition might represent a preferred activity that could then be used as the context for assessment of PLBs and as a context for intervention, but also because of data suggesting that behavioural states significantly influence the degree to which an individual with PMD might keep their eyes open, direct their eye gaze and orient their body towards a stimulus, and be able to remain alert in order to learn new skills or constructively participate within a social interaction (Arthur, 2003; Arthur-Kelly et al., 2007; Dillon & Carr, 2007; Green et al., 1991; Guess et al., 2002). Comparatively, sub-optimal learning states involve behaviours indicative of non-engagement, boredom, frustration, or disinterest in an activity/stimuli where the learner might close their eyes, remain still, or sleep for prolonged periods of time (Arthur, 2003; Green & Reid, 1996). Thus indices of engagement, alertness, and happiness in the current four participants formed the first direct assessment in Study Two (Chapter Four). It is of critical importance that variables that either evoke behaviours consistent with demonstrations of motivation, or those that lead to drowsy or low levels of alertness and engagement, are identified such that variables and conditions promoting more positive behaviour states can be re-created (Goetz et al., 1985; Guess et al., 2002). Based upon the theory of engagement and motivation being critical components in one's willingness and determination to achieve or engage in their immediate environment and larger existence (Felce & Perry, 1957), being alert and engaged in an activity has been suggested as an important assessment objective (Arthur, 2003; Green et al., 1991; Green & Reid, 1996, Green et al., 1997; Guess et al., 1990; Siegel-Causey & Bashinski, 1997).

To assess engagement, alertness, and indices of happiness, I created two conditions that were intended to be different in terms of the amount and type of social interaction and sensory stimulation being provided to the participants. If the participants demonstrated more of certain types of behaviours during the social interaction/sensory stimulation condition, compared to the alone condition, then this it might be taken as some evidence that these behaviours were indicative of engagement, alertness, and happiness (Arthur, 2003; Dillon & Carr, 2007; Green & Reid, 1996). In contrast, behaviours observed in the alone condition may have been indicative of low levels of alertness, frustration, boredom, and non-engagement. The decision to arrange these two conditions in this manner was based on other studies that have evaluated engagement, alertness, and/or indices of happiness in persons with PMD. Studies on this topic often assess the person's behaviours under conditions where the trainer either provides social interaction and/or sensory stimulation versus conditions in which there are less or fewer opportunities for social interaction/stimulation. The results of these studies suggests that interactions that incorporate both sensory stimulation and one-on-one social interactions appear to be optimal for evoking higher levels of engagement and alertness, suggesting that higher levels of interaction/stimulation are more motivating (e.g., Davis et al., 2004; Favell, Realon, & Sutton, 1996). However, it could also be that social interaction and/or sensory stimulation merely functions to elicit activity via a respondent action, rather than evoking more active engagement.

Fluctuating levels of awareness and engagement can have negative consequences for behavioural interventions that require sustained attention and contingency awareness (Goetz et al., 1985; Lyons, 2005). For people with PMD who experience low levels of engagement and awareness, movement is significant. Individuals with PMD tend to move slower, respond slower, and demonstrate slower acquisition of new skills or even lack of success in learning new skills (Ivancic & Bailey, 1996). Restricted motor repertoires and physical capabilities might also limit the response forms that are available to these individuals which in turn, may mean that carers resort to applying stimulation to individuals with PMD rather than seeking to enable the person to exert more choice and control over stimulation. Overall, prolonged conditions of receiving stimulation without the opportunity to exert control over the onset of such simulation may lead to increased passivity and even learned helplessness (Cannella et al., 2005; Guess et al., 1990; Guess et al., 2002; Marcus & Vollmer, 1996).

Orienting or moving towards a preferred stimulus, reaching out to access a stimulus, or orienting towards an individual and vocalising have been described as potential indicators for the continuation of access to reinforcing stimuli or interactions (Green & Reid, 1996; Green et al., 1997). Providing access to a highly motivating or reinforcing stimulus might lead to increases in rates of movement/responding and might also induce positive affective states, indicated by increased acts of smiling and/or laughing (Arthur, 2003; Green et al., 1991; Ivancic & Bailey, 1996; Lyons, 2005). Preferences and reinforcing stimuli/activities that might be used in instructional programs might also be identified through the observation and analysis of behavioural states under differing stimulus conditions, as was done in Studies Two and Three. More generally, the person's observable behavioural states are considered potential indicators into their inner emotional and physiological state. Higher levels of alertness, engagement and/or more indices of happiness, for example, might be suggestive of that an activity, condition, and/or stimulus being preferred and reinforcing (Arthur, 2003; Atkin & Lorch, 2014; Greathead et al., 2016; Green & Reid, 1996; Green et al., 1997; Lyons, 2005). Behavioural states analyses might also have some relevance to enhancing the person's overall quality of life by specifically working to increase their opportunities to experience and control activities, conditions, and/or stimuli that are associated with increased levels of alertness, increased engagement, and more indices of happiness (Arthur, 2003; Arthur-Kelly et al., 2007; Green & Reid, 1996; Lyons, 2005). Furthermore, these behaviours indicating states of happiness and engagement are consistent with behaviours indicative of interest-excitement and enjoyment, described as the fundamental basis behind motivation (Csikszentmihalyi, 1975; Izard, 1977)

The data from the assessment implemented in Study Two with the present cohort of four participants seemed to have provided some insight into the types of behaviours that were seemingly indicative of engagement, alertness, happiness and motivation in these four students.

Specifically, the following insights were reported:

(a) Differentiated actions and behavioural states across the two assessed conditions where participants were able to adapt their behaviours depending on the presence or absence of interaction; demonstrating social awareness contingency,
(b) Higher rates of body orientation and directed eye gaze towards the communication partner as well as increased rates of smiling and laughing during the social interaction conditions
(c) Higher rates of closed eyes, sleeping, and SIB and stereotypy (for some) during the alone conditions.

The ability to more reliably identify positive behavioural states where an individual is engaged, happy, alert, and motivated, is critical in creating a stimulating and enjoyable environment where the learner is in an optimal learning state, and demonstrates motivation for a stimulus/interaction through individualised movement or vocal responses (Arthur, 2003; Arthur-Kelly et al., 2007; Arthur-Kelly et al., 2008; Green & Reid, 1996). Furthermore, the results of this study suggest that to more clearly distinguish between engaged and non-engaged behaviour states, it might require more than just a variable degree of stimulation, where an instructional context implemented during a highly motivating activity might evoke greater instances of engagement, alertness, movement, and happiness from participants (Lancioni et al., 2002; Lyons, 2005).

Assessing the Communicative Functions of PLBs

In order to achieve more effective and functional communication, it may be helpful to ensure the speaker has a response form that can be readily understood by his or her communication partners. PLBs are often restrictive for effective communication exchanges because they are often difficult for communication partners to interpret. Often PLBs are subtle or idiosyncratic and might therefore be misinterpreted or overlooked as an intentional communicative act (Meadan et al., 2012). Thus assessing the communicative function, if any, of a child's existing PLBs could be seen as critical to assigning the correct meaning and subsequent response to these behaviours. I attempted to assess the communicative function, if any, of the four participants' existing PLBs using a stimulus interruption procedure (Gee et al., 1991; Gee et al., 1995; Hall & Sundberg, 1987). The stimulus interruption procedure used in Study Three was clearly related to the social interaction/sensory stimulation condition of Study Two, which appeared to be motivating for all four students. In light of this, it was reasoned that temporarily interrupting the social interaction/sensory stimulation would create an opportunity or need for communication and thus any PLBs that occurred consistently during the interruption might be viewed as functioning as a communicative request for reinstatement of the social interaction/sensory stimulation. Based on the results of Study Three, the stimulus interruption procedure appeared to be an effective method of creating opportunities for communication that did in fact evoke PLBs that appeared to function as requests for continuation. That is, during the interruptions, three of the four participants produced a consistent form of a PLB and from the context in which they occurred, one might reasonably assume that these PLBs were a form of requesting behaviour. The PLBs could more specifically be seen as a request for more or a request for continuation of the social interaction/sensory stimulation that was interrupted.

The fact that three of the four participants came to produce a characteristic form of PLB (e.g., reaching) consistently during the interruptions of Study Three suggests that they might also have developed an awareness of contingency, that is that they understood that their response was necessary to reinstate the activity. Contingency awareness is considered a critical developmental stage in the process of learning and acquiring new skills, especially in regards to acquiring new and more complex communication skills (Gee et al., 1991; Goetz et al., 1985; Kaiser & Goetz, 1993; Schweigert, 2012). Contingency-based awareness also seems to be critical for those with PMD as the lack of understanding that one's behaviour has consequences on one's immediate environment, or frequent and continuous non-contingent access to reinforcement, can reduce a learner's motivation to actively participate or respond within a learning environment (Marcus & Vollmer, 1996). A reduction in this connection between one's behaviour and consequences can often lead to learned helplessness in individuals with PMD, which may result in severe levels of passivity, and low levels of engagement or alertness (Arthur, 2003; Guess et al., 1985; Guess et al., 1990; Marcus & Vollmer, 1996). Unfortunately, the stimulus interruption assessment failed to identify any consistent responses from Anna. This may be due to her not having the request function, not having a recognisable PLB that functioned as a request or that was detected by the observers, or perhaps due to limited contingency awareness.

The stimulus interruption assessment of Study Three could also be seen as a method for trying to validate the reported forms and prelinguistic requesting that Thomas, Blake and Josie were reported to use according to the teacher reports on the IPCA and the BIAS. Results from the IPCA and the behaviours used as an apparent method for regaining/reinstating the preferred stimuli during the interruptions were consistent where Blake was reported to take an item or reach for something that he wished to have access to. Thomas would direct his body towards or reach for an item he wanted, and Josie would move towards and lean in to request more of a stimuli she wanted access to. There were no reported potential communicative behaviours for Anna in terms of requesting objects.

The stimulus interruption assessment of Study Three could also be seen as a useful step for planning a communication intervention because when we have correctly identified a behaviour as having intent and particular meaning, we can reliably respond in an appropriate way (Carter & Iacono, 2002; Iacono et al., 1998; Schweigert, 2012; Yoder & Warren, 2001). Meadan et al. (2012) suggest that communicative intent can be misinterpreted or completely overlooked depending upon the communication partner and the context under which the behaviour was observed. Further, the misinterpretation of communicative attempts by a communication partner can result in the learner's behaviours escalating to more problematic forms of communication, such as aggression or SIB (Carr & Durand, 1991; Durand, 1993).

Study Three also could be seen as providing some insight into reinforcing/motivating activities for Thomas, Blake and Josie. Successful outcomes from communication intervention studies with persons with PMD seems to benefit from identifying highly motivating reinforcers and/or the creation of situations where the learner is highly motivated to communicate. Therefore, if the value of a chosen reinforcer is not strong enough to create a desire or reason to communicate, or the effort for the required response is too challenging, the outcome may be unsuccessful. Prior observations and assessments are required to identify specific behaviours that exist within the learner's repertoire, and that are easily and consistently executed by the learner (Keen et al., 2001; Schweigert, 2012; Sigafoos et al., 2006). Further, repeated exposure and familiarity with potential reinforcing stimuli might be useful in order for the learner to develop a strong interest in the item to create a state of motivation (Lancioni et al., 2013; Lancioni et al., 2014; Rowland & Schweigert, 1992; Schweigert, 2012). This is often a difficult task when designing interventions for persons with PMD as these individuals can be extremely passive and experience fluctuating levels of alertness. Thus the identification of stimuli or contexts that appeared to be preferred and reinforcing for these three participants from Studies Two and Three were critical for the design and implementation of the following three intervention case studies.

Strengthening and Enhancing Prelinguistic Requesting Skills

The combined results of the three assessment studies informed the interventions that were developed and evaluated in Chapters Six, Seven and Eight. The aim of these interventions was to strengthen and enhance the PLBs that seemed to be each participant's method of requesting the reinstatement of a seemingly preferred activity involving social interaction and sensory stimulation. Strengthening and enhancing PLBs might help to further develop the communication competency of these participants. For Thomas and Blake the enhancement approach involved having them reach and activate a microswitch linked to a SGD. Thomas and Blake were thus able to continue to use an existing PLB while also potentially increasing the comprehensibility and intelligibility of the PLB for listeners. The approach appeared to be successful in that both Thomas and Blake showed increased use of the SGD during the course of intervention.

For Josie, however, enhancing her PLB with the microswitch and SGD intervention approach was not successful. Josie did not show any increase in using the SGD. It was hypothesised that this was due to the mis-match between Josie's motoric ability and the required response to activate the microswitch. Additionally, Josie's orienting response was not as accurately matched with the target response required for the activation of the microswitch, whereas reaching for Thomas and Blake was more accurately matched to the pressing of the microswitch. This may have made this task harder for Josie to accomplish. However, with more time and instructional sessions, Josie may have been able to independently activate the microswitch as was observed during Thomas and Blake's interventions. Josie's existing PLB (i.e., approaching the communication partner and leaning towards the source of stimulation) was reinforced during every session for every interruption trial in an attempt to strengthen this behaviour. The approach appeared to be successful in that her orienting response did increase during the intervention and she began to orient directly towards the trainer at a more rapid pace during the interruptions.

Unfortunately for Anna, the next step of intervention was not implemented. The data collected from studies One and Two indicated that Anna was not reported as having an existing PLB that functioned as a request for preferred stimuli, and no consistent PLB was able to be evoked during Study Three. Furthermore, reports from the head teacher informed me that Anna's health had deteriorated and the teachers and school staff were apprehensive about challenging Anna or introducing new tasks and activities. The main focus for Anna became stabilising her medical condition and providing positive stimulation for her during her days at school. Thus it was decided that she would not participate in an intervention study.

It is perhaps not surprising that the interventions implemented for the other three participants were generally successful because they contained the following elements, which have been recommended for strengthening and enhancing PLBs of individuals with developmental disabilities, that include: (a) identify an existing potential communicative act that functions as a PLB through the use of meaningful assessment, (b) identify a context that appears to be motivating/ or stimuli that are highly reinforcing for the communicator, (c) identify procedures to evoke one PLB that is consistently produced during a context that is highly motivating, and (d) create structured opportunities for the person to produce this response, and reinforce the response by reinstating or providing continued access to the stimuli as if the response was a functional communicative act. In this way, the communication partner is more responsive and sensitive to the PLB produced by the person with PMD, and this response might be strengthened as a functional request for 'more'.

In addition to the above, when communication interventions adopt the use of assistive technology, researchers have suggested that three factors are associated with successful outcomes. First, the movement or response required to produce the target response must exist within the learner's repertoire. Second, the response must be meaningful for the learner and must evoke the same level of motivation for the stimulus as it previously had when natural gestures were used. This is to ensure that the learner will still engage in the existing form to communicate for a highly preferred stimulus. Lastly, the response effort required from the learner in order to produce the required response must be equivalent to that of the original response, such that the motivation for the reinforcing stimulus is higher than the response effort required. Successful strategies that result in independent microswitch and SGD use for persons with PMD not only offer a functional and socially appropriate method of communicating, they may positively impact upon the user's quality of life as a result of increased engagement and meaningful social interaction (Lancioni et al., 2002; Lancioni et al., 2014; Lancioni et al., 2013).

Furthermore, microswitch activations could be seen as intentional functional acts to request preferred stimuli by each of the participants. In order for a communicative act to be regarded as intentional, the person must be directing, through eye gaze and body orientation, towards a listener/communication partner, their behaviour should be consistent and they should demonstrate motivation for the item they are requesting (Carter & Iacono, 2002; Iacono et al., 1998; Schweigert, 2012; Yoder & Warren, 2001). In order for an individual to reach a level where they might exhibit intentional communication, they must have some basic understanding of social contingencies where their behaviour can impact and influence another's behaviour. From Studies Two and Three, the data demonstrate that these participants were aware of their environment, motivated to regain access/reinstate a preferred activity, and produced consistent behaviours during an interruption in preferred stimuli. Therefore, the increase in differentiated switch activations from Thomas and Blake, and the strengthened orientation response observed during Josie's evaluation, may suggest that these participants were able to increase their functional and intentional communication skills.

An alternative explanation for the seemingly positive intervention effects might be that these participants were simply stimulated and more active, thus they activated their microswitches more frequently in a more reactive state rather than in an intentional manner. And that these independent microswitch activations were similar to an 'extinction burst' where the participant engaged in high levels of appropriately timed activations without the intended meaning of communicating. If so, and according to previous studies, it would indicate that overtime these well timed microswitch activations/orienting responses would decrease in frequency, as seen in studies assessing extinction bursts (Lerman & Iwata, 1995). However, this was not the case. In-fact, for each participant, the targeted responses increased.

Still, it is not entirely certain as to the function of the additional activations apparent during Thomas's sessions. As discussed in Chapter Six of this thesis, this finding aligns with that of Sobsey and Reichle (1989) who analysed the function of microswitch activations produced by six children with multiple disabilities. The evaluation was implemented using an alternating treatments experimental design that compared four conditions of microswitch activations. From this treatment analysis, higher rates of responding were demonstrated during the attention and buzzing noise (from the microswitch) condition. This suggested that the microswitch was used by participants as a functional method of gaining attention. However, there were still microswitch activations under the condition of the buzzing noise only- suggesting that for some participants, the noise of the microswitch was reinforcing in the absence of attention. This may explain Thomas' additional activations where the speech out-put from the SGD following a microswitch activation may have been reinforcing for him, in addition to using the microswitch for functional communicative purposes.

Challenges and Limitations

One of the challenges faced in collecting data was the fact the participants were often absent from school due to illness. This meant that data collection had to span a considerably longer period of time to obtain what was considered a reasonable amount of data for Study Two and Three assessments and the intervention case studies. In addition, it was often difficult to collect data on some days when the children were present due to conflicts with their regular schools schedule and the time required for them to complete various necessary activities, such as lunch and toileting. Data collection with Josie was particularly delayed due to her moving to a new town and school about mid-way through the third study. This required travelling an extra 1.5 hours one way to implement sessions at her new school.

Another challenge arose due to having a limited budget for acquisition of assistive technology. Consequently, I was restricted to using fairly basic microswitches and SGDs. This might have been a factor in Josie's initial intervention failure as it appeared that reaching out and activating the microswitch with her hands was motorically difficult for her. This presumption is consistent with her diagnosis of Rett syndrome, which is associated with minimal functional hand use. It is possible that a motion-detecting microswitch would have been a better option for her as it could have been activated by the more general body approach movements that comprised her prelinguistic requesting response. Unfortunately, such technology was too expensive for purchase for use in her intervention. Another challenge was the need for me to code the videotapes manually, without the aid of any type of video analysis software. More detailed analysis of the children's engagement, alertness, and indices of happiness would have been possible had I had access to more sophisticated video analysis software.

Another challenge stemmed from the participants' complex health and disability issues. One practical problem that this presented was that it was difficult to find a range of activities or stimuli that might be tested as reinforcers for the participants. This is why I ended up using a single and fairly general social interaction and sensory stimulation activity as the assessment and intervention context. Thomas and Anna were tube fed, for example, and so snacks could not be used and were completely disregarded as potential reinforcers. Josie had a history of intestinal issues and therefore food items were restricted for her consumption. Blake was the only participant for which food items were appropriate for use as a reinforcer. This restriction limited the range of PLBs that could be evoked as requests for continuation of a seemingly preferred activity, rather than also being able to assess PLBs related to requesting other preferred objects and rejecting non-preferred objects. The use of a wider range of activities and contexts would have strengthened the studies included in this thesis.

An additional factor that may have impacted upon these results is the way in which I (the communication partner) interacted with the participants. Literature suggests that interactions between carers and students are significantly influenced by the quality and frequency of reciprocal interaction and reaction (Arthur, 2003; Arthur-Kelly et al., 2007; Atkin & Lorch, 2014; Kaiser & Goetz, 1993; Maes et al., 2007). Further, the critical role of the communication partner is highlighted in previous studies where a more responsive and supportive listener for an individual with PMD can influence the frequency of communicative attempts, the fluency and the quality or content of the communication exchange (Cater & Iacono, 2002; Greathead et al., 2016; Kaiser & Goetz, 1993; Schweigert, 2012). During Studies Two and Three (Chapters Four and Five), I suspect that this might have been a relevant factor, especially when interacting with Blake and Anna. These two participants appeared to demonstrate higher fluctuating levels of attention and alertness and, for Anna in particular, were often drowsy or partially asleep. In comparison, Josie and Thomas were often more frequently physically active, engaged, and more reciprocal to my communicative and social overtures. After numerous viewings of my video data, there appeared to be slight discrepancies in my interaction efforts and frequency of communicative attempts with the participants, in that my rate of communicative attempts and physical interactions with Josie and Thomas were more frequent than with Anna and Blake. During the last three case studies however (Chapters Six, Seven, and Eight), my behaviours became more consistent, perhaps due to the rapport I had developed with the participants and the higher frequencies of responding from Blake during his intervention sessions. Still, throughout all of the studies, the level of social interaction and sensory stimulation provided did not appear to vary too greatly and was done in ways that were intended to be very natural and in line with the students' responsiveness.

Perhaps the most challenging aspect of this research project was however the learning abilities and degree of diversity across participants in regards to (a) deficits due to awareness levels, (b) deficits due to physical limitations and, (c) intellectual abilities to understand behavioural contingencies. In the end, the assessment and intervention approaches were designed in light of what the participants' were observed to be doing. The intervention studies conducted in Chapters Six, Seven and Eight, for example, could thus be considered examples of a highly responsible approach in which the specific evaluation plan was modified in light of the participants' responsiveness rather than following a pre-determined sequence of phases. As stated at the end of chapter five, the pre-planned experimental designs had to be compromised in light of the low levels of responding observed in Blake, and the unanticipated responses observed from Thomas and Josie. This resulted in three evaluation approaches that ended up being non-experimental, which lack rigor and restricted the validity of the results. Additionally, these three case studies lack a social validity component, which is important to assess in order to determine whether the new SGD responses are in-fact more easily detectable and conventional forms for communication partners to respond to. Even though I met with the teachers involved with the students following the completion of the three case studies, no rigorous social validity questionnaire or assessment was carried out. Still, the case studies outlined in this thesis would seem to be practical approaches to evaluate interventions that teachers or speech-language pathologists could apply in classroom settings, and were approaches that would still provide functional and beneficial outcomes for these three participants.

Recommendations

To capture the extent to which an individual might have an ability to communicate using PLBs, teachers and speech-language pathologists might consider using the types of assessment approaches outlined in Studies One, Two, and Three of this thesis. Following from this, PLBs that appear to have a clear communicative function could be strengthened and enhanced along the lines of the case studies for Thomas, Blake, and Josie. The effects of efforts to strengthen and enhance PLBs with clear communicative functions might be evaluated by tracking the frequency of use by the student over the course of intervention. Increased frequency of use would suggest the intervention is having a positive effect. In this way, teachers and speech-language pathologists may be able to begin a communication intervention programme for students with PMD that could form the basis for strengthening and enhancing additional communication skills. Assisting teachers and speech-language pathologists in beginning a communication intervention for students with PMD is important as there may remain a general sense that such students are non-communicators and hence unlikely to benefit from systematic communication assessment and intervention. The approach taken in the present thesis is arguably preferable to more passive programs that seek to increase stimulation levels through sensory rooms or interactions (Calculator, 1988; Kaiser & Goetz, 1993; Lancioni et al., 2006b; Lancioni et al., 2014; Maes et al., 2007; Schweigert, 2012). Furthermore, it remains imperative that practioners, therapists, teachers, and researchers 'take what the learner gives you' meaning; the responses and behaviours we observe from our learners should guide our intervention plans and procedures. This requires altering and individualising the intervention approach and procedures to match the learner's unique characteristics. This ability to adapt is necessary to ensure interventions remain beneficial for the learner, even if this means the rigor of planned experimental designs are compromised.

Conclusion

The overall aim of the present thesis was to evaluate an approach for identifying, strengthening, and enhancing PLBs in four adolescents with PMD. In the attempt to achieve this aim, I designed and completed four studies that focused on: (a) assessing the adaptive behaviour functioning, including the communication forms and functions of four adolescents with PMD, (b) determining the extent to which social interaction/sensory stimulation would evoke PLBs and other behaviours that might be indicative of engagement in and motivation for social interaction/sensory stimulation, (c) determining if brief interruptions in seemingly preferred sources of simulation would reliably evoke PLBs that might be functioning as communicative requests for re-instatement of that activity, and (d) making use of that assessment information to design an intervention aimed at strengthening and enhancing PLBs that appeared to function as communicative requesting responses.

The methodologies employed in this thesis consisted of: (a) in-direct assessment with a familiar teacher and communication partner as the informant, (b) direct behavioural assessment where participants were assessed across two conditions differentiated by the degree of social interaction and stimulation provided by a communication partner, (c) the implementation of a systematic stimulus interruption procedure to evoke potential PLBs that appeared to function as the communicative form of requesting for each participant, and (d) the implementation of three individualised intervention approaches that aimed to evaluate a stimulus interruption procedure to enhance the participants existing PLBs and instruct the participants to use a microswitch activated SGD to request. Specifically, during the last three case studies, systematic instructional procedures including time delay, prompting hierarchies, and contingent reinforcement were used to promote and enhance consistent and functional use of the participants existing PLB forms of requesting. The general approach adopted in this thesis was derived from assessment and intervention models related to constructs of PLBs whereby the existing forms and functions of individuals considered non-conventional communicators might be enhanced through meaningful and appropriate instruction (Calculator, 2002; Lancioni et al., 2014; Lancioni et al., 2013; Siegel-Causey & Bashinski, 1996). .

Individuals with PMD who are considered non-symbolic communicators often develop idiosyncratic forms of communication and can be categorised as intentional communicators or non-intentional communicators. Those who are identified as non-intentional or pre-intentional communicators might be able to develop intentional communicative behaviours. This might be achieved by: (a) identifying a potential communicative act that exists within the learners motor repertoire through the use of meaningful assessment, (b) identifying a motivating context or stimuli that is highly reinforcing for the communicator, (c) identifying procedures to evoke one PLB that is consistently produced during a context that is highly motivating, and (d) creating structured opportunities for the person to produce this response, and reinforce this response by reinstating or providing access to the reinforcing stimuli as if the response was a functional communicative act.

These guidelines align with the main ideas forming the Tri-Focus Framework developed by Siegel-Causey & Bashinski (1997). This framework focuses on the development of communication as influenced by (a) the learner/communicator, (b) the communication partner, and (c) the environmental context. When evaluating the learner, assessments are required to identify factors such as their ability to exhibit intentional communicative acts, degree of deficit in terms of disability, and the potential (likely) need of individualised instruction and teaching strategies. The role of the communication partner could be enhanced through increasing or strengthening their ability to be an engaged and responsive listener when interacting with the learner within a communication context. The third focus of this framework is the environment. When evaluating the environmental context under which communication develops, it is important to consider both the physical and social aspects and whether these aspects inhibit or promote communication opportunities for a learner. This framework then identifies the particular literature and influential factors that impact upon the learner, communication partner, and environmental context. Specifically, developmental factors such as the general psychology and cognitive abilities will impact upon the learner's development of communication and how a communication partner will interpret a learner's communicative attempt. In particular, the effects of sub-optimal behavioural states tend to negatively impact upon learning and skill acquisition such that communication partners often struggle to interpret the behaviours and signals of persons with PMD (Arthur, 2003; Arthur-Kelly et al., 2007; Guess et al., 1990; Guess et al., 2002). Further, educational styles and strategies will impact upon the learner where specialised teaching, involving various alternative strategies and methods, can impact upon the development of communication. In particular, the effects of naturalistic contexts, the design and implementation of reinforcement contingencies, and individualised systematic instruction can impact heavily on enhancing communication skills for the learner. Lastly, clinical factors influence the environmental context of communication development where access to assistive technology and options for implementing AAC interventions can be pivotal in successful outcomes for communication development or enhancement (Siegel-Causey & Bashinski, 1997).

From this, methods to intervene for the purpose of enhancing or strengthening communication in persons with multiple disabilities and PMD can be devised. Along these lines, Calculator developed the ENG program, evaluated in Chapter Two of this thesis. Existing behaviours that are considered as meaningful ways to communicate can be strengthened to become functional and used consistently to gain control over some aspect of a learner's environment (Calculator, 1988; Keen et al., 2001; Reichle, 1997; Sigafoos et al., 2006). Because these natural gestures already exist as communicative forms for the user, there is no intensive teaching or training only required, strengthening the use of these gestures, and increasing the sensitivity and consistency of responding from communication partners. Calculator (2002) suggests that participants must meet six criteria to be viable candidates for ENG training. These include, severe to profound ID, severe communication impairment, varied success with prior AAC use, limited motor and cognitive ability excluding abstract or symbolic communication forms, and some evidence that some intentional and meaningful natural gestures exist within the learner's communicative repertoire. These aspects of ENGs incorporate all critical factors identified in the framework devised by Siegel-Causey & Bashinski (1997) where (a) the learners intent, motivation, and existing form of communication is identified, (b) communicative goals are selected and targeted based on the learners cognitive and motoric capabilities, (c) the communication partner(s) is/are instructed to be responsive and attentive listeners and responders, in addition to strengthening and enhancing the learners attempts through reinforcement contingencies and systematic instructional procedures, and (d) access to alternative communication forms, such as assistive technology or SGD modes, are introduced where appropriate or necessary in order to enhance the learner's communication.

With regard to the latter, Calculator suggests that all communicative functions should be acceptable that are naturally useful and meaningful for a learner. Increasingly communication interventions focus on enhancing communicative attempts using assistive technology or AAC devices (Beukelman & Mirenda, 2005; Light & Drager, 2007; Sutherland, Sigafoos, Schlosser, O'Reilly & Lancioni, 2010). Technology aides can, and often do, take precedence over more natural communication forms as they are considered to provide more comprehensible and conventional communicative messages. Be that as it may, in some cases it might benefit the communicator to use their original and existing forms of communication to express needs, wants, and to interact with others, as opposed to instructing the person to use a communication mode or device that is perhaps less accessible or less preferred over more natural forms of communication (Calculator, 1988; 2002). It might be better for the learner to have access to multiple forms of communication, and be able to use each form during circumstances where a particular mode or message is better suited or preferred (Beukelman & Mirenda, 2005; Calculator, 1988; Reichle & Karlan, 1985). Furthermore, those who are deemed as more adept communicators are often those who are able to use multiple modes of communication (Calculator, 1988; Light & Drager, 2007). In an early study conducted by Cirrin & Rowland (1985) children who were considered as more communicatively proficient were identified as those who used one behaviour to communicate multiple ideas/functions and those who used multiple behaviours to communicate one particular function. Therefore, in this thesis, the acceptance and reinforcement of the existing PLBs from Thomas, Blake, and Josie during their respective intervention studies aligns with this construct that meaningful communicative attempts from the learner should be identified, acknowledged and responded to, and then enhanced if necessary or appropriate (Calculator, 1988, 2002; Siegel-Causey & Bashinski, 1997).

From the four studies conducted for this thesis, the main findings were:

1. Four participants in this thesis demonstrated existing behaviours that were regarded as potential communicative acts by a reliable and familiar communication partner.
2. Demonstrations of behavioural and social contingency awareness were observed where participants were able to alter their behaviours during an assessment consistent with increased levels of engagement, alertness, and indices of happiness.
3. At least one existing communicative behaviour, or PLB, was successfully evoked to reinstate/regain access to seemingly preferred stimuli in three of the four participants that may function as a form of requesting.
4. These existing behaviours were strengthened for one participant and enhanced for two participants with the use of microswitch and SGD technology to (a) enhance the detectability of the communicative requests, and (b) provide a more conventional communicative form that teachers and other communicative partners might be more able to respond appropriately to.

The first finding could be seen as ‘understanding the learner with PMD’, and the second and third findings could be seen as ‘facilitating behavioural states of alertness and engagement’ and ‘identifying the learner’s level of intentionality’. The last main finding could be seen as ‘enhancing the learners communicative meaning’, ‘increasing communication opportunities’ and ‘modifying the environment to promote a natural and motivating communication context’. All of the above align with suggested intervention targets from Siegel-Causey & Bashinski (1997). These findings support the general approach to identify, strengthen and enhance the existing natural gestures, or PLBs, used by individuals with PMD to communicate in line with the theoretical frameworks and constructs behind communication development and intervention. This thesis provides a comprehensive package of one approach to enhance the communication skills of four individuals with PMD where both in-direct and direct behavioural assessment could guide the development of individualised communication intervention to translate non-conventional and ambiguous forms of communication into enhanced functional communicative acts.

In light of these findings, it might be possible to categorise the learners and the developments observed in their skills as they progressed through the three/four studies within this thesis. Individuals with PMD who are considered beginning or prelinguistic communicators often appear to develop PLBs that have communicative intent (McLean, McLean, Brady & Etter, 1991; McLean & Snyder-McLean, 1987). As previously discussed, intentionality is viewed as a product of having developed (a) contingency awareness, (b) consistency and persistence in performing the [communicative] act until the goal is met, and (c) combining the communicative act with other behaviours that are directed towards establishing joint attention with the communication partner (e.g., via body orientation, eye gaze/direction, and directed attention) (Ogletree et al., 1996; Schweigert, 2012; Yoder & Warren, 2001). An individual demonstrating an intent to communicate might then be categorised further into either a primitive signaller, or a conventional signaller. McLean et al. (1991) described a primitive signaller as one who requires and is limited to contact gestures, such as reaching, pulling, grabbing, or additional physical acts, which result in the direct access to stimuli or communication/interaction partners. In contrast, a conventional signaller might develop decontextualized gestures that are able to be used across settings and which often include more advanced acts such as; paired vocalisations with a distal point or directed reach to gain access to reinforcement that is distant to the communicator (Ogletree et al., 1996; McLean et al., 1991; McLean & Synder-McLean, 1987). Conventional communicators often utilise more complex communicative forms and engage in higher rates of communicative acts in comparison to primitive signallers (Ogletree et al., 1996; McLean et al., 1991; Siegel-Causey & Bashinski, 1997).

Those who are identified as non-intentional or pre-intentional communicators might still be able to develop intentional communicative behaviours. This might be achieved by identifying a potential communicative act that exists within the learner's motor repertoire and identifying a motivating context or stimuli that is highly reinforcing for the communicator. Next identifying procedures to evoke one PLB that is consistently produced during a context that is highly motivating, and creating structured opportunities for the person to produce this response, and reinforce this response by reinstating or providing access to the reinforcing stimuli as if the response was a functional communicative act could potentially enable a primitive signaller to shift to a conventional signaler.

In line with the framework outlined above, Thomas and Blake could be categorised as intentional, albeit primitive, signallers as they both displayed consistent PLBs that appeared to be directed at the listener and persisting until the goal was met (i.e., attention and persistence). Throughout the four studies conducted in this thesis, the PLBs exhibited by these two boys appeared to have been successfully enhanced (during the intervention) and this enhancement could be seen as perhaps shifting them from primitive to more conventional signallers. Josie, in comparison, may have originally functioned as a non-intentional signaller, as the existing PLB she possessed did not seem to be as consistently executed by her in the same way as was observed for Thomas and Blake. However, during her intervention, she appeared to have shifted from a seemingly more non-intentional signaller to displaying more consistent PLBs characteristic of that of an intentional primitive signaller. To further advance Josie's functional communicative repertoire, further opportunities for her to strengthen her existing PLB and perhaps enhance this

PLB with some other type of assistive technology might enable her to progress from a primitive signaller to a more conventional signaller. In comparison, Anna could perhaps be viewed as showing signs characteristic of a non-intentional or pre-intentional signaller in that she did not seem to exhibit any identifiable PLBs during the direct assessment studies (Studies Two and Three). Furthermore, Anna did not appear to demonstrate contingency awareness or persist in any way to achieve a desired functional outcome when given opportunities to access reinforcing stimulation.

When deciding upon a course of action for individuals with PMD significant challenges, such as low levels of engagement and responsiveness, the heterogeneity of this population of learners, and the discrepancies in intellectual functioning, sensory impairment and physical impairment, must be overcome (Atkin & Lorch, 2014; Maes et al., 2007; Nakken & Vlaskamp, 2002). When addressing the needs and wellbeing for these individuals, it would seem useful to take advantage of existing skills and strengths, and perhaps aim to improve upon weaknesses or areas of deficits. In some cases, it may help to analyse a teaching or instructional program in line with an idea based around 'the least dangerous assumption' (Donnellan, 1984). When designing interventions that might enhance or improve the functioning of an individual with PMD, the decision might be to focus more on skills that will enable a greater degree of independence or improve quality of life, instead of assuming their behaviours are reactive, and that they lack contingency awareness and the ability to acquire new functional skills, and thus implement programs that might increase their happiness through stimulation (Donnellan, 1984). More specifically, it may be useful to ask what is the greater mistake or the least dangerous assumption?: (a) to assume these participants with PMD used their existing PLBs to communicate a request for the continued access/reinstatement to preferred stimuli/reinforcing interaction, and therefore aim to strengthen and enhance these behaviours, or (b) to assume that they lack intentionality and therefore simply aim to provide them with stimulation rather than attempting to intervene and enhance their potential communicative forms. In this thesis, the former option of aiming to strengthen and enhance the PLBs that were consistently produced during contexts that implied their use of communication was adopted, as this seemed to be the least dangerous assumption, at least for three of the four students.

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Glossary of Terms

AA's: Additional Activations (Recorded during Thomas' intervention study, Chapter Six)

AAIDD: American Association of Intellectual and Developmental Disabilities

AS: Angelman Syndrome

ASD: Autism Spectrum Disorder

BIAS: Behaviour Indication Assessment Survey

CP: Cerebral Palsy

CP: Communication partner

DSM-IV: Diagnostic and Statistical Manual- 5th Edition

EG: Eye gaze

ENGs: Enhanced Natural Gestures

FCT: Functional Communication Training

GMs: General Movements

IBC: Interrupted Behaviour Chain

ID: Intellectual Disabilities

II: Intensive Interaction

IPCA: Inventory of Potential Communicative Acts

MCDs: Malformations of Cortical Development

MCS: Minimally Conscious State

MSE: Multi-Sensory Environment

PLBs: Prelinguistic Behaviours

PMD: Profound and Multiple Disabilities

RTT: Rett Syndrome

SI: Systematic Instruction

SIB: Self-Injuring Behaviours

SGD: Speech Generating Device

STPY: Stereotypy/Stereotypical behaviours

VOCA: Voice Out-put Communication Aides

WHO: World Health Organisation

Appendix A

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

MEMORANDUM

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TO	Jeff Sigafoos
COPY TO	Laura Roche
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	29 October 2014
PAGES	1
SUBJECT	**Ethics Approval: 21119** Teaching Communication Skills to Children with Developmental Disabilities

Thank you for your request to amend your ethics approval. This has now been considered and the request granted.

Your application has approval until 7 July 2017. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with your research.

Allison Kirkman
Human Ethics Committee

Appendix B

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healthcare

TUTORIAL AND SYNTHESIS ARTICLE

Microswitch Technology for Enabling Self-Determined Responding in Children with Profound and Multiple Disabilities: A Systematic Review

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Abstract
We reviewed 18 studies reporting on the use of microswitch technology to enable self-determined responding in children with profound and multiple disabilities. Identified studies that met pre-determined inclusion criteria were summarized in terms of (a) participants, (b) experimental design, (c) microswitches and procedures used, and (d) main results. The 18 studies formed three groups based on whether the microswitch technology was primarily intended to enable the child to (a) access preferred stimuli (7 studies), (b) choose between stimuli (6 studies), or (c) recruit attention/initiate social interaction (5 studies). The results of these studies were consistently positive and support the use of microswitch technology in educational programs for children with profound and multiple disabilities as a means to impact their environment and interact with others. Implications for delivery of augmentative and alternative communication intervention to children with profound and multiple disabilities are discussed.

Keywords: *Augmentative and alternative communication; Choice making; Intervention research; Microswitch technology; Profound and multiple disabilities; Recruiting attention, Self-determination; Systematic review*

Introduction

Educating children with profound and multiple disabilities (PMD) represents a significant challenge. The challenge arises, in part, from the complex nature of the associated impairments. Although there are varying definitions of PMD (cf. Bellamy, Croot, Bush, Berry, & Smith, 2010), the term generally refers to individuals with severe to profound intellectual disability and significant motor impairment, such as spastic quadriplegia or tetraparesis (Harding, Lindsay, O'Brien, Dipper, & Wright, 2011; Lancioni, Sigafoos, O'Reilly, & Singh, 2013). Many such children also have hearing impairment and/or vision impairment, and/or significant health issues, such as complex seizure disorders (Orelove, Sobsey, & Silberman, 2004).

With respect to communication, children with profound and multiple disabilities typically present with little or no speech and rely primarily on "nonsymbolic modes of communication, such as gestures, vocalizations, facial expressions, and body language" (Beukelman & Mirenda, 2013, p. 225). Pre-symbolic or non-symbolic forms of communication are prone to frequent misunderstanding (Brady & Halle, 2002; Brady, McLean, & Johnston, 1995) and limiting in terms of the complexity of messages that can be communicated. Thus, these children are candidates for intervention to enable them to communicate using augmentative and alternative communication (AAC). However, researchers (e.g., Blain-Moraes & Chau, 2012; De Bortoli, Arthur-Kelly, Foreman, Balandin, & Mathisen, 2011; Harding et al., 2011) have noted several challenges with respect to the provision of AAC intervention to these children, who often have significant difficulty in initiating and maintaining social interaction. Additional challenges include pronounced learning difficulties, limited mobility, poor motor control, and fluctuating levels of alertness (Arthur, 2003; Blain-Moraes & Chau, 2012; Orelove, Sobsey, & Silberman, 2004). All of these challenges would seem to complicate the educational process, including provision of AAC intervention.

Over 30 years ago, Bailey (1981) argued that, in light of the significant challenges associated with PMD,

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habilitation efforts should focus on enriching the environment through the provision of preferred stimulation and social interaction. This type of "stimulation programming" was considered more likely to be helpful to the child than systematic instruction to teach adaptive behaviors. This emphasis on stimulation programming remains prevalent today in the guise of intensive interaction (Berry, Firth, Leeming, & Sharma, 2014) and in the prevalent use of multisensory environments in educational programs for children with profound and multiple disabilities (Hogg, Cavet, Lambe, & Smeddle, 2001; Stephenson, 2002; Stephenson & Carter, 2011).

While stimulation programming, which involves exposure to preferred stimulation and social interaction, might be one way to enrich the environment and possibly increase a child's enjoyment and quality of life, conceptual advances over the past 30 years have emphasized a more active approach to habilitation/educational programming for persons with developmental disabilities. Specifically, the self-determination principle highlights the importance of enhancing the autonomy of persons with disabilities (Singh et al., 2003; Wehmeyer, 1992; Wehmeyer & Abery, 2013). Enabling children with profound and multiple disabilities to exert a greater degree of control over the environment might be one way to enhance their self-determination. Specific types of self-determined responding might include (a) controlling access to preferred sources of stimulation, such as music and video, (b) choosing between two or more objects or activities, and (c) recruiting attention/initiating social interaction.

While a case for the desirability of enhancing self-determination has been made in the literature (Singh et al., 2003; Wehmeyer, 1992; Wehmeyer & Abery, 2013), an important question is whether children with profound and multiple disabilities can learn to (a) control access to preferred stimuli, (b) make choices between stimuli, and (c) recruit attention/initiate social interaction. One potentially effective approach for increasing the impact of an individual on their environment would be to train their communication partners to better recognize and respond appropriately to the person's existing prelinguistic communication behavior as suggested by Sigafoos, Arthur-Kelly, and Butterfield (2006). Along these lines, Tait, Sigafoos, Woodyatt, O'Reilly, and Lancioni (2004) demonstrated that parents could be trained to enhance the prelinguistic behavior of their children with developmental and physical disabilities. The intervention was effective in enabling the children to, among other outcomes, more effectively access preferred stimuli (i.e., request preferred objects). However, as noted before, prelinguistic behavior is often prone to frequent communicative breakdowns (Brady & Halle, 2002; Brady, McLean, & Johnston, 1995). To counteract this possibility, it might be possible to enable children to independently control access to preferred stimulation using aided forms of AAC (Snodgrass, Stoner, & Angell, 2013) and related forms of assistive technology. A potential advantage of aided forms of AAC and related technology is that it consistently recognizes the child's communicative attempts, unlike human mediators who often miss the child's communicative attempts (Brady & Halle, 2002; Brady et al., 1995). To this end, various assistive technologies/AAC devices have been developed that might enable self-determination in children with PMD. Microswitches, for example, represent one type of assistive technology that would seem to have considerable potential for enabling self-determined responding in children with profound and multiple disabilities.

Lancioni et al. (2013) defined microswitches as a type of assistive technology that enables the person to perform adaptive behaviors (e.g., access preferred stimuli, choose between stimuli, and initiate social interaction) via some existing motor action, such as moving a finger or arm, head turning, touching/pushing, or chin movement. At present there are a growing number of individual studies examining the use of microswitches (Lancioni et al., 2013). However, these studies have typically involved a small number of participants using microswitches for a small number of tasks. What is needed is an integrated understanding of how past research can inform interventions to promote self-determination among children with profound and multiple disabilities using microswitch technology. For what types of tasks has microswitch technology been proven to be of benefit? For what children have these interventions been successful? What types of instruction was needed for these children to learn to use microswitches to make self-determined responses?

The aim of this review is to attempt to answer these questions by providing a systematic review of research that has evaluated the use of microswitch technology for enabling children with profound and multiple disabilities to make self-determined responses, specifically: (a) accessing preferred stimuli, (b) choosing between stimuli, and (c) recruiting attention/initiating social interaction. These types of responses could be considered important examples of self-determination and important educational goals for children with profound and multiple disabilities. Teaching these children to use microswitch technology to make these types of responses might represent a useful starting point for AAC intervention. Indeed, these types of responses could be conceptualized as beginning communication skills related to requesting objects and gaining attention. As Reichle, York, and Sigafoos (1991) argued, such beginning communication skills are important because they enable the child to access reinforcement and exert some degree of control over the environment, including control over the actions of other people in the environment.

The specific objectives of the present review were to (a) identity and summarize research studies that evaluated the use of microswitch-based interventions for enabling self-determined responding in children with profound and multiple disabilities, and (b) gain an overall picture of the success of these interventions. A review of this type could be helpful in advancing evidence-based practice. Advancing evidence-based practice is important because interventions based on high quality research are more likely to be effective (Cook, Tankersley, & Landrum, 2013). In addition, legislative mandates, such as the Individuals with Disabilities Education Act (IDEA, 2004) and No Child Left Behind Act of 2001, require the use of research evidence in educational programming (Yell & Rozalski, 2013). Thus a review of research in this area might help guide research-based classroom interventions for children with PMD. A review of this type might also identify gaps in the existing evidence base and stimulate new research to fill those gaps.

Method

We systematically searched for intervention studies that evaluated the use of microswitch technology for enabling children with profound and multiple disabilities to (a) access preferred stimuli, (b) choose between stimuli, and/or (c) recruit attention/initiate social interaction. Identified studies that met pre-determined inclusion criteria were summarized in terms of (a) participants, (b) experimental design, (c) microswitches and procedures used, and (d) results.

Search Procedures

We searched the 56 electronic databases covered by ProQuest on 22 August 2014. The search terms were "microswitch" and "multiple disability" or "profound disability." These search terms were entered into the Abstract field as free text. The search was restricted to English language articles in peer-reviewed scholarly journals. Limiting the search to peer-reviewed scholarly journals was intended to ensure that studies included met the peer-reviewed research requirement of IDEA 2004 (Yell & Rozalski, 2013). Two additional search strategies involved (a) reviewing the reference lists of articles identified from the electronic database to search for other relevant studies, and (b) searching for additional studies by the first author of each included study from the initial database search.

Screening and Inclusion Criteria

To be included in the review, the study had to meet three inclusion criteria. First, it had to focus on evaluating the use of microswitch technology with at least one participant who was 18 years of age or younger. Based on Lancioni et al. (2013), a microswitch was defined as any type of assistive technology that would enable the person to perform one of three self-determination responses: accessing preferred stimuli, choosing between stimuli, and/or recruiting attention/initiating social interaction. Microswitches were activated via some existing motor action that the child performed, such as moving a finger or arm, head turning, touching/pushing, or chin movement. PMD was defined as the presence of (a) severe/profound intellectual disability, (b) severe physical impairment (e.g., spastic quadriplegia or spastic tetraparesis), and (c) severe communication impairment/complex communication needs. Severe communication impairment referred to having little or no speech/spoken words based on the study's description of participants. Second, the microswitch technology had to be primarily intended to provide the child with a way of (a) gaining access to preferred stimuli, (b) choosing between stimuli, or (c) recruiting attention/initiating social interaction. Third, the studies had to have an experimental design. Experimental designs included a range of single case experimental designs, such as ABAB, multiple baseline, and alternating treatments designs (Kennedy, 2005), but could have also included randomized control trials, although no studies using this latter design were identified. Including only experimental studies increases the certainty of evidence and is in line with the No Child Left Behind Act of 2001, which requires educational instruction to be based on scientific (i.e., experimental) research.

The initial database search returned 261 results. The titles and abstracts of these 261 returns were given an initial screening by the first author, resulting in 23 studies for possible inclusion. The second author independently screened these 261 studies against the inclusion criteria and rated 18 as meeting the inclusion criteria. After discussion, six of the first author's 23 studies were excluded because they were judged to be primarily focused on improving motor performance/control rather than on enabling participants to (a) access preferred stimuli, (b) choose between stimuli, and/or (c) recruit attention/initiate social interaction. In addition, one study nominated by the second author, but initially excluded by the first author, was subsequently deemed to meet the inclusion criteria, resulting in a total of 18 studies for inclusion in this review.

Data Extraction and Coding

The 18 studies were classified into three groups based on whether the microswitch technology was primarily intended to enable the child to (a) access preferred stimuli, (b) choose between stimuli, or (c) recruit attention/initiate social interaction. For each group of studies, we extracted data on the following variables: (a) participant numbers, gender, ages, and diagnoses, (b) experimental design, (c) microswitches and procedures used, and (d) results. Data extraction for all 18 studies was performed by the first author and checked for accuracy by the second author.

Results

Accessing Preferred Stimuli

Table I provides a summary of seven studies (Studies 1–7) that focused on enabling participants to access preferred stimuli via microswitch technology. A total of 12 participants received intervention in these seven studies. They ranged from 4–18 years of age ($M = 9$)

Table I. Summary of Seven Studies Focused on Evaluating Microswitch Technology for Enabling Children to Access Preferred Stimuli.

Study	Participants	Design	Microswitch intervention	Results
1. Lancioni, O'Reilly, Oliva, and Coppa (2001)	Two boys (7 and 9 years old) with congenital cerebropathy, spastic tetraparesis, epilepsy, profound intellectual disability, and no speech.	Non-concurrent multiple baseline across participants.	A contact microphone was affixed to each participant's throat. It was activated by 70 dB or higher vocalizations. Baseline activations had no consequences. For intervention, activations triggered 5–7 s of preferred stimulation (e.g., songs, bells, clapping).	Activations were low during baseline and increased with intervention.
2. Lancioni and Lems (2001)	Two boys (4 and 18 years old) with spastic tetraparesis, epilepsy, and profound intellectual disability.	ABAB reversal design for one child and an AB design for the other child.	Contact microphone activated by 70 dB or higher vocalizations. Baseline activations had no consequences. For intervention, activations triggered 5–7 s of preferred stimulation (e.g., songs, vibration, and lights)	Activations were low during baseline and increased with intervention.
3. Lancioni, Singh, O'Reilly, and Oliva (2002)	Two girls (6 and 13 years old) with cerebropathy, spastic tetraparesis, epilepsy, visual impairment, profound intellectual disability, and no speech.	Non-concurrent multiple baseline across participants with 3-month follow-up.	Table-top vibration switch activated by tapping the table. Baseline activations had no consequence. Intervention and follow-up activations triggered stimuli (e.g., songs, lights).	Activations were low during baseline, increased with intervention, and were maintained at a 3-month follow-up.
4. Lancioni et al. (2004)	One boy (17 years old) with congenital cerebropathy, vision impairment, profound intellectual disability, and no speech.	ABAB design with 12-week follow-up.	Lever switch activated by downward chin movements. Baseline activations had no consequence. For intervention and follow-up, activations triggered 7 s of preferred stimulation (e.g., music, lights, vibration).	Activations were lower during the baseline phases than during the intervention and follow-up phases.
5. Lancioni, Singh, O'Reilly, Oliva, and Groeneweg (2005)	One girl (8 years old) with congenital cerebropathy, vision impairment, epilepsy, profound intellectual disability, and no speech.	ABAB design with 2-month follow-up.	A contact microphone affixed to the participant's throat and another placed near her face to reduce false positives. Both microphones were activated by vocalizations of 50 dB or higher and both had to be activated to trigger preferred stimuli. Baseline activations had no consequence. For intervention and follow-up, activations triggered preferred stimulation (e.g., music, songs, vibration).	Activations were lower during the baseline phases than during the intervention and follow-up phases. The second microphone reduced false positives.
6. Lancioni et al. (2006a)	Two children (a 7-year-old girl and an 8-year-old boy) with cerebropathy, visual impairment, severe to profound intellectual disability, and no speech.	ABAB design with 2-month follow-up.	Position and optic sensor microswitches activated by downward chin movements. Baseline activations had no consequence. For intervention and follow-up, activations triggered 4–10 s of stimulation (e.g., animal noises, music, lights, vibration).	For both children, activations were lower during the baseline phases than during the intervention and follow-up phases.
7. Lancioni et al. (2007a)	Two children (a 6-year-old girl and a 14-year-old boy) with encephalopathy, vision impairment, epilepsy, profound intellectual disability, and no speech.	ABAB design with 6-week follow-up.	Optic sensor microswitches activated by forehead movement. Baseline activations had no consequence. For intervention and follow-up, activations triggered preferred stimulation (e.g., songs, vibration).	For both children, activations were lower in baseline phases than during the intervention and follow-up phases.

and included seven males and five females. Most were diagnosed with the following combination of conditions: (a) cerebropathy, (b) spastic tetraparesis, (c) epilepsy, (d) vision impairment, and (e) profound intellectual disability. Most participants were also described as having no speech and requiring wheelchairs for mobility.

The therapeutic aim of these studies was to enable participants to control access to preferred stimulation (e.g., music, songs, vibration, and/or lights) via microswitch activation. Four microswitch response combinations were evaluated: (a) microphone switches activated by vocalizations, (b) vibration switches activated by tapping/hitting the table surface on which the switch had been placed, (c) lever switches activated by chin movement, and (d) optic microswitches activated by forehead movements. Switch activations produced different outcomes/consequences depending on the phase of the study. Specifically, switch activations that occurred during the baseline phase did not produce any stimulation, whereas switch activations that occurred during the intervention phase produced 4–10 s of access to preferred stimulation (i.e., 4–10s of music, songs, vibration, and/or lights).

During the baseline phases, children were given access to the microswitch technology (e.g., the lever switch was positioned next to their chin), but switch activations produced no consequences. After baseline, a few practice sessions were provided, during which children were assisted to activate the switch four to six times (with consequent brief access to stimulation). After these practice sessions, the children had intervention sessions during which independent activation of the microswitch resulted in varying durations (4–10 s) of preferred stimulation. Thus the instructional procedures involved initial practice sessions using graduated guidance and the subsequent contingent reinforcement sessions that were conducted within a free-operant paradigm (Duker, Didden, & Sigafoos, 2004). The paradigm was free operant in the sense that the child could access preferred stimulation, via switch activation, at any time during the session. This free-operant paradigm could be seen as an especially powerful approach for evaluating whether the intervention did in fact produce self-determined responding. The power comes from the fact that after the practice sessions, the children were never prompted, instructed, or in any way cued by others to activate the switch. Thus it was the children themselves who determined when and how often to make the switch activating response so as to gain stimulation. Indeed, the intervention sessions differed from baseline sessions only by virtue of the fact that each switch activation resulted in contingent reinforcement in the form of 4–10 s of preferred stimulation. In line with this free-operant arrangement, the main dependent variable was the number (frequency) of switch activations per session, which was sometimes converted into a rate per minute measure.

To evaluate the intervention, five studies used ABAB reversal designs and two studies used the non-concurrent multiple baseline across participants design (Kennedy, 2005). Five studies included from 6 weeks to 3 months of follow-up. In the reversal designs, the return to baseline conditions meant that switch activations no longer produced contingent stimulation. That is, responses that were reinforced in the previous intervention phase were now placed on an extinction schedule. The change from the extinction schedule (in effect during the baseline phases) to the continuous reinforcement schedule (in effect during the intervention phases) was not signalled to the children in any way. Any change in responding from baseline to intervention could therefore be attributed to the change in the contingencies (i.e., the change from no reinforcement to contingent reinforcement) rather than to any antecedent instruction or cueing. In addition, any increase in responding with intervention would provide evidence of cause-effect learning; that is, the children had learned that activating the switch caused the stimulation (Calculator & Jorgensen, 1991).

Positive results were reported in all seven studies and for all 12 children. Visual inspection of the graphed data in these studies showed that switch activations were very low during baseline phases, but increased to much higher and steady levels with intervention. Switch activations also remained higher during follow-up than during baseline. A calculation of response frequencies indicated that across these seven studies, switch activations during baseline averaged approximately six responses per session, whereas during intervention and follow-up, switch activations averaged approximately 18 responses per session. These approximations were based on calculations made by the second author, which were then independently checked for accuracy by the last author. Thus, switch activations were roughly three times higher during intervention and follow-up sessions than during baseline sessions. The results suggest that the microswitch technology and the intervention procedures employed enabled the children to independently control (i.e., self-determine) access to preferred stimuli. The higher levels of independent switch activations during intervention and follow-up also provide clear evidence of cause-effect learning (Calculator & Jorgensen, 1991).

Making Choices

Table II provides a summary of six studies (Study 8–13) focused on enabling participants to make choices using microswitch technology. A total of 11 participants received intervention in these six studies. They ranged from 6–17 years of age ($M = 11$ years) and included four males and seven females. Participants were diagnosed with the following combination of conditions: (a) cerebropathy, (b) spastic tetraparesis, (c) epilepsy, (d) vision impairment, and (e) severe to profound intellectual disability. Six participants were described as having some spoken words or recognizable vocalizations.

The therapeutic aim of these studies was to enable participants to experience a brief sample of various stimuli and then choose the stimulus that they wanted to access. The study by Lancioni et al. (2006c; Study 11), will serve as an illustrative example of the studies in this group. In this study, the participant had only one microswitch and a computer system, which presented him with brief stimulus samples. After each sample, he was to decide/choose whether he wanted to access that stimulus or not. In the first case, he was expected to activate his microswitch. In the second case, he was expected to abstain from activating the microswitch. In the other studies, participants were taught to use two or more microswitches. In three of those studies (Studies

Table II. Summary of Six Studies Focused on Evaluating Microswitch Technology for Enabling Children to Make Choices.

Study	Participants	Design	Microswitch intervention	Results
8. Lancioni, Singh, O'Reilly, and Oliva (2003)	This study included two participants, but only one was less than 18 years old. The (17-year-old) girl had cerebropathy, spastic tetraparesis, vision impairment, epilepsy, spastic tetraparesis, vision impairment, and severe intellectual disability. The child could speak some words.	Multiple probe across behaviors design with 2-month follow-up. The separate behaviors were use of different microswitches.	A mercury switch for head raising, a right-hand push button switch, and a left-hand press bar switch were used to request stimuli and a microphone switch, activated by saying *yes* was used to choose presented stimuli. Baseline activations had no consequence. For intervention and follow-up, activations were used to present a stimulus offer, which could then be chosen by the microphone switch. At the start of intervention, the child was initially prompted to activate each microswitch.	Activations of each microswitch increased only when intervention was applied to that microswitch.
9. Lancioni Singh, O'Reilly, and Oliva (2004)	One girl (17 years old) and one boy (6 years old) with cerebropathy, spastic tetraparesis vision impairment, severe intellectual disability and some speech/ recognizable vocalizations.	Multiple probe across behaviors design with 14 follow-up sessions. The separate behaviors were use of different microswitches.	Each child used 2 or 3 microswitches (e.g., mercury switch, optic sensor, and/or pressure switch) to request stimuli and then used a microphone switch, activated by vocalizations, to choose presented stimuli. Baseline activations had no consequence. For intervention, activations resulted in stimulus presentations, which could then be chosen by activating the microphone switch. At the start of intervention, the children were initially prompted to activate each microswitch.	Activations of each microswitch increased only when intervention was applied to that microswitch.
10. Lancioni et al. (2006b)	Three girls (7, 9, and 15 years old) with cerebropathy, vision impairment, epilepsy, severe to profound intellectual disability, and no speech.	Multiple probe design across two behaviors. The two behaviors were use of two different microswitches. A final phase assessed use of both switches to make choices.	Contact microphone switch affixed to one of the girl's throats was activated by vocalizations. A position sensor attached to the chin of one of the girl's was activated by downward chin movements. Multiple mercury switches were activated by body and knee movements, and an adapted position microswitch was activated by hand opening. Each MS activation triggered a specific preferred stimulus. Each participant had two microswitches to make choices between two types of stimuli. Baseline activations had no consequence. For intervention, activations enabled the child to choose among different stimuli.	Activations of each microswitch increased only when intervention was applied to that microswitch. The final phase indicated that all three children used both of their acquired microswitch responses to make choices.
11. Lancioni et al. (2006c)	One boy (9 years old) with cerebropathy, vision impairment and intellectual disability. He had previous experience using chin movements to activate microswitches to request preferred stimuli.	ABAB design with 6- and 10-week follow-ups.	A sensor switch attached to the boy's face was activated by an upward eyebrow movement. Samples of preferred and non-preferred stimuli were presented via a computer and could be chosen by switch activations. Baseline, activations had no consequence. For intervention, activations enabled the child to choose the presented stimulus.	Switch activations were low during baseline phases. With intervention, switch activations for preferred stimuli increased while switch activations for non-preferred stimuli remained low. This differential pattern was maintained during follow-up.

(*Continued*)

Table II. (Continued)

Study	Participants	Design	Microswitch intervention	Results
12. Lancioni et al. (2006d)	One boy (9 years old) and one girl (12 years old) with cerebropathy, spastic tetraparesis, epilepsy, blindness, and severe to profound intellectual disability.	Multiple probe across behaviors with a 3-week follow-up and generalization probes. The two behaviors were use of two different microswitches to indicate "yes" to choose a preferred stimulus and to indicate "no" to reject a non-preferred stimulus.	For the boy, two mercury switches were used and activated by head ("no") and foot movements ("yes"). For the girl, microphone switches were used to detect vocalizations (for indicating "yes") and a mercury switch was used to detect head movements (for indicating "no"). Preferred and non-preferred stimuli were shown to the child and he/she could choose or reject the item by activating the "yes" or "no" switch, respectively. Baseline, activations had no consequence. For intervention, activations enabled the child to choose or reject the presented stimulus.	The boy had low percentages of correct switch activations during baseline (i.e., choosing preferred or rejecting non-preferred stimuli), but the girl was 20–40% correct during baseline. With intervention, correct responding increased to above 70% correct for both children and for both the "yes" and "no" responses. Correct performance remained high during follow-up.
13. Lancioni et al. (2007b)	One boy (12 years old) and one girl (14 years old) with cerebropathy, spastic tetraparesis, epilepsy, vision impairment, and severe to profound intellectual disability. They had no spoken words, but made vocalizations that were interpreted as yes/no responses.	Multiple probe across behaviors design with 3- and 6-week follow-ups. The behaviors were use of two different microswitches.	Both participants had two microswitches. One switch was either a pressure switch or a mercury switch to trigger a computer system to present samples of preferred and non-preferred stimuli. When a sample of a stimulus had been presented, activation of microphone switches by "yes" or "no" vocalizations resulted in receiving or rejecting that stimulus.	Microswitch activations were low during baseline and increased with intervention. With intervention, the children consistently used the *yes* microswitch to request preferred stimuli and used the *no* microswitch to reject non-preferred stimuli. Performance remained high during follow-up.

8, 9, and 13), for example, the children were provided with one or more request microswitch(es). Activating the request microswitch(es) informed the children as to the specific stimulus on offer. After this, activation of the second (choice) microswitch allowed the children to choose the offered stimulus. However, if the child did not activate the second (choice) microswitch, then the offered stimulus was rejected. After any choice or rejection, the children could restart the aforementioned sequence with a new activation of the request microswitch(es). The types of stimuli offered in these studies included vibration, familiar voices, songs, and animal noises. Some studies (e.g., Studies 11 and 13 in Table II) included highly preferred stimuli and less-preferred or non-preferred stimuli with the intention that participants would learn to choose preferred stimuli and reject the less- or non-preferred stimuli.

The microswitch-response combinations evaluated in these six studies included: (a) microphone switches activated by vocalizations, (b) mercury switches activated by slight body (e.g., head, knee, or hand) movements, (c) lever and pressure switches activated by touching/pushing movements, and (d) optic/movement sensing switches activated by chin or eyebrow movements. Procedurally, during the baseline phases, children had the microswitch technology, but switch activations produced no consequences. During intervention, activation of the first microswitch switch was followed by presentation of a stimulus, which could then be accessed for 15–20 s by activation of the second (choice) microswitch. As in the first set of seven studies, intervention sessions were often proceeded by several practice trials during which children were physically assisted to perform the sequence. To evaluate the intervention, five studies used a multiple-probe across behaviors design, while one study used an ABAB reversal design (Kennedy, 2005). In the multiple-probe studies, intervention was generally provided to the initial request microswitch first, then the second and third microswitches, respectively. Five studies included follow-ups of up to 3 months. Within the multiple-probe designs, the two behaviors probed were use of the first microswitch and use of the second microswitch, respectively.

Positive results were reported in all six studies and for all 11 children. Generally, switch activations were low during baseline phases, increased to higher and steady levels with intervention, and remained high and steady during follow-up. When choices for preferred versus non-preferred stimuli were compared (e.g., Studies 11 and 13 in Table II), correct use of the switch activation sequence to make choices for preferred stimuli averaged approximately 5% during baseline, but increased to above 70% during intervention and follow-up. Choices for non-preferred stimuli remained low (5% or less). The results suggest that the microswitch technology, and the intervention procedures employed, enabled the children to access a list of stimulus options and then choose whether or not to experience each specific option. The higher levels of independent switch activations for both microswitches during intervention and follow-up, compared to baseline, provide convincing evidence that the children had learned a rather complex behavioral chain consisting of two sequential microswitch responses.

Recruiting Attention/Social Interaction

Table III provides a summary of five studies (Study 14–18) that focused on enabling participants to recruit attention and initiate social interaction via the use of microswitch technology. A total of 22 participants received intervention in these five studies. They ranged from 5–18 years of age ($M = 11$) and included 12 males and 10 females. The diagnostic descriptions of the children in these studies varied. Sobsey and Reichle (1989; Study 14), for example, described their six participants as "multiply handicapped" (p. 48). These children appeared to have at least severe intellectual disability and motor impairments. Most were also described as producing either only vocalizations or a few words of speech. The 16 children in the other studies generally had two or more of the following conditions: (a) cerebropathy, (b) spastic tetraparesis, (c) epilepsy, (d) vision impairment, and (e) severe to profound intellectual disability.

There were two main therapeutic aims addressed in these five studies. The first aim, addressed in Sobsey and Reichle (1989; Study 14), was to determine what type of consequence maintained the children's use of a call buzzer; specifically, whether the maintaining consequence was the resulting attention from an adult or simply the noise of the call buzzer. In this study, the six children were taught to activate a call buzzer. The call buzzer could be activated by touching, hitting, or pushing a pressure microswitch. Under some conditions activation of the switch was followed by having an adult approach and speak to the child (e.g., *Hello [child's name]. Did you call me?*), while in other conditions switch activations only produced a buzzer noise.

In the other four studies, the main therapeutic aim was to enable participants to recruit attention/initiate a social interaction. In these four studies, microswitch activations triggered digitized or synthesized output from a speech-generating device (SGD). Kennedy and Haring (1993; Study 15), for example, taught participants to activate a toggle switch, which triggered a recorded message (e.g., "*Can we do something else?*") and a relevant social response from a peer (e.g., talking to the child and engaging the child in a new activity). Four types of microswitches were evaluated in these five studies: (a) pressure and toggle switches activated by touching, hitting, or pushing the switch with head or hands, (b) tilt switches activated by body (e.g., wrist) movements, (c) microphone switches activated by vocalizations, and (d) optic microswitches activated by eye, mouth, or head-turning movements.

To evaluate the effects of different consequences on the frequency of microswitch activations, Sobsey and Reichle (1989, Study 14) used an alternating-treatments design with four different conditions compared. The other studies used a multiple-probe across participants design (Study 15), or multiple-probe across behaviors design (Studies 16–18). In the Sobsey and Reichle study, children were first taught to use the microswitch to recruit attention using verbal, gesture, and physical prompts (Duker et al., 2004) and were then exposed to the four conditions in an alternating treatments design. In the other studies, children had the microswitch technology during both baseline and intervention sessions. In baseline, switch activations produced no consequences, whereas during intervention each switch activation triggered speech output, which was then followed by receiving attention/social interaction. In addition to these differential consequences, Kennedy and Haring (1993; Study 15) also used physical prompting to assist the children in making the response.

In the Sobsey and Reichle (1989, Study 14) study, acquisition training appeared to be effective, as evidenced by a gradual increase in independent switch activations as training progressed. When the four conditions were then alternated, participants showed more responding during the buzzer plus attention condition, followed by the attention only, buzzer only, and no attention/no buzzer conditions. These data suggest that the children had learned to use the microswitch to recruit attention, but that some level of responding also seemed to be maintained by the sound of the buzzer. However, responses that occurred in the buzzer only and no attention/no buzzer conditions might have stemmed from resistance to extinction given that attention was no longer forthcoming for switch activations during these latter two conditions.

The other four studies (Studies 15–18) reported positive intervention effects for all 16 participants. This is evidenced by visual inspection of the graphed data, which showed that switch activations to initiate social interactions were low during baseline phases and increased to higher and steady levels with intervention. Responding was also generally maintained at levels comparable to those of intervention during follow-up (Studies 16 and 17). For example, during baseline, the three children in the Kennedy and Haring study (1993, Study 15) had a mean response frequency of less than one response per session. With intervention, the children were routinely making 4–16 responses per session. The results from Studies 15–18 suggest that the microswitch technology and the intervention procedures employed enabled the children to activate an SGD so as to recruit attention/initiate social interaction. The higher levels of independent switch activations under conditions when switch activations resulted in social interaction suggests that the children had learned to operate the switch as a means of recruiting attention/social interaction.

Table III. Summary of Five Studies Focused on Evaluating Microswitch Technology for Enabling Children to Recruit Attention/Initiate Social Interaction.

Study	Participants	Design	Microswitch intervention	Results
14. Sobsey and Reichle (1989)	Six children (3 boys and 3 girls) ranging from 6–16 years of age. All were described as having multiple handicaps.	Alternating treatments design with an initial acquisition-training phase. After children had acquired the microswitch response, four conditions were alternated to determine if responding was maintained by attention and/or buzzer sound from the microswitch. The conditions were: (a) buzzer only (buzz sound of the switch), (b) attention only, (c) attention plus buzzer, and (d) no attention plus no buzzer.	A pressure switch connected to a call buzzer was activated by a touching response. Acquisition training involved verbal, gesture, and physical prompts until children independently activated the switch. In the buzzer-only condition, switch presses resulted in the buzzer noise. In the attention-only condition, switch presses produced attention from an adult, but not the buzzer. In the attention plus buzzer condition, switch activations resulted in attention and the buzzer. In the final condition, switch pressing produced neither the buzzer nor attention.	Each child learned to activate the switch independently with acquisition training. In the subsequent alternating treatments phase, switch activation frequencies were highest in buzzer plus attention condition, followed by attention only, and then the buzzer-only condition. Frequencies of switch activations were lowest under the no-attention plus no-buzzer condition.
15. Kennedy and Haring (1993)	The study included four participants, but only three were children. The children were one girl (5 years old) and two boys (6 and 18 years of age) with microcephaly, spastic tetraparesis, epilepsy, and "no formal means of communication" (p. 64).	Three studies were conducted; Study 1 involved a preference assessment, which identified 12 low and 14 high preference items for each participant. Study 2 followed a multiple probe across students with an alternating treatments design to train microswitch activation. Study 3 involved a stimulus generalization baseline phase (from instructor to peer) followed by an alternating treatments design with three treatment conditions to control social interaction with non-disabled peers	The microswitches included a contact switch and a toggle switch. Switch activation triggered digitized (recorded) output (i.e., *"Can we do something else?"* or *"Let's try something new"*). The three alternating treatment conditions were (a) participant in control of stimuli, (b) non-disabled peer in control of stimuli, or (c) stimuli duration and sequence matched that of the peer-control condition and the microswitch was not available	During Study 2, switch activations increased during intervention from baseline when preferred stimuli were present. When preferred stimuli were absent, switch activations were low. Additionally, the length of time participants engaged with highly preferred stimuli increased during intervention. During Study 3, switch activation generalized to non-disabled peers
16. Lancioni et al. (2008a)	One boy (16 years old) and one female (18 years old) with cerebropathy, spastic tetraparesis, vision impairment, profound intellectual disability, and no speech	Multiple probe across three behaviors with 1.5 month follow-up. The behaviors were use of two different microswitches and operation of a speech-generating device via a microphone switch.	Children were taught to use tilt, pressure, and microphone switches to (a) access preferred stimuli, and (b) trigger a speech-generating device to initiate social interaction (e.g., *"Could somebody talk to me"*). In baseline, switch activations had no consequence. For intervention, different switches produced preferred stimuli or the speech output, which then resulted in an interaction with a caregiver.	Microswitch activations were low during baseline and increased with intervention. Within the third intervention tier, the children consistently used all three microswitches to access preferred stimuli and initiate social interaction. Performance remained high during follow-up.
17. Lancioni et al. (2008b)	Two boys 10 and 11 years old) and one girl (15 years old) with spastic tetraparesis, encephalopathy, vision impairment, severe to profound intellectual disability and no speech. All had previous experience in using microswitches.	Multiple probe across three behaviors with 1.5- to 3-month follow-up. The behaviors were use of three different microswitches.	Children were taught to use pressure and tilt microswitches to (a) access preferred stimuli, and (b) trigger a speech-generating device to initiate social interaction (i.e., *"Can somebody play with me?"*). In baseline, switch activations had no consequence. For intervention, different switches produced preferred stimuli or the speech output, which then resulted in an interaction with a caregiver.	Microswitch activations were low during baseline and increased with intervention. Within the third intervention tier, the children consistently used all three microswitches to access preferred stimuli and initiate social interaction. Performance remained high during follow-up.

(*Continued*)

Table III. (Continued)

Study	Participants	Design	Microswitch intervention	Results
18. Lancioni et al. (2009)	Four boys and four girls ranging from 5–17 years of age with encephalopathy, vision impairment, and severe to profound intellectual disability.	Multiple probe across behaviors design. The behaviors were use of two different microswitches.	Children were taught to use optic, pressure, and/or tilt microswitches to (a) access preferred stimuli, and (b) trigger a speech-generating device to initiate social interaction (e.g., *"Can you play with me?"*). In baseline, switch activations had no consequence. For intervention, different switches produced preferred stimuli or the speech output, which then resulted in an interaction with a caregiver.	Microswitch activations were low during baseline and increased with intervention. Within the third intervention tier, the children consistently used their microswitches to (a) access preferred stimuli, and (b) initiate social interaction. Performance remained high during follow-up.

Discussion

We identified 18 studies reporting on the use of microswitch technology to enable three types of self-determined responding in children with profound and multiple disabilities. The results of these studies were consistently positive. Indeed, each study provided convincing experimental data that every participant learned to activate one or more microswitches to (a) access preferred stimuli, (b) choose between stimuli, or (c) recruit attention/initiate social interaction. The positive results from these 18 experimental studies, involving 45 participants, would seem to provide sufficient empirical evidence to support and justify the use of microswitch technology in educational programs for these children.

The studies included in this review were scientific (i.e., involved experimental designs) and peer reviewed, thus meeting the requirements of NCLB and IDEA. Each study also was judged by the first and last authors to have provided sufficiently detailed intervention protocols to enable replication in applied settings, such as classrooms. Indeed, these studies could be seen as technological and analytic (Baer, Wolf, & Risley, 1987). The studies were technological in the sense of providing an objective description of the procedures and analytic in the sense of providing a convincing demonstration of a positive intervention effect. In addition, the findings would appear to have considerable external validity given that the main findings of any given study were often reproduced across several additional, yet independent studies (Sidman, 1960/1988). For example, the seven studies evaluating microswitch technology to enable children to access preferred stimulation (see Table I) could be viewed as systematic replications in the sense that all of these studies used the same basic arrangement and the same general intervention approach and all of them reported similarly positive findings. The same could be said for most of the studies summarized in Tables II and III.

In terms of procedures used to teach microswitch use, all of the studies used well-established instructional strategies, such as (a) physically assisting the child to activate the switch (i.e., response prompting), (b) fading out this assistance (i.e., graduated guidance/prompt fading), and (c) contingent reinforcement. These instructional strategies have extensive empirical support for teaching a range of adaptive responses to persons with developmental and physical disabilities (e.g., Duker et al., 2004; Snell & Brown, 2006). It is perhaps not surprising that these same procedures could be effectively applied to teach children with profound and multiple disabilities to activate microswitches to (a) access preferred stimuli, (b) choose between stimuli, or (c) recruit attention/initiate social interaction. Overall, the positive findings from these studies suggest that after a relatively brief period of instruction/practice, the children came to independently use the microswitches without the need for any ongoing cueing or prompting. This suggests the children were capable of learning cause-effect relations and that they were also able to self-determine the onset and offset of preferred stimuli, make choices among available stimuli, and initiate social interaction. The microswitch technology could be seen as enabling them to overcome the handicap imposed by motor impairments. Given the positive results reported in the present set of studies, the creative skills of interventionists in configuring such technology might be the only real limit to what children with profound and multiple disabilities could achieve. While accessing preferred stimuli, choosing between stimuli, and recruiting attention/initiating social interaction are important, microswitch-based interventions might also enable such children to perform more communication, academic, community living, and vocational skills.

While it is perhaps not surprising that well established instructional procedures and the free-operant/contingent reinforcement paradigm, can be successfully applied to enable self-determined responding in children with profound and multiple disabilities, it must be remembered that 30 years ago, such direct instructional approaches were often considered inappropriate, due to their serious neurological impairments. Instead, passive stimulation programming was recommended (Bailey, 1981). Even today, various stimulation programs (e.g., intensive interaction and multisensory environments) appear to be widely used for these children, despite having limited empirical support (Berry et al., 2014; Hogg et al., 2001; Stephenson, 2002; Stephenson & Carter, 2011).

Of course, it is not necessarily the case that one must choose between promoting self-directed versus merely providing stimulation and/or social interaction to the child. Instead, it is possible that these two approaches could be usefully integrated. That is, microswitch-based interventions, aimed at enabling self-determined responding, might be successfully combined with intervention efforts aimed at training communication partners to recognize and respond appropriately to the child's desire for preferred stimulation and social interaction. For example, communication partners might be taught how to effectively present an array of choices that the child could then choose/request using a microswitch-based SGD.

The present set of studies offers an empirically validated alternative, or supplement, to stimulation programming; an alternative or supplement that is seemingly more consistent with the contemporary philosophy of self-determination (Singh et al., 2003, Wehmeyer, 1992; Wehmeyer & Abery, 2013). By combining microswitch technology with systematic instruction and the free-operant/contingent reinforcement paradigm, the participating children appeared to have learned the cause-effect relations arranged via the microswitch program. They also appeared to have demonstrated self-determination in the sense of choosing when to access preferred stimulation, what type of stimulation to access, and when to initiate a social interaction. While self-determination encompasses more than just these three types of responses (Singh et al., 2003; Wehmeyer, 1992; Wehmeyer & Abery, 2013), enabling children with profound and multiple disabilities to independently perform such responses would nonetheless seem to be highly functional and potentially quite empowering.

The three types of responses that were the focus of this review could be seen as important early communication skills and thus this review has implications for children with PMD who require AAC and who are at the beginning stages of AAC intervention. The five studies that focused on enabling participants to recruit attention/initiate social interaction, for example, provided successful examples of how educators could use microswitch technology to enable children to communicate with an SGD. The manner in which participants accessed preferred stimuli and made choices in some of these studies did not involve message exchange with a communication partner, but it might be possible to arrange a situation whereby accessing preferred stimuli and making choices via a microswitch set-up occurs within the context of a communication interaction with a listener. In either case, using microswitch technology to access preferred stimuli and make choices could be considered a type of early requesting behavior that could be targeted in the beginning stages of an AAC intervention.

In addition to making use of well-established instructional procedures, a critical factor for success in any such intervention would seem to be the employment of microswitches suited to the child's motor abilities. In the present set of 18 studies, a range of microswitch-response combinations were used, including (a) pressure switches activated by touching/hitting or pushing the switch, (b) toggle switches activated by bumping, hitting, or swiping, (c) microphone switches activated by vocalizations, (d) vibration switches activated by tapping/hitting the table surface on which the switch had been placed (e) lever switches, activated by chin movement and (f) optic microswitches activated by forehead movements. Such a range of microswitch-response combinations is likely to be necessary because children with profound and multiple disabilities present with varying degrees and types of motor abilities and impairments. Lancioni et al. (2013) noted three factors that appear to be related to the success of microswitch-based programs for these individuals: (a) ensuring the microswitch is easy for the person to activate given the person's existing motor abilities, (b) ensuring that each switch activation produces a meaningful (i.e., reinforcing) outcome, and (c) ensuring the person receives sufficient support and practice (i.e., systematic instruction) to gain independence and fluency with the technology.

One limitation of this set of studies is that the participating children were taught to use only one or two microswitches for a limited number of functions/purposes. The extent to which children with PMD could learn to manage such technology for accomplishing other functions/purposes is an empirical question that could be addressed in future research. One limitation of the present set of 18 studies is that Lancioni and colleagues published most of them. Confidence in the reliability of the findings from these studies would be enhanced by replications by other research teams. Another potentially useful direction for future research would be to ascertain whether children with profound and multiple disabilities could learn to use emerging new technologies (e.g., eye gaze control of computers) to exercise control over the environment and interact with others. Answering these questions might not be immediately easy. Still, the results of the present review provide empirically validated examples of how microswitch technology can be applied to promote three types of self-determined responses in these children.

Surely, AAC professionals can build on this existing research by developing new communication technologies and demonstrating their successful and creative application to promote even greater self-determination among children with profound multiple disabilities. The gains over the past 30 years have been impressive. The field has moved from a view that such children were incapable of learning and needed others to stimulate them, to a view that such children should be enabled to self-determine when, how much, and what type of stimulation they want to receive. Thirty years from now, such children should be able to accomplish so much more using technology more sophisticated than can yet be imagined. AAC researchers and practitioners should be at the forefront of developing and applying existing and future such technologies. Mirenda's (2014) call to arms is worth repeating: "If we do this, the lives of children . . . will be changed again . . . We can do this; we must do this" (p. 7).

Declaration of interest: Sigafoos has received royalties from Pro-ed for the book: Duker, P., Didden, R., & Sigafoos, J. (2004). One-to-one training: Instructional procedures for learners with developmental disabilities. Austin, TX: Pro-Ed. Sigafoos has also received royalties for the book: Sigafoos, J., Arthur-Kelly, M., & Butterfield, N. (2006). Enhancing everyday communication for children with disabilities. Baltimore: Paul H. Brookes Publishing Co. Sigafoos, O'Reilly, and Lancioni will likely receive future royalties from Springer for the book: Lancioni, G. E., Sigafoos, J., O'Reilly, M. F., & Singh, N. N. (2013). Assistive technology interventions for individuals with severe/profound and multiple disabilities. New York: Springer. All three of these books are referenced in this paper. The authors alone are responsible for the content and writing of the paper.

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Appendix C

A

Inventory of Potential Communicative Acts

BACKGROUND

The Inventory of Potential Communicative Acts (IPCA) is based on 3 years of research funded by The University of Queensland and the Australian Research Council. To date, the research and field testing have involved more than 30 children with developmental disabilities and severe communication impairments. Current research is examining the validity of the IPCA for intervention purposes. At the present time, the instrument can be used for gathering descriptive information on communicative behaviors.

The IPCA is designed to be completed by educators, therapists, family members, or other people who know the individual well enough to serve as useful informants. As a general rule of thumb, anyone who has known and cared for the individual for at least 6 months could complete the IPCA. The IPCA seeks to identify any potential communicative acts that might be used by an individual for any of 10 different communicative functions.

A *potential communicative act* is defined as any behavior that you think the individual uses for communicative purposes. These behaviors might include vocalizations, body movements, facial expressions, breathing patterns, challenging behaviors, or stereotyped movements. They might also include more symbolic forms of communication, such as speaking some single words, producing a few manual signs, or using a picture-based communication board. To help you in identifying these types of behaviors, Table 2.1 lists a number of behaviors that are used by some individuals with developmental disabilities and severe communication impairments to communicate with others. This list is not exhaustive. In completing the IPCA, you are encouraged to identify any behaviors that you have observed the person using while communicating with others.

Inventory of Potential Communicative Acts

Name of the individual: ______________________________

Name of the informant: ______________________________

Informant's relationship with the individual:

❑ Teacher ❑ Parent ❑ Other ____________________ (Specify)

How long have you known this individual? ________ years ________ months

Individual's date of birth: ______________________________

Diagnoses: ______________________________

Social convention
Please describe how the individual...

Items	Behaviors	Examples
For example:		
1. Greets you/others	*Smiles*	*When I walk up to Jenny in the morning*
	Eye contact	*and say hello, she always looks at me,*
	Extending arms out	*smiles, and reaches out her arms.*
1. Greets you/others	____________	____________
	____________	____________
	____________	____________
2. Indicates farewell to you/others	____________	____________
	____________	____________
	____________	____________
3. Responds to his or her own name	____________	____________
	____________	____________
	____________	____________

4. Other		

Attention-to-self
Please describe how the individual...

Items	Behaviors	Examples
1. Gets your attention		
2. Seeks comfort		
3. Requests a cuddle/tickle		
4. Shows off		
5. Other		

(continued)

Reject/protest
What does the individual do if...

Items	Behaviors	Examples
1. His or her routine is disrupted		
2. He or she is required to do something that he or she doesn't want to do		
3. He or she doesn't like something		
4. A favorite toy/food is taken away		
5. An adult stops interacting with him or her (e.g., stops playing)		
6. Other		

Appendix D

B

Behavior Indication Assessment Scale

PURPOSE AND INSTRUCTIONS

The purpose of this questionnaire is to identify specific behaviors that the person uses to communicate basic wants and needs. There are 12 questions. For each question, please indicate how often each of the listed behaviors occurs. If the individual uses some *other* behavior, please briefly describe what the person does to communicate.

The BIAS is based on Duker, P.C. (1999). The Verbal Behavior Assessment Scale (VerBAS): Construct validity, reliability, and internal consistency. *Research in Developmental Disabilities, 20,* 347–353.

Behavior Indication Assessment Scale

Part A: Gaining and Maintaining Attention and Social Interaction

I. How does the person attempt to get your attention?

	Never	Sometimes	Often	Always
1. Uses problem behaviors (tantrums, aggression, self-injury)	0	1	2	3
2. Makes sounds/noises	0	1	2	3
3. Uses his or her eyes (e.g., looks at you intently)	0	1	2	3
4. Makes a distinctive facial expression (e.g., arched eyebrows)	0	1	2	3

(continued)

5. Moves body (e.g., arches back, moves head)	0	1	2	3
6. Reaches/touches/grabs	0	1	2	3
7. Guides another person's hand/leads the person somewhere	0	1	2	3
8. Points with isolated index finger	0	1	2	3
9. Uses sign language or conventional gestures	0	1	2	3
10. Uses pictures/symbols/communication board	0	1	2	3
11. Uses an electronic communication device	0	1	2	3
12. Speaks in words or sentences	0	1	2	3
13. Other (please describe): ________________	0	1	2	3

II. How does the person let you know when he or she wants to continue to have your attention or continue to interact with you?

	Never	Sometimes	Often	Always
1. Uses problem behaviors (tantrums, aggression, self-injury)	0	1	2	3
2. Makes sounds/noises	0	1	2	3
3. Uses his or her eyes (e.g., looks at you intently)	0	1	2	3
4. Makes a distinctive facial expression (e.g., arched eyebrows)	0	1	2	3
5. Moves body (e.g., arches back, moves head)	0	1	2	3
6. Reaches/touches/grabs	0	1	2	3
7. Guides another person's hand/leads the person somewhere	0	1	2	3
8. Points with isolated index finger	0	1	2	3
9. Uses sign language or conventional gestures	0	1	2	3
10. Uses pictures/symbols/communication board	0	1	2	3
11. Uses an electronic communication device	0	1	2	3
12. Speaks in words or sentences	0	1	2	3
13. Other (please describe): ________________	0	1	2	3

Part B: Requesting Objects and Activities

III. How does the person let you know when he or she wants a preferred object, such as food, drink, or toy?

	Never	Sometimes	Often	Always
1. Uses problem behaviors (tantrums, aggression, self-injury)	0	1	2	3
2. Makes sounds/noises	0	1	2	3
3. Uses his or her eyes (e.g., looks at you intently)	0	1	2	3
4. Makes a distinctive facial expression (e.g., arched eyebrows)	0	1	2	3
5. Moves body (e.g., arches back, moves head)	0	1	2	3
6. Reaches/touches/grabs	0	1	2	3
7. Guides another person's hand/leads the person somewhere	0	1	2	3
8. Points with isolated index finger	0	1	2	3
9. Uses sign language or conventional gestures	0	1	2	3
10. Uses pictures/symbols/communication board	0	1	2	3
11. Uses an electronic communication device	0	1	2	3
12. Speaks in words or sentences	0	1	2	3
13. Other (please describe): ________________	0	1	2	3

IV. How does the person let you know when he or she wants to do something, such as go outside to play?

	Never	Sometimes	Often	Always
1. Uses problem behaviors (tantrums, aggression, self-injury)	0	1	2	3
2. Makes sounds/noises	0	1	2	3
3. Uses his or her eyes (e.g., looks at you intently)	0	1	2	3
4. Makes a distinctive facial expression (e.g., arched eyebrows)	0	1	2	3
5. Moves body (e.g., arches back, moves head)	0	1	2	3
6. Reaches/touches/grabs	0	1	2	3
7. Guides another person's hand/leads the person somewhere	0	1	2	3
8. Points with isolated index finger	0	1	2	3
9. Uses sign language or conventional gestures	0	1	2	3
10. Uses pictures/symbols/communication board	0	1	2	3
11. Uses an electronic communication device	0	1	2	3
12. Speaks in words or sentences	0	1	2	3
13. Other (please describe): ________________	0	1	2	3

V. How does the person let you know when he or she wants *more* of a preferred object, such as more food or drink?

	Never	Sometimes	Often	Always
1. Uses problem behaviors (tantrums, aggression, self-injury)	0	1	2	3
2. Makes sounds/noises	0	1	2	3
3. Uses his or her eyes (e.g., looks at you intently)	0	1	2	3
4. Makes a distinctive facial expression (e.g., arched eyebrows)	0	1	2	3
5. Moves body (e.g., arches back, moves head)	0	1	2	3
6. Reaches/touches/grabs	0	1	2	3
7. Guides another person's hand/leads the person somewhere	0	1	2	3
8. Points with isolated index finger	0	1	2	3
9. Uses sign language or conventional gestures	0	1	2	3
10. Uses pictures/symbols/communication board	0	1	2	3
11. Uses an electronic communication device	0	1	2	3
12. Speaks in words or sentences	0	1	2	3
13. Other (please describe): ________________	0	1	2	3

VI. How does the person let you know when he or she wants to continue a preferred activity, such as playing a game?

	Never	Sometimes	Often	Always
1. Uses problem behaviors (tantrums, aggression, self-injury)	0	1	2	3
2. Makes sounds/noises	0	1	2	3
3. Uses his or her eyes (e.g., looks at you intently)	0	1	2	3
4. Makes a distinctive facial expression (e.g., arched eyebrows)	0	1	2	3

(continued)