Procedural Integrity and Social Validity Issues in Parent use of the Picture Exchange Communication System (PECS) in Naturalistic Settings

Submitted by

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ABSTRACT

While recent reviews of the Picture Exchange Communication System (PECS) research have provided support for the efficacy of PECS, they have also identified the need for future research to examine the long term maintenance of skills acquired through PECS training, as well as the social validity and procedural integrity of the intervention as used in practice (Flippin, Reszka, & Watson, 2010; S. L. Hart & Banda, 2010; Preston & Carter, 2009; Sulzer-Azaroff, Hoffman, Horton, Bondy, & Frost, 2009; Tincani & Devis, 2011). The aim of the present study was to examine the social validity and procedural integrity of parent implemented PECS in naturalistic settings, utilising three approaches: an analysis of YouTube videos, an internet survey, and a long-term follow-up. Results demonstrated a high rate of observed and reported procedural errors in parent's implementation of PECS with their children in naturalistic settings and limited long-term maintenance of skills acquired through PECS training, despite parents indicating that they feel overwhelmingly positive about the PECS program, including the program's effectiveness and ease of implementation. These results contribute to a better understanding of parents' use of PECS with their children in naturalistic settings and highlight the contextual variables that are likely to affect the maintenance of gains acquired through PECS training. Further implications of these results are discussed.

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General Declaration

In accordance with Monash University Doctorate Regulation 17.2 Doctor of Philosophy and Research Master's regulations the following declarations are made:

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes one original paper published in peer reviewed journals and zero unpublished publications. The core theme of the thesis is an examination of procedural integrity and social validity issues in parent use of the Picture Exchange Communication System (PECS) in naturalistic settings. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the candidate, working within the Faculty of Education under the supervision of Professor Dennis Moore and Dr Angelika Anderson.

In the case of Chapter Three my contribution to the work involved the following:

Thesis chapter	Publication title	Publication status*	Nature and extent of candidate's contribution
Chapter 3	Parent implemented picture exchange communication system (PECS) training: An analysis of YouTube videos	Published in Developmental Neurorehabilitation, 15(5), 351-360, DOI: 10.3109/17518423.2012.692125	I have conceptualized and developed this work under the guidance of Prof Dennis Moore and Dr Angelika Anderson. I independently implemented stated methodologies and data analysis and prepared the draft manuscript. The final manuscript was completed under the guidance and collaboration of Prof Dennis Moore and Dr Angelika Anderson

I **have not** renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis.

Signed: [redacted] **Date:** **23 November 2015**

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the student and co-authors' contributions to this work.

Signed: [redacted] **Date:** **23 November 2015**

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CHAPTER ONE

INTRODUCTION

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder that is currently understood to involve impairments of social interaction and social communication, and restricted, repetitive and stereotyped patterns of behaviour, activities, and interests (American Psychiatric Association [APA], 2013). ASD is highly heterogeneous in clinical presentation with variability in the symptoms manifested by any individual at a particular time (Kabot, Masi, & Segal, 2003). In addition there may be significant comorbidity with other conditions such as intellectual impairment, psychiatric disorders, sensory impairment, ADHD, learning difficulties, epilepsy, and sleep disorders, (APA, 2013; Bryson & Smith, 1998). A recent epidemiological study of ASD, reviewing 61 studies conducted in 18 different countries and published between 1966 and 2010, suggests that the best estimate for the prevalence of ASD is approximately 70 per 10,000 (Campbell, Davarya, Elsabbagh, Madden, & Fombonne, 2011). In Australia, the Australian Bureau of Statistics (2012) reported the number of Australians diagnosed with ASD to be 0.5%. In addition, a significant difference in the incidence of ASD has also been reported with respect to gender, with a higher incidence among boys than girls in a 4 : 1 ratio (APA, 2013; Baron-Cohen et al., 2011; First & Tasman, 2004; Rivet & Matson, 2011).

A central component to the definition and diagnosis of ASD are deficits in communicative abilities used for social interaction. The characteristic communication impairment in individuals with ASD may take the form of a delay in, or total lack of, the development of vocal language (APA, 2013). Approximately only 35-40% of individuals with ASD develop vocal language skills (APA, 2013). It is this delay or failure that alerts

many parents to be concerned about their child's development (Paul & Gilbert, 2011). This lack of vocal language development is, however, also a symptom of a more fundamental problem of deficits in social communication (Davies, 1997). Communication is the functional activity of exchanging shared meanings, such as information, needs, ideas, feelings, or other messages, using conventional and mutually recognised vocal and non-vocal forms (Hulit & Howard, 2006; Kaiser, Hester, & McDuffie, 2001; Messer, 1994). Even those individuals with ASD that do acquire some vocal language skills demonstrate impairments in social communication and social pragmatic skills (Bernstein Ratner, 2005; First & Tasman, 2004). Having the means to communicate is sufficient only if an individual understands how and when to use those forms (Jordon, 1993).

Addressing this impairment of vocal and non-vocal communication in individuals with ASD is particularly important because the literature suggests that the level of communicative competence achieved by individuals with ASD is an important predictor of more positive outcomes (Charlop-Christy & Jones, 2006; Wetherby, Prizant, & Schuler, 2000). Researchers maintain that there is a window of opportunity for teaching children with ASD that occurs before five years of age (Wetherby, et al., 2000), similar to the critical period for language development in typically developing children (Bochner & Jones, 2003). This window may reflect the neuroplasticity of the brain and the ability to learn or make up for what has not been learned at developmentally typical ages (Mundy & Stella, 2000). This, the stress of social-communicative deficits of ASD on families, and evidence that gains in social-communication skills are related to the prevention and reduction of maladaptive behaviours, makes the need to teach social-communication, including communication through vocal language, imperative (Landa, 2007; Sigafoos, 2000).

Alternative and Augmentative Communication (AAC) Systems are utilized to supplement individuals' with ASD existing vocal language or to provide an alternative method of expressive communication (Mirenda, 2003). Due to some individuals' with ASD inability to produce vocal language, AAC systems are often employed as an option for intervention. There are two types of AAC techniques: aided and unaided. Unaided communication refers to techniques that do not require any equipment that is external to the body, for example, sign language. Aided communication techniques, however, incorporate devices that are external to the body, for example the use of symbols such as pictures, words or photographs, or voice output communication aids (VOCAs; Mirenda, 2003). The main purpose of all AAC techniques is to compensate for the impairments of individuals with ASD and to assist them in becoming communicatively competent to meet their communication needs (Mirenda, 2001). Currently, aided picture-based systems are used more frequently with individuals with ASD because of the match between characteristics of ASD and the ease of use of these systems (Charlop-Christy & Jones, 2006; Ganz & Simpson, 2004; S. L. Hart & Banda, 2010). Difficulties in imitation and fine motor problems associated with ASD, and the low representational similarity between manual signs and their referents, has further contributed to the preferred use of aided picture-based systems (Ganz & Simpson, 2004; Sundberg & Partington, 1998).

The Picture Exchange Communication System (PECS) is one such picture-based aided AAC system that is widely used to teach functional communication to individuals with little or no functional communication skills. PECS is suitable to a variety of individuals as few pre-requisite skills are required for the implementation of PECS (Ganz, Simpson, & Lund, 2012). At the commencement of training, an individual needs only to be able to attend to a two-dimensional stimulus and have the physical ability to hand it to a communicative partner. PECS does not have requirements that other communication systems have in terms of eye

contact, verbal and/or motor imitation, and match-to-sample skills (Charlop-Christy & Jones, 2006; J. Smith, Hand, & Dowrick, 2013). Therefore, PECS can be easily utilised by individuals with limited behavioural repertoires to ensure some degree of effective communication from the beginning of the intervention.

PECS is unique in that it teaches individuals with communicative disorders to initiate communicative interactions within a social framework (Bondy & Frost, 2001). Through PECS individuals are taught how to communicate, as opposed to "how to talk" (Liddle, 2001, p. 391). The PECS program commences with teaching requests through the exchange of a picture or symbol, in the place of vocal requests, for desired objects or activities. The program then moves through a series of phases addressing generalisation, discrimination between pictures, simple sentence construction, expanding vocabulary including attributes, responding to requests by others, and commenting (Bondy, 2012; Bondy & Frost, 2001; Frost & Bondy, 2002). PECS also incorporates the use of learner preferred reinforcers and the use of motivating operations (such as placing preferred items within a learner's view but out of their reach) to increase the frequency of communicative opportunities (Bondy & Frost, 2001). PECS is advantageous in that, unlike other AAC systems such as sign language, pictures used in PECS are easily understood by most members of the community without extensive training, and can therefore be easily used in a variety of settings to promote generalised use (Sundberg & Partington, 1998).

PECS is an extensively researched communication program (Preston & Carter, 2009). An increasing number of studies have been conducted to evaluate the effectiveness of PECS training with children and adults with diverse diagnostic conditions, including ASD, and several of these studies have demonstrated that the use of PECS can be acquired rapidly (Beck, Stoner, Bock, & Parton, 2008; Bock, Stoner, Beck, Hanley, & Prochnow, 2005; Carre, Le Grice, Blampied, & Walker, 2009; Cummings, Carr, & LeBlanc, 2012; Ganz, Heath,

Rispoli, & Earles-Vollrath, 2010), and have further documented concomitant improvements in vocal language and social-communicative behaviours, and decreases in disruptive, problem behaviours (Anderson, Moore, & Bourne, 2007; Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Frea, Arnold, & Vittimberga, 2001; Ganz & Simpson, 2004; Jurgens, Anderson, & Moore, 2009; Kravits, Kamps, Kemmerer, & Potucek, 2002; Magiati & Howlin, 2003; Schwartz, Garfinkle, & Bauer, 1998). Recent support documenting PECS as an effective AAC system has also come from several reviews and meta-analyses (Flippin, et al., 2010; Ganz, Davis, Lund, Goodwyn, & Simpson, 2012; S. L. Hart & Banda, 2010; Preston & Carter, 2009; Sulzer-Azaroff, et al., 2009; Tincani & Devis, 2011). These recent reviews and meta-analyses of the PECS research have also, however, raised a number of concerns regarding the experimental designs, reliability measures, procedural integrity, and behavioural change outcomes of this research (Flippin, et al., 2010; S. L. Hart & Banda, 2010; Preston & Carter, 2009; Sulzer-Azaroff, et al., 2009; Tincani & Devis, 2011). A number of directions for future PECS research have been identified, particularly the need for further research into the long term maintenance of skills acquired through PECS, as well as the social validity and procedural integrity of the intervention as used in practice.

While the evidence is growing for the effectiveness of PECS in improving children's communication skills in the short term (Angermeier, Schlosser, Luiselli, Harrington, & Carter, 2008; Bondy & Frost, 1994; Cannella-Malone, Fant, & Tullis, 2010; Charlop-Christy, et al., 2002; Conklin & Mayer, 2011; Gordon et al., 2011; Greenberg, Tomaino, & Charlop, 2012b; Heneker & MacLaren, 2003; Howlin, Gordon, Pasco, Wade, & Charman, 2007; Malandraki & Okalidou, 2007; Park, Alber-Morgan, & Cannella-Malone, 2011; Rosales & Rehfeldt, 2007; Travis & Geiger, 2010; Yoder & Stone, 2006b), insufficient evidence is available to determine whether PECS results in the long term maintenance of communication and vocal language gains. Further research is required that extends beyond 12 months post intervention

follow up (Flippin, et al., 2010; S. L. Hart & Banda, 2010; Preston & Carter, 2009). Clinically this lack of research is of concern as the generalisation of PECS over time relates to the social validity of the intervention. Incorporation of maintenance measures provides information not only on how social contexts affect and are affected by interventions, but also the ecological variables within that social context that sustain or do not sustain those behaviour changes (Kennedy, 2002), and thereby provide information on the social validity of an intervention. Interventions that contain goals, methods, and outcomes that are perceived as socially valid (in addition to being objectively valid) are those that are most likely to be adopted by parents and carers, and will result in more widespread continued use (J. E. Carr, Austin, Britton, Kellum, & Bailey, 1999; Rapoff, 2010; Schlosser, 1999).

Current research is, however, also limited in examining how effective parents perceive PECS to be, as few research studies have documented measures of the social validity of the PECS intervention implemented (Ben Chaabane, Alber-Morgan, & DeBar, 2009; Boesch, Wendt, Subramanian, & Hsu, 2013; Cannella-Malone, et al., 2010; Carre, et al., 2009; Cihak, Smith, Cornett, & Coleman, 2012; Greenberg, et al., 2012b; Jurgens, et al., 2009; Magiati & Howlin, 2003; Park, et al., 2011; Schreibman & Stahmer, 2013; Tincani, 2004; Travis & Geiger, 2010; Yoder & Stone, 2006a). PECS has the potential to have high social validity as it is portable, inexpensive, and can be easily understood by untrained persons, but further research on the social validity of PECS is required (S. L. Hart & Banda, 2010).

The social validity of PECS further impacts upon the procedural integrity with which PECS is implemented. Interventions that are perceived to be high in social validity tend to also be implemented with greater procedural integrity (Gresham, 1997). The PECS protocol is, however, a highly complex manualised training system that utilises a number of behaviour modification procedures, such as most-to-least prompting, least-to-most prompting, shaping,

backward chaining, and error correction strategies (Tincani & Devis, 2011). This complexity opens the door to intended and unintended procedural variations. Adherence to the training protocol is essential to establish positive behavioural gains and avoid prompt dependence (Bondy, 2012; Bondy & Frost, 2001; Frost & Bondy, 2002). The authors of PECS have identified various aspects of trainers' behaviour on which students may become dependent including facial expressions, eye contact, vocalisations made prior to the exchange, and gestural prompts such as pointing to or tapping on a picture (Frost & Bondy, 2002).

It is critical for implementers and research to demonstrate fidelity with the training protocol to validate the PECS training protocol as well as to be able to attribute the results of a research study to the implementation of the published PECS program. The extent to which fidelity measures are reported within published studies varies, and due to researchers either using differing procedures to calculate procedural integrity, or not reporting quantitative integrity data, the interpretation of procedural integrity data remains inconclusive (Flippin, et al., 2010; Preston & Carter, 2009; Tincani & Devis, 2011). Further research, documenting data on the procedural integrity of the implementation of PECS training, is needed to be able to directly attribute the reported effectiveness of PECS in improving functional communication skills, and concomitant behaviour changes, to the published PECS training protocol, with a diverse population of participants and under a variety of conditions.

In particular, the need to document the procedural integrity of parent-implemented PECS is critical. The assessment of procedural integrity in practice is just as important as the assessment of procedural integrity in research. An evidence-based program will not produce benefits in practice unless it is properly implemented (McCall, 2009). Researchers expect that implementers (teachers, parents, professionals etc.) will implement an intervention as intended and planned (Gresham, 1997). Implementers, however, may implement all, some,

or none of the procedures specified in an intervention protocol, or may supplement prescribed strategies with procedures not in the intervention manual (Perepletchikova, 2011).

PECS has been designed with the flexibility to be implemented by teachers, carers and parents of children with ASD. Teaching parents to implement and use PECS with their child in the home and community environment is an important component of the program to reinforce generalised use and promote social validity, through functional use of the skill (Frost & Bondy, 2002). The PECS training protocol refers to the unstructured training environment and stop, drop, and talk approach (that is, whenever a communicative opportunity arises the communicative partner must stop what they are doing, drop to the student's eye level, and do a PECS trial) to encourage the use of PECS in daily life at every opportunity (Frost & Bondy, 2002). This approach, therefore, necessitates the involvement of parents to implement the intervention in a child's daily routines outside of formal structured PECS training sessions. The PECS, although highly manualised, is a complex program utilising a variety of technical teaching procedures and parents who have difficulties with the program's implementation may not experience the best outcomes for their child and may be likely to discontinue training (Tincani & Devis, 2011).

Few research studies have examined the effectiveness of parent-implemented PECS training (Ben Chaabane, et al., 2009; Park, et al., 2011). In each of these studies, parents were provided with intensive training and support in the use of PECS with their children and the results demonstrated that parents can be taught to implement PECS with their children with high procedural integrity (Ben Chaabane, et al., 2009; Park, et al., 2011). Not all parents of children with communication difficulties, however, receive the opportunity or funding to engage in such intensive PECS training or good support and guidance; rather they utilize the system with their children, to the best of their ability, through self-educative means and

minimal support from trained professionals. This raises the question of the procedural integrity with which PECS is conducted under such conditions. Further research reporting the procedural integrity with which PECS is conducted by parents in this context is warranted (Preston & Carter, 2009; Sulzer-Azaroff, et al., 2009). The procedural integrity of this form of parent implemented PECS impacts not only on the social validity of the PECS, but also on a child's outcome in developing functional communication skills.

Aim

The present study aims to fill these research gaps and extend the PECS literature on the social validity and procedural integrity of parent implemented PECS in naturalistic settings. This will be accomplished utilising three approaches: an analysis of videos uploaded to YouTube by parents demonstrating PECS use with their children, an internet survey distributed to parents via national and international PECS and ASD organisations, and a long-term follow-up of the maintenance of a child with ASD's PECS and vocal communication skills 3years 7months post training of all six phases of the PECS training protocol.

Ultimately, the aim of this thesis is to contribute to a better understanding of parents' use of PECS with their children in naturalistic settings, in order to recommend refinement and improvement to the PECS program. This is to ensure positive experiences and outcomes for parents and their children in the use of PECS and ascertain a long-term maintenance of these gains.

CHAPTER TWO

LITERATURE REVIEW

The aim of the present literature review is to examine the social validity and procedural integrity of parent-implemented behaviour interventions, in particular the Picture Exchange Communication System (PECS), to improve the impairments (principally functional communication) of individuals with Autism Spectrum Disorder (ASD). The first section discusses the context within which the present conceptualization of ASD has developed, including prevalence statistics and aetiological theories. The second section explores the constructs of communication and language and examines the communication and language development of typically developing children, including theories of communication and language development, as differentiated from the development of communication and language in individuals with ASD. Section three reviews current behavioural approaches to the treatment of the skill deficits of ASD, in particular applied behaviour analysis, discrete trial training, pivotal response training, and alternative and augmentative communication systems, and discusses qualities of effective early behavioural intervention practices for individuals with ASD. The fourth section discusses the theoretical underpinnings of PECS and reviews literature relating to the effectiveness of the system and associated concomitant behaviour improvements. The literature review concludes with a summary of the limitations of current PECS research and future directions.

2.1. Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder (APA, 2013). Neurodevelopmental disorders, including ASD, are typically diagnosed early in development and are characterised by delay in attaining developmental milestones, deficits in executive functioning or learning, fine or gross motor skill development, cognitive deficits and/or social-emotional deficits often characterised by atypical language development (APA, 2013). ASD can be defined at three interdependent levels: as a neurological disorder related to brain development; as a psychological disorder of cognitive, behavioural and emotional development; and as a relationship disorder in which there is impairment in socialization (Kabot, et al., 2003). Since children manifest different combinations of these symptoms depending on their age and ability, ASD is viewed as a spectrum disorder (APA, 2013; Kabot et al., 2003).

2.1.1. Characteristic Impairments of Autism Spectrum Disorder

ASD is highly heterogeneous in clinical presentation. There is variability in the symptoms manifested by any individual at a particular time and there may be significant comorbidity with other conditions such as intellectual impairment, structural language disorder, psychiatric disorders, sensory impairment, ADHD, learning difficulties, developmental coordination disorder, epilepsy, sleep disorders, and constipation (APA, 2013; Bryson & Smith, 1998). There is also great individual variability in intellectual functioning in ASD (First & Tasman, 2004). Approximately 20 to 25% of children with ASD have an IQ over 70, with 30 to 35% having mild to moderate intellectual disability, and 40 to 45%

having severe to profound intellectual disability (Fombonne, 2005). Impairments of ASD are typically recognized between 12 and 24 months of age, but may be noted earlier than 12 months if symptoms are severe, or noted later than 24 months if developmental delays are subtle (APA, 2013). There is considerable evidence to suggest that children can be reliably diagnosed with ASD at 24 months of age, although most children are not diagnosed until three years of age (Woods & Wetherby, 2003). ASD is currently understood to involve impairments of social interaction and social communication, and restricted, repetitive and stereotyped patterns of behaviour, activities, and interests (APA, 2013).

The characteristic impairments in social interactions include a relative lack of eye-to-eye contact, inappropriate use of facial expressions or body language, or a failure to exhibit social-emotional reciprocity (Deisinger, 2001). These social impairments are evident in a lack of initiating social interactions, lack of cooperative play with others, failure to develop personal friendships, and a lack of demonstrating empathy or perceiving other's feelings or responses, resulting in socially inappropriate mannerisms (First & Tasman, 2004). A further area in which impairments are displayed relates to non-vocal communicative abilities used for social interaction. Individuals with ASD may not only be delayed in their acquisition of vocal language, but they characteristically show impairments in a variety of pre-linguistic communication skills that are understood to precede or underlie vocal language acquisition including a failure to demonstrate social imitation, lack of gestural pointing and other joint-attention skills, delayed meaningful use of objects, delayed appropriate use of miniature objects, and a lack of imaginative or make-believe play (Bernstein Ratner, 2005; Rutter, 1978). Addressing this impairment of vocal and non-vocal communication in individuals with ASD is particularly important because research suggests that persons without a mode of functional communication may develop problem behaviours to fill that communicative function (Sigafoos, 2000).

Individuals with ASD also tend to engage in unusual patterns of behaviour, which Kanner (1943) and Rutter (1978) termed an "insistence on sameness" Individuals with ASD are frequently resistant to changes in their environment and routine, and may have significant difficulty with new experiences (Deisinger, 2001). They may also demonstrate repetition of stereotyped motor acts such as hand clapping or body rocking, repetitive use of objects (e.g. lining up toys) and repetitive speech (e.g. echolalia), and some individuals with ASD engage in self-injurious behaviour such as head banging or biting (First & Tasman, 2004). Individuals with ASD may also present with highly restricted fixated interests, that are abnormal in intensity or focus, or unusual interest in sensory aspects of their environment, as well as hyper- or hypo-reactivity to sensory input (APA, 2013). These behavioural impairments can have a significant impact on the vocal and non-vocal communication development of an individual with ASD, by restricting social interactions with others.

2.1.2. Diagnosis of Autism Spectrum Disorder

The first attempt to define the syndrome today recognized as ASD was undertaken by Leo Kanner (1943), who systematically observed 11 children with a previously unspecified condition. Kanner's description of these 11 children provided a comprehensive picture of a variety of behavioural characteristics that distinguished them from children with other psychiatric disorders. Rutter (1978) synthesized Kanner's description and provided subsequent research, highlighting the need to identify particular symptoms and features of ASD that were characteristic of all children with ASD and were significantly less frequent in other disorders. This resulted in Rutter identifying three symptoms that were essential to the diagnosis of ASD, including a profound failure to develop social relationships, impaired communication development, and ritualistic or compulsive behaviours. These three specific

symptoms confirmed Kanner's observations and are characteristic of present day definitions of the syndrome (Paluszny, 1979).

Rutter's (1978) definition of ASD had a profound influence on the definition of ASD in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III; American Psychiatric Association, 1980). It was within DSM-III that ASD was, for the first time, recognized as an official diagnostic category and was included in a class of disorders, named the pervasive developmental disorders. The pervasive developmental disorders, were later conceptualized as autism spectrum disorders within the DSM-IV-TR (APA, 2000), and consisted of four separate disorders: autistic disorder, Asperger's disorder, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified (APA, 2000). Within the current DSM-V (APA, 2013) these four separate disorders have been combined into a single umbrella disorder called autism spectrum disorder to provide a more accurate, and medically and scientifically useful way of diagnosing individuals with autism related disorders. Distinctions within the autism spectrum disorder are made based on severity levels, which are derived from the amount of support required due to challenges with the impairments of ASD (level one- requiring support; level two-requiring substantial support; or level three- requiring very substantial support; APA, 2013). Revisions to the diagnostic criteria have also been made, primarily more detailed and strict criteria, and a reorganization of the domains of impairments such that communication and social interaction domains have been combined. Additionally, the requirement of a delay in vocal language development is no longer necessary for a diagnosis (APA, 2013). The current diagnostic criteria of ASD consists of persistent deficits in social communication and social interaction across multiple contexts (as manifested by deficits in social-emotional reciprocity, deficits in nonverbal communicative behaviours, and deficits in developing, maintaining and understanding relationships); and restricted, repetitive patterns of behaviour, interests, or activities (as

manifested by at least two of the following: stereotyped or repetitive motor movements; insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behaviour; highly restricted, fixated interests that are abnormal in intensity or focus; or hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment) (APA, 2013). An additional change in the diagnosis of ASD from the DSM-IV-TR (APA, 2000) to the DSM-V (APA, 2013) is the requirement for individuals to demonstrate symptoms from early childhood, even if those symptoms are not recognized until later. This change is to encourage earlier diagnosis of ASD, but also allows those individuals whose symptoms may not be fully recognized until social demands exceed their capacity, to receive diagnosis (APA, 2013).

The narrowing definition of ASD within the DSM-V (APA, 2013) caused considerable concern and controversy amongst researchers, practitioners, parents and individuals with ASD. In particular, there is concern that some individuals, particularly those more cognitively able or those with pervasive developmental disorder not otherwise specified, may be less likely to receive a DSM-V diagnosis of ASD, which may impact on their eligibility for intervention services (Christiansz, Gray, Taffe, & Tonge, 2016). In addition, concern has been raised regarding the requirement for symptoms to be present in early childhood, which makes retrospective diagnosis difficult for individuals presenting in adolescence or adulthood, and also places unreasonable demands on clinicians to identify potential symptoms in infants (Giles, 2014; Wing, Gould, & Gillberg, 2011). A further concern relates to the combining of social interaction and general communication into a single category of social communication. Researchers and practitioners argue that there are important theoretical and clinical arguments for the separation of these two constructs (Wing, et al., 2011). The integration of Asperger's disorder into the autism spectrum, however, received the most criticism (Carmack, 2014).

Since the inclusion of Asperger's disorder in the DSM in 1994, there has been ongoing controversy regarding the Asperger's disorder label. Questions have been raised about the distinctiveness of Asperger's disorder from high functioning autism (Giles, 2014; J. L. Matson & Wilkins, 2008), and the increasing diagnostic rates of autism spectrum disorders since the introduction of Asperger's disorder into the DSM (Kaland, 2011; Kite, Gullifer, & Tyson, 2013). The removal of Asperger's disorder as a separate diagnostic label in the DSM-V (APA, 2013), aimed to reduce some of the confusion caused by the range of diagnostic terms describing autism spectrum disorders that were incorporated in the DSM-IV-TR (APA, 2000; Kite, et al., 2013). The main concern regarding the inclusion of Asperger's disorder in the autism spectrum, however, centers primarily on the implications that changing that definition has on issues of identity for people with Asperger's disorder and the community, with the suggestion that the elimination and integration with autism will change the fundamental meaning of what it means to be an individual with Asperger's disorder (Carmack, 2014). Additional concerns relate to the perception of autism and Asperger's disorder being different conditions, with differing characteristics and intervention needs (Kite, et al., 2013). Despite these concerns, raised primarily from individuals with Asperger's disorder and their parents, Asperger's disorder was excluded as a diagnostic label in the DSM-V, and has been incorporated into the single umbrella disorder of ASD.

The assessment of ASD is a complex process that is best completed using a multidisciplinary approach evaluating social behaviour, vocal and non-vocal communication, adaptive behaviour, motor skills, atypical behaviours, and cognitive functioning (Deisinger, 2001; Kabot, et al., 2003). Diagnostic evaluations for ASD usually consist of a combination of carefully collected developmental history, exclusion of sensory, audiological and medical concerns, direct observation of behaviour, and psychometric measure/s, including the use of diagnostic instruments developed for ASD (Pilowsky, Yirmiya, Shulman, & Dover, 1998).

Questionnaires, checklists, standardized interviews with caregivers, and direct behaviour observation protocols have been developed to support the diagnosis of ASD, such as the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & LeCouteur, 1994), the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1988), the Gilliam Autistic Rating Scale (GARS; Gilliam, 1995), and the Autism Diagnostic Observation Schedule (ADOS-II; Lord et al., 2012). While the CARS is a widely used instrument in the screening and diagnosis of ASD because of its ease of administration and brevity (Kabot, et al., 2003), the ADI-R and ADOS-II are regarded to be the gold standard in diagnostic evaluations for ASD, particularly when combined with clinical judgment (deBildt et al., 2004; Kanne, Randolph, & Farmer, 2008).

2.1.3. Prevalence of Autism Spectrum Disorder

Several epidemiological studies of ASD have been conducted since the mid-1960s, indicating an apparent increase in the incidence of the disorder (Volkmar, Lord, Bailey, Schultz, & Klin, 2004). A review of 61 studies conducted in 18 different countries and published between 1966 and 2010, using previous diagnostic definitions of ASD, found the prevalence rate of autistic disorder to be approximately 22 per 10,000 and the prevalence rate for all ASDs to be approximately 70 per 10,000 (Campbell, et al., 2011). The DSM-V (APA, 2013) reports frequencies for ASD across US and non-US countries to have approached 1% of the population, with similar estimates in child and adult samples. In Australia, the Australian Bureau of Statistics (2009) reported the number of Australians diagnosed with ASD to have doubled between 2003 and 2009 from 34,200 to 64,600 people. Further, the most recent prevalence rates by the Australian Bureau of Statistics (2012) report the number of Australians diagnosed with ASD to be estimated at 115,400 (0.5%), which is a 79%

increase on the 64,600 people estimated to have ASD in 2009. The apparent increase in prevalence rates may be interpreted as an actual increase in the incidence of ASD , however, the current consensus is that this increase is a result of changes in diagnostic practice, increased awareness, earlier diagnosis, different research designs and a problem of diagnosis substitution (Bryson & Smith, 1998; J. L. Matson & Kozlowski, 2011; Volkmar, et al., 2004).

A significant difference in the incidence of ASD has also been reported with respect to gender, with a higher incidence among boys than girls in a 4 : 1 ratio (APA, 2013; Baron-Cohen, et al., 2011; Rivet & Matson, 2011). However, research indicates that when females are affected, they have a greater likelihood of an accompanying intellectual disability (APA, 2013; Rivet & Matson, 2011; Volkmar, Klin, Marans, & McDougle, 1996). The reported prevalence rates do not appear to be influenced by socioeconomic or immigrant status.

2.1.4. Aetiology of Autism Spectrum Disorder

Although ASD has been relatively well described at a symptom level, the nature of the underlying processes responsible for the behavioural symptoms are not yet well understood (Ozonoff, 1995). The attempt to identify a specific cause of ASD has been confounded by the great complexity of the neurological and behavioural processes that underlie the disorder (First & Tasman, 2004).

Early psychoanalytic accounts of the disorder maintained ASD results from poor parental attitudes and poor parent-child bonding (Bernstein Ratner, 2005; Paluszny, 1979). Recent research has, however, refuted these accounts and has demonstrated that incorporating parental involvement and the family context into interventions for autism can enhance outcomes (Frea & Hepburn, 1999; R. L. Koegel, Koegel, & Brookman, 2003; Moes & Frea, 2000). More contemporary aetiological theories suggest a genetic or early neuro-

developmental disturbance with the potential modifying role of environmental experiences (Boucher, 2009; Cook Jr., 1998). There is general consensus in the literature that ASD is related to abnormalities of brain structure or function and that the most likely basis of these abnormalities is genetic susceptibility. There is also general agreement that there are unidentified factors within the pre- and postnatal environment that may trigger the onset of symptoms (Boucher, 2009; Kabot, et al., 2003). Such accounts have suggested genetic conditions, such as Fragile X Syndrome, viral infections, such as rubella, and Measles-mumps-rubella (MMR) immunizations, as potential causes (Cook Jr., 1998). Explanations of the behavioural symptomology in relation to the neurobiology of ASD are, however, still unclear and researchers continue to explore links between dysfunctions of the nervous system and the observed behaviours (Kabot, et al., 2003; Volkmar, et al., 2004). This has led researchers to review deficits in cognitive-psychological theories of aetiology. Three cognitive-psychological theories, including the Theory of Mind hypothesis, the Executive Functions hypothesis, and the Weak Central Coherence hypothesis dominate the literature. Each account hypothesizes deficits in various cognitive mechanisms that cause the symptomology of ASD. They differ with respect to the specific postulated cognitive mechanism involved (Boucher, 2009).

2.1.4.1. Theory of mind hypothesis

The first strong theory to emerge as a possible explanation for the social and communication impairments associated with ASD is the Theory of Mind (ToM) hypothesis (Garfield, Peterson, & Perry, 2001). Theory of mind is defined as "the ability to impute mental states to others and to oneself" (Leudar, Costall, & Francis, 2004, p. 571), and to relate this knowledge to the understanding and prediction of behaviour (Garfield, et al., 2001).

Individuals with an intact theory of mind are able to understand that others may have different perspectives to their own about objects or other people within the environment (Wahlberg, 2001a). Typically developing children acquire ToM between the ages of three and five years, but children with ASD have demonstrated serious delays in ToM development, which is connected to deficits associated with concepts of mental representation (Garfield, et al., 2001). Proponents of this position maintain that a deficit in a theory of mind mechanism (ToMM) underlies the impairments associated with ASD (Baron-Cohen, 1995) and results in an inability to construct a social world that is directed by desires, intentions and beliefs (Volkmar, et al., 2004).

The concept of ToM has become one of the fastest growing bodies of psychological research, and has given rise to several theoretical positions (Leudar, et al., 2004). Some theorists maintain that ToM is a necessary precursor to the development of language and social cognition (Baron-Cohen, 1995; Tager-Flusberg, 1997). Such accounts imply that the acquisition of ToM may assist children with ASD in developing vocal language. Others, however, argue that language and social skills are causally sufficient and necessary for the development of ToM (Garfield, et al., 2001). Such accounts imply that the acquisition of language and communicative skills may assist children with ASD in developing a theory of mind.

Strength of the ToM model is the ability to account for the pragmatic deficits in ASD. The hypothesis has, however, been criticised for not being able to account for the very early symptoms present in the first 12 months of life in children with ASD, such as gaze following, joint attention and protodeclarative pointing deficits (Boucher, 2009). Baron-Cohen (1995) therefore proposed the mindblindness theory as an explanation of the mind-sharing abilities that precede theory of mind in typical development. Mindblindness refers to "an inability to understand what minds are, to 'read' the minds of others or to introspect about one's own

mind" (Boucher, 2009, p.152). Baron-Cohen (1995) proposed that individuals with ASD fail to become mind readers, which precedes the development of a theory of mind. In this account the principal psychological cause of impaired social interaction and communication in ASD is an impaired shared attention mechanism (Happe & Frith, 1995). A strength of the mindblindness theory is that it is able to explain some of the early occurring social impairments in ASD, such as the joint attention and protodeclarative pointing deficits (Boucher, 2009).

2.1.4.2. Executive Functions Hypothesis

An alternative cognitive theory proposed to explain the symptomology of ASD is the executive function model, which suggests that the social-cognitive and social-communicative impairment in ASD is an impairment of executive cognitive processes (Mundy & Stella, 2000). Executive functions are high-level cognitive abilities thought to underlie purposeful behaviour and influence more basic abilities like attention, memory and motor skills (Boucher, 2009; Wahlberg, 2001a). Executive function behaviours include organizing, prioritizing, focusing, sustaining and shifting focus to tasks, regulating alertness and processing speed, managing frustration and regulating emotions, working memory, and self-monitoring and regulating action (often called inhibiting; Ozonoff, 1995). Executive functions are thought to be necessary for goal-directed behaviour. They include the ability to initiate and stop actions, to monitor and change behaviour as needed, and to plan future behaviour when faced with novel tasks and situations (Boucher, 2009; Mundy & Stella, 2000).

Children with executive functioning deficits often struggle with focus, attention, transitions, organizing, memory, time management, regulating emotions, and managing

frustration (Boucher, 2009; Wahlberg, 2001a). Several research studies have provided empirical support for the existence of executive function deficits in individuals with ASD, suggesting that executive function impairment may be a central deficit of ASD (Ozonoff, 1995). Executive functions such as mental flexibility and planning that have been shown to be impaired in ASD are, however, relatively high-level and late developing abilities, and research has been unable to demonstrate low-level, early occurring executive function impairments in infants and pre-school children (Boucher, 2009). Executive function deficits are also quite common in other neurodevelopmental disorders and research is yet to demonstrate a unique pattern of executive function strengths or deficits, specific to individuals with ASD (Boucher, 2009).

2.1.4.3. Weak Central Coherence Hypothesis

Weak Central coherence is another cognitive theory that attempts to explain the various symptomologies associated with ASD. Central coherence is the ability to derive overall meaning from a mass of details (Noens & van Berckelaer-Onnes, 2008). In colloquial terms, it is the ability to see the big picture instead of getting lost in details. Individuals with ASD appear to have a weak drive for central coherence, focusing on local rather than global information, which affects the way they process general information (Noens & van Berckelaer-Onnes, 2008; Wahlberg, 2001a). Individuals with ASD typically fail to extract and use global meaning from a situation or written context, and are therefore unable to derive overall meaning from a situation (Wahlberg, 2001a). This weakness results in these individuals making less use of the content while paying more attention to parts rather than wholes (Wahlberg, 2001a). For example, an individual with strong central coherence, looking at an endless expanse of trees, would see a forest, while an individual with weak

central coherence would see only a whole lot of individual trees. The notion of weak central coherence can explain both the deficits *and* strengths of individuals with ASD (Noens & van Berckelaer-Onnes, 2008). When a task requires an individual to extract global meaning from many details, to get the "big picture", people with ASD would be at a disadvantage. However, when picking out extreme detail from surrounding masses of information is required, people with ASD are at an advantage (Noens & van Berckelaer-Onnes, 2008).

Frith and Happe (1994) proposed that the weak drive for central coherence theory can account for symptomology of ASD that does not fit under the theory of mind hypothesis. Specifically, these authors argue that high functioning adults with ASD who can pass theory of mind tasks, continue to show patterns of performance characteristic of a weak central coherence, such as their above average performance on block design tests. In block design tests individuals with ASD are not slowed by seeing the goal pattern as an unsegmented whole, unlike others. Other examples that support a weak drive for central coherence in the analytic thinking style of individuals with ASD are the observed savant skills, inherent insistence on sameness, specific odd interests, and poor comprehension of written text observed in ASD (Wahlberg, 2001a).

These three cognitive-psychological theories of the aetiology of ASD have dominated the literature for several decades and have increased the understanding of the skill strengths and deficits of individuals with ASD (Boucher, 2009). It is of significant practical importance to understand the causes of ASD, such that treatment methods can be improved, and methods of prevention can be identified (Boucher, 2009). None of these three cognitive-psychological theories are, however, able to completely explain all the impairments associated with ASD and gaps remain in psychological explanations of the impairments of ASD, including the impairments of vocal and non-vocal communication.

2.2. Communication and language

> We transmit messages of all kinds by speech, the written word, Morse code, semaphore flags, Braille, facial expressions, gestures, art, music, dance, the distance we maintain when we interact, vocal variations, the clothes we wear, hairstyles, our natural and purchased odors, and the list goes on. We communicate hundreds, perhaps thousands, of messages every day.... Communication is so much part of the human experience that we are constantly sending and receiving messages (Hulit & Howard, 2006, p. 3).

2.2.1. Construct clarification: Communication and Language

Communication and language are socially shared activities that allow humans to express their needs, convey information, ideas, or feelings, and develop and maintain relationships with others (Bochner & Jones, 2003). While the terms language and communication are frequently used interchangeably, they are two separate, but related, processes.

Communication is a social activity that entails the exchange of shared meanings, such as information, needs, ideas, feelings, or other messages, using conventional and mutually recognised vocal and non-vocal forms (Hulit & Howard, 2006; Kaiser, et al., 2001; Messer, 1994). Communication is therefore multimodal and children learn to convey messages in diverse ways using different combinations of these vocal and non-vocal means (Buckley, 2003). One form of communication is language.

Language is "a system of abstract symbols and rule governed structures, the specific conventions of which are learned" (Hulit & Howard, 2006, p. 4). The symbols of a language may be sounds that are combined into spoken words, elements of sign language that are combined into larger units, or letters that are combined into words. The specific principles of a language are established by the conventional usage of a specified people, and change over

time as a language evolves (Hulit & Howard, 2006). All formal language systems, such as English, German, French or Mandarin, have four main components: form (phonology), meaning (semantics), rules (syntax and morphology), and use (pragmatics; Bochner & Jones, 2003). Phonology refers to the rules governing the pronunciation and articulation of sounds, and the rules governing how speech sounds are combined to form words (Landa, 2007; Wilkinson, 1998). Semantics defines the rules governing word meanings and concepts (Carroll, 2008). Semantic conventions govern our ability to acquire new words and their meanings, to organise concepts in memory, and produce or respond to those words during meaningful communication with a communicative partner (Wilkinson, 1998). Syntax refers to the rules governing how words are combined to form sentences (Wilkinson, 1998), while morphology defines the rules signalling grammatical information at the word level, such as when words are inflected with past tense markers (Landa, 2007). Pragmatics refers to the principles governing language use within social interactions and includes non-vocal social behaviours such as turn-taking and the use of eye contact, as well as vocal social behaviours such as formality of speech or topic selection (Carroll, 2008; Wilkinson, 1998).

Language is a form of vocal communication (Buckley, 2003). Communication also includes non-vocal forms such as gestures, eye-gaze, facial expression and body language. Messages can also be conveyed through symbols, pictures, and signs (Buckley, 2003). These basic concepts of communication and language provide the context for our understanding of both typical and atypical children's development.

2.2.2. Communication and Language Development in Typically Developing Children

The process of communication and language acquisition in typically developing children begins soon after birth at a point that precedes intentional communication and

continues to a level where children are able to use language in more complex ways, such as asking questions and indicating plurality (Bochner & Jones, 2003). Through observations of emerging communication and language skills in typically developing children, age ranges associated with the emergence of specific skills have been identified, which provide developmental milestones in children's communication and language development and aid in identifying children who are not meeting these developmental milestones (Bochner & Jones, 2003).

In typically developing children, the foundations of communication are established, during the prelinguistic stage, when infants begin to show an interest in people and objects within their environment. Infants begin to develop joint attention skills by learning to follow a parent's gaze, and experience that when something interesting attracts their attention, their parent will notice their interest and comment on it or move them closer so that they can see more closely or touch the object of interest. Infant's first communicative acts are usually triggered by physical states such as hunger or cold, and often take the form of cries and calls. Parents attribute meaning to these sounds based on context and respond to the infant's sounds (Bochner & Jones, 2003). From approximately 6 to 7 months of age, typically developing children begin to babble and learn that sounds can be used pragmatically to change their environment (Bochner & Jones, 2003). They also develop more complex strategies for exploring and interacting with their environment and learn about the people and objects within it, developing appropriate functional play skills through engagement with those objects. Partaking in social games and nursery rhymes such as "peek a boo" and "incy, wincy spider" encourages the development of turn-taking and imitation of actions and sounds (Lightbrown & Spada, 1999). Children learn to use gestures to communicate intently at approximately eight months of age (Carroll, 2008). Indicative gestures are used to either engage the help of another person or obtain a desired objective (proto-imperative gestures), or

as a strategy to gain attention (proto-declarative gestures; Carroll, 2008). Children's progression to speech is "learning how to do with words what already has been done without words" (Carroll, 2008, p.256).

Prior to the production of first words, typically developing children begin to use performatives, which are sounds that are linked to entities or actions, for example, saying "br'mmm" while pushing a toy car. They also begin to use protowords or idiomorphs, which are word-like vocalisations that are intentionally used in a consistent context to convey a specific meaning, for example sounds used by an infant for a favourite food or toy. These words are not similar to the words they replace but have a recognisable tone and pitch. Typically developing children use these idiomorphs when they have learnt that words can be used to achieve a purpose but have not yet learnt to produce the appropriate sounds (Bochner & Jones, 2003; Carroll, 2008). First recognisable words are spoken at approximately 12 months of age in typically developing children, and for several months most of their utterances consist of single words produced in isolation (Carroll, 2008). The first words that children produce are characteristically labels for objects and people in their immediate environment, and other socially useful words, such as "no", "more" and "bye" (Bochner & Jones, 2003). Concurrently, typically developing children acquire the ability to make comments about the world around them (Carroll, 2008). Once a child has approximately 50 words in their spoken vocabulary and can comprehend approximately 200 words, they begin to combine words into simple sentences (Bochner & Jones, 2003). This typically occurs between 18 and 24 months of age (Carroll, 2008). When children begin to combine words into sentences, they also begin to acquire morphemes. Once children can combine words into more complex sentences, there is often a rapid expansion in the size of their vocabulary and growth in their overall grasp and use of their native language, including to ask and answer questions, to give and obtain information, and to protest (Bochner & Jones, 2003; Carroll,

2008). By the age of three and a half or four years, most typically developing children have mastered the basic structures of a language that has been spoken to them and can ask questions, give commands, report real events, and create stories about imaginary people, using correct grammatical morphemes (Lightbrown & Spada, 1999).

These developmental stages in typically developing children's acquisition of communication and language highlight that a child's understanding of communication to influence the attention and actions of others precedes and facilitates their acquisition of the phonology, syntax and semantics of a language (Carroll, 2008; Davies, 1997). A child may acquire a variety of gestures and sounds, but these skills are of no benefit if the child is not able to use them to influence the attention and actions of others (Bochner & Jones, 2003).

2.2.3. Theories of Communication and Language Development

Efforts to explain the acquisition of communication and language abilities in children have given rise to several contrasting theoretical positions. Several viable accounts of language acquisition currently exist, which focus on explaining communication and language development but differ along several dimensions, including the emphasis placed on the structural versus functional aspects of children's language, the emphasis placed on children's competence in the knowledge of language as opposed to their actual use of language, and the emphasis placed on the degree to which posited mechanisms of language development reside exclusively within the individual child, the environment, or a combination of the two (Bohannon III, 2005; Evans, 2007; Karmiloff-Smith, 2001; Messer, 1994).

2.2.3.1. Nativist Accounts

Nativist accounts are concerned with children's innate linguistic knowledge and view language as a species-specific innate ability, in which the child is biologically programmed with the grammatical structures of language (Evans, 2007). Nativist accounts became prominent with Noam Chomsky's (1964, 1986, 2005) theory of language acquisition. A critical argument for Chomsky is that the grammar of a language, the way that linguistic elements are organised, makes it different to other forms of communication such as prelinguistic gestures, which do not contain or require the same level of organisation to convey a message (Messer, 1994). Chomsky therefore limited the influence of pre-linguistic communication on the language acquisition process in his theory of language acquisition (Messer, 1994). Chomsky maintained that language is too complex and is acquired too rapidly to be learned through any known methods (e.g. imitation) and because children's linguistic experience is not rich enough to explain this learning, Chomsky argued that an innate predisposition must be present to aid the acquisition process (Messer, 1994; N. Smith, 2005).

Chomsky proposed that the child is born with a genetically determined language-faculty or language acquisition device (LAD), such that at birth the child is equipped with a Universal Grammar, which consists of general principles that determine the grammatical features of language and a specification of the range of possible variation in human languages (Chomsky, 1964, 1986; Chomsky, Belletti, & Rizzi, 2002; N. Smith, 2005). Universal Grammar is conceptualized as a system of principles and parameters. A particular grammar is derived from universal grammar principles by fixing the parameters in a certain manner on the basis of the language they are exposed to (Chomsky, 2005; Chomsky, et al., 2002). It is assumed that this linguistic genotype is homogeneous across the human species such that

linguistically we all have the same potential for adaptation and that any person may develop to be a speaker of any language, depending entirely on their linguistic experience (Lightfoot, 2005). These views have had an enormous impact primarily because Chomsky limits the influence of environmental or learning processes on the language acquisition process. Like nativist accounts of language acquisition, cognitive accounts also maintain that the child has innate processes involved in language acquisition. However, the nature of these innate processes differ from nativist views, in that they maintain that language is not a separate innate characteristic that a child is born with, but is rather only one of several schematic cognitive processes that result from cognitive maturation (Bohannon III, 2005).

2.2.3.2. Cognitive Accounts

Cognitive theories are concerned with the role of cognition and thinking processes in children's interaction with their environment and have developed from Piaget's (1959) theory of the stages of childhood development. Cognitive theories maintain that the child brings innate cognitive categories such as agents, patients, actions, and locations to the language learning process. These domain-general innate forms are representational and assist the child in interpreting his/her environment. Only later in development do abstract grammatical classes such as noun and verb phrases emerge because of the reorganisation of the innate semantic categories (Evans, 2007).

Although Piaget (1959) maintained that there are no cognitive structures that serve specific communicative or linguistic functions, his position has had a significant impact on cognitive theories of language acquisition as he maintained that social and communicative developments arise as a result of developments in general cognitive capacity. Further, Piaget maintained that cognitive structures are constructed as a consequence of the child's action

and interaction with the world. Therefore the child's understanding of the world is not the result of innate abilities or experience alone, but rather the result of infants applying a set of general cognitive processes to their experiences of the world (Lightbrown & Spada, 1999; Messer, 1994). Piagetian theory has been used to account for links between cognitive abilities and communication development, specifically the possibility that general cognitive development towards the second half of the first year may be associated with developments in the use of intentional communication (Messer, 1994). Piaget argued that at about this time infants begin to use new ways to solve problems, and are able to go beyond the immediate problem to find solutions in the broader context of their activities. Piaget also supposed that the general capacity to manipulate symbols is necessary for word use, and partly for this reason he regarded the ability to handle abstract concepts as being fundamental to the development of language (Messer, 1994). While cognitive theories acknowledge the influence of social-interaction, the extent of this influence is limited when compared with social interaction accounts of children's communication and language acquisition.

2.2.3.3. Social Interaction Accounts

Social-Interaction accounts are focused on the role of social interaction in children's acquisition of communication and language and argue that the functional use of communication and language within social-communicative contexts drives development (Bochner & Jones, 2003). These accounts posit that the unique form of talk directed to children by caregivers, that is child-directed speech, is a critical part of the developmental process, with parents providing a customized learning environment for the child (Carroll, 2008; Evans, 2007). These theories have developed from a Vygotskian perspective.

Vygotsky (1934) supposed that social interaction and culture provide the basis for communication and language development. He assumed that understanding has to occur in a social context before it can be incorporated into a person's cognitive structures. This gives prominence to the role of social behaviour in developing skills (Messer, 1994). Vygotsky's ideas have been extended to assist in explaining the transition between social interaction, intentional communication, and language acquisition (Messer, 1994). According to this theory initially children's actions do not involve any intent to communicate with others. However, certain actions can be interpreted by adults as being intentional. During social interaction adults will respond to these types of actions as if they are intentional communications. The result is that infants come to recognize that their actions can influence others and that they have communicative powers (Messer, 1994). A similar process is supposed to occur in the development of vocal language. The initial impetus comes from adults indicating and labeling objects. Children will imitate these words, but it is supposed that they have little or no understanding of the meaning of the words. The words begin to take on a communicative purpose and meaning through the adult's social responses (Messer, 1994). Therefore, theories in the Vygotskian tradition propose that social communication develops out of interaction with adults and from this it is supposed that the adult's social responses to children's actions and words lead to the emergence of the intention to communicate and to new methods of communication (Messer, 1994). Unlike Chomsky's (1964, 1986, 2005; Chomsky, et al., 2002) and Piaget's (1959) accounts of the language acquisition process, Vygotsky's theory moves towards viewing the language acquisition process as residing more in the environment and linguistic experience than as an innate process. This is similar to behaviourist accounts of language acquisition.

2.2.3.4. Behaviourist Accounts

Behaviourist accounts are concerned with environmental influences on children's acquisition of language and highlight the observable and measureable aspects of language (Bohannon III, 2005). Language is viewed as a behaviour like any other, emphasizing the functional aspects of language development rather than an account of language development that relies on an inherent knowledge or a language competence (Evans, 2007; Skinner, 1957). The most prominent exponent of this perspective is Skinner in his *Analysis of Verbal Behavior* (Skinner, 1957). Skinner (1957) described language from a behaviour analytic perspective, as verbal behaviour which is acquired, extended and maintained by environmental variables. Skinner's intention was not to address how to teach verbal behaviour, but rather to propose a theory explaining relevant conditions for the occurrence of verbal behaviour.

In Skinner's (1957) theory verbal behaviour is reinforced through the mediation of another person's behaviour, therefore it is reliant on the presence of a communication partner or listener; making the activity innately social. Listeners reinforce verbal behaviour of speakers because they provide a verbal or behavioural response to the speaker's behaviour (Skinner, 1957). Skinner also defined six verbal operants (variants of verbal behaviour) that describe verbal behaviour in terms of the functional relations between controlling variables and verbal responses, and classify what is said by function rather than form. These verbal operants include mands (requests), tacts (comments), echoics (imitations), intraverbals (responses to questions), textuals (reading, writing) and autoclitics (verbal behaviour that is based upon and modifies the function of a speaker's own verbal behaviour; Sundberg & Partington, 1998). It is maintained that each of these verbal operants is learned by the child through operant conditioning, and therefore this perspective clearly limits the influence of

innate mechanisms of language development but rather proposes that mechanisms of language development reside within the child's environment and linguistic experience (Bohannon III, 2005; Evans, 2007; Skinner, 1957).

While each of these accounts differs in the emphasis placed on the degree to which posited mechanisms of language development reside exclusively within the individual child or the child's environment and linguistic experience, scientists today acknowledge that children's communication and language development is influenced by a combination of environmental and internal factors (Buckley, 2003). The study of communication and language development in children with neurodevelopmental disorders, such as ASD, has also provided insight into the mechanisms that underlie how all children acquire communication and language (Tager-Flusberg, 2007).

2.2.4. Communication and Vocal Language Development in Children with Autism Spectrum Disorder

The characteristic communication impairment in individuals with ASD may take the form of a delay in, or the total lack of, the development of vocal language (APA, 2013). Children with ASD show very high rates of delayed onset or failure to acquire vocal language and it is this delay or failure that alerts many parents to be concerned about their child's development (Paul & Gilbert, 2011). Approximately 35-40% of individuals with ASD do, however, acquire some vocal language skills, but these may still be marked by impairments in the ability to initiate or sustain a conversation with other people (Bernstein Ratner, 2005; First & Tasman, 2004). Three aspects of vocal language development that individuals with

ASD display significant deficits include pragmatic aspects, semantic aspects, and comprehension.

The language deficit in individuals with ASD is most evident in their social or pragmatic use of language. Many aspects of the conversational skills of vocal individuals with ASD are noticeably problematic, including the use of irrelevant detail, perseveration on specific topics, problems with longer utterances, queries requiring inference, indirect requests for information, inappropriate shifting of topics, pausing, turn-taking, complex interpretive linguistic skills, ignoring initiations by others, concrete and literal comprehension, and a lack of strategy for repair when there are problems in their conversations (Tager-Flusberg, 2007; Wilkinson, 1998). Investigation into the deficits of the semantic aspects of language indicate that individuals with ASD often use a limited range of words during conversations, which may limit their ability to communicate their wants and needs in everyday life. The language they use often displays peculiar characteristics including neologisms, echolalia, and pronoun reversal (Wahlberg, 2001b; Wilkinson, 1998). Individuals with ASD also demonstrate an apparent difficulty comprehending particularly longer sentences that require inferences and requests for information. To the speaker it may appear that these individuals are inattentive or uninterested when engaged in a conversation, when in fact these individuals may be trying to comprehend what the speaker is saying (Wahlberg, 2001b).

The pragmatic abnormalities evident in the vocal language of children with ASD are also evident in their prelinguistic development of communication (Messer, 1994). Children with ASD frequently do not engage in prelinguistic conversations with their parents (i.e. using gaze, body movement, facial expression or babbling) for the purpose of shared social interaction (Bernstein Ratner, 2005; Kaiser, et al., 2001). When children with ASD do communicate they do so for the purpose of having their needs met, and the modes of communication are typically unconventional, such as the use of unusual gestures and the use

of negative maladaptive behaviours, such as hand biting or head banging (Paul & Gilbert, 2011). Children who go on to be diagnosed with an ASD also show reduced reciprocity in their engagement, and there may be a lack of give-and take in their prelinguistic conversations with others (Landa, 2007). Attention is focused more on objects than people and they show little to no interest in social reciprocal games (Kaiser, et al., 2001; Paul & Gilbert, 2011). Children with ASD often fail to show responsiveness to words in their second year and there is also evidence demonstrating that prelinguistic vocalizations of children with ASD are atypical (Landa, 2007; Paul & Gilbert, 2011).

2.2.4.1. Communicative Functions Theory

In the study of language deficits associated with ASD, it has been suggested that researchers often overlook the functional aspects of communicative efforts, focusing rather on structural features (Wetherby, 1986; Wilkinson, 1998). As Jordon (1993) highlights "having the means to communicate is not enough if there is little understanding of how and when to use those forms" (p.234). Vocal behaviours such as echolalia, thinking aloud, metaphorical expressions and stereotypic utterances, used by children with ASD, can be conceptualized as reflecting intentional efforts to initiate and sustain communication, although ineffective in that the listener is not able to interpret the message (Mesibov, Adams, & Klinger, 1997; Wetherby, 1986; Wetherby, et al., 2000). Through observational methodology it appears that children with ASD use certain verbal strategies in an effort to engage in functional communication and participate in social interaction, despite their limited range of more conventional communicative means (Wetherby, 1986).

Fifteen categories of interactive and non-interactive communicative functions have been identified by Wetherby and Prutting (1984). Interactive communicative functions

include requesting objects, requesting actions, requesting social routines, requesting permission, requesting information, protesting, acknowledgement of others, showing off, and commenting. Non-interactive communicative functions include self-regulatory functions, labelling functions, performative functions, and exclamatory functions (Wetherby & Prutting, 1984). In examining the acquisition of these communicative functions in typically developing children and children with ASD it appears that children with ASD acquire several of these communicative functions in a quantitatively and qualitatively different manner to typically developing children. Based on these observations, Wetherby (1986) proposed a preliminary model of the acquisition of communicative functions in children with ASD.

This model suggests that while typically developing children acquire the ability to communicate for a variety of functions concurrently, children with ASD acquire communicative functions one at a time, evolving from contextually restricted to contextually flexible forms (Wetherby, 1986). There appears to be some homogeneity in the order of emergence of communicative functions in children with ASD, developing from the ability to regulate another person's behaviour to obtain an environmental end, such as requesting a desired toy or food item (also known as Manding), developing the competence to attract another's attention, and later acquiring other communicative functions, such as attracting another person's attention to themselves, or directing another person's attention to an object or event for a social end (commenting/labelling; Calloway, Myles, & Earles, 1999; Jordon, 1993; Stone & Caro-Martinez, 1990; Wetherby, 1986). In light of the evidence concerning the sequential development of communicative functions, Wetherby (1986) has proposed that language intervention programs should account for the interplay between communicative means and communicative functions in children with ASD, focusing first on developing lower-order communicative functions such as manding (requesting desired objects) and once

these basic communicative functions have been learnt, build upon these to develop higher-order communicative functions such as commenting or labelling (Wetherby, 1986).

The literature on ASD further suggests that the level of communicative competence achieved by individuals with ASD is an important predictor of more positive outcomes (Charlop-Christy & Jones, 2006; Wetherby, et al., 2000). Researchers maintain that there is a window of opportunity that occurs before 5 years of age, in teaching children with ASD (Wetherby, et al., 2000). This window may reflect the neuroplasticity of the brain and the ability to learn or make up for what has not been learned at developmentally typical ages (Mundy & Stella, 2000). This, the stress of social-communicative deficits of ASD on families, and evidence that gains in social-communication skills are related to the prevention and reduction of maladaptive behaviours, makes the need to teach social-communication, including communication through vocal language, imperative (Landa, 2007; Sigafoos, 2000).

2.3. Behavioural Approaches to the Skill Deficits of Autism Spectrum Disorder

There are a myriad of treatment options currently available to professionals and parents who support children diagnosed with ASD (Heflin & Simpson, 1998). The task of choosing a treatment or intervention can be a particularly overwhelming given individual differences in symptom presentation and the vast information on available treatments and cures (Kabot, et al., 2003). The internet also now serves as a direct information and referral source for programs, interventions or therapies and products available to parents. The concern is the validity of this information presented to parents online (Kabot, et al., 2003). Professionals in

the field are required to evaluate and provide parents with the skills to assess these treatment options independently (Kabot, et al., 2003).

Intervention options available for children with ASD include biomedical and pharmacology treatments (such as vitamin and mineral supplements, elimination diets, toxin removal, immunologically-based therapies, and neurosecretory agents such as secretin to alleviate the behavioural symptoms of ASD), alternative medicine systems (e.g. Chinese medicine, acupuncture), body-based therapies (e.g. sensory integration therapy), energy therapies (e.g. magnet therapy), and other non-biological based therapies (such as auditory integration therapy, craniosacral manipulation, holding therapy, facilitated communication, hyperbaric oxygen therapy; Kabot, et al., 2003; Schechtman, 2007; Williams & Williams, 2010). There is, however, a paucity of research and no broad consensus regarding many of these treatment options (Schechtman, 2007). Some of these treatment options have been demonstrated to be ineffective and in some cases harmful for individuals with ASD (Schechtman, 2007).

A significant amount of research has, however, demonstrated the effectiveness of behaviourally based approaches for treatment of the skill deficits of ASD (J. L. Matson, 2007; Stahmer, Schreibman, & Cunningham, 2011; Williams & Williams, 2010). Two noteworthy efforts identifying evidence based practices in ASD treatment have recently been completed by the National Autism Center (2009, 2015) and the National Professional Development Center (Wong et al., 2014). The National Professional Development Center report aimed to delineate practices that have sufficient support to be termed evidenced-based through a comprehensive review of 456 studies published between 1990 and 2011 which investigated the efficacy of focused intervention practices for individuals with ASD. The results provide strong support for the evidence base of behaviourally based interventions for the treatment of ASD (Wong et al., 2014). The National Standards Project report also investigated and

provides comprehensive information about the level of scientific evidence that exists in support of the many educational and behavioural treatments currently available for children and adults with ASD. The results from two phases included data from more than 1000 studies, published between 2007 and 2012, and provides further support for the efficacy of interventions based on the principles of applied behaviour analysis (ABA) for the treatment of ASD (National Autism Center, 2009, 2015).

Applied Behaviour Analysis (ABA) is a science that is committed to the understanding and improvement of human behaviour (Cooper, Heron, & Heward, 2007) and developed out of earlier work on behaviour modification (Heflin & Simpson, 1998). The ABA paradigm focuses on objectively defining behaviours of social significance, and systematically applying methods of behaviour modification with a variety of populations including, but not limited to, those that require intensive and structured learning, to teach behaviours of social significance (Cooper, et al., 2007). Baer, Wolf and Risley (1968) presented seven specific dimensions of ABA that remain current as critical elements of the discipline: 1) *Applied* (the work of an applied behaviour analyst must address problems of social significance to the consumer); 2) *Behavioural* (ABA must be pragmatic and address measurable behaviour); 3) *Analytic* (ABA attempts to address the maintaining variables of behaviour through direct and systematic observation); 4) *Technological* (techniques utilised are identified and described); 5) *Conceptual system* (The procedures used are both technologically precise and can be explained in behavioural terms); 6) *Effective* (Successful application of ABA technology has practical value); and 7) *Generality* (ABA uses techniques and procedures that produce durable change in varied settings). Research in the area of ABA has contributed greatly to the understanding of ASD and ABA is currently acknowledged as being the most efficient and empirically validated method for the treatment of a wide range of core symptoms of ASD (Heflin & Simpson, 1998; J. L. Matson et al., 2012; Rosenwasser & Axelrod, 2001).

There are a number of agreed qualities of effective early behavioural intervention practices for individuals with ASD, including that interventions should be provided at the earliest possible age, interventions must be intensive, and that the intervention must be systematic with individualised goals and objectives (Kabot, et al., 2003; J. L. Matson, 2007; Williams & Williams, 2010). In addition, parent training and support should be incorporated into programs, the intervention must demonstrate social validity and be implemented with high procedural integrity in research and in practice, a particular focus must be placed on teaching generalisation within the intervention, the intervention should ensure the development of fluency in skills taught, and the intervention needs to focus on the social and communicative impairments of ASD (Kabot, et al., 2003; J. L. Matson, 2007; Williams & Williams, 2010).

2.3.1. Family involvement

Families are recognised as a valuable resource in the design and implementation of early intervention for children with ASD and other disabilities (Ingersoll & Dvortcsak, 2006; Moes & Frea, 2000, 2002). Parents not only provide comprehensive information about the values, circumstances, and interactive relationships of children with disabilities in the family environment (L. K. Koegel & Koegel, 1995), but their involvement increases the quantity and availability of intervention (Benson, Karlof, & Siperstein, 2008; Schultz, Schmidt, & Stichter, 2011; Symon, 2005). Consequently, parental involvement may contribute to a heightened understanding and increased potential for effective intervention and improved child outcomes (Lucyshyn, Albin, & Nixon, 1997; Maglione, Gans, Das, Timbie, & Kasari, 2012).

Since parents spend more time than practitioners with their child throughout the day, evenings and weekends, they are able to provide learning opportunities and implement

interventions across the child's day, in various routines and settings (e.g. home and community), which supports the generalised use of skills (Steiner, Koegel, Koegel, & Ence, 2012; Sundberg & Partington, 1998), as well as the maintenance of treatment gains over time (Ingersoll & Dvortcsak, 2006; M. L. Matson, Mahan, & Matson, 2009). Further, by learning strategies that improve children's behaviour, parents may also experience a reduction in some aspects of parental stress and increase their sense of self-efficacy, particularly when programs are carefully designed to fit naturally into the family's everyday routine (M. L. Matson, et al., 2009; Schultz, et al., 2011; Steiner, et al., 2012). A naturalistic approach takes very little time from a family's schedule, but when implemented systematically can provide the child with many learning opportunities throughout the day in the context of daily routines (Benson, et al., 2008; Steiner, et al., 2012; Symon, 2005). For example, if the child's intervention focuses on enhancing communication skills, parents can provide the child with multiple opportunities to practice and build fluency in communication skills during daily routines, such as meal times when their child is hungry or thirsty.

Parent education and support is essential to ensure the effectiveness of interventions delivered at home (Maglione, et al., 2012; Steiner, et al., 2012). In parent education programs, parents are taught techniques to effectively work with their child so that the intervention can continue to be used outside of formal professional-implemented training sessions (Steiner, et al., 2012). Parent education programs may entail various formats, including in vivo teaching, group programs, or a combination of individual and group programs. With advances in technology, self-directed technological training programs or web-based programs, have become increasingly popular and particularly helpful for families in remote locations (Steiner, et al., 2012). Individualised parent education is the most common approach and has the advantage of the intervention strategy being tailored to the individual child and family's needs. An emphasis is placed on parent's practicing teaching

skills, in the natural environment, with their child, and being provided with immediate feedback by the professional. Studies have indicated that interventions that include opportunities for parents to practice skills with their child during training sessions, and include feedback, are more effective than parent-training interventions without these elements (Carson, Moosa, Theurer, & Cardy, 2012).

The importance of training parents as intervention providers for children with ASD was first emphasized by Lovaas, Koegel, Simmons, and Long (1973) when they noted that following intensive treatment, children whose parents were trained to carry on the intervention continued to make gains, whereas children who were returned to an institutional setting lost their previously acquired skills (Lovaas, et al., 1973). Since this observation, further research has demonstrated the benefits of parent training and inclusion in successfully contributing to the implementation of interventions across a variety of areas (including managing behaviour, teaching social skills, and teaching communication skills) and improving child outcomes and parent-child interactions (McConachie & Diggle, 2007; Schultz, et al., 2011; Steiner, et al., 2012; Strauss et al., 2012). Incorporation of parents as intervention providers also contributes to the social validity of an intervention (Lucyshyn et al., 2007).

2.3.2. Social Validity

A core aspect of behavioural interventions is the social validity of the intervention, which refers to the appropriateness and meaningfulness of the intervention to both the clinical and social worlds (King & Valdovinos, 2009). The assessment of social validity in applied behaviour analysis was initially proposed in the 1970s and has become a hallmark of studies in applied behaviour analysis (A. E. Kazdin, 1977; Wolf, 1978). Kazdin (1977) and Wolf

(1978) reasoned that it is not enough for behavioural procedures to be effective; they also need to be accepted by those with whom they are intended to be used. Wolf delineated three primary foci of social validity assessment: 1) the social significance of the targeted behaviour and goals; 2) the social appropriateness of the intervention procedures; and 3) the social importance of the results or effects. This framework has become the primary guide for the development of social validity methods in research literature in the field of applied behaviour analysis (J. E. Carr, et al., 1999). Seemingly, goals, methods, and outcomes that are socially valid (in addition to being objectively valid) are those that are most likely to be adopted by consumers and will result in more widespread continued use (J. E. Carr, et al., 1999; Rapoff, 2010; Schlosser, 1999).

Social validity can be assessed using a variety of methods, including questionnaires or interviews completed by consumers (subjective evaluation) and by comparing treatment outcomes with established behavioural norms (normative comparison; J. E. Carr, et al., 1999; Finn & Sladeczek, 2001; Foster & Mash, 1999; Schlosser, 1999). Establishing who the consumers of an intervention are is a key question in assessment of social validity. Schwartz and Baer (1991) proposed a categorisation of consumers, including direct consumers (primary recipients of the intervention, e.g. the child); indirect consumers (purchase or hire the program for someone else or are strongly affected by the behaviour change targeted in the intervention, e.g. parents); members of the immediate community (those who interact with the direct and indirect consumers on a regular basis, e.g. teachers); and members of the extended community (those who do not interact with the direct or indirect consumers but live in the same community, e.g. waitress at a local restaurant). Each of these categories of consumers may evaluate the social validity of an intervention program differentially. The categorisation of consumers allows interventionists to astutely select how many consumer

types are desirable for assessing the social validity of an intervention, and who may be the most suitable individual to fit the profile of a particular type of consumer (Schlosser, 1999).

Despite the importance of demonstrating the social validity of an intervention, Carr et al. (1999) demonstrated a lack of the research literature, during the first 31 years of the *Journal of Applied Behavior Analysis,* to report social validity measures of treatment outcomes and treatment acceptability. The results indicated that overall treatment outcome and acceptability measures were reported in less than 13% of articles, with studies conducted in naturalistic settings being seven times more likely to report social validity measures than studies conducted in analog settings. Measuring social validity is, however, critical as the willingness of relevant adults to continue using an intervention is dependent upon it (J. E. Carr, et al., 1999).

The long term maintenance of behaviour change is intrinsically entwined with the issue of social validity (R. A. Baer, 1989; Kennedy, 2002; Lucyshyn, et al., 2007). The maintenance of behaviour change is defined as "the continuing durability in levels of behavior once operational goals, procedures, and outcomes of an experiment have been achieved" (Kennedy, 2002, pg. 595). It is generally acknowledged that an effective behaviour change intervention not only provides solutions to a behavioural problem in the short term, but remains effective for a significant period of time (D. M. Baer, et al., 1968; R. A. Baer, 1989). Incorporation of maintenance measures provides information on how social contexts affect and are affected by interventions, as well as the ecological variables within that social context that sustain or do not sustain those behaviour changes (Kennedy, 2002), and thereby provide information on the social validity of an intervention. For families of children with disabilities, ''survivable'' interventions are those that remain acceptable, effective, and sustainable across a long period of time, best measured in years after formal behaviour support services have ceased (Lucyshyn et al., 2015, p. 3527).

Assessment of long term maintenance following the departure of the researchers is, however, rare (Lucyshyn, et al., 2007; Lucyshyn, et al., 2015). It is possible that once researchers depart, the intervention is no longer implemented by parents, which may result in subsequent loss of improvements gained during the intervention (R. A. Baer, 1989). An active strategy for programming for maintenance of treatment gains in any intervention is teaching the learning principles that underlie the procedures to relevant adults in the child's life, for example parents. Maintenance of child behaviour change is often dependent on the continued implementation of intervention procedures and provision of opportunities for the child to use and practice learned skills by relevant adults in the child's environment (R. A. Baer, 1989; Kennedy, 2002). Baer (1989) suggests that maintenance of child behaviour change over the long term is likely to require permanent changes in the behaviour of relevant adults. As such, efforts need to be directed towards changes in adults' behaviour as well as the child's behaviour.

Research, focusing on maintenance, could greatly contribute to our knowledge of factors that influence the long term maintenance of skills acquired through intervention (R. A. Baer, 1989). Currently, of the studies that have reported follow up, the extent to which the children are still engaging in target behaviours is reported, but these studies have not monitored the extent to which the relevant adults are continuing to support the behaviour change (R. A. Baer, 1989). Thus it is difficult to know whether the children's behaviour maintained because the experimental procedures were still being implemented or for some other reason. If a follow-up assessment reveals that the children's behaviour has returned to pre-treatment levels and that the relevant adults are no longer continuing to support the behaviour change, a more detailed assessment of why the adults discontinued the procedures is warranted. It is possible that the procedures are viewed by the adults as too time

consuming, too expensive, not effective, or as addressing a problem of less severity (R. A. Baer, 1989).

Another method for assessing the social validity of interventions is the monitoring of procedural integrity (Gresham & Lopez, 1996). Several researchers have suggested that procedural integrity is the critical link between the acceptability of interventions (social validity) and their use, as interventions that are perceived by consumers to be effective and acceptable may be implemented with greater compliance and adherence to the protocol than interventions perceived as ineffective (Gresham, 1997; Gresham & Lopez, 1996; A. E. Kazdin, 1982). Therefore, observations or rating scales measuring procedural integrity could be used as an index of the degree of acceptability of the intervention (Finn & Sladeczek, 2001).

2.3.3. Procedural Integrity

Procedural Integrity (also referred to as treatment integrity, intervention integrity, or treatment fidelity) refers to the extent to which an intervention is implemented accurately and as intended (Cooper, et al., 2007). It reflects the accuracy and consistency of the implementation of each component of the intervention; and direct measurement of procedural integrity is crucial for improvements in behaviours to be directly attributed to the strategies utilized (Gresham, Gansle, & Noell, 1993; Hwang & Hughes, 2000). In addition, when interventions are found to be ineffective, measures of procedural integrity allow determination of whether the intervention should be modified or whether they were ineffective due to being implemented incorrectly (Digennaro-Reed, Codding, Catania, & Maguire, 2010). Research into the importance of procedural integrity in relation to the internal and external validity and successfulness of ABA interventions in general (Schlosser,

2002), has identified that lack of procedural integrity has negative implications on intervention progress and student outcomes (Digennaro-Reed, et al., 2010; Gresham, 1997; Gresham, et al., 1993; Hagermoser Sanetti & Kratochwill, 2009; Ingham & Greer, 1992; Noell et al., 2000; Pelletier, McNamara, Braga-Kenyon, & Ahearn, 2010; Plavnick, Ferreri, & Maupin, 2010; Shore, Iwata, Vollmer, Lerman, & Zarcone, 1995).

Several factors have been identified that are directly related to the procedural integrity of interventions, including: the complexity of interventions, the time required to implement interventions, the materials and resources required, the number of implementers required, the perceived and actual effectiveness of the intervention, and the motivation of implementers (Gresham, 1997; Salend, 1984). A general principle of behaviour change is that the more complex the intervention is to implement, the lower the fidelity of that intervention (Salend, 1984). Therefore, simplifying procedures decreases concerns related to procedural integrity (Greenberg, et al., 2012b). There is also an interaction between the complexity of an intervention and the amount of time required to implement that intervention. Complex interventions usually require more time to implement than simple interventions, and requiring implementers to invest lots of time in an intervention (with other existing demands on time) is likely to result in poorer implementation of the intervention (Gresham, 1997). An additional factor affecting procedural integrity is the materials and resources required to implement an intervention. Interventions that require additional materials beyond what is commonly available in the immediate environment are likely to be implemented with poorer fidelity (Gresham, 1997). It has also been demonstrated that the number of people required to implement an intervention affects levels of procedural integrity. Interventions that require multiple implementers can be ineffective because of failures on the part of each implementer to follow the intervention protocols (Gresham, 1997). In addition, the motivation of implementers to invest their efforts into an implementation directly affects procedural

integrity. A lack of motivation by parents, for example, in the implementation of an intervention that requires their participation, can cause serious deficits in the fidelity of their implementation of the protocol and directly affect the child's intervention outcomes (Gresham, 1997). A final factor affecting procedural integrity is the knowledge and training of implementers. Skilled individuals who are trained to properly administer the treatment conditions are less likely to engage in implementer errors (McCall, 2009; Salend, 1984). Therefore, instruction in the specific strategies used in intervention protocols is particularly important when implementers are parents or paraprofessionals.

Procedural integrity can be assessed using either direct or indirect measures. Direct measures entail observation of the intervention's implementation in applied settings, while indirect measures include rating scales, self-monitoring, self-report, and behavioural interviews (Hagermoser Sanetti & Kratochwill, 2008). Since implementer's adherence to protocol may also deteriorate over time, it is also critical that procedural integrity checks, using direct or indirect measures, are conducted during all intervention phases (Salend, 1984).

2.3.3.1.Procedural integrity of interventions in research

In experimental research, procedural integrity is a key aspect in determining the significance of the effects of an independent variable (intervention) on a dependent variable (behaviour), and thereby also central to establishing the internal validity of an intervention (Gresham, et al., 1993). Procedural integrity also affects the external validity of interventions. When replicating an intervention that has been identified as resulting in positive behavioural change in an experimental setting, procedural integrity is essential to ensure the same behavioural changes occur in future replications of that research study, and thereby are in fact a result of the intervention and not a result of other external factors. Furthermore, replication

assesses whether behavioural changes of an intervention are effective across populations and environments (Cooper, et al., 2007). Therefore, documenting the procedural integrity of an intervention's implementation within an experimental study is essential in establishing the internal and external validity of the research outcomes.

Despite this importance several reviews have demonstrated a lack of research to document data on the procedural integrity of the intervention implemented (Gresham, et al., 1993; Hagermoser Sanetti, Dobey, & Gritter, 2012; Peterson, Homer, & Wonderlich, 1982; Wheeler, Baggett, Fox, & Blevins, 2006). Peterson et al. (1982) conducted one of the first and most influential reviews of procedural integrity assessment of all experimental articles published in the Journal of Applied Behavior Analysis between 1968 and 1980. The results demonstrated that the majority of articles published did not use any assessment of procedural integrity of the independent variable, and a sizeable minority did not include operational definitions of the independent variable. Gresham et al. (1993), building on Peterson et al. research, also demonstrated that of all applied behaviour analysis studies with children, published in the Journal of Applied Behaviour Analysis between 1980 and 1990, only 16% of the studies measured the accuracy of implementation of the independent variable.

Another review by Wheeler et al. (2006) evaluated the frequency of procedural integrity assessment in behavioural intervention studies conducted with children with ASD. Of the 60 intervention studies reviewed (published between 1993 and 2003) results indicated that 92% reported operational definitions of the intervention, 18% operationally defined the intervention and assessed procedural integrity, 5% reported that they monitored procedural integrity but did not provide data, and 68% did not mention procedural integrity. A more recent review by Hagermoser Sanetti et al. (2012) examined experimental intervention studies published in the Journal of Positive Behavior Interventions between 1999 and 2009 and demonstrated that while a majority of published studies included a definition of the

independent variables, 51.4% of researchers failed to report procedural integrity data. Although these reviews of procedural integrity in the research literature utilised different methods, the results suggest that it is more common for researchers to operationally define the independent variables than quantitatively measure them.

2.3.3.2. Procedural integrity of interventions in practice

The assessment of procedural integrity in practice is just as important as the assessment of procedural integrity in research. An evidence-based program will not produce benefits in practice unless it is properly implemented (McCall, 2009). Researchers expect that implementers (teachers, parents, professionals etc.) will implement an intervention as intended and planned (Gresham, 1997). Implementers, however, may implement all, some, or none of the procedures specified in an intervention protocol, or may supplement prescribed strategies with procedures not in the intervention manual (Perepletchikova, 2011). Empirically little is known about the implementation of behaviourally based programs within the social contexts in which they are intended to be used (McCall, 2009).

Interventions that may be at higher risk for implementation errors (such as complex interventions, or those delivered by parents or teachers) require more rigorous procedures for ensuring procedural integrity (Perepletchikova, 2011). Empirically supported strategies that have been shown to be effective in improving the accuracy with which implementers implement interventions include verbal feedback, written performance feedback, rehearsal and practice sessions, and video modelling (DiGennaro Reed & Codding, 2011). Pelletier et al. (2010), for example, demonstrated that when staff were shown video recordings of their own training sessions with students and asked to assess their procedural integrity during each session, they were more likely to perform future training sessions more effectively,

complying with procedures. Plavnick et al. (2010) found similar results when training staff at a public school to implement a token economy. Although procedural integrity was found to be low following initial training, the use of self-monitoring through video footage was identified as an effective tool for decreasing errors and increasing procedural integrity (Plavnick, et al., 2010). A further study by Digennaro-Reed et al. (2010) demonstrated that the addition of verbal performance feedback to video modelling increased and maintained the accurate implementation of behavioural treatments by three teachers.

2.3.4. Generalisation of skills

A student's ability to learn a behaviour or skill and generalise that behaviour or skill to different settings, materials, and people is an indicator not only of the social significance of that behaviour but also of the quality of an intervention (Edelstein, 1989; Openden, Whalen, Cernich, & Vaupel, 2009; Stokes & Osnes, 1989). Generalisation is defined as "the occurrence of relevant behavior under different, non-training conditions (i.e., across subjects, settings, people, behaviors, and/or time) without the scheduling of the same events in those conditions as had been scheduled in the training conditions" (Stokes & Baer, 1977, p. 350). Specifically, stimulus generalisation is when behaviour occurs appropriately when new materials, people and/or settings elicit a desired response. Stimulus generalisation primarily includes the desired behaviour in the presence of any variation of the setting (Openden, et al., 2009). Response generalisation refers to variation of the student's response to particular stimuli; for example if a student is taught in a training setting to respond to another person's greeting by saying "Hello", they would demonstrate response generalisation if they reciprocated greetings in various ways, such as "Hi" or "Hey" (Openden, et al., 2009). Another important component of generalisation is the maintenance of treatment effects. A

student needs to not only demonstrate stimulus and response generalisation of a skill or behaviour through intervention, but that skill or behaviour also needs to be demonstrated over time. A learned behaviour or skill is, therefore, said to have generalised only if it appears in a wide variety of environments, produces functionally equivalent variations of the behaviour, and is observed over time (D. M. Baer, et al., 1968; Openden, et al., 2009).

Clinically, generalisation of skills across settings, materials, and/or people is an area in which many children with ASD have significant difficulties (Cowan & Allen, 2007; Openden, et al., 2009). It is unclear in the research literature whether this difficulty individuals with ASD have with generalisation is due specifically to the disorder, or the nature, delivery, or quality of interventions, or a combination of the two (Openden, et al., 2009). Nonetheless, due to the importance and social significance of the ability to generalise a skill or behaviour to untrained settings, people and material, generalisation needs to be planned for and built into an intervention, rather than just expected to occur naturally (Stokes & Baer, 1977).

There is widespread agreement within the literature, that generalisation should not be expected to occur unless there are specific procedures implemented to facilitate its occurrence (Cowan & Allen, 2007; Edelstein, 1989; Stokes & Baer, 1977; Stokes & Osnes, 1989). A number of tactics for promoting generalisation have been proposed that are grouped into three general principle areas: use natural consequences, train diversely, and incorporate mediators (Stokes & Osnes, 1989). Use of natural consequences recognizes that behaviours are more likely to generalise when trainers use reinforcing consequences that occur naturally in the environment (Stokes & Osnes, 1989). Training diversely refers to using less rigid programming, allowing for natural variations in the conditions of training and using a variety of different stimuli with which to train (Stokes & Osnes, 1989). Incorporating mediators entails using stimuli in training that will also be present in other situations and natural conditions (Stokes & Osnes, 1989). Each of these tactics aims to loosen the tightly controlled

training environment, making it more like conditions that the student will experience in natural environments (Cowan & Allen, 2007; Stokes & Baer, 1977; Stokes & Osnes, 1989).

2.3.5. Fluency of skills

Another challenge in designing effective behaviour interventions for children with ASD is building fluency in the various skills associated with the programs. Fluency is defined as the combination of speed, accuracy and functionality (Binder, Haughton, & Bateman, 2002; Kerr, Smyth, & McDowell, 2003; Kubina & Wolfe, 2005; Weiss, 2001) and is a metaphor for flowing, effortless, well-practised, and accurate performance (Johnson & Layng, 1996). It is achieved through over-learning or practice (Weiss, 2001).

Learning can be categorised into several stages or levels indicating the degree of competence a student has obtained: acquisition, fluency, maintenance and generalisation (Kubina & Wolfe, 2005). The first stage of acquisition focuses on achieving accuracy. The stage of fluency refers to the student responding both accurately and fast. The next level of maintenance suggests that a behaviour will occur for an extended period of time without having to retrain the skill, and the final level of generalisation requires the student to use the skill in situations different from the acquisition setting (Kubina & Wolfe, 2005). Each of these levels of response competence are interdependent such that a student must firmly acquire a response before they can attain fluency. For maintenance, the student must reach the fluency level, and without maintenance the student will not generalise the response (Kubina & Wolfe, 2005).

Many children with ASD demonstrate difficulties in fluency and fail to respond in a timely fashion to initiations from others (Weiss, 2001). Fluency, therefore, needs to be

systematically programmed into all behavioural interventions (Kubina & Wolfe, 2005). In monitoring the effectiveness of an intervention program, fluency relates to the measured effects of the behaviour changes, describing how well a child has learned a certain skill and when she or he can use these skills automatically and functionally within practical situations (Kerr, et al., 2003; Kubina & Wolfe, 2005; Weiss, 2001).

2.3.6. Behavioural Approaches to the social and communicative impairments of ASD

2.3.6.1.Discrete Trial Training

Traditional methods of ABA focused on discrete trial training (DTT), developed through the work of Lovaas during the 1960s. DTT represents a highly structured method of training, in which trainers attempt to control all aspects of the intervention, and uses the behavioural procedures of prompting, imitation, reinforcement and shaping (Ogletree & Oren, 2001; Soorya, Carpenter, & Romanczyk, 2011). In a seminal study, Lovaas (1987) demonstrated that with intensive and early DTT intervention of sufficient duration, children with ASD could make intellectual and social gains previously seen as impossible. This study included an experimental group of 19 children with ASD who received at least 40 hours of one-to-one DTT per week for more than two years, and control groups of 40 children with ASD who received 10 hours or less of DTT per week. The results in outcome measurements between the groups was profound, with 47% of experimental group participants achieving IQ scores exceeding 100 compared to only 2% of participants in the control groups. Several of the experimental group students were also successfully mainstreamed in regular classrooms (Lovaas, 1987). DTT techniques have, however, been criticized for their limited generalisability of learned skills to environments beyond training, and their poor fit between

training techniques and the functional communication target (Cowan & Allen, 2007; Ogletree & Oren, 2001; Soorya, et al., 2011).

More recent approaches based on the principles of ABA incorporate more natural training paradigms and incidental teaching. These methods attempt to maintain a training naturalness, such as not to constrain generalisable learning, and emphasize following the child's lead, incorporating child preferred variables and relying on child initiations (Ogletree & Oren, 2001; Stahmer, Ingersoll, & Carter, 2003). A method that has reduced the gap between highly structured methods such as DTT and more naturalistic methods such as incidental teaching is pivotal response training (PRT), which can be used in a structured or naturalistic format (Stahmer, et al., 2003).

2.3.6.2. Pivotal Response Training

While research into the effects of behaviour interventions demonstrated that many children with ASD made considerable gains with these interventions, the process of targeting behaviours individually proved lengthy and arduous (R. L. Koegel, Koegel, & McNerney, 2001). Therefore, researchers began to search for core pivotal areas of the disorder that, when targeted for intervention, would have widespread effects across non-targeted behaviours. These pivotal behaviours are central to wide areas of functioning, such that a change in the pivotal behaviour results in improvement across a number of behaviours (R. L. Koegel, Koegel, & Carter, 1999).

Pivotal response training is an approach based on the principles of ABA, which combines discrete trial and more naturalistic methods. It involves using a discrete trial format, in that clear instructions are provided with prompting and consequences for

responding (R. L. Koegel, et al., 1999). It is, however, different from an analog discrete trial format in that it uses more natural reinforcement as opposed to arbitrary reinforcement, it relies on interspersing mastery trials and the use of child-preferred materials as opposed to relying on massed trials and adult-selected materials, and it teaches child-initiated responses (Hwang & Hughes, 2000; R. L. Koegel, et al., 1999). Furthermore, rather than targeting behaviours individually as in an analog approach, PRT targets core pivotal behaviours within a teaching paradigm such that wider effects are produced (Hwang & Hughes, 2000; R. L. Koegel, et al., 1999). Several pivotal behaviours have been identified, including motivation, self-initiations, joint-attention, and responsivity to multiple cues.

2.3.6.2.1. Motivation

Motivation to respond to environmental and social stimuli has been demonstrated as a pivotal area that is lacking in children with ASD (R. L. Koegel, et al., 2003). Motivation "refers to observable characteristics of a child responding such that an improvement in motivation is broadly defined as an increase in responsiveness to social and environmental stimuli" (R. L. Koegel, et al., 1999, p. 578). Several variables have been identified that increase children with ASD's responsiveness to social and environmental stimuli, including child choice of stimulus materials, task variation and interspersal of maintenance tasks, reinforcement of response attempts, and the use of natural and direct reinforcers (L. K. Koegel & Koegel, 1995; R. L. Koegel, et al., 2001). The aim of PRT is to incorporate all these variables into teaching opportunities in the natural environment (R. L. Koegel, et al., 2003).

Child choice refers to using child-preferred or selected materials, toys, and activities in learning opportunities. Varying task sequences and interspersing new tasks with previously

learned tasks in an activity can also improve motivation. Research has further demonstrated that motivation can be increased by incorporating natural reinforcers that are directly related to the child's response (R. L. Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998), and that the incorporation of these variables leads to broader generalized treatment gains (R. L. Koegel, O'Dell, & Koegel, 1987) and decreases in disruptive behaviours (R. L. Koegel, Koegel, & Surratt, 1992). In addition to increasing a child's motivation to respond, another pivotal behaviour in ASD is teaching self-initiations in social and learning contexts (R. L. Koegel, et al., 2001).

2.3.6.2.2. Self-initiations

While typically developing children demonstrate a variety of initiations in social and learning contexts, children with ASD generally do not use initiations that lead to such interactions (R. L. Koegel, et al., 1999). Self-initiations are defined as the individual commencing a new non-vocal or vocal social interaction, self-initiating a task that results in social interactions, or changing the direction of an interaction (R. L. Koegel, et al., 2003). In PRT, motivational variables, such as those described above, are incorporated into teaching procedures to motivate the child to engage in self-initiations (R. L. Koegel, et al., 2003). Several studies have demonstrated that teaching children with ASD to self-initiate can lead to generalized behavioural improvements.

Oke and Schreibman (1990) demonstrated the importance of teaching children with ASD to self-initiate social interactions with peers, and further documented increases in social responding and decreases in disruptive behaviours. A study by Koegel, Carter, and Koegel (2003) has also demonstrated that children with ASD can be taught to self-initiate. Their results further demonstrated that teaching a self-initiated strategy resulted in the children

acquiring targeted morphemes and generalizing the self-initiations into other question forms and increasing verbal skills. Another pivotal behaviour in ASD that has been identified is joint-attention.

2.3.6.2.3. Joint-attention

Joint-attention is a behaviour that acts to direct attention "between interactive social partners in order to share an awareness of objects or events" (Mundy, Sigman, & Kasari, 1990, p. 116). Joint-attention skills refer to gestures such as pointing to objects or showing objects to other people, and also includes the use of eye contact. In typically developing children these behaviours appear between eight and 13 months of age, but a lack of these skills has been noted in children with ASD (Mundy, et al., 1990). The development of joint-attention skills is believed to reflect the emergence of social-cognitive processes that underlie the acquisition of language and theory of mind (Charman et al., 2000; Mundy, et al., 1990). A study by Mundy et al. (1990) examined the degree to which individual differences in joint-attention skills, including pointing, showing objects to others, and eye contact, predicted language development. Results indicated that the gestural joint-attention skills of a group of children with ASD were less developed than a group of children with mental retardation, and that nonverbal gestural joint-attention was a significant predictor of language development in the group of children with ASD. A further pivotal behaviour that has been identified is responding to multiple cues.

2.3.6.2.4. Responsivity to multiple cues

The ability to respond to multiple cues is classified as a pivotal area because it is a prerequisite for many types of learning (R. L. Koegel, et al., 1999). Research has demonstrated stimulus overselectivity in children with ASD, such that they tend to respond to an overly restricted portion of cues in an environment, or on the basis of an irrelevant element of a complex stimulus (R. L. Koegel, et al., 2001). Therefore, children with ASD fail to use all of the relevant cues in an environment.

A study by Burke and Cerniglia (1990) indicated that children with ASD have difficulty in responding correctly as stimulus complexity increases, but they can be taught to respond to multiple cues. Results further demonstrated that using PRT to increase responsivity to multiple cues had generalised effects on increasing children's responses to complex structured and social stimuli. These results have important implications for understanding and changing children with ASD's responsivity and development, and for the education of children with ASD.

2.3.6.3. Augmentative and Alternative Communication Systems

Alternative and Augmentative Communication (AAC) Systems are utilized to supplement individuals' with ASD existing vocal language or to provide an alternative method of expressive communication (Mirenda, 2003). Due to some individuals' with ASD inability to use vocal language, AAC systems are often employed as an option for intervention. There are two types of AAC techniques: aided and unaided. Unaided communication refers to techniques that do not require any equipment that is external to the body, for example, sign language. Aided communication techniques, however, incorporate

devices that are external to the body, for example the use of symbols such as pictures, words or photographs, or voice output communication aids (VOCAs; Mirenda, 2003). The main purpose of all AAC techniques is to compensate for the impairments of individuals with ASD and to assist them in becoming communicatively competent to meet their communication needs (Mirenda, 2001).

Several research studies have undertaken to compare the utility of aided and unaided AAC techniques, but disagreement remains concerning which techniques are most practical and effective. Adkins and Axelrod (2002) compared the effects of American Sign Language and the Picture Exchange Communication System (PECS) on the acquisition of a mand repertoire (requests for items) by a seven year old boy with a diagnosis of pervasive developmental disorder and ADHD. Results demonstrated that the use of PECS produced a better acquisition rate, more spontaneous usage, and a higher generalisation rate than the use of sign language. The authors suggested that further research is needed with a greater number of participants. Chambers and Rehfeldt (2003) also compared the PECS program with sign language on the acquisition of mand skills in four adults with severe mental retardation. The results demonstrated that the participants mastered manding skills with both PECS and manual signs. Two of the four participants mastered both systems and three participants acquired PECS more easily than the manual signs. In addition, all participants were more likely to mand items out of sight using PECS than by using manual signs. Tincani (2004) compared the effects of the PECS and sign language training on the acquisition of mands, specifically in children with ASD. The results were variable with sign language training producing a higher percentage of mands for one participant and PECS producing a higher percentage of mands for another participant. Sign language training, however, produced a greater percentage of vocalizations during training. Tincani suggested that the results may vary as a function of student characteristics, in particular hand-motor imitation

skills, and for individuals with poor hand-motor imitation skills, picture-based systems, such as PECS, may be more appropriate.

Currently, aided picture-based systems are used more frequently with individuals with ASD because of the match between characteristics of ASD and the ease of use of these systems (Charlop-Christy & Jones, 2006; Ganz & Simpson, 2004; S. L. Hart & Banda, 2010). Difficulties in imitation and fine motor problems associated with ASD, and the low representational similarity between manual signs and their referents, has further contributed to the preferred use of aided picture-based systems (Ganz & Simpson, 2004; Sundberg & Partington, 1998).

Several studies have been conducted to compare the utility of various aided AAC systems for individuals with limited functional communication skills (Beck, et al., 2008; Bock, et al., 2005; Boesch, et al., 2013; Ganz, Simpson, et al., 2012; Lancioni et al., 2007; Son, Sigafoos, O'Reilly, & Lancioni, 2006). A recent study by Boesch et al. (2013), for example, investigated the comparative efficacy of PECS and a VOCA in developing manding skills for three preschool aged children with ASD. Using a combination multiple baseline across participants design and alternating treatments design, the results demonstrated increases in requesting for all the participants, across intervention phases with both interventions. In addition, a statistically significant difference between PECS and VOCAs was not found for any participant suggesting that PECS and VOCAs are equally appropriate for developing initial requesting skills in children with ASD. This finding has been demonstrated in previous research.

Bock et al. (2005), for example, compared the effectiveness of PECS and VOCA, utilising an alternating treatments design, on the manding skills of six four-year old boys diagnosed with developmental delay who did not communicate functionally. Results

demonstrated that PECS was acquired at a slightly higher rate than VOCA for three of the participants, while the other three participants demonstrated equivalent acquisition rates between the two systems. Five of the six participants appeared to have a preference for one type of communication modality over the other and this preference could not always be predicted from intervention data. The authors suggested that children should be taught and encouraged to use multiple means of communication to allow them to select from an array of options when given the opportunity to choose how to express themselves.

In a replication of Bock et al. (2005) study, Beck et al. (2008) also compared the use of PECS and a VOCA with four preschool children who were either non-speaking or were limited in their ability to speak and did not communicate functionally using an AAC. In this study the researchers measured not only the participants' preference for each system, but also their vocalisations during system use. The results demonstrated that the participants learned phases I to III of the PECS training protocol in a relatively short time period, however participants' preference for one mode of communication were not predictable and the influence of the communication system on each participant's vocalisations varied. In both of these studies (Beck, et al., 2008; Bock, et al., 2005) the authors noted that participants had difficulty in the physical manipulation of the VOCA device which limited the benefit of this system as a student must be able to physically handle, manipulate and transport a communication device to promote self-initiated communication and generalised use. Another disadvantage noted of VOCAs is the high cost of the devices. In contrast, the PECS format can easily travel with the individual thus increasing the potential for training and generalisation; icons can be easily created to correspond to items in the individual's environment therefore allowing for specific tailoring to the individual's settings/preferences; and the low tech nature of PECS eliminates issues of technology failure and greatly reduces the cost of associated materials (Boesch, et al., 2013; Ganz, Simpson, et al., 2012).

2.4. The Picture Exchange Communication System

The Picture Exchange Communication System (PECS) is a picture-based aided AAC system that is widely used to teach functional communication to individuals with little or no functional communication skills. PECS was developed by Andy Bondy and Lori Frost and emerged out of many years of research and clinical and educational practice at the Delaware Autism Project for preschool children with ASD and other communicative disorders (Bondy & Frost, 2001). PECS is unique in that it teaches individuals with communicative disorders to initiate communicative interactions within a social framework (Bondy & Frost, 2001). Through PECS individuals are taught how to communicate, as opposed to "how to talk" (Liddle, 2001, p. 391). The PECS program commences with teaching requests (mands) through the exchange of a picture or symbol, in the place of vocal requests, for desired objects or activities. The program then moves through a series of phases addressing generalisation, discrimination between pictures, simple sentence construction, expanding vocabulary including attributes, responding to requests by others, and commenting (tacts) (Bondy, 2012; Bondy & Frost, 2001; Frost & Bondy, 2002). PECS also incorporates the use of learner preferred reinforcers and the use of motivating operations (such as placing items within a learner's view but out of their reach) to increase the frequency of communicative opportunities (Bondy & Frost, 2001). PECS is advantageous in that, unlike other AAC systems such as sign language, pictures used in PECS are easily understood by most members of the community without extensive training, and can therefore be easily used in a variety of settings to promote generalised use (Sundberg & Partington, 1998).

PECS is suitable to a variety of individuals, including those who lack a method of functional communication that allows them to express their wants and needs, those that have trouble making their communication understood by others, those that currently have an

inadequate communication system that fails to support them to express their wants and needs, and those who lack a communication system that allows spontaneous expressive communication across a variety of settings (Ganz, Simpson, et al., 2012). Few pre-requisite skills are required for the implementation of PECS. At the commencement of training, an individual needs only to be able to attend to a two-dimensional stimulus and have the physical ability to hand it to a communicative partner. PECS does not have requirements that other communication systems have in terms of eye contact, verbal and/or motor imitation, and match-to-sample skills (Charlop-Christy & Jones, 2006; J. Smith, et al., 2013). Therefore, PECS can be easily utilised by individuals with limited behavioural repertoires to ensure some degree of effective communication from the beginning of the intervention.

2.4.1. The PECS training protocol

The PECS program consists of six distinct phases that use teaching strategies such as prompt fading and backward chaining to build on skills mastered in the previous phase (Bondy & Frost, 2002). Completion of each phase is dependent on reaching specific criteria, which are necessary for successful implementation of the program and progression to the following phase (Frost & Bondy, 2002). The six phases of PECS training are generally designed to correspond to typical communication development (Ganz, Simpson, et al., 2012).

Experimental validation of the PECS training protocol has been provided by Cummings et al. (2012) who evaluated the effects of training during each of the six phases of the PECS with seven children with developmental or language disorders. Results demonstrated that for phases I to IV each of the seven participants only emitted a phase's target behaviour after it had been trained, validating that segment of the PECS protocol. Increases, however, in PECS responses occurred during tests for phases V and VI responses as soon as training was

completed in phase IV. The researchers noted that there are, however, plausible conceptual explanations for this occurrence and concluded that the results in sum support the PECS training structure of all six phases.

2.4.1.1.Phase I: Physical exchange- How to communicate

The initial goal of PECS is to teach students that communication serves a useful purpose through a focus on teaching independent manding skills. During phase I the student is taught to request a highly preferred item through the exchange of a picture of that item (Frost & Bondy, 2002). Discrimination between pictures of items is not yet required at this phase; rather, the student is taught the functional importance of exchanging a picture in order to receive what is desired. Only tangible objects are used for exchange at this point as these objects are most effective due to their innate reinforcing value (Frost & Bondy, 2002). The effectiveness of PECS is grounded in the use of natural reinforcement in the form of the desired item. Therefore, the key concept taught at this phase is that when the student feels a natural need such as hunger (A) and is motivated by this need, he/she must perform an action, i.e. exchange a picture with the communicative partner (B), in order to receive the reinforcement, food (C). While social reinforcement (praise) is provided in addition, the natural reinforcing value of receiving the desired item is essential in order to teach this ABC behavioural chain. Initiation is therefore a key aspect of teaching PECS.

Two trainers are required at this phase of training, one person acts as the communicative partner and the second as the physical prompter (Frost & Bondy, 2002). The communicative partner entices the student with a desired item, and as the student initiates by reaching for the item, the communicative partner provides an open hand prompt, while the physical prompter guides the student's hand to pick up the picture, reach toward the

communicative partner and release the picture into the communication partner's hand. The communication partner then reinforcers the exchange with the desired item within 0.5 seconds. Reinforcement must be delivered immediately following the exchange, in order for the child to associate the reinforcement directly with the exchange of the picture (Frost & Bondy, 2002). The physical prompts that are used to teach the student to exchange the picture are then systematically faded using backward chaining. The importance of using a second trainer during this first phase is paramount in order to avoid prompt dependence (Bondy, 2012; Frost & Bondy, 2002). Prompt dependence is an area of concern when working with students with ASD due to the rigidity and repetitiveness of behaviour associated with the disorder (Woods & Wetherby, 2003). Due to the lack of understanding of social-communication, children with ASD often identify irrelevant aspects of the environment and associate these with a particular behaviour or expected response (MacDuff, Krantz, & McClannahan, 2001). Therefore, when teaching PECS to children with ASD, additional care must be taken to avoid the development of prompt dependency (Bondy & Frost, 2001; Frost & Bondy, 2002). Communication skills that become prompt dependent are not functional, in that communication will not occur independently or spontaneously as a result of a need, but rather as a result of a prompt (MacDuff, et al., 2001). Prompt dependency therefore undermines the purpose of PECS to teach self-initiated functional communication.

Vocal prompts are also not used during this phase as they are significantly more difficult to fade than physical hand-over-hand prompts (Sundberg, 2008). The student must also be allowed time to engage with and enjoy the requested item to increase the reinforcing value of the exchange. As the item is exchanged, the communicative partner vocally labels the item being requested by its name (e.g. "lolly"), but there is no requirement for the student to name the item. A range of items throughout the day should be used during this phase, in

order to increase fluency and generalisation of the skill. Similarly, PECS should be used with a variety of communicative partners and embedded into the daily routine of the student (Frost & Bondy, 2002). By doing so, the student will learn that PECS can be used in a variety of situations with all people rather than being a skill that is used only during structured training lessons with specific individuals.

2.4.1.2. Phase II: Distance and Persistence

Once the student has mastered the skill of exchanging a picture for a desired item, as evidenced by the use of PECS in a range of situations, with a range of people, and requesting a variety of different items or activities; the student is taught spontaneous, persistent communication when a communicative partner is distant. During phase II of the PECS program the student is taught to travel to their communication book, retrieve the picture and travel to a communicative partner, obtain their attention and then exchange the picture for the desired item. In natural settings, more effort may be required of the student to request a desired item. This phase therefore teaches the student to travel greater distances to retrieve a picture needed to complete the exchange, and that the attention of their communication partner must be gained in order to communicate their request (Frost & Bondy, 2002).

During phase II the distance between the student, communication book and communicative partner is gradually increased until the student is travelling between different rooms or areas within a setting to retrieve a picture from their communication book and then locate a communicative partner to complete the exchange. The student is also taught to gain the communication partner's attention by tapping his/her arm. This skill is maintained throughout training as it is an essential aspect of communication that the student is required to master. During this phase a second trainer may be required to assist the student in

travelling to the communication book and the communicative partner. All communicative partners must be aware of their body language and facial expressions, because as with vocal prompting, expressions, body language and eye contact may lead to inadvertent prompt dependence (Frost & Bondy, 2002; Sundberg, 2008).

2.4.1.3. Phase III: Picture Discrimination

The objective of phase III is to teach students to discriminate between pictures using an array of symbols. Picture discrimination is first taught using one picture of a highly desired item and a picture of an extremely undesired item (phase IIIa). It is important to ascertain that the two items used fulfil these criteria. Vocal feedback is used during this phase to assist the student in picture discrimination. When the student reaches for the picture of the highly desired item, the communication partner says "yes" or "ah-ha" thereby reinforcing the choice. If the student reaches for the picture of the undesired item, no vocal sound is made and the exchange is made as per protocol, leading to the student receiving the undesired item of no reinforcing value. A four-step error correction procedure is then utilised: (1) the communicative partner shows the student or taps the picture of the highly desired item that should have been exchanged to receive that item; (2) the communicative partner holds open their hand near the target picture and over the distracter picture for the student to exchange the correct picture and the student receives praise for exchanging the correct picture but is not given the item; (3) The student's attention is diverted using a switch in attention by asking the student to do something unrelated to PECS such as "Touch your nose"; (4) the student is enticed again with both items. This four-step error correction procedure is important to establish correct picture recognition (Frost & Bondy, 2002).

Once the student is able to distinguish between a picture of a preferred item and a picture of a non-preferred item, task difficulty is increased by using pictures of two student preferred items (phase IIIb). The communicative partner entices the student with two preferred items. Once the student exchanges one of the pictures the communicative partner indicates for the student to take the corresponding item they desire. The communicative partner assesses whether the correct picture has been chosen based on the item the student reaches for following the exchange. If the student reaches for the item that does not correspond with the picture exchanged, the communicative partner blocks the student from taking the item and the four-step error correction procedure is applied (Frost & Bondy, 2002).

By this stage of training, the student's vocabulary of pictures has increased and the communication book's insert pages can be used to store pictures. The student is taught to look through their communication book and choose the picture of an item they desire. The pages can be organised by category, although the student may decide to organise pictures in a way most useful to them. This is also a good time to teach the student to request items that are out of sight which adds to the ecological validity of PECS use (Frost & Bondy, 2002).

2.4.1.4. Phase IV: Sentence Structure

Phase IV teaches students to construct sentences combining a sentence starter card (I want) with a picture of a desired item, and exchanging the sentence strip instead of a single picture card exchanged in previous phases (Frost & Bondy, 2002). Once the student initiates by taking a picture from the communication folder, the communicative partner provides a physical hand-over-hand prompt, guiding the student to place the picture next to an "I want" card on the sentence strip, and exchange the entire sentence stip. The communicative partner then reads the strip back to the student. The physical prompt to place the picture of the

desired item next to the "I want card" on the sentence strip is then gradually faded using backward chaining. Social feedback of "Ah-ha" or "yes" is provided when the student independently places the picture on the sentence strip. Mastery of this step is achieved when the student can independently place the picture of a desired item on the sentence strip and exchange the entire sentence strip (Frost & Bondy, 2002). Once independence is achieved, the "I want" picture is removed from the sentence strip and placed on the communication book. The student is taught to take the "I want" picture first and place it on the sentence strip before placing the reinforcer picture next to it. As this skill is learnt, the communication partner continues to read the sentence to the student while pointing to each picture (Frost & Bondy, 2002).

It is important for the student to learn to read the sentence strip with the communicative partner by pointing to each card as it is read out, before receiving the reinforcer. Physical hand-over-hand prompting may be necessary to teach the student to point to each picture and backward chaining is then used to fade this prompt. During this stage the communicative partner gives the student the opportunity to produce vocal language while pointing to each picture. The sentence strip is turned toward the student, the communication partner reads out the first words: "I want", then introduces a progressive time delay by pausing for 2-3 seconds and looking expectantly at the student while pointing to the next picture. This serves to give the student an opportunity to vocally label the item. If the student responds with a vocal approximation or the word, the student's effort is reinforced with additional social praise or an increase of the desired item (for example, the student receives five M&Ms instead of just one) to differentially increase the reinforcement (Frost & Bondy, 2002). An additional time delay for the "I want" picture can later be introduced to encourage the student to vocally read the entire sentence strip. At this phase it is important, however, to never insist on vocal language. If the student does not vocally produce the word

or an approximation during the time delay, the communicative partner continues to read out the sentence and the student is reinforced for the exchange. The reinforcer must never be withheld from the student if vocal language is not produced. Insisting on vocal language undermines the communication skills the student has already developed and may lead to frustration and possibly cause the student to a discontinue communication altogether (Frost & Bondy, 2002).

During this phase a back-step error correction procedure is applied when an error is made, that is the student is taken back to the last step performed correctly (Frost & Bondy, 2002). The student may occasionally put pictures in reverse order and in this case the communication partner can switch the pictures around to the correct order and begin reading. If, however, this becomes a frequent mistake the communication partner can pretend not to understand what the student is communicating and put the sentence strip back on the communication book. This is often a natural cue for the student to correct the error (Frost & Bondy, 2002).

As the student becomes more skilled with using the sentence strip, multiple reinforcers can be requested. The student may request "I want" "paper" and "crayons". An "and" card can also be introduced at this stage. This skill leads to the next stage of assigning attributes to the reinforcer. The student can be taught to request "pink" "paper" using two pictures instead of just one "paper". When teaching attributes it is important to distinguish which attributes carry important reinforcing value to the student. The student should be motivated by the attribute, for example if the student likes the blue ball more than the red ball, the student can be taught to request the blue ball specifically. Discrimination training is required to teach the student different attributes (Frost & Bondy, 2002).

2.4.1.5. Phase V: Answering Questions

In phase V students build on their current skills, and learn to answer the direct question of "What do you want?". Spontaneous requesting, increasing vocabulary and commenting are continuously developed while a vocal question is posed to the student. Delayed prompting is used to introduce the "What do you want?" question. The question forms a natural cue which is introduced simultaneously while pointing to the "I want" picture with which the student is now familiar. Physical prompting can also be used to assist the student to respond to the question. As the student begins to respond, the delay interval can be increased before pointing to the "I want" picture. The goal of this phase is for the student to beat the communicative partner to answering the question by reaching for the "I want" picture before the communicative partner does. During this phase the student should be switching between responsive requesting and spontaneous requesting to maintain the ecological validity of the skill (Frost & Bondy, 2002).

2.4.1.6. Phase VI: Commenting

The final phase teaches students to make comments using an increasing number of sentence starter cards. During this phase the student is taught to answer questions such as "What do you see?", "What do you have?", "What do you hear?" and "What is it?" using sentence starters such as "I see", "I have", "I hear", and "It is". The goal of this phase is for the student to demonstrate responsive and spontaneous commenting. Commenting primarily results in social or educational reinforcement, therefore reinforcement should be provided in an appropriate form depending on whether the student is communicating a request or a comment (Frost & Bondy, 2002).

The student also needs to find the stimulus interesting or unusual in some way to be inclined to comment on it. Therefore, when designing training sessions the student's interests need be taken into account. The first sentence starter taught should be based on the interests of the student. For example, "I see" can be taught when using a book of animals. The sentence starter is placed on the front page of the communication book with other reinforcers and the "I want" picture removed. The communicative partner teaches the student in the same way as responding to "I want" was taught, by pointing to the "I see" picture and asking "What do you see?". Pointing to the "I see" picture acts as a gestural prompt to the student to remove the picture and complete the sentence. Only social reinforcement is provided following completion of the sentence, such as "Yes, that is a lion!". The item is not given to the student. Delayed prompting is then applied to remove the physical helping prompt of pointing to the "I see" picture (Frost & Bondy, 2002). As the student becomes skilled with the first question type a second question type can be introduced. The student will then need to learn to discriminate between sentence starters in the same way they learnt to discriminate between reinforcer items. This is taught by providing two sentence starters and posing different questions to the student, requiring the student to answer with the correct sentence starter. Four-step error correction is used to correct mistakes (Frost & Bondy, 2002).

For many children with ASD and language disorder, commenting will remain a difficult skill to acquire, therefore it is also important to maintain spontaneous requesting throughout this phase (Frost & Bondy, 2002). The ultimate goal of phase VI is for the student to spontaneously comment on their surroundings. It is therefore essential to maintain an interesting and stimulating environment for the student which allows for spontaneity. Reinforcement for commenting behaviours are social in nature, although the student continues to receive tangible reinforcement for requests. As the student becomes more

skilled with responding to questions, the questions are systematically faded (Frost & Bondy, 2002).

2.4.2. PECS and Verbal Behaviour

The PECS program combines behavioural and developmental perspectives of learning theory. PECS is based on Skinner's (1957) *Analysis of Verbal Behavior* utilizing the operant principles of antecedent (i.e. deprivation, discriminative-stimuli etc.), response (e.g. mand), and consequence (i.e. reinforcement); as well as verbal operant classes (Frost & Bondy, 2006). Skinner's verbal operant classes include mands (requests), tacts (comments), echoics (imitations), intraverbals (responses to a question), textuals (reading, writing) and autoclitics (verbal behaviour that is based upon and modifies the function of a speaker's own verbal behaviour); and illustrate a direct relationship between the antecedent, the consequence, and the particular verbal operant (Bondy, 2012). Skinner's analysis of verbal behaviour formed the basis of the PECS training programme for teaching particular skills at specific points in the training sequence and also provided the guidelines for how best to design the teaching strategies (Bondy, 2001). This was combined with basic operant principles, incorporating specific non-vocal prompting, reinforcement, and error correction strategies during each phase of the training protocol (Bondy & Frost, 2001).

The main focus of the PECS program is to teach manding skills through a student's spontaneous initiations. A mand is a verbal operant for which the response is under the functional control of motivating operations and specific reinforcement (Skinner, 1957). Therefore, a mand results in a functional response which provides reinforcement to the speaker (Bondy, 2012; Bondy & Frost, 2001; Frost & Bondy, 2002). For example, a student feels thirsty, directs a request toward a communicative partner by saying "drink please",

which is reinforced by the communicative partner providing a drink. The aim of phase I is to shape a student's nonverbal reach for a desired item into verbal behaviour directed to the listener (Bondy, Tincani, & Frost, 2004). Students continue to learn manding skills as they progress through the PECS training protocol by learning to request from an array of two to five pictures of desired items or activities, and using the sentence structure of the "I want" picture with a picture of a desired item. Whereas other operants are controlled by the verbal behaviour of other people, mands are not under the stimulus control of immediately preceding vocal stimuli and therefore are useful in teaching students spontaneous self-initiated communication (Bondy, et al., 2004).

In each phase of the PECS protocol, verbal operants are also mixed (Frost & Bondy, 2002). For example, in the first three phases of the PECS programme, compound mand-tact responses are elicited by a student in the exchange, as the item requested by the student is within the student's view. In order to produce a pure mand, the item needs to be removed from the stimulating environment (Frost & Bondy, 2002). When students are using only single pictures, it can be difficult for a communicative partner to understand whether the student is using the picture as a request (mand) or comment (tact). In typically developing children, at a comparable point in language development, they use single word utterances for manding and tacting. Listeners are able to discriminate whether the child is requesting or commenting by the differences in a child's intonation that accompany these single words (Frost & Bondy, 2002). Intonations function as an autoclitic; that is intonations act to modify the function of a child's verbal behaviour (Skinner, 1957).

One type of autoclitic used in the PECS protocol is designed to function as an autoclitic frame (Skinner, 1957). In phase IV of the PECS training protocol the "I want" frame is added to a single picture previously established without changing the nature of the overall function (Bondy, et al., 2004). For example, the student is taught to construct a sentence "I

want biscuit" using an "I want" picture and a picture of biscuit. This is still a mand but with an autoclitic frame (Frost & Bondy, 2002).

In phase V of the programme an intraverbal-mand compound allows for teaching students how to communicate what they want in response to another speaker's vocal behaviour (Frost & Bondy, 2002). A teacher may ask a student "what do you want" with the item available in front of the child, while simultaneously pointing to the "I want" symbol. The teacher asking this question results in the student's response being partially under the control of the teacher's vocal stimulus, and the item is the reinforcer that prompts the student's mand. The student therefore responds to the question with an intraverbal-mand (Frost & Bondy, 2002).

During phase VI of the training protocol, additional autoclitic frames are introduced, including "I see", "I have", "I hear" etc., and intraverbal-tact compound responses are established. For example, with an object in sight, a teacher asks "What do you see?" while simultaneously touching the "I see" picture card. Given the gestural prompt and the student's mastery of skills in previous phases of the training protocol the student is likely to place the "I see" picture card and picture of the item on the sentence strip. Upon receiving the sentence strip the teacher reads back the sentence strip to the student, but does not give the item to the student. The student's response that is established is therefore an intraverbal-tact compound that is controlled by the teacher's vocal stimulus and the item in sight, and results in social consequences rather than direct consequences (Bondy, et al., 2004). In order to develop a pure tact response, the vocal stimulus of the intraverbal-tact compound is faded (Frost & Bondy, 2002).

2.4.3. Research demonstrating the effectiveness of the PECS program

PECS is an extensively researched communication program (Preston & Carter, 2009). An increasing number of studies have been conducted to evaluate the effectiveness of PECS training with children with ASD, and several of these studies have demonstrated that the use of PECS can be acquired rapidly (Beck, et al., 2008; Bock, et al., 2005; Carre, et al., 2009; Cummings, et al., 2012; Ganz, Heath, et al., 2010), and have further documented concomitant improvements in vocal language and social-communicative behaviours, and decreases in disruptive, problem behaviours (Anderson, et al., 2007; Charlop-Christy, et al., 2002; Frea, et al., 2001; Ganz & Simpson, 2004; Jurgens, et al., 2009; Kravits, et al., 2002; Magiati & Howlin, 2003; Schwartz, et al., 1998). The efficacy of PECS in teaching adults functional communication skills has also been demonstrated (Chambers & Rehfeldt, 2003; Conklin & Mayer, 2011; Rehfeldt & Root, 2005; Rosales, Stone, & Rehfeldt, 2009; Stoner et al., 2006; Ziomek & Rehfeldt, 2008); as has the effectiveness of modified versions of PECS for use with deaf or blind students and trainers (Charlop, Malmberg, & Berquist, 2008; Lund & Troha, 2008; Malandraki & Okalidou, 2007). Recent support documenting PECS as an effective AAC system also comes from several meta-analyses (Flippin, et al., 2010; Ganz, Davis, et al., 2012; S. L. Hart & Banda, 2010; Preston & Carter, 2009; Sulzer-Azaroff, et al., 2009; Tincani & Devis, 2011). In addition, a review by Lancioni et al. (2007) noted only three failures of 173 PECS users. Table 1a below summarises the research conducted to date on the effectiveness of PECS intervention for individuals with ASD and other disabilities.

Table 1a

Description of published PECS research studies (Case Reports, Single-Subject Designs, & Group Comparisons)

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Adkins & Axelrod (2002)	Sign vs. PECS	1	PDD & ADHD	7:0	ATD	N/R	Yes- sessions later each day	No	No	No	No	The use of PECS produced a better acquisition rate, more spontaneous usage, and a higher generalisation rate than the use of sign language.
Anderson, Moore, & Bourne (2007)	Teach functional communication through PECS & monitor behaviour change in home	1	ASD	6:0	Case Report (ABCD)	1-4	Yes- across rooms in the home	Yes	No	No	No	PECS was easily acquired. Increases in manding, initiations, and cumulative words spoken. Increase in play and decrease in TV watching (stereotypic behaviour).
Angermeier, Schlosser, Luiselli, Harrington, & Carter (2008)	Effect of Symbol iconicity (high vs. low) on the acquisition of PECs manding.	4	ASD PDD	6:0-9:0	ATD with MB across subjects	1-2	No	Yes	No	No	Yes-1 week post intervention	Participants learned to request desired objects using PECS; no difference between the effectiveness of requesting between highly iconic and low iconic symbols.
Beck, Stoner, Bock, & Parton (2008)	PECS vs. VOCA	4	ASD, PDD, & Speech-Language Impairment	Pre-schoo l aged	ATD	1-3	Yes- in the home 1 week after treatment ended	Yes	Yes	No	No	Participants learned to use PECS in a short time period; preferences for PECS or VOCA are not predictable; influence of PECS and VOCA on each participants' verbalisations varied.
Ben Chaabane, Alber-Morgan, & DeBar (2009)	Examine the extent to which parents can train their child to exchange novel pictures to request items using PECS	2	ASD	5:0-6:0	MBD across descripto rs	Descri-ptors	Yes- across items	Yes	Yes	Yes	No	Parents can teach their children to use novel pictorial response forms; both children improvised by using alternative symbols when the corresponding symbol was unavailable across all symbol categories.

Note. RD = Research Design. RCT = Randomised Control Trial. MBD: Multiple Baseline Design. CCD = Changing criterion Design. ATD = Alternating Treatments Design. MPD = Multiple Probe Design. ASD= Autism Spectrum Disorder. PDD= Pervasive Developmental Disorder. DD = Developmental Delay. ADHD =Attention Deficit Hyperactive Disorder. ID= Intellectual Disability. N/R = Not reported.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Bock, Stoner, Beck, Hanley, & Prochnow (2005)	VOCA vs. PECS	6	DD	4:0	ATD	1-3	Yes-across settings	Yes	Yes	No	No	2 participants performed better with PECS; 1 participant performed better with VOCA.
Boesch, Wendt, Subramanian, Hsu (2013)	PECS vs. SGD	3	ASD	4:0-12:0	MBD across participa nts & ATD	1-3	No	Yes	Yes	Yes	Yes-8 weeks post intervention	Increases in requesting observed for all participants across intervention phases for both interventions. No statistically significant difference between PECS and SGDs observed for any participant.
Bondy & Frost (1993)	Demonstration of the implementation of PECS in a centre in Peru	74	N/R	N/R	Case Report	1-3	No	No	No	No	No	Over 3 months, 28 participants using phase I, 28 participants using phase II, 18 participants using phase III at a Centre in Peru.
Bondy & Frost (1994)	Effect of PECS on functional communication and spoken language skills	85	ASD	>5:0	Case Report	Varied by child	No	No	No	No	Yes- 1 year post intervention	76% of all the children came to use speech either as their sole mode of communication or augmented by PECS following PECS training
Cannella-Malone, Fant & Tullis (2010)	Use of PECS with peers	2	ASD PDD	6:0 14:0	MBD across behaviou rs	1-3	No	Yes	Yes	Yes	Yes- for 1 participant, 1 month post intervention	Both participants increased in their social interactions using PECS with their peers, and also demonstrated a general preference for verbal communication.
Carr & Felce (2007b)	Effect of PECS on communication skills	24/4 1	ASD	3:0-7:0	Comparis on Group	1-3	No	Yes	No	No	No	Communicative initiations and dyadic interactions increased significantly between children and teachers in the PECS group but not for the control group.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Carr & Felce (2007a)	Effect of PECS on spoken word production	5/41	ASD	3:0-7:0	Comparis on Group	1-3	No	Yes	No	No	No	Five of the 24 children who received PECS training showed concomitant increases in speech production; No children in the PECS group demonstrated a decrease in spoken words after receiving PECS training.
Carre , LeGrice, Blampied, Walker (2009)	Generalisation of PECS to untrained settings and people	3	ASD DD	5:0-6:0	MBD across subjects	1-3	Yes-across settings & people	Yes	No	Yes	No	All participants acquired the ability to mand using PECS. Slight generalisation effects to the classroom and home.
Carson, Moosa, Theurer & Cardy (2012)	Measure changes in speech production associated with PECs; explore if these changes are related to specific individual characteristics	3	ASD	2:0-3:0	CCD	1-3	No	Yes	No	No	No	Increases in speech production were evident for two participants. Stronger imitation skills may increase the likelihood of the development of functional speech after PECS use.
Chambers & Rehfeldt (2003)	Manual sign vs. PECS	4	ID	Adul ts	ATD	1-3	Yes-across settings	Yes	No	No	No	PECS training was more effective in establishing mand skills than manual sign training; demonstrated generalisation across settings.
Charlop-Christy, Carpenter, Le, LeBlanc & Kellet (2002)	Teach functional communication through PECS & monitor behaviour change	3	ASD	3:8-12:0	MBD across subjects	1-5	No	Yes	No	No	Yes- for 1 participant, 10 months post intervention	All participants met the learning criterion for PECS and showed concomitant increases in verbal speech (spontaneous speech and imitation, MLU); increases in social communicative behaviours (joint attention, eye contact, toy play); and decreases in problem behaviours (tantrums, out of seat).

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Charlop, Malmberg, & Berquist (2008)	Use of a Braille modified PECS system for use between a visually impaired therapist and sighted children	3	ASD	5:2-9:11	MBD reversal across subjects	Braille-modified PECS 1-5	No	Yes	No	No	No	Participants communicated using the modified PECS with a visually impaired therapist; decreased problem behaviours.
Cihak,Smith, Cornett & Coleman (2012)	Use of video modelling procedures with PECS to increase communicative initiations	4	ASD & DD	3:0	ATD	Not stated	No	Yes	Yes	Yes	No	All students learned to use PECS and increased in number of independent communicative initiations. The students rate of learning was quicker when using video modelling with PECS training.
Conklin & Mayer (2011)	Effect of PECS on the independent initiations of adults with severe communication deficits	3	DD	Adults	MBD across subjects	1-6	Yes-across settings & people	Yes	Yes	No	Yes- 6 months post intervention	All participants increased their independent request initiations following PECS training. Collateral effects in decreases in problem behaviours demonstrated.
Cummings, Carr, & LeBlanc (2012)	Experimentally evaluate the manualised PECS training structure	7	Autism, CP, ID,Down Syndrome, apraxia	4:0-11:0	MBD across behaviours	1-6	No	Yes	Yes	No	No	PECS was taught in a short period of time and required few pre-requisite skills. PECS responses increased only after training was completed for phases I-IV, validating phase I-IV training protocol. Increases in PECS responses occurred during tests of phase V & VI as soon as training was completed for phase IV.
Frea, Arnold, & Vittemberga (2001)	Effects of PECS on severe aggressive behaviour	1	ASD	4:0	MBD across settings	1-3	No	Yes	No	No	No	Aggressive behaviour decreased when picture communication was introduced; anecdotally peer play increased following intervention.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Ganz, Cook, Corbin-Newsome, Bourgeois, & Flores (2005)	Modifications of PECS training protocol to support PECS acquisition	1	ASD	5:1	CCD	1 & 3	No	Yes	No	No	No	Incorporating additional phases (using a hierarchy of visuals) allowed for more authentic representation of desired reinforcement. Actual items were incorporated and additional phases added allowing the participant to exchange pictures more gradually-successful for the participant.
Ganz, Heath, Rispoli, & Earles-Vollrath (2010)	Effect of PECS & verbal modeling on picture requests, imitated verbalizations, picture discrimination, & speech	1	ASD	3:0	Multi-treatment design	1-2	Yes-across items	Yes	Yes	No	No	PECS training led to increases in picture requests which were maintained during the verbal modelling intervention phase; No change in imitated verbalisations, picture discrimination, and related speech following either intervention.
Ganz, Hong & Goodwyn (2013)	Efficacy of a tablet computer PECS and participant preference for the app vs traditional PECS	3	ASD	3:0-4:0	MBD across subjects	3-4	No	Yes	Yes	No	No	Participants rapidly demonstrated mastery of the PECS app. While 2 participants demonstrated a preference for the app, 1 participant preferred the traditional PECS book.
Ganz, Lashley, & Rispoli (2010)	Investigate the failure of PECS as a functional communication system for participants	2	ASD	2:2-4:6	Case Report	1	No	Yes	No	No	No	Neither participant concluded the study with a consistent independent functional communication system.
Ganz, Sigafoos, Simpson, & Cook (2008)	Generalisation of PECS across people and distance	1	ASD	12:0	Multi-element design	Modi-fied	Yes-across people	Yes	No	No	No	Participant was able to generalize his communication skills across a variety of instructors; and respond to communication obstacles.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Ganz & Simpson (2004)	Effect of PECS on spoken language	3	ASD &DD	3:9-7:2	CCD	1-4	No	Yes	No	No	No	Participants rapidly mastered PECS; word utterances increased in number of words and complexity of grammar.
Ganz, Simpson, & Corbin-Newsome (2008)	Effects of PECS on intelligible words	3	ASD & DD	3:1-5:1	MBD across subjects	1-4	No	Yes	No	No	No	Two participants mastered PECS; participants did not increase in use of word approximations or intelligible words.
Gordon, Pasco, McElduff, Wade, Howlin, & Charman (2011)	Examine form and function of students communication and outcome predictors following classroom PECS intervention	84	ASD	4:0-10:0	RCT	N/R	No	No	No	No	Yes-9 months post intervention	PECS enhanced participant's spontaneous communication for instrumental requesting using pictures, speech, or both. Effects of PECS training were moderated by baseline factors- PECS training increases spontaneous speech for participant's who could talk a little in baseline.
Greenberg, Tomaino, & Charlop (2012b)	Generalisation of PECS across people and settings	4	ASD	4:2-8:4	MBD across subjects	1-4	Yes-across people and settings	Yes	Yes	Yes	Yes- 1month post intervention for 2 participants, 12months for 1 participant & 18months for 1 participant	All four participants generalized PECS use across settings and people, and maintained PECS use at follow-up. Findings support the use of a train and probe technique to assess PECS generalisation.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Greenberg, Tomaino, & Charlop (2012a)	1. Examine the vocalization during and after PECS 2. Determine if children with limited vocal abilities can be taught to pair PECS with spontaneous vocalisations	4	ASD	4:2-8:4	MBD across subjects	1-4	Yes- across people and settings	Yes	Yes	Yes	Yes- 1month post intervention for 2 participants, 12months for 1 participant & 18months for 1 participant	1. Three of the participants demonstrated higher frequencies of vocalisations post intervention. Further, two of the participants used both PECS and vocalisations to mand at different times, but did not pair the two modalities. 2. Both participants made a spontaneous vocalisation every time they used PECs following intervention using a time delay and verbal prompting procedure.
Heneker & MacLaren Page (2003)	Effectiveness of introducing PECS to classes within ASD school	N/R	ASD	N/R	Case report	N/R	No	No	No	No	Yes- 6 month & 10 month post intervention	Participants showed an overall increase in the number of communicative attempts, and a greater awareness of the importance of having somebody's attention before communicating.
Howlin, Gordon, Pasco, Wade, & Charman (2007)	Effect of training and supporting teachers in using PECS with students	84	ASD	4:0-11:0	RCT	N/R	No	No	No	No	Yes	In the groups receiving PECS training there were significant post-treatment increases in the rate of their initiations and rate of PECS use in the classroom; For one group this was not maintained at follow-up; Failed to demonstrate any increases in spoken language or scores on language tests and the children continued to show significant impairments in communication.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Jurgens, Anderson, & Moore (2009)	Teach functional communication through PECS & monitor concomitant behaviour change	1	ASD	3:7	CCD	1-4	Yes-across settings	Yes	Yes	Yes	No	Increases in measures of spoken language, including MLU; acquired functional communication; increased time engaged in play.
Kern, Gallagher, Staosta, Hickman, & George (2006)	Demonstrate the durability of change in aggressive behaviour over 3 years through PECS training	1	ADHD, Down Syndrome, ODD	10:0	Case Report	N/R	No	Yes	Yes	No	No	Participant learnt to use PECS to request breaks, attention, and participation; observed decrease in aggression.
Kodak, Paden & Dickes (2012)	Effects of extinction and prompts on training and generalisation of peer-directed mands using PECS	2	ASD	5:0 & 9:0	Single subject design	N/A	Yes-across people (novel peer)	Yes	No	No	No	Independent mands with a peer increased during treatment for both participants, generalized to a novel peer, and maintained in a naturalistic setting.
Kravits, Kamps, Kemmerer, & Potucek (2002)	Effect of PECS on communication skills and social interaction	1	ASD	6:0	MBD across settings	1-3	No	Yes	No	No	No	Increases in spontaneous language, intelligible vocalisations, and social interaction.
Lerna, Esposito, Conson, Russo, & Massagli (2012)	Effect of PECS on social-communicative skills taking into account standardized psychometric and data of apdaptive behaviour	18	ASD	1.6-5:0	Group comparis on	1-4	No	Yes	No	No	No	PECS group showed a significant improvement compared to the control group in standardized measures of social-communicative abilities (joint attention, request, initiation, cooperative play).

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Liddle (2001)	Demonstration of the establishment of PECS in a special school	21	ASD	N/R	Case Report	N/R	No	No	No	No	No	All participants, except one, learned to use PECS to at least request desired items.
Lund & Troha (2008)	Effectiveness of modified PECS training protocol using tactile symbols	3	ASD & Blind	12:0-17:0	MBD across subjects	1-3	No	Yes	No	No	No	PECS may be an effective method to teach requesting using tactile symbols for individuals with visual impairments.
Magiati & Howlin (2003)	Effect of training teachers in the use of PECS with students	34	ASD	5:0-12:0	Case Report	1-6	No	No	No	Yes	No	Most children showed significant improvements in their use of PECS; with the phases of PECS, frequency of PECS uses, and extent of PECS vocabulary all increasing over time.
Malandraki & Okalidou (2007)	Effectiveness of modified PECS training protocol for hearing loss	1	ASD & Hearing loss	10:0	Case Report	1-6 with modificat ions	No	Yes	No	No	Yes-6 months post intervention	Participant achieved a higher level of communicative ability using PECS; Onset of vocalisations observed during phase IV; Maintenance and follow-up probes suggest that the participant continued to use PECS spontaneously to request and comment.
Marckel, Neef & Ferreri (2006)	Examine improvisation when using PECS	2	ASD	4:0-5:0	MBD across descripto rs	Mastered 1-6 prior to study	Yes-across items, classes, settings, & listeners	Yes	Yes	No	No	Training increased the number of improvised requests, skills generalised to novel items within classes but not across classes, and across settings and listeners in the natural environment.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Park, Alber-Morgan, & Cannella-Malone (2011)	Effects of mother-implemented PECS training on children's communication skills	3	ASD	2:5-2:7	CCD	1-3	Yes-across people	Yes	Yes	Yes	Yes- 1month post intervention	Mothers can be trained to implement PECS training with their children with high procedural integrity; participants acquired independent picture exchanges, which generalized to other communicative partners and were maintained for 1month; Limited to no improvement in vocalizations.
Pasco & Tohill (2011)	Explore utility of using developmental age to predict degree of progress using PECS	23	ASD	5:0-6:0	Comparis on Group	1-3	No	Yes	No	No	No	16 children mastered phase III had total developmental age scores of 16 months or above, providing predictive information of the degree of likely progress students using PECS can make.
Rehfeldt & Root (2005)	Examine Improvisation	3	ID	Adul ts	MBD across subjects	1-3	No	Yes	No	No	No	All three participants demonstrated derived requesting skills following training.
Rosales & Rehfeldt (2007)	Examine derived requesting skills	2	ID	Adul ts	MBD across subjects	1-3	No	Yes	No	No	Yes- 1month post intervention	Participants showed emergence of derived manding; participants vocally requested during maintenance probes
Rosales, Stone, & Rehfeldt (2009)	Effect of behavioural skills training in teaching PECS to adults	3	DD	Adul ts	MBD across subjects	1-3	Yes	Yes	Yes	No	Yes- one Participant for 1 month post intervention	Participants mastered PECS and skills were generalised to a novel setting
Schreibman & Stahmer (2013)	Compare the efficacy of PRT and PECS on the acquisition of spoken language by children with autism	39	ASD	2:0-4:0	Randomi sed Comparis on	1-6	No	No	Yes	Yes	Yes-three months	Children in both intervention groups demonstrated increases in spoken language skills, with no significant difference between the two groups.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Schwartz, Garfinkle & Bauer (1998)	Effect of PECS on functional communication skills of children with severe language delay	1) 31 2)18	ASD, Down Syndrome, DD	3:0-6:0	Case Report	1-4	Yes-across people and activities	Yes	No	No	No	1) All participants learned to use PECS effectively 2) PECS use generalised to untrained settings and had concomitant effects on untrained language functions; 44% demonstrated increases in spoken language.
Simon, Whitehair & Toll (1996)	FC vs. PECS	1	ADHD & moderate mental retardation	7:0	Statistical Comparis on	N/R	No	Yes	No	No	No	Correctly identified known object inside bag with pictures 100% but 0% with facilitated communication (FC)
Stahmer & Ingersoll (2004)	Evaluate outcomes for children under 3 of an inclusive program	20	ASD	2:4-2:9	Inferentia l statistics	N/R	No	No	No	No	No	At program exit 18 children independently used a system, and 16 exited with spoken language. Functional systems included PECS, sign or spoken. All of the children who used PECS or sign combinations also acquired spoken words. 2 of the children on the PECS system began to use spoken language consistently and discontinued PECS.
Stoner, Beck, Bock, Hickey, Kosuwan, Thompson (2006)	Effect of PECS on the communication skills of adults with developmental delay	5	DD	Adul ts	ABAB	1-4	Yes-across settings	Yes	No	No	No	Three participants successfully completed PECS training through to phase IV; demonstrated generalisation to community settings; 2 participants did not progress past phase III of training.
Tincani (2004)	PECS vs. Manual signing	2	ASD	5:10-6:8	ATD	1-3	Yes-across people	Yes	Yes	Yes	No	Acquisition of PECS and sign language may vary as a function of individual student characteristics, particularly motor imitation skills prior to intervention.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Tincani, Crozier, & Alazetta (2006)	Effect of PECS on manding and speech development	1) 2 2) 1	ASD	9:2-11:9	1)Delayed MB 2)ABAB	1-4	Yes-across people	Yes	Yes	No	No	1) Increased levels of manding after PECS implementation. Only one participant demonstrated speech which occurred primarily during phase IV of PECS. Skills generalised to classroom teacher. 2) Vocal reinforcement procedures differentially increased participant's speech.
Travis & Geiger (2010)	Effect of PECS requesting, commenting, and length of verbal utterances	2	ASD	9:0	MB across behaviours	1-6	No	Yes	No	Yes	Yes- 3 months post intervention	Both participants benefited from the introduction of PECS: Increases in requesting visible from phase I, increases in MLU from phase IV, increases in commenting from phase VI; Requesting maintained at Follow up
Yoder & Lieberman (2010)	Effect of RPMT and PECS on far transfer/generality	36	ASD	1:6-6:0	RCT	N/R	N/R	Yes	Yes	N/R	N/R	PECS training increased the number of picture exchanges more than the alternative intervention in a far-transfer measurement context-supporting evidence that PECS can successfully teach a generalized means of showing coordinated attention to object and person without requiring eye contact
Yoder & Stone (2006b)	Effect of RPMT and PECS on turn taking, requesting, and joint attention	36	ASD	1:6-6:0	RCT	N/R	N/R	Yes	Yes	N/R	N/R	RPMT facilitated the frequency of generalised turn taking and generalised initiating joint attention more than PECS for children who began treatment with at least some initiating joint attention. In contrast, PECS facilitated generalized requests more than RPMT in children with very little initiating joint attention prior to treatment.

Table 1a *(continued)*

Author(s) (Year)	Purpose/Aim	N	Diagnosis	Age	RD	PECS Phases imple-mented	Measures of general-isation	Measures of Inter-observer reliability	Measures of procedur al integrity	Measures of social validity	Maintenance/ Follow up	Results
Yoder & Stone (2006a)	Effect of RPMT and PECS on spoken communication	36	ASD	1:6-6:0	RCT	NR	Yes-across people, items & settings	Yes	Yes	Yes	Yes-6 month post intervention	PECS was more successful than RPMT in increasing the frequency of nonimitative spoken communication acts and the number of different nonimitative words used at posttreatment. The growth rate of the number of different nonimitative words was faster in the PECS group for children who began treatment with high object exploration. RPMT benefited children with initially low object exploration.
Ziomek & Rehfeldt (2008)	PECS vs. Manual Sign	3	DD	Adul ts	ATD	1-3	Yes-across people & settings	Yes	No	No	No	Mands for preferred items and for items needed to complete a chained task were acquired more rapidly and in fewer training blocks for PECS than manual sign; Mands established using PECS generalised across settings and communicative partners; untrained tacts and intraverbals using PECS emerged for some participants following PECS training.

2.4.3.1. The effectiveness of PECS in improving functional communication skills

Since its development PECS has been widely used in intervention programs. As a result, PECS has been subject to various studies to assess its efficacy. Much of this research has shown that children with ASD and other communication disabilities successfully acquired functional communication through PECS training (Liddle, 2001). For example, Schwartz, Garfinkle, and Bauer (1998) examined the impact of PECS participation for children with severe developmental disabilities. Thirty-one children, aged between three and six years of age, who used PECS and were enrolled in an inclusive university preschool took part in the study. The results indicated that all 31 children acquired high levels of functional communication with adults and peers through PECS training.

Another study by Carr and Felce (2007b) investigated whether developing spontaneous communicative initiation through the early phases of PECS (phase I to III) had any corollary effects on the dynamics of communicative interactions between 24 children with ASD and their teachers. The results showed that communicative interaction between children with ASD and their teacher increased significantly following PECS training. Spontaneous communicative initiations were achieved within the first 15 hours of PECS training. Spontaneous initiations with PECS also generalised in the use of objects, activities, settings and people within the classroom.

Some case studies have, however, reported that children with ASD had difficulties learning functional communication successfully with the visual symbols of the PECS program (Ganz, et al., 2005; Ganz, Lashley, et al., 2010). Researchers have therefore recommended that further research is needed to identify individual characteristics that would indicate the implementation of a particular AAC (Flippin, et al., 2010; Ganz, Heath, et al., 2010; Greenberg, et al., 2012a; S. L. Hart & Banda, 2010; Tincani & Devis, 2011). In an

attempt to identify such characteristics, Pasco and Tohill (2011) investigated the developmental level of PECS users that determine the amount of progress that they are likely to make with the system. Twenty-three children, aged between five and six years, were trained in the use of PECS from phases I to III. The results showed that 16 children who had a total developmental age of 16 months or above, as measured by the Psycho Educational Profile-revised (PEP-R), mastered the PECS program and developed functional communication. Six children, however, who were below a developmental age of 16 months did not master the PECS training. This study suggests that a developmental age of 16 months and above may be the best point at which to commence PECS training.

Gordon, Pasco, McElduff, Wade, Howlin, and Charman (2011) also explored individual characteristics that predict a better outcome with PECS intervention. The results of a randomised control trial (n = 84) of pre-school aged children demonstrated that less severe ASD symptomology at baseline predicted the greatest increases in spontaneous vocal language use. The results further indicated that for children who were already using vocalisations or vocal language prior to implementation, PECS appeared to provide these children with a structure to use vocal language without prompting. The authors noted, however, that despite the fact that all children in the study were impaired in terms of vocal and non-vocal skills, spontaneous use of pictures to communicate and spontaneous requesting did increase significantly, and this was not predicted by better baseline language or less severe ASD symptoms. This supports the idea that few pre-existing vocal or non-vocal skills are required to learn to use PECS (Bondy & Frost, 1998).

2.4.3.2. Concomitant gains in vocal language associated with PECS training

Despite the recognized benefits of AACs, some parents and professionals continue to be hesitant to implement an AAC intervention due to concerns that AAC will inhibit vocal language development (Millar, Light, & Schlosser, 2006; Schlosser & Wendt, 2008). Several research reviews, however, have demonstrated that AAC interventions do not appear to impede vocal language development and many studies demonstrated that there is potential for gains in vocal language (Millar, et al., 2006; Schlosser & Wendt, 2008). While the main goal of PECS does not entail the acquisition or expansion of vocal language, it is an important long-term goal for children with ASD (Frost & Bondy, 2008). Research has demonstrated that PECS may in fact promote the development of independent vocal language.

Bondy and Frost (1994), for example, first reported that 59% of the children involved in the Delaware Autism Project developed independent vocal language following PECS training. Schwartz et al. (1998) also reported a positive correlation between PECS training and vocal language development. Another study by Kravitz et al. (2002) provided further support for increases in spontaneous communication skills following PECS training. A six-year old girl with ASD was trained in using PECS across her home and school environments. She demonstrated increases in vocal requests and comments, and increased peer social interaction. However, these results may have been confounded by additional social skills training. Ganz and Simpson (2004) demonstrated that word utterances increased in number of words and complexity of grammar following phases I to IV PECS training in three young children with ASD. Although PECS training data were reported, this study did not include baseline and non-training generalisation observations. The authors recommended that further systematic replications of the study should be undertaken to examine the generalisability of the findings.

A study by Jurgens et al. (2009) incorporated such baseline and non-training generalisation observations in an investigation of the effects of PECS training on vocal language, social and communicative behaviour, and play for a three year old boy with ASD. Results demonstrated that the participant rapidly acquired mastery of PECS phases I to III. Although PECS exchanges were rarely observed in generalisation sessions, results demonstrated clear increases in vocal mands and other vocal initiations in kindergarten and home generalisation settings. In addition the participant demonstrated increases in vocal vocabulary and in the length of comprehensible vocal utterances in free-play settings, as well as an increase in the time spent in developmentally appropriate play. Cannella-Malone et al. (2010) also examined the effectiveness of PECS on the social communicative and vocal language skills of two participants (aged six and fourteen years) with severe communication delays with their peers. The results indicated that both participants mastered phases I to III of the PECS training protocol in a short period of time, increased their social interactions using PECS with their peers, and demonstrated concomitant increases in vocal language.

While the above mentioned studies have utilised case study or single subject design methodology, other researchers have investigated the effects of PECS on vocal language development using group comparison methodologies. Carr and Felce (2007a), for example, reported that five of the 24 participants who received phases I to III PECS training in a group comparison study (D. Carr & Felce, 2007b), demonstrated concomitant increases in vocal language production, either in initiating communication with staff or in responding, or both. Further, none of the children in the PECS group demonstrated a decrease in spoken words following PECS training. Another study by Yoder and Stone (2006a) compared the efficacy of Responsive Education and Prelinguistic Milieu Teaching (RPMT) and PECS on spoken communication in 36 pre-schoolers with ASD in a randomised group experiment. Results demonstrated that both interventions increased children's generalised vocal language at post

treatment and follow-up, however PECS resulted in a differentially higher frequency of vocal language for children who demonstrated high object exploration before treatment. This finding is significant given the initial emphasis of PECS to use children's pre-existing interests in reinforcing items to promote communication (Tincani & Devis, 2011). In a recent randomised trial comparison study comparing the effectiveness of PECS and PRT on the acquisition of vocal language, Schreibman and Stahmer (2013) also demonstrated increases in vocal language skills for children receiving both interventions (n = 39), with no significant difference found between the two conditions. The researchers also noted however that, similar to previous studies, children in the PECS condition often began to use vocal language once they reached phase IV of the protocol.

The improvement in vocal language demonstrated during phase IV of the PECS training protocol may be due to the introduction of vocal modelling and time delay strategies. Time delay strategies have been demonstrated to increase the likelihood of vocal language development and growth in communication programs (Bondy & Frost, 2008; Ogletree, Oren, & Fischer, 2007). In an attempt to investigate the functional relationship between PECS phase IV time delay procedures and vocal language development, Tincani et al. (2006) implemented phase IV PECS training with one participant under two conditions: reinforcement provided for vocalisations after a three to five second delay, and no reinforcement provided for vocalisations. Results demonstrated that the reinforcement delay procedures differentially increased the participant's vocal language.

Greenberg et al. (2012a) also investigated the relationship between PECS training and children's vocalisations with four children with ASD (aged four to eight years). Vocalisations were operationalised as any sound that the child made to request an item, not including vocal stereotypy, whining or crying. In this study vocalisations did not have to be phonetically related to the item name. Using a multiple baseline across participants design,

the results indicated that three of the four participants vocalised at higher frequencies during follow-up than during baseline. The authors noted three different patterns in children's vocalisations over the course of the study: 1) no vocalisations throughout the study; 2) no change in vocalisations until follow up; and 3) a decrease in vocalisations followed by an increase at follow up. The third pattern has been noted in previous studies (Tincani, 2004; Tincani, et al., 2006). Greenberg et al. extended this research to investigate if children with limited vocal abilities could be taught to pair PECS with spontaneous vocalisations using time-delay and vocal modelling procedures. Results provided support for the utility of the time delay procedures, indicating that children are more likely to make a vocalisation when a delay is inserted.

Recent research has commenced investigating individual characteristics of users who are likely to develop vocal language skills through PECS training. Carson et al. (2012), for example, explored the effect of adaptive functioning, symbolic representation, motor imitation, and receptive and expressive language skills, on the acquisition of vocal language skills during PECS training of three children with ASD (aged two to three years). The results of a changing criterion design identified a pattern of vocalisation acquisition across the three participants that is similar to that identified by Greenberg et al. (2012a), and further demonstrated that stronger imitation skills pre PECS intervention increased the likelihood of vocal language development.

Questions remain, however, regarding the identification of pre-treatment characteristics of individuals (such as cognitive level, age, disability, and imitation abilities) who are more likely to achieve vocal language gains through PECS training (Flippin, et al., 2010; Greenberg, et al., 2012a; S. L. Hart & Banda, 2010; Tincani & Devis, 2011). Although several studies have documented vocal language development or improvement associated with PECS training, there is variation in how studies measure vocalisations, such as different

environmental arrangements (for example, PECS book present or absent) and under different contingencies (for example, reinforcing vocal approximations or complete word vocalisations), which limits the conclusions that can be drawn about the efficacy of PECS in promoting vocal language (Greenberg, et al., 2012a). Although there is no evidence within the literature to suggest that PECS inhibits the development of vocal language, a few studies have failed to demonstrate concomitant improvements in vocal language following PECS training (Ganz, Simpson, et al., 2008; Howlin, et al., 2007). Further research is needed to identify pre-treatment characteristics of individuals who are more likely to achieve vocal language gains through PECS training, as well as whether the documented increases in vocal language are a result of the introduction of vocal modelling and/or time delay strategies in the PECS training protocol (Flippin, et al., 2010; Preston & Carter, 2009).

2.4.3.3. Concomitant gains in other behaviours associated with PECS training

Studies evaluating the effectiveness of PECS have also demonstrated increases in social-communicative behaviours and decreases in problem behaviours in association with PECS training (Anderson, et al., 2007; Charlop-Christy, et al., 2002; Frea, et al., 2001; Jurgens, et al., 2009; Magiati & Howlin, 2003). Charlop-Christy et al. (2002) conducted one of the first empirical investigations to test the effectiveness of PECS. Using a multiple baseline design with three children with ASD, Charlop-Christy et al. demonstrated concomitant gains in social-communicative behaviours, such as increases in requests, initiations, and joint-attention, and decreases in problem behaviours for all three children. Frea et al. (2001), also utilizing a multiple baseline design, demonstrated a reduction in the aggressive behaviour of a four-year old boy with ASD when picture exchanges were learnt. Results also indicated an anecdotal increase in peer play following the intervention. A

further study by Anderson et al. (2007) also demonstrated concomitant increases in communicative initiations and manding, functional play, and decreases in television watching, identified as a problem behaviour prior to intervention, in a six-year old boy with ASD. These improvements generalized to non-training settings, but the results may have been confounded by additional compliance training.

A recent group comparison by Lerna et al. (2012) investigated the effects of PECS on the social-communicative skills of 18 children with ASD (aged between one year-six months and five years), utilising standardized psychometric data, standardised functional assessment of adaptive behaviour and information on social communicative behaviours, coded in unstructured settings. The 18 participants were matched and assigned to one of two intervention approaches: PECS (phases I to IV) or Conventional Language Therapy (CLT), which served as a control group. Results demonstrated that the PECS group showed significant improvement compared to the control group on the scores of the social domain of the Vineland Adaptive Behaviour Scales, and on all the social communicative abilities coded in the unstructured setting (including joint attention, requesting, initiations, and cooperative play), except eye contact. These findings provide further support for PECS in improving the social-communicative skills of children with ASD.

2.4.3.4. Generalisation of skills acquired through PECS training

An important aspect of PECS is the generalisation of communication skills acquired through training to different settings, situations, materials, and people (Frost & Bondy, 2002). Generalisation is planned for and built into the PECS training protocol through strategies that vary stimulus, response, and reinforcer variables throughout the training phases (Bondy & Frost, 2009). The protocol guides instructors to train across different settings, in different

areas within settings, at different times of the day, during a variety of routines, and using different adults, peers, and siblings. In addition, the protocol suggests that communicative partners vary their response characteristics (such as their facial expressions and degree of attention), change the location of the student's pictures and communication book, ensure a wide array of reinforcers are utilised, vary the picture types used, and the placement or position of the pictures in the communication book, to promote generalisation (Frost & Bondy, 2002).

Several research studies have monitored the generalisation of skills acquired through PECS training. These studies have assessed a number of different types of generalisation including generalisation across people (Ganz, Sigafoos, et al., 2008; Tincani, 2004; Tincani, et al., 2006), generalisation across settings (Chambers & Rehfeldt, 2003), generalisation across time of day (Adkins & Axelrod, 2002), and generalisation across pictures (Ganz, Heath, et al., 2010; Marckel, et al., 2006). Other studies have assessed both generalisation across settings and people (Bock, et al., 2005; Carre, et al., 2009; Jurgens, et al., 2009; Stoner, et al., 2006; Ziomek & Rehfeldt, 2008). The results of these studies have demonstrated inconsistent results with some reporting generalisation across people, settings, and/or items, while others have reported a failure of skills to sufficiently generalise to untrained settings, people and/or items.

Ganz et al. (2008), for example, investigated the use of a modified PECS protocol to teach functional communication to a 12-year old boy with ASD and demonstrated that the participant was able to generalise his communication skills across a variety of instructors and to use functional non-verbal strategies to respond to communication obstacles. Marckel et al. (2006) demonstrated the generalisation of PECS use across pictures through an examination of the effect of the PECS program for children with ASD. Two preschool aged boys participated in the study and training was conducted sequentially across three classes of

descriptors (functions, colours, and shapes) in a different order for each participant. The results showed that the children increased their requesting skills steadily and maintained these at high levels. In addition, they both used novel combinations to make requests for untrained stimuli during generalisation probes and in their natural environment (e.g., "I want eat white circle" to request a marshmallow).

Carre et al. (2009) investigated the degree to which PECS training transfers reliably from the training setting to other settings. Three, five- to six-year old children with ASD completed phases I to III of PECS training at school and concurrent observations sessions were undertaken in the participants' regular classroom and home to probe the degree of generalisation. Training was structured to promote generalisation in that training initially commenced in an isolated small room off the classroom and was gradually introduced into the classroom by opening doors and removing barriers. Results for all participants demonstrated rapid acquisition of PECS in training. Spontaneous generalisation of PECS initiations, however, occurred only to a slight to moderate degree in the classroom and to a slight degree in the children's home. The authors suggested that functionally significant degrees of spontaneous generalisation of PECS training may be difficult to achieve, and cannot be assumed to occur.

A more recent study by Greenberg et al. (2012b) found that their participants used PECS more frequently in generalisation probes than children in previous generalisation studies and hypothesised that procedural differences among studies may explain the discrepancies evidenced amongst studies examining PECS generalisation. Participants in the Greenberg et al. study had restricted access to the highly preferred items and were tempted with a highly reinforcing item once every minute in the generalisation probe, unlike other previous studies which have assessed generalisation in free-play settings typical of everyday conditions. They suggested that it is possible that because the participants in these studies

had free access to their preferred items, they did not need to request the items to enjoy them. A recommendation for future research is to investigate the effects of contextual variables on children's PECS use, especially since the PECS training protocol advises that parents and educators create communicative opportunities, throughout a child's day, by restricting access to preferred items (Frost & Bondy, 2002; Greenberg, et al., 2012b). These opportunities will encourage generalisation and practice of PECS and develop a child's fluency in PECS use. It is, however, unclear how often this is currently being done in research and clinical settings, as well as during children's typical everyday lives.

2.4.3.5. Long term maintenance of skills acquired through PECS intervention

An important component of generalisation and social validity of an intervention is the maintenance of treatment effects over time. Numerous studies in the PECS literature, including case reports, single subject designs, and randomised group experiments, have monitored the maintenance of skills acquired through PECS training ranging from one week to one year post intervention (Angermeier, et al., 2008; Bondy & Frost, 1994; Cannella-Malone, et al., 2010; Charlop-Christy, et al., 2002; Conklin & Mayer, 2011; Gordon, et al., 2011; Greenberg, et al., 2012b; Heneker & MacLaren, 2003; Howlin, et al., 2007; Malandraki & Okalidou, 2007; Park, et al., 2011; Rosales & Rehfeldt, 2007; Travis & Geiger, 2010; Yoder & Stone, 2006a). The expectation at follow-up is that the participant's PECS and/or vocal language skills and concomitant behaviours would be at least at the same level or further improved compared to the last phase of the PECS training conducted.

Several studies have demonstrated the maintenance of PECS use for requesting with participants of varying age groups. Research by Park et al. (2011) collected maintenance data once a week for one month for three children with ASD (aged two-years) and demonstrated

that all three participants maintained independent PECS exchanges post-intervention. Further research by Conklin and Mayer (2011) also demonstrated continued use of PECS, as well as an increase in icon vocabulary, and reduced levels of problem behaviours six months post intervention for two adult participants with intellectual disabilities who had completed phase IV and phase VI of the PECS training protocol. In a more recent study, Greenberg et al. (2012b) gathered maintenance data one month post intervention for two participants, 12 months post intervention for one participant, and 18 months post intervention for one participant. All participants (aged four- to eight-years) demonstrated the maintenance of PECS use at follow-up.

Other studies have demonstrated the maintenance of vocal language skills following PECS training. In one of the first studies to gather follow up data, Charlop-Christy et al. (2002) demonstrated maintenance of spontaneous vocal language and imitation, increased mean length of utterance, increased requests and initiations, and increased time engaged in eye contact, joint attention and play, 10 months post intervention for a 12- year old boy with ASD who had completed all six phases of the PECS training protocol. At one month post intervention, Rosales and Rehfeldt (2007) also found adult participants vocally requesting during maintenance probes. A randomised control trial by Gordon et al. (2011) further demonstrated a maintenance effect of PECS training on nonverbal children with ASD's (aged 4 – 10 years) spontaneous vocal language for requesting objects, nine months post intervention. This long-term effect was, however, not maintained on their spontaneous use of picture cards for requesting.

Other research studies have, however, demonstrated mixed findings in relation to the maintenance of skills acquired through PECS training. Travis and Geiger (2010) demonstrated the maintenance of positive effects on requesting using PECS at follow up for one nine-year old participant with ASD three months post intervention, while a decrease in

effect was observed for the other nine-year old participant. It was suggested that this was most likely due to the difficulties the parent had in maintaining PECS use at home during the three month period. A randomised control trial by Howlin et al. (2007) also demonstrated that for one treatment group positive effects on outcome measures were not maintained once consultations ceased. It is unclear whether this was due to less reliable or frequent PECS implementation as procedural integrity measures were not taken.

The research on the long term maintenance of PECS skills remains inconclusive and further research is required that extends beyond 12 months post intervention follow up. Clinically, the long term maintenance of skills is essential in establishing the social validity of the PECS intervention, as interventions that are perceived as having high social validity are more likely to be implemented by parents and carers long term (Flippin, et al., 2010; Maglione, et al., 2012; Preston & Carter, 2009). Current research is, however, also limited in examining how effective parents, carers and teachers perceive PECS to be, as few research studies have documented the social validity of the PECS intervention implemented (Ben Chaabane, et al., 2009; Boesch, et al., 2013; Cannella-Malone, et al., 2010; Carre, et al., 2009; Cihak, et al., 2012; Greenberg, et al., 2012b; Jurgens, et al., 2009; Magiati & Howlin, 2003; Park, et al., 2011; Schreibman & Stahmer, 2013; Tincani, 2004; Travis & Geiger, 2010; Yoder & Stone, 2006a). PECS has the potential to have high social validity because it is portable, inexpensive, and can be easily understood by untrained persons, but further research on the social validity of PECS is required (S. L. Hart & Banda, 2010). The social validity of PECS is further intrinsically linked to the procedural integrity with which PECS is implemented, as interventions that are perceived with high social validity tend to be implemented with greater procedural integrity (Gresham, 1997).

2.4.3.6. Procedural Integrity of PECS intervention

The PECS protocol is a complex training system that utilises a number of behaviour modification procedures, such as most-to-least prompting, least-to-most prompting, shaping, backward chaining, and error correction strategies (Tincani & Devis, 2011). Adherence to the training protocol is essential to establish positive behavioural gains and avoid prompt dependence (Bondy, 2012; Bondy & Frost, 2001; Frost & Bondy, 2002). The authors of PECS have identified various aspects of trainers' behaviour on which students may become dependent when learning to use PECS including facial expressions, eye contact, vocalisations made prior to the exchange, and gestural prompts such as pointing to or tapping on a picture (Frost & Bondy, 2002).

The complexity of the technical teaching strategies within the PECS protocol opens the door for intended and unintended procedural variations. It is critical for researchers and implementers to demonstrate fidelity with the training protocol to validate the PECS training protocol as well as to be able to attribute the results of a research study to the implementation of the published PECS program. The extent to which fidelity measures are reported within published studies varies, however, and due to researchers either using differing procedures to calculate procedural integrity, or not reporting quantitative integrity data, the interpretation of procedural integrity data remains inconclusive (Flippin, et al., 2010; Preston & Carter, 2009; Tincani & Devis, 2011). Further research, documenting data on the procedural integrity of the PECS training implemented, is needed to be able to directly attribute the reported effectiveness of PECS in improving functional communication skills and concomitant behaviour changes, to the current published PECS training protocol, with a diverse population of participants and under a variety of conditions.

2.4.3.6.1. Procedural integrity of teacher-implemented PECS intervention

PECS has been designed with the flexibility to be implemented by teachers, carers and parents of children with ASD. To investigate the effectiveness of teacher-implemented PECS, Magiati and Howlin (2003) demonstrated rapid significant increases in the level of PECS attained, PECS vocabulary, and frequency of PECS use over time, by thirty-four children with ASD from eight specialist schools, following teaching staff attendance at a two-day PECS implementers skills workshop and six half-day PECS consultant visits. Measures of the procedural integrity of teacher's use of PECS were, however, not completed.

To further explore the effectiveness of teacher implemented PECS training, Howlin et al. (2007) conducted a study, including eighty-four pre-school aged children with ASD, at 17 different specialist schools in England. The teachers and children were assigned to one of three intervention groups: immediate treatment group, a delayed treatment group, and a no treatment group. The immediate treatment group received PECS training immediately after baseline assessment; the delayed treatment group received PECS training nine months later; and the no treatment group did not receive any training. Six teachers and six parents from each group attended a two-day PECS implementer skills workshop prior to the commencement of data collection. One week following the PECS implementer skills workshop, a PECS specialist went to the immediate treatment group's classroom and monitored the use and effectiveness of teacher implementation of PECS, providing information and strategies to the teachers to further benefit the children with ASD, over a period of five months. The delayed treatment group was monitored in the same way as the immediate treatment group by PECS specialists, but not immediately following completion of the two-day workshop. The PECS specialists did not monitor or visit the no treatment group of participants. The results demonstrated that at the conclusion of the study, the children in

the classroom who received treatment, whether immediate or delayed, demonstrated both an increase in initiations as well as an overall increase in PECS use compared to the no treatment group. These results highlight the effectiveness of PECS teacher training and consultancy in the implementation of PECS by teachers.

Another study by Barnes, Dunning and Rehfeldt (2011) evaluated staff training procedures for teaching three support care staff to implement phases I to III of PECS with 3 adults with ASD, using a multiple probe design. Results indicated that although training with verbal instructions and an instructional video were effective in enhancing performance above pre-test levels, performance of the staff remained below criterion levels. These results highlight the limited utility of workshops and instructional videos alone in teaching paraprofessional staff to implement the complex teaching procedures in the PECS training protocol and the authors recommend that modelling and corrective feedback, through consultancy and support, may be necessary for staff to master the complex teaching skills (Barnes, et al., 2011).

2.4.3.6.2. Procedural Integrity of parent-implemented PECS intervention

Teaching parents to support communication and language development is an essential component of effective communication interventions, due to the significance of the linguistic environment parents provide to their children in children's communication and language development (Ingersoll & Dvortcsak, 2006; Kaiser & Roberts, 2011). In a seminal study investigating the impact of parent-child interactional strategies and parent linguistic behaviour on the language of children from various socioeconomic backgrounds, Hart and Risley (1995) identified specific aspects of parent behaviour associated with language development in typically developing children and in children with language impairments,

including the amount of parent-child interaction, parent responsiveness to child communication, the amount and quality of parent linguistic input, and parent use of language learning support strategies. Hart and Risley further demonstrated that differences in the amount of children's language experience were strongly linked to differences in child outcomes. Given the significance of these aspects of parent behaviour on children's language development, particularly the amount of talk between children and their parents, Hart and Risley recommend that intervention programs focus on helping parents learn to talk to their children more.

Teaching parents to implement and use PECS with their child in the home and community environment is an important component of the program to reinforce generalised use and promote social validity, through functional use of the skill (Frost & Bondy, 2002). The PECS training protocol refers to the unstructured training environment and stop, drop, and talk approach (that is, whenever a communicative opportunity arises the communicative partner must stop what they are doing, drop to the student's eye level, and do a PECS trial) to encourage the use of PECS in daily life at every opportunity (Frost & Bondy, 2002). This approach, therefore, necessitates the involvement of parents to implement the intervention in a child's daily routines outside of formal structured PECS training sessions. The PECS, although highly manualised, is a complex program utilising a variety of technical teaching procedures and parents who have difficulties with the program's implementation may not experience the best outcomes for their child and may be likely to discontinue training (Tincani & Devis, 2011).

Few research studies have examined the effectiveness of parent-implemented PECS training (Ben Chaabane, et al., 2009; Carson, et al., 2012; Park, et al., 2011). Carson et al. (2012), for example, utilised a parent training model in an investigation of the effects of PECS acquisition on the vocal language skills of children with ASD. The mothers of three

children with ASD (aged two- to three-years) received weekly clinic PECS training sessions, during which they were provided with modelling of PECS implementation skills and verbal feedback as they implemented trials with their child. They were then asked to continue PECS with their child at home and additional weekly home consultation sessions were provided to support, observe and provide feedback on the mothers' implementation skills. While the results demonstrated acquisition of PECS for all three participants and concomitant gains in vocal language for two of the participants, procedural integrity of the parent implementation of PECS was not reported. In addition the use of PECS within the home environment, that is, the amount of time spent weekly using PECS, relied on parental report.

Another study by Ben Chaabane et al. (2009) examined the extent to which two mothers were able to train their children with ASD to exchange novel pictures to request items using PECS. Their results demonstrated that both children improvised by using alternative symbols when the corresponding symbol was unavailable across all symbol categories (colors, shapes and functions), and also showed that parents can teach their children to use novel pictorial response forms with high procedural integrity.

In an attempt to extend the literature on using parents as the primary trainer, Park et al. (2011) investigated the effects of mother-implemented PECS training on the communicative behaviours of three young children with ASD. Three mothers were trained to implement PECS training with their child in sessions prior to baseline data collection and during phases I through IIIb of the PECS training protocol. The mothers were trained in the application of PECS using written guidelines, verbal explanations, video clips, in vivo modelling, practice, and immediate feedback (Park, et al., 2011). Results demonstrated that all the child participants successfully acquired independent picture exchanges that were generalised to different communication partners and maintained for at least one month. In addition, the results demonstrated that the mothers conducted the training with high procedural integrity

(Park, et al., 2011). A stated limitation of this study, however, is that the mother participants may not be representative of all mothers of young children with ASD, in that they all volunteered for the study and had relatively high education attainments (Park, et al., 2011). To be able to generalise these outcomes to a larger population, further research needs to focus on parents and children with more diverse characteristics. In addition, many parents of children with ASD do not receive the opportunity or funding to engage in such extensive PECS training and guidance, and utilize the system with their children, to the best of their ability, through self-educative means and minimal support from trained professionals. This raises the question of the procedural integrity with which PECS is conducted under such conditions.

2.5. Conclusion

The present literature review aimed to examine the social validity and procedural integrity of parent-implemented behaviour interventions, in particular the PECS, to improve the impairments (principally functional communication) of individuals with ASD. This has been accomplished through a thorough examination of literature pertaining to the impairments, diagnosis, prevalence, and aetiology of ASD; the development of communication and language in typically developing children, including prominent theories of communication and language development; as differentiated from the development of communication and language in individuals with ASD; current behavioural approaches, including qualities of effective behavioural interventions, for the treatment of the skill deficits of ASD; and the theoretical underpinnings of PECS as well as a review of the literature relating to the effectiveness of the system and associated concomitant behaviour improvements.

Considerable evidence is now available concerning the efficacy of the Picture Exchange Communication System (PECS) in teaching effective non-vocal communication in a relatively short period of time (Beck, et al., 2008; Bock, et al., 2005; Bondy & Frost, 1994; D. Carr & Felce, 2007b; Carre, et al., 2009; Cummings, et al., 2012; Ganz, Heath, et al., 2010; Gordon, et al., 2011; Liddle, 2001; Pasco & Tohill, 2011; Schwartz, et al., 1998). There is also growing evidence of concomitant improvements in vocal language and social-communicative behaviours, and decreases in disruptive, problem behaviours associated with PECS training (Anderson, et al., 2007; Cannella-Malone, et al., 2010; D. Carr & Felce, 2007a; Charlop-Christy, et al., 2002; Frea, et al., 2001; Ganz & Simpson, 2004; Jurgens, et al., 2009; Kravits, et al., 2002; Magiati & Howlin, 2003; Tincani, et al., 2006; Travis & Geiger, 2010; Yoder & Stone, 2006a).

Recent reviews and meta-analyses of the PECS research have, however, raised a number of concerns regarding the experimental designs, reliability measures, procedural integrity, and behavioural change outcomes of this research (Flippin, et al., 2010; Ganz, Davis, et al., 2012; S. L. Hart & Banda, 2010; Preston & Carter, 2009; Sulzer-Azaroff, et al., 2009; Tincani & Devis, 2011). A number of directions for future PECS research have been identified, particularly the need for further research into the long term maintenance of skills acquired through PECS, as well as the social validity and procedural integrity of the intervention as used in practice.

While the evidence is growing for the effectiveness of PECS in improving children's communication skills in the short term, insufficient evidence is available to determine whether PECS results in the long term maintenance of communication and vocal language gains. Further research is required that extends beyond 12 months post intervention follow up (Flippin, et al., 2010; S. L. Hart & Banda, 2010; Preston & Carter, 2009). Clinically this lack of research is of concern as the generalisation of PECS over time relates to the social

validity of the intervention. Interventions that are perceived to have high social validity are more likely to be implemented by parents and carers in the longer term.

Current research is also limited in examining how effective parents perceive PECS to be, as few research studies have documented measures of the social validity of the PECS intervention implemented (Ben Chaabane, et al., 2009; Boesch, et al., 2013; Cannella-Malone, et al., 2010; Carre, et al., 2009; Cihak, et al., 2012; Greenberg, et al., 2012b; Jurgens, et al., 2009; Magiati & Howlin, 2003; Park, et al., 2011; Schreibman & Stahmer, 2013; Tincani, 2004; Travis & Geiger, 2010; Yoder & Stone, 2006a). PECS has the potential to have high social validity as it is portable, inexpensive, and can be easily understood by untrained persons, but further research on the social validity of PECS is required (S. L. Hart & Banda, 2010).

The social validity of PECS further impacts upon the procedural integrity with which PECS is implemented by parents. Interventions that are perceived to have high social validity tend to also be implemented with greater procedural integrity (Gresham, 1997). PECS is, however, a complex implementation system involving an array of technical teaching techniques, which opens the door to intended and unintended procedural variations. It is critical for implementers and research to demonstrate fidelity with the training protocol to validate the PECS training protocol as well as to be able to attribute the results of a research study to the implementation of the published PECS program. The extent to which fidelity measures are reported within published studies varies, and due to researchers either using differing procedures to calculate procedural integrity, or not reporting quantitative integrity data, the interpretation of procedural integrity data remains inconclusive (Flippin, et al., 2010; Preston & Carter, 2009; Tincani & Devis, 2011). Further research, documenting data on the procedural integrity of the PECS training implemented, is needed to be able to directly attribute the reported effectiveness of PECS in improving functional communication skills

and concomitant behaviour changes, to the current published PECS training protocol, with a diverse population of participants and under a variety of conditions.

In particular, the need to document the procedural integrity of parent-implemented PECS is critical, due to the system necessarily requiring the involvement of parents through the need for PECS to be used throughout the day in various contexts to promote generalised use and fluency in the system (Frost & Bondy, 2008). Although research has demonstrated that parents can be taught to implement PECS with their children with high procedural integrity through intensive training and support (Ben Chaabane, et al., 2009; Park, et al., 2011), many parents of children with ASD do not receive the opportunity or funding to engage in such extensive PECS training and guidance, and utilize the system with their children, to the best of their ability, through self-educative means and minimal support from trained professionals. Further research reporting the procedural integrity with which PECS is conducted by parents in this context is warranted (Preston & Carter, 2009). The procedural integrity of this parent implemented PECS impacts not only on the social validity of the PECS, but also on a child's outcome in developing functional communication skills.

CHAPTER THREE

PUBLISHED PAPER

PECS on YOUTUBE

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Monash University

Declaration for Thesis Chapter Three

Declaration by candidate

In the case of Chapter Three, the nature and extent of my contribution to the work was the following:

Nature of contribution	**Extent of contribution (%)**
I have conceptualized and developed this work under the guidance of Prof Dennis Moore and Dr Angelika Anderson. I independently implemented stated methodologies and data analysis and prepared the draft manuscript. The final manuscript was completed under the guidance and collaboration of Prof Dennis Moore and Dr Angelika Anderson.	80%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	**Nature of contribution**	**Extent of contribution (%) for student co-authors only**
Angelika Anderson	Guidance for the development of research aims, and completion of methodologies and data analysis. Guidance and collaboration for the review of manuscript throughout the duration of the project.	10%
Dennis Moore	Guidance for the development of research aims, and completion of methodologies and data analysis. Guidance and collaboration for the review of manuscript prior to submission for peer review.	10%

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 23.11.2015
Main Supervisor's Signature	[redacted]	**Date** 23.11.2015

*Note: Where the responsible author is not the candidate's main supervisor, the main supervisor should consult with the responsible author to agree on the respective contributions of the authors.

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Parent-implemented Picture Exchange Communication System (PECS) training: An analysis of YouTube videos

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Abstract
Purpose: To investigate the integrity with which parents and carers implement PECS in naturalistic settings, utilizing a sample of videos obtained from YouTube.
Methods: Twenty-one YouTube videos meeting selection criteria were identified. The videos were reviewed for instances of seven implementer errors and, where appropriate, presence of a physical prompter.
Results: Forty-three per cent of videos and 61% of PECS exchanges contained errors in parent implementation of specific teaching strategies of the PECS training protocol. Vocal prompts, incorrect error correction and the absence of timely reinforcement occurred most frequently, while gestural prompts, insistence on speech, incorrect use of the open hand prompt and not waiting for the learner to initiate occurred less frequently.
Conclusions: Results suggest that parents engage in vocal prompting and incorrect use of the 4-step error correction strategy when using PECS with their children, errors likely to result in prompt dependence.

Keywords: *Picture Exchange Communication System/PECS*, *procedural integrity/treatment fidelity*, *parent training*

Introduction

A substantial body of research including recent meta-analyses attests to the efficacy of training in the Picture Exchange Communication System (PECS) in teaching effective non-vocal communication in a relatively short period of time [1–5]. There is also growing evidence of concomitant improvements in speech and social-communicative behaviours and decreases in disruptive, problem behaviours associated with PECS training [6–12]. PECS has been shown to be very efficient for children and adults with diverse diagnostic conditions and some researchers have assessed the procedural integrity of the PECS training, providing evidence of training accuracy in experimental trials [13–22]. However, a need for further research assessing the generalization and maintenance of skills acquired through PECS training and reporting on procedural integrity in that context has also been identified [4,5].

A particular strength of the PECS programme is its focus on the functional use of communication and learner initiations of communication acts. This is achieved through a number of specific teaching strategies that capitalize on motivating operations to encourage learner spontaneity and initiations and avoid prompt dependency from the outset [23]. Prompt dependency occurs when a learner's correct responding is dependent on a controlling prompt, and difficulty is experienced in fading out the prompts [24,25]. Communication skills that are prompt-dependent are not functional, as the individual cannot use the skills spontaneously and independently to indicate needs as they arise. This special feature of the PECS programme can be compromised if procedures are not followed correctly [26,27]. Embedded in each phase of the PECS training protocol, is the 'Stop/Drop/and Talk' approach, which aims to capitalize on communicative opportunities when they arise throughout the day in various environments [26]. This clearly necessitates the involvement of parents and carers and raises the issue of the procedural integrity of PECS implemented by parents or carers within children's homes, outside of formal PECS intervention sessions.

Studies which have examined the effects of parent-implemented PECS training on children's communication skills have shown that parents can implement PECS with fidelity and achieve good outcomes

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for their children [15,28]. However, not all parents have the benefit of extensive training or good support and guidance, rather they utilize the system with their children to the best of their ability through self-educative means with no, or minimal, support from trained professionals. This raises the question of the procedural integrity with which PECS is conducted under such conditions. The purpose of this study was to investigate the procedural integrity with which parents and carers implement PECS with their children in naturalistic settings, utilizing an unsolicited sample of videos obtained from YouTube depicting parents conducting PECS training with their children.

Method

Search strategy

A complete review of PECS videos uploaded on YouTube was undertaken over a period of ~2 months from 6 June 2011 to 15 August 2011. Utilizing the search term *Picture Exchange Communication System* yielded 42 000 results, which included not only videos relating to the Picture Exchange Communication System, but also videos depicting the Hungarian city of Pecs and videos demonstrating enhancement of pectoral muscles. Therefore, the search term *Picture Exchange Communication System Autism* was utilized and returned 186 results. Of the 186 results obtained 165 videos were excluded, including:

(a) videos in a language other than English,
(b) videos explaining how to conduct PECS,
(c) videos detailing personal experiences using PECS,
(d) videos demonstrating classrooms and programmes set up to maximize PECS use,
(e) videos describing/demonstrating the use of token economies, schedule boards, choice boards and visual timers,
(f) videos demonstrating digital and computer-based systems similar to or based on the PECS protocol (e.g. iPrompts),
(g) videos or advertisements about available PECS CDs, websites and books,
(h) videos describing personal autism stories,
(i) videos raising autism awareness,
(j) videos describing general information about autism interventions and services,
(k) videos describing Alternative and Augmentative Communication systems other than PECS,
(l) videos stating to be demonstrating PECS use, but depicting other strategies and interventions, and
(m) videos of PECS being conducted by trainers in a school or therapy session.

Sample

The remaining 21 videos were retained in the sample. Each of these videos demonstrated the use of PECS with learners, in their homes, by parents/carers. The 21 videos are representative of 12 different families. A detailed description of the 21 videos in the sample is provided in Table I, including the length of each video, the author, date the video was uploaded, the video description provided on YouTube and the number of views/hits each video had received at the time that it was downloaded by the researcher.

Operational definitions of implementer errors

(1) *Vocal prompt*: Defined as an audible stimulus that raises the probability of the learner exchanging a picture card, e.g. 'give me the picture', 'show me . . .'. In phases I– IV a vocal prompt of 'Do you want more . . .' or 'what do you want?' or 'what's this?' is also recorded as an error;
(2) *Gestural prompt*: Defined as a physical movement that raises the probability of the learner exchanging a picture card, including pointing to or touching a picture to indicate a correct response. A gestural prompt is recorded as an error in phases I–IV;
(3) *Open hand prompt errors*: In phase I the communicative partner opens her hand to receive the picture before the learner has reached for the item or the picture;
(4) *Learner initiation errors*: In phases I and II the prompter does not wait for the learner's initiation before prompting: The prompter does not wait for the learner to reach for the item that the communicative partner is enticing them with before physically assisting the learner to pick up the picture, reach to the communicative partner and release the picture into the communicative partner's open hand;
(5) *Timely reinforcement errors*: The communicative partner does not reinforce the learner's communicative behaviour within 0.5 seconds of the learner handing the picture/sentence strip to the communicative partner;
(6) *Insistence on speech*: The communicative partner and/or prompter insist on the learner producing speech with a PECS exchange, for example 'Say . . .';
(7) *Incorrect error correction*: In phase III the communicative partner does not conduct the 4-step

Table I. Description of PECS videos comprising the sample.

Video title	Length	Author	Date uploaded	Description provided on YouTube	No. of views
PECS want strip day 2	0:14	Mabot4kidz	27 Jul 2010	2nd day, after intro. Notice A, self corrects placement of pic on the strip, and hands it directly to her mom. After notice her intent to recognize my praise by glancing back at me.	94
Sam jumping on the bed (PECS)	0:15	corywoodrow	4 Jun 2008	Sam practicing PECS by asking Kathy to run and jump on the bed with him	839
Sam on the swing (PECS)	0:16	corywoodrow	4 Jun 2008	Sam does PECS lessons by asking to be swung on the swing	2,901
Oliver PECS July 2011	0:17	TheChriskimpton	20 Jul 2011	Distance and persistence	12
PECS-Picture Exchange Communication System	0:21	Nicolajanes	20 Jul 2007	J was recently diagnosed with Autism. We started using PECS, the Picture Exchange Communication System, to try to get J to tell us what he wants. We started a few weeks ago with pictures of things that he likes and he has just begun doing it well. I am SO proud.	54,920
PECS want sentence strip use	0:21	Mabot4kidz	27 Jul 2010	Using the PECS sentence strip to request. 6 and 1/2 months after starting PECS! Notice in this one, she initially goes to hand the pic to her mom, mom gives physical redirect and A independently hands strip to mom! Verbalizing the entire time!	1,195
Want PECs exchange	0:22	Mabot4kidz	27 Jul 2010	This is A (2.4 year old) using a sentence strip after being introduced 1 day ago. Notice her intent to hand her mother the picture, physical prompt by mom to place pic on strip and finally the hand off to her mom. It is difficult to hear but she is verbalizing through the entire process. 6.5 months after starting PECS!	331
Oliver PECS Phase II- Day 2	0:35	TheChriskimpton	19 May 2010	This time we are in the pool, see how motivating this is for Oliver—he tries to just do a back flip and get in.	697
Zain doing PECS (Phase 4)	0:36	ali786haq	23 Jun 2010	Zain has learnt PECS very quickly. We have now introduced the I want strip and he's picked that up quite quickly.	4,054
Roman doing PECS	0:42	TTRmom	20 Nov 2010	A quick video of Roman working with his PECS book. PECS stands for Picture Exchange Communication System and is used for communicating with non-verbal individuals.	154
A after 2 mon. of PECS	0:44	Mabot4kidz	12 Feb	A after 2 months of PECS (Picture Exchange Communication System) training in home. A is a 21 month old little girl diagnosed with Autism. At Thanksgiving she was unable to communicate her wants and needs. She was introduced to PECS by my team. She was unable to look at the pictures, pull them from the book and hand them to anyone. Now she can discriminate between pictures and make requests without tantrums! The team and family have been hard at work!	1,705
Pecs 2	1:05	dorionschenk	21 Aug 2009	PECS 2.	5,549
PECS communication	1:07	Lori10677	6 Apr 2009	Austin uses his PECS communication binder to request items he has Autism and is NON-VERBAL but will repeat words. Austin is 14 years old and is the oldest of my three sons with Autism.	21,442
Zain doing PECS (phase 4) part 2	1:25	ali786haq	23 Jun 2010	Zain has learnt PECS very quickly. We have now introduced the I want strip and he's picked that up quite quickly.	2,875
PECS Phase 1	1:39	jamzsab	23 Feb 2011	Phase 1-Physical Exchange	259
My lil' PECS sweetie pie;) talk to me!	1:39	ayrianerissen	11 Apr 2008	I'm SO excited! So is Ayrissen;) This is her 3rd time ever being exposed to this idea & she is already grasping the concept, even initiating it on her own! What a smart girl! She wants to tell us things & I think we've begun the best way to help her do so. PECS, or Picture Exchange Communication	7,748

(*continued*)

Table I. Continued.

Video title	Length	Author	Date uploaded	Description provided on YouTube	No. of views
				System, is exactly what the name suggests. The exchange of a picture to communicate. This system was developed to help people with autism and developmental disabilities who are non-verbal or have limited verbal communication. PECS may also be used in conjunction with a voice output communication device. There are six phases when teaching a child to use the picture exchange system. (In my personal experience, not all children will be able to comprehend the full programme. My son uses picture exchange but has never been able to follow this 'programme' or go through the steps listed. He just points to what he wants.) Phase I–The first phase is to spontaneously request items or activities. Identify what the child wants. Find the things that they will 'ask' for. i.e. a favourite toy. This phase usually requires two teachers (a parent, teacher, therapist, brother, or sister). The first teacher shows the child something that they really like. The second teacher stays behind the child and waits for her to reach for the item. Then helps the child to pick up the picture of that item and hand it to the first teacher. When the first teacher has the picture, they immediately give the child the item requested. Verbal confirmation is given by the first adult (e.g. 'Oh, you want a cookie'). The second teacher should slowly back off, working towards the child independently reaching for the picture and handing it to the first teacher. The teacher should not ask what the child wants or tell them which picture to choose. The goal in this phase is for the child to spontaneously initiate communication.	
Oliver PECS Phase 1 day 24	1:47	TheChriskimpton	6 May 2010	Oliver is now clearly exchanging PECS for swimming, food, bike riding, etc. That's my boy—time for Phase II.	655
Oliver PECS Phase II- day 1	2:12	TheChriskimpton	19 May 2010	We started the day with many activities before breakfast and got him hungry. Phase II began with toast which worked well except that there were distractions and confusion with returning to a set location or sitting between exchanges. Later we came up with this, it is not the usual method but overcame many of the boundary and locational issues.	1,614
PECS Phase 3 a	3:04	Plahski	25 Jul 2011	I'm uploading this video as a parent who was looking for similar videos back when we started with PECS. There aren't many out there so I hope this one helps anyone who is thinking of starting PECS. Sorry for the daggy PJ's I'm wearing—we do most of our PECS sessions/big lessons in the morning! 'C' is my daughter. She was diagnosed as being on the Autism Spectrum earlier this year. She is almost 4 years old and has no words but many sounds (as you will hear). She's had a rough time with seizures in the past, but she's really going ahead now and is picking up PECS quite well. In this video 'C' is learning to use Picture Exchange Communication, Phase 3 a. In Phase 3 a 'C' is learning to discriminate between a picture of a Highly preferred item (mirror) and a non-preferred item (sock). When 'C' exchanges the picture of the sock we do a 4-step error correction procedure; MODEL, PRACTICE, SWITCH, REPEAT. When she hands over the picture of the sock we MODEL the correct picture by pointing to	178

(*continued*)

Table I. Continued.

Video title	Length	Author	Date uploaded	Description provided on YouTube	No. of views
				it. We then PRACTICE choosing the correct picture by covering the incorrect picture with an open hand. At this point we don't exchange the mirror because we want her to choose it independently. We SWITCH her focus (where's your nose/bellybutton—sometimes we sing a quick song). The switch of attention is done so we know she isn't just quickly repeating what was right last time. Finally we REPEAT the exchange. If, on the repeat, she hands the mirror picture over we praise her and she is then able to play with the mirror. If she hands over the sock picture we go through the 4 step error correction again. If she makes the same mistake 2–3-times on the repeat we take away the sock option during the SWITCH so that she is able to succeed a couple of times before reintroducing it. In this video I've put in a few correct exchanges with two 4-step error corrections. In this whole session we had about 20 exchanges with four different items (two preferred and two non-preferred). Since we are teaching her to discriminate between the pictures, I praise her when she picks the correct card with a simple 'that's right'. Then I name the object upon exchanging it. NOTE: I'm NOT a PRO at this—I'm a parent who's learning as I go! So any suggestions are great.	
Oliver PECS Phase 3-day 2	3:16	TheChriskimpton	20 May 2010	Toast, brush, brush, brush, brush, brush, Toast, brush, brush, brush, Toast. What going on ???? We was enjoying the exchange while chewing, once his mouth was clear he wanted to get some more toast he asked for it. He's a boy with a LOT to say.	7,826
Parenting My Exceptional Child—Episode 11—PECS in Action	6:36	Moandozzy	25 Feb 2011	Horrible lighting and no make-up, but my son will actually use his PECS cards for you to watch. I also give a little update on how well he's doing with them.	56

error correction procedure, as specified in the PECS training protocol [26]. If the learner exchanges the distracter icon or reaches for the incorrect item, the trainer does not conduct the 4-step error correction procedure, namely:

- *Model or Show*: The communicative partner does not point to or tap the target/correct picture;
- *Prompt*: The communicative partner does not hold open their hand near the target picture or physically prompt the learner;
- *Switch*: The communicative partner does not ask the learner to complete another task, such as 'do this . . .', or turn the PECS book over;
- *Repeat*: The communicative partner does not repeat the trial by enticing with both items.

Analysis procedure

In this study the independent variables were the PECS training protocol for each phase, as described by Frost and Bondy [26]. Each video recording in the sample was viewed and analysed and the following outcome variables were identified and recorded:

- *PECS phase*: Videos were checked for the phase of PECS training stated to being implemented in the video and, for those videos without a stated phase, a PECS phase was assigned according to the PECS training criteria [26] identified in Table II;
- *Presence of prompter*: Each Phase 1 and 2 video was viewed to confirm the presence of a physical prompter. The physical prompter is one of two trainers in PECS training whose role is to provide physical prompts to the learner and to physically assist the learner to complete the PECS exchange. The physical prompter remains behind the learner during training and does not interact with the learner;
- *Number of exchanges*: A tally of the total number of PECS exchanges that occurs in each video was recorded. A PECS exchange is defined as the physical act of a learner handing a picture card or

Table II. PECS training protocol [26].

Phases	Phase name	Description
Phase I	Physical exchange: How to communicate	The student is taught to initiate communication by initially reaching towards a preferred object held by the communicative partner and then being prompted to instead give a picture card of the object to the communicative partner to receive the object. The student and two trainers, a physical prompter and communicative partner, are required to perform this phase. The physical prompter sits behind the student to provide physical assistance and the communicative partner sits in front of the student to provide the child's requested items.
Phase II	Distance and persistence	The student learns to exchange single pictures for items or activities they really want across increased distances between themselves, their communication book and the communicative partner. They are also taught to be more persistent communicators.
Phase III	Picture discrimination	The student learns to select from two or more pictures to ask for their favourite things. These are placed in a communication book—a ring binder with Velcro® strips where pictures are stored and easily removed for communication. Once the student masters discriminating between pictures of a preferred and non-preferred item, they are taught to discriminate between pictures of two-to-five preferred items and to complete the exchange to receive the item. During this phase, the student also learns to page through the communication book to locate pictures.
Phase IV	Sentence structure	The student learns to construct simple sentences on a detachable sentence strip using an 'I want' picture followed by a picture of the item being requested. The student learns to exchange this entire sentence strip for the desired item. When the communication partner receives the sentence strip from the student, they read the strip back to the student (e.g. 'I want banana'), while pointing at the relevant picture cards.
Phase V	Answering questions	The student learns to use PECS to answer the question, 'What do you want?' The communicative partner asks the question 'what do you want?' The student is taught to respond to this question by constructing and exchanging the PECS sentence strip taught in previous phases.
Phase VI	Commenting	The student is taught to comment in response to questions such as, 'What do you see?', 'What do you hear?' and 'What is it?' They learn to make up sentences starting with 'I see', 'I hear', 'I feel', 'It is a', etc.

sentence strip to the communicative partner, with or without physical prompting.

In addition, each video was analysed for the occurrence of the seven dependent variables (implementer errors) detailed above. The occurrence of these variables was measured utilizing an event recording system. Engagement in or incorrect use of these variables was identified as an error through a thorough examination of the PECS training protocol and the PECS Implementer Skills Assessment worksheet [26].

Inter-observer agreement

Measurement of the dependent variables was undertaken through direct observations of the video recordings. The reliability of the observations was evaluated by having a second observer independently record the occurrence of the dependent variables during at least 30% of the video recordings, utilizing the same criteria as the main observer (the first author). The second observer was a PhD student experienced in the application/use of PECS and who has completed the basic PECS implementer skills training course through Pyramid Education Consultants in Melbourne, Australia.

Inter-observer agreement was obtained for seven of the 21 videos (33.3%). These seven videos were randomly selected. Agreement was calculated using a point-to-point agreement ratio (number of agreements divided by number of agreements plus disagreements, multiplied by 100) to produce a percentage of agreement [29]. The mean inter-observer agreement for all dependent variables was 94.9%, exceeding the 80% criteria for inter-observer agreement recommended by Kazdin [29].

Results

The combined time of all 21 videos was 28 minutes 33 seconds ($M = 1$ minute 22 seconds, range = 14 seconds–6 minutes 36 seconds). The combined total of the number of views each of the 21 videos had received was 104 403 hits ($M = 4971.57$, range = 12–54 920). Nine videos (42.9%) contained at least one identified error, while 12 (57.1%) of the videos did not contain any errors. Sixty-seven per

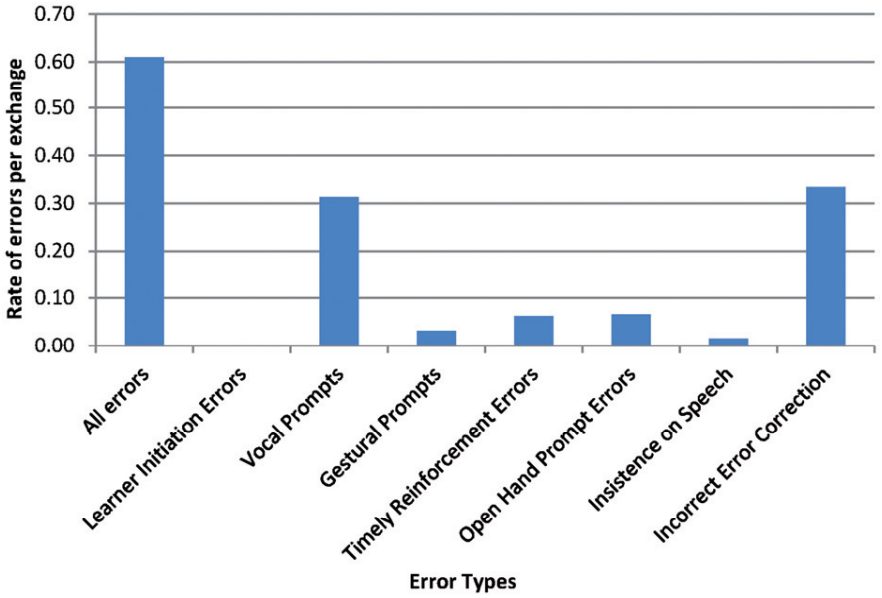

Figure 1 Rate of errors per exchange.

cent of the 12 families portrayed engaged in at least one of the identified errors.

PECS phases represented

Eight of the videos (38%) in the sample demonstrated implementation of phase IV of the PECS training protocol. Five showed the implementation of phase I (24%) and four videos (19%) each depicted the implementation of phases II and III. No videos in the sample demonstrated implementation of phases V and VI of the PECS training protocol.

Presence of prompter

Of the phase I and II videos ($n=9$) in the sample, 67% ($n=6$) did not have a prompter present in the PECS training recorded in the video. Of these phase I and II videos that did not have a prompter present, 50% ($n=3$) contained at least one of the identified errors, including three vocal prompt errors, one open hand prompt error and one timely reinforcement error. None of the three phase I and II videos that demonstrated the presence of a prompter contained any of the identified errors.

Exchanges and observed errors

A total of 64 exchanges were recorded ($M=3.05$, range = 1–16) and 39 errors were observed ($M=1.86$, range = 0–11) across the sample videos. Figure 1 presents the rate of errors per exchange.

From Figure 1 it can be seen that errors occurred at a rate of 0.61 per exchange. Error correction strategy errors occurred at a rate of 0.33 per exchange in all phase III exchanges and constituted 44% ($n=11$, range = 0–10) of the errors in the videos depicting the implementation of phase III of the PECS training protocol. Vocal prompts occurred at a rate of 0.31 in all the exchanges and comprised 51% ($n=20$, range = 0–11) of all observed errors. In contrast, open hand prompts occurred at a rate of 0.07 in all phase I exchanges, while timely reinforcement errors occurred at a rate of 0.06 in all the exchanges and constituted 10% ($n=4$, range = 0–1) of all the errors. Gestural prompts represented 5% ($n=2$, range 0–1) of all errors occurring at a rate of 0.03, while the insistence on speech error occurred at a rate of 0.02, comprising 3% ($n=1$, range 0–1) of all errors observed. There were no observed errors in the communicative partner not waiting for the learner to initiate.

Discussion

The aim of this study was to investigate the procedural integrity with which parents implement the Picture Exchange Communication System (PECS) with their children in naturalistic settings, utilizing an unsolicited sample of videos obtained from YouTube depicting parents conducting PECS training with their children. The videos obtained represented phases I–IV of the PECS training protocol and depicted 12 different families utilizing PECS at home. The results of this YouTube analysis demonstrated that nine of the videos contained errors and that 61% of the observed exchanges depicted

parents incorrectly applying the specific teaching strategies incorporated in the PECS training protocol and engaging in techniques that are not advised or discouraged in the training protocol. These results are important for two reasons. First, they arguably give an indication of the number of families making errors using PECS with their children in non-research conditions and without the support of an instructor, as well as providing an indication of the type of errors parents are likely to be making under these conditions. Secondly, the rate at which these videos are being viewed suggests that these errors might be propagated as other parents use the videos as models. As one parent reports on their blog

> I have prepared the materials for PECS since last year but we have not started it because I wasn't really sure how to do it and I have heard that we have to do it right or else, it doesn't really work. So I started to read the manual and watched some YouTube videos [30].

The results of the current study demonstrated a high occurrence of parents engaging in vocal prompting and incorrectly using the 4-step error correction strategy when using PECS with their children. Vocal prompting occurred in 31% of all the exchanges recorded and incorrect implementation of the 4-step error correction strategy occurred in 33% of all the phase III exchanges. Unlike the high rate of vocal prompts and error correction strategy errors recorded, open hand prompt errors, timely reinforcement errors, gestural prompts, insistence on speech and learner initiation errors occurred at low rates and there were no errors related to the physical prompter not waiting for the learner to initiate the communicative interaction.

The importance of the accurate implementation of these specific teaching strategies in the PECS protocol is primarily that through these the learner remains motivated to engage in self-initiating communicative interactions rather than become dependent on prompts to complete communicative exchanges [25]. Vocal prompts are not used in phases I–IV of the PECS training protocol [26]. If the learner were to give the picture to the communicative partner only after the communicative partner said 'What do you want?' he would be responding to the question rather than learning to initiate communicative interactions [27]. Correct use of the error correction strategy is also essential in teaching learners to independently discriminate between pictures [26,27]. While it may be easier for the trainer to simply show the learner the correct picture and provide access to that item, this is likely to result in the learner learning that he only has to wait for the trainer to point to the correct picture and then give that picture to the trainer, a prompted response, to gain access to the item. The learner would not be learning independent picture discrimination.

Further, an interesting finding of the current study is that a large proportion of the Phase I and II videos in the sample did not have a prompter present during the PECS training, despite protocol specifications. Many of these videos contained errors, particularly parents using vocal prompts. One purpose of having a second prompter present in the first two phases of PECS training is to eliminate the use of vocal prompts by the communicative partner. The training protocol instead provides for the use of specific physical prompts which, when used correctly, are easier to fade than vocal prompts and there is less likelihood of the child developing prompt dependency [24,26,27].

These results highlight a need for parent education in the importance of having a second prompter present in using PECS in the early phases of training and a focus on the remediation of parents engaging in vocal prompts and incorrectly using the 4-step error correction strategy.

The results of the current study should be interpreted in the context of several methodological limitations. First, the videos are only representative of phases I–IV of the PECS training protocol and future research is needed in assessing the procedural integrity of parent-implemented PECS training for all phases of the PECS training protocol, as each phase incorporates specific teaching strategies that need to be implemented according to the protocol to ensure successful communication outcomes for learners. Secondly, the need to include the term *Autism* in the YouTube search, due to the large number of irrelevant returns on the term *Picture Exchange Communication System* alone, may have excluded videos depicting parents using PECS with learners with other disabilities. Research has demonstrated that PECS is not only an effective communication training programme for children and adults with an autism spectrum disorder, but also for individuals with other diagnostic conditions, including intellectual disabilities, cerebral palsy, developmental delays and attention-deficit/hyperactivity disorder [1–5]. Thirdly, conjecture was involved in determining whether the trainers depicted in the videos were therapists trained in PECS or parents and this determined whether the videos were included or excluded from the sample. The researchers considered the setting the video was recorded in, the presence of individuals recording data on PECS trials, the written description/notes provided with the video on YouTube and the audible content of the video depicting conversation between adults in the

videos, in determining whether the video depicted parent- or PECS therapist-implemented PECS training.

Despite these limitations and small sample, the current study contributes to the literature on the procedural integrity of parent-implemented PECS training with children in naturalistic settings. The findings highlight a need for parent education and support in the delivery of PECS with their children to ensure a positive learning experience for the child and parents, as well as to successfully improve the communication skills of children with communication difficulties.

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CHAPTER FOUR

INTERNET SURVEY

Considerable evidence is now available concerning the efficacy of the Picture Exchange Communication System (PECS) in teaching effective non-vocal communication in a relatively short period of time (Flippin, et al., 2010; S. L. Hart & Banda, 2010; Lancioni, et al., 2007; Preston & Carter, 2009; Sulzer-Azaroff, et al., 2009). There is also growing evidence of concomitant improvements in speech and social-communicative behaviours, and decreases in disruptive, problem behaviours associated with PECS training (Anderson, et al., 2007; Charlop-Christy, et al., 2002; Frea, et al., 2001; Ganz & Simpson, 2004; Kravits, et al., 2002; Magiati & Howlin, 2003; Schwartz, et al., 1998). While PECS has been shown to be very efficient for children and adults with diverse diagnostic conditions, a need for further research assessing the procedural integrity and social validity of the intervention, as used in practice, has been identified (Flippin, et al., 2010; S. L. Hart & Banda, 2010; Preston & Carter, 2009; Sulzer-Azaroff, et al., 2009; Tincani & Devis, 2011).

Teaching parents to support communication and language development is an essential component of effective communication interventions, due to the significance of the linguistic environment parents provide to their children in children's communication and language development (S. L. Hart & Banda, 2010; Ingersoll & Dvortcsak, 2006; Kaiser & Roberts, 2011). Teaching parents to implement and use PECS with their child in the home and community environment is an important component of the program to reinforce generalised use and promote social validity, through functional use of the skill (Frost & Bondy, 2002). The PECS training protocol refers to the unstructured training environment and the stop, drop, and talk approach (that is, whenever a communicative opportunity arises the communicative

partner must stop what they are doing, drop to the student's eye level, and do a PECS trial) to encourage the use of PECS in daily life at every opportunity (Frost & Bondy, 2002). This approach, therefore, necessitates the involvement of parents to use the intervention in a child's daily routines outside of formal structured PECS training sessions.

The PECS is, however, a complex manualised training system that utilises a number of behaviour modification procedures, such as most-to-least prompting, least-to-most prompting, shaping, backward chaining, and error correction strategies (Tincani & Devis, 2011). Adherence to the training protocol, in structured training sessions and unstructured daily use, is essential to establish positive behavioural gains and avoid prompt dependence (Bondy, 2012; Bondy & Frost, 2001; Frost & Bondy, 2002). Prompt dependency occurs when a learner's correct responding is dependent on a controlling prompt, and difficulty is experienced in fading out the prompts (Fisher, Kodak, & Moore, 2007; Sundberg, 2008). The authors of PECS have identified various aspects of trainers' behaviour on which students may become dependent when learning to use PECS including facial expressions, eye contact, vocalisations made prior to an exchange, and gestural prompts such as pointing to or tapping on a picture (Frost & Bondy, 2002). Communication skills that are prompt dependent are not functional as the individual cannot use the skills spontaneously and independently to indicate needs as they arise. Parents who have difficulties with the program's implementation may not experience the best outcomes for their child and may be likely to discontinue training (Tincani & Devis, 2011).

The assessment of procedural integrity in practice is, therefore, just as important as the assessment of procedural integrity in research. An evidence-based program will not produce benefits in practice unless it is properly implemented (McCall, 2009). Researchers expect that implementers (teachers, parents, professionals etc.) will implement an intervention as

intended and planned (Gresham, 1997). Implementers, however, may implement all, some, or none of the procedures specified in an intervention protocol, or may supplement prescribed strategies with procedures not in the intervention manual (Perepletchikova, 2011). Few research studies have examined the effectiveness of parent-implemented PECS training (Ben Chaabane, et al., 2009; Carson, et al., 2012; Park, et al., 2011). In each of these studies, parents were provided with intensive training and support in the use of PECS with their children. Not all parents of children with communication difficulties, however, receive the opportunity or funding to engage in such extensive PECS training or good support and guidance, rather utilize the system with their children, to the best of their ability, through self-educative means and minimal support from trained professionals. This raises the question of the procedural integrity with which PECS is conducted under such conditions.

Current research is also limited in examining how effective parents, carers and teachers perceive PECS to be, as few research studies have documented social validity of the PECS intervention implemented (Ben Chaabane, et al., 2009; Boesch, et al., 2013; Cannella-Malone, et al., 2010; Carre, et al., 2009; Cihak, et al., 2012; Greenberg, et al., 2012b; Jurgens, et al., 2009; Magiati & Howlin, 2003; Park, et al., 2011; Schreibman & Stahmer, 2013; Tincani, 2004; Travis & Geiger, 2010; Yoder & Stone, 2006a). Social validity refers to the appropriateness and meaningfulness of an intervention to the clinical and social worlds (King & Valdovinos, 2009). The assessment of social validity in applied behaviour analysis was initially proposed in the 1970s when Kazdin (1977) and Wolf (1978) reasoned that it is not enough for behavioural procedures to be effective; they also need to be accepted by those with whom they are intended to be used. Wolf (1978) delineated three primary foci of social validity assessment: 1) the social significance of the targeted behaviour and goals; 2) the social appropriateness of the intervention procedures; and 3) the social importance of the results or effects. Seemingly, goals, methods, and outcomes that are socially valid (in

addition to being objectively valid) are those that are most likely to be adopted by consumers and will result in more widespread continued use (J. E. Carr, et al., 1999; Rapoff, 2010; Schlosser, 1999). Further, researchers suggest that the social validity of interventions is intrinsically linked with the procedural integrity of interventions, in that interventions that are perceived to be effective and acceptable tend to be implemented with greater compliance and adherence to the protocol than interventions perceived as ineffective (Gresham, 1997; Gresham & Lopez, 1996; A. E. Kazdin, 1982). PECS has the potential to have high social validity because it is portable, inexpensive, and can be easily understood by untrained persons, but further research on the social validity of PECS is required (S. L. Hart & Banda, 2010).

The present study aims to document the procedural integrity and social validity of parent-implemented PECS training utilising an internet survey distributed to parents via national and international PECS and ASD organisations. Specifically, the present study aimed to assess the procedural integrity of parent-implemented PECS training with their children in naturalistic settings, and investigate the social validity of parent-implemented PECS training in improving children's communication skills.

Method

Survey Development

The online survey consisted of 48 questions designed to gather comprehensive information from parents on their use of and experience with the PECS intervention. The questions consisted of multiple choice, five-point likert-type scale, and open-ended formats; and were clustered according to demographic information, parent's training and support in

the implementation of PECS, parent's application of PECS, procedural integrity of parent's PECS use, and social validity of the PECS program.

Demographic questions gathered information on parent's country of residence, marital status, educational attainment, and number and age of children. In addition, questions asked parents for information regarding the diagnosis of their child or children, their child's or children's age at diagnosis, and the gender of their child or children with these diagnoses. The survey also included questions on parent's level of training in the application of the PECS intervention as well as ongoing support to implement the intervention. Questions related to the application of PECS included the child's age at PECS commencement, PECS phase acquired, the structured PECS training implementer (parent or professional), number of times the child uses PECS to communicate daily, the child's PECS use with other people and in environments outside of formal training sessions, the size of the child's PECS vocabulary, and the child's use of vocal communication.

The procedural integrity questions were based on the implementation of the technical teaching strategies utilised in the PECS training protocol (Frost & Bondy, 2002), and aimed to gather information on parent's execution of each of these teaching strategies when using PECS with their children. Engagement in or incorrect use of these variables was identified as an error through a thorough examination of the PECS training protocol and the PECS Implementer Skills Assessment worksheet (Frost & Bondy, 2002). Several implementer errors were identified, including:

1. Absence of a physical prompter: The physical prompter is one of two trainers in phases I and II of the PECS training protocol whose role is to provide physical prompts to the student and to physically assist the student to complete the PECS exchange.

2. Open hand prompt error: In phase I the communicative partner opens her hand to receive the picture before the learner has reached for the item or the picture.
3. Learner initiation error: In phases I and II the physical prompter does not wait for the learner's initiation before prompting: The prompter does not wait for the learner to reach for the item that the communicative partner is enticing them with before physically assisting the learner to pick up the picture, reach to the communicative partner, and release the picture into the communicative partner's open hand.
4. Vocal prompt: Defined as an audible stimulus that raises the probability of the learner exchanging a picture card, e.g. "give me the picture", "show me...". In phases I- IV a vocal prompt of "Do you want more..." or "what do you want? or "what's this?" is also recorded as an error.
5. Gestural prompt: Defined as a physical movement that raises the probability of the learner exchanging a picture card, including pointing to, or touching a picture to indicate a correct response. A gestural prompt is recorded as an error in phases I-IV.
6. Incorrect 4-step error correction: In phase III the communicative partner does not conduct the 4-step error correction procedure, as specified in the PECS training protocol (Frost & Bondy, 2002). If the learner exchanges the distracter icon or reaches for the incorrect item, the trainer does not conduct the 4-step error correction procedure, namely:
    - Model or Show: The communicative partner does not point to or tap the target/correct picture;
    - Prompt: The communicative partner does not hold open their hand near the target picture or physically prompt the learner;

- Switch: The communicative partner does not ask the learner to complete another task, such as “do this...”, or turn the PECS book over.
- Repeat: The communicative partner does not repeat the trial by enticing with both items.

7. Timely reinforcement errors: The communicative partner does not reinforce the learner’s communicative behaviour within 0.5 seconds of the learner handing the picture/sentence strip to the communicative partner.
8. Insistence on speech: The communicative partner and/or prompter insist on the learner producing speech with a PECS exchange, for example “Say...”

The social validity questions were derived from items of the Caregiver’s Acceptance of Treatment Survey (Sathupathy, 2005), and included questions designed to gather parent’s perspectives on the effectiveness of PECS in improving their child’s communication skills and other behaviours, whether the implementation of the PECS intervention was worthwhile, reasonably straightforward to implement, and stressful or difficult to implement, and whether they would recommend PECS to other families in a similar situation.

The entire question set was reviewed by Dr Andy Bondy, co-developer and founder of PECS and Pyramid Education Consultants. A copy of the survey question set is presented in Appendix A.

Survey Distribution

Prior to data collection, the project was approved by the Monash University Human Research Ethics Committee (approval no. CF12/1729-2012000947; see Appendix B).

The online survey was created utilising Qualtrics, a web-based research survey software tool. The survey commenced with an explanatory statement, providing information

about the research study (including the aim of the survey, eligibility for participation and the anticipated time required to complete the survey), consent statement, details of the project's ethics approval, and details of the principal researchers (See Appendix C). This explanatory statement was followed by the 48 question set with instructions for completion by respondents, as required throughout the survey.

The survey was anonymous and configured on Qualtrics such that no identifiable information was captured or recorded. It was also constructed such that the survey could only be completed once on any particular computer. Respondents, therefore, could not complete the survey more than once. Respondents were able to complete the survey at their convenience and leave the survey, returning at a later time or date, using the link which would direct respondents back to the last question completed. There was no requirement for questions to be completed before proceeding to the next question or completing the survey. Completed responses were stored on Qualtrics for retrieval by the researcher. Prior to advertising the link to the survey, the researcher tested the online version of the survey on Qualtrics. This testing confirmed that the survey could be accessed and completed online using the provided link and that responses would be received and stored on Qualtrics.

The survey was advertised on national and international ASD and PECS websites. The advertisement "Parent's perspectives on the useability and usefulness of PECS" detailed the aim of the survey, requirements for and of participation, and invited parents to complete the survey using an attached link (see Appendix D). The advertisement was displayed on the Autism Victoria (Amaze) research project website [http://www.amaze.org.au/get-involved/research-projects/projects-recruiting-participants/]; in the August 2012 e-alert and July 2012 quarterly newsletter of the Australian Autism Behavioural Intervention Association; in the August 2012 eNewsletter of a Southern California parent run ASD informational

website - Valeries List [http://www.valerieslist.com/]; and on the websites of PECS Australia [http://www.pecsaustralia.com/], PECS United States of America [http://www.pecsusa.com/], PECS Canada [http://www.pecs-canada.com/], and PECS United Kingdom [http://www.pecs-unitedkingdom.com/].

The survey was launched on August 16, 2012 and remained active until March 14, 2013. When the seven month period expired, the complete set of responses was exported to PDF and Microsoft Office Excel for data analysis.

Results

Number of responses

A total of 51 surveys were submitted via Qualtrics during the seven month data collection period. However, only 17 were considered usable, that is the response included at least some demographic information, the respondent indicated that they had or were using PECS with at least one of their children, and the respondent completed at least 50% of the procedural integrity and social validity multiple choice questions. The analyses reported are therefore based on the 17 useable submissions.

Characteristics of the respondents

Geographic location

Geographic Location was indicated on all of the 17 submissions (100%). The majority of respondents lived in Australia (n = 8, 47.06%) and the United States of America (n = 8, 47.06%), and one respondent lived in the United Kingdom (5.88%).

Marital status of respondents

All 17 submissions provided data on their marital status (100%). Most of the respondents indicated that they were married (*n* = 13, 76.47%), while an equal number of respondents indicated that they were single (*n* = 2, 11.76%), and separated or divorced (*n* = 2, 11.76%).

Educational level of respondents

The highest level of education attained by respondents was indicated on all 17 submissions (100%). The majority of respondents indicated that they had attained a university qualification (*n* = 11, 64.71%), whereas five (29.41%) of the respondents indicated that they had a TAFE or community college qualification, and one (5.88%) respondent indicated that they had completed Year 10 or equivalent.

Relation to respondent's children

Relation to children for whom the surveys were completed was specified in all 17 submissions (100%). All respondents in the sample indicated that they were the children's mother (*n* = 17, 100%).

Characteristics of respondent's children

Age of children

The age of the children for whom the surveys were completed was indicated on 14 (82.35%) of the submissions. The age of three of the children was not available due to

incomplete responses. The mean age of the 14 submissions was 10years 5months (*R* = 3years 5months – 14 years 9months).

Gender of children

The gender of the children for whom the surveys were completed was indicated on 15 (88.24%) of the submissions. The gender of two of the children was not specified. All 15 submissions indicated the gender of their child as male.

Children's type of disability

Parents were asked to indicate the type of their child's disability by indicating if the child had a diagnosis of either autism spectrum disorder, developmental delay or another diagnosis (with a request to specify the diagnosis). Of the 17 submissions, parents provided information on the type of disability in all 17 cases. Fourteen children (82.35%) were recorded as having Autism Spectrum Disorder, while three children (17.65%) were recorded as having a developmental delay. No other diagnosis was specified in the 17 cases.

Age at Diagnosis

The age at which the respondent's children were diagnosed was available for 15 submissions (88.24%). The mean age at diagnosis for the 15 submissions was 2years 8months (*R* = 1year 3months – 7years).

Parent training and support to use PECS

Parents responded to questions relating to how they found out about PECS, learned to use PECS, and ongoing support to deliver PECS in all 17 submissions (100%). Table 3

presents the percentage of parent responses in relation to the training and support received to use PECS with their children.

Table 3

Percentage of parent responses to questions regarding training and support to use PECS

Question	Percentage of Responses				
Found out about PECS	EIC/SS 43.48%	Friend 4.35%	Professional 34.78%	Internet 17.39%	
Learnt to use PECS	PECS Training 24.00%	Friend 0.00%	Professional 48.00%	Internet 8.00%	PECS manual 20.00%
Ongoing support to use PECS	EIC/SS 30.43%	Friend 4.35%	Professional 34.78%	Internet 8.70%	No support 21.74%

Note. EIC = Early Intervention Centre, SS = Specialist School

As can be seen from Table 3 the majority of respondents indicated that they first found out about PECS through their child's early intervention centre or specialist school (n = 10), and/or through a professional such as a speech therapist or psychologist (n = 8); while four of the respondents also indicated that they first found out about PECS on the internet, and one respondent indicated that they also first found out about PECS through a friend.

Table 3 also demonstrates that most of the parents indicated that they learnt to use PECS through a professional such as a speech therapist or psychologist (n = 12). Six respondents indicated that they had attended a PECS training course provided by either a practitioner (psychologist or speech therapist) or an accredited PECS training course by

Pyramid Education Consultants. Five respondents indicated that they had read the PECS manual, while two of the respondents indicated that they had used the internet.

Parents were also asked to indicate from whom they received support in relation to their ongoing use of PECS with their child. As depicted in Table 3 the majority of the respondents indicated that they receive support from a professional such as a speech therapist or psychologist (n = 8), and/or their child's early intervention centre or specialist school (n =7). Two respondents indicated that they consult the internet for support, and one respondent stated that they receive support from a friend. Five respondents stated that they do not receive ongoing support in the use of PECS with their child.

Application and use of PECS

Parents were asked questions relating to their child's application and use of PECS. The child's age of PECS commencement was indicated in nine submissions (52.94%), while the phase of PECS training acquired, structured training implementer, PECS daily usage, use of PECS with people other than the parent, environments in which PECS is used (outside of formal training sessions), size of the child's PECS vocabulary, and the child's use of vocal language was specified in all 17 submissions (100%). Table 4 presents the percentage of parent responses in relation to their child's use of PECS.

Table 4

Percentage of parent responses to questions regarding their child's use of PECS

Question	Percentage of Responses				
PECS age of commencement	Mean 3 years 1month		Range 1 year – 5years 5 months		
PECS phase mastered	Phase II 5.88%	Phase III 17.65%	Phase IV 41.17%	Phase V 17.65%	Phase VI 17.65%
Structured training implementer	Parent 35.29%		Professional 64.71%		
Child's PECS daily usage	0–5 times 41.48%	5–10 times 11.76%	10-15 times 5.88%	>15 times 41.48%	
Child's use of PECS with other people	Uses PECS with others 88.24%		Does not use PECS with others 11.76%		
Other people child uses PECS with	Teachers 28%	Other family 26%	Siblings 18%	Other adults 16%	Peers 12%
Environments child uses PECS	Home 41.67%	EIC/SS 27.78%	MK/MS 16.66%	Community 11.11%	Respite 2.78%
Child's PECS vocabulary	0–20 icons 5.88%	21–50 icons 23.53%	51–80 icons 17.65%	81–100 icons 5.88%	>100 icons 37.06%
Child's use of vocal language	Uses vocal language 64.71%		Does not use vocal language 35.29%		
Child's vocal vocabulary	0-20 words 36.26%	21-50 words 0.00%	51-80 words 0.00%	81-100 words 9.09%	>100 words 54.55%

Note. EIC = Early Intervention Centre, SS = Specialist School, MK = Mainstream Kindergarten, MS= Mainstream School

PECS age of commencement

As depicted in Table 4 the mean age of commencing PECS for the nine submissions was 3 years 1month (*R* = 1 year – 5years 5 months).

PECS phase mastered

Table 4 also demonstrates that the majority of children for whom the survey was completed had acquired phase IV of the PECS training protocol (*n* = 7), while an equal number of respondents indicated that their child had attained phase III (*n* = 3), phase V (*n* = 3), and phase VI (*n* = 3). One respondent stated that their child had mastered phase II.

Structured Training Implementer

Parents were asked to indicate who completed the structured PECS training sessions with their child. As can be seen from Table 4, 11 respondents indicated that a professional conducted the structured training sessions with their child, while six parents indicated that they conducted the structured PECS training sessions with their children.

PECS Daily usage

Parents were also asked to indicate the number of times their child uses PECS to communicate with them (outside of structured PECS training sessions) each day. As depicted in Table 4 an equal number of parents indicated that their child used PECS (outside of formal PECS training sessions) to communicate with them between zero and five times (*n* = 7) and more than 15 times each day (*n* = 7). Two respondents stated that their child uses PECS to communicate with them between five and 10 times each day, and one respondent recorded that their child uses PECS between 10 and 15 times to communicate with them each day.

Child's use of PECS with other people

Table 4 demonstrates that the majority of parents indicated that their child uses PECS to communicate with people other than the parent (n = 15), while two respondents stated that their child does not use PECS to communicate with people other than the parent. Table 4 also demonstrates that of the 15 respondents whose children use PECS to communicate with other people, the children use PECS to communicate with teachers (n = 14), other family (n = 13), siblings (n = 9), other adults (n = 8), and peers (n = 6).

Environments PECS used in

The environments in which respondent's children use PECS (outside of formal PECS training sessions) is demonstrated in Table 4. Parents indicated that their children use PECS (outside of formal PECS training sessions) within their home (n = 15), early intervention centre or specialist school (n = 10), mainstream kindergarten or school (n = 6), community (n = 4), and respite (n =1).

Child's PECS vocabulary

Parents were asked to indicate the size of their child's PECS vocabulary. The data in Table 4 illustrates that the majority of parents indicated that their child's PECS vocabulary size was greater than 100 icons (n = 8). Four respondents stated that their child's PECS vocabulary was between 21 and 50 icons, while three respondents recorded their child's PECS vocabulary to be between 51 and 80 icons. An equal number of respondents reported their child's PECS vocabulary to be between zero and 20 icons (n = 1) and between 81 to 100 icons (n = 1).

Child's use of vocal language

Children's use of vocal language is also depicted in Table 4 and demonstrates that 11 respondents indicated that their child uses vocal language, while six respondents stated that their child does not use any vocal language. Of the 11 respondents that indicated that their child uses vocal language, six respondents indicated recalling their child's first word (54.55%). The children's first words recorded include "dog", "up", "apple", "water", "grapes", and "mama".

Of the 11 respondents that indicated that their child uses vocal language, all 11 responses stated the size of their child's vocal vocabulary (100%). The majority of these responses, as shown in Table 4, indicated that the number of word's their child uses purposefully is greater than 100 words (n = 6), while four parents stated that their child uses between zero and 20 words purposefully, and one parent stated that their child uses 81 to 100 words purposefully.

Procedural integrity of parent implemented PECS

Parent engagement in or use of each of the identified implementer errors was indicated by all 17 respondents for the absence of physical prompter, student initiation error, vocal prompt, gestural prompt, timely reinforcement error, and insistence on speech questions (100%). Sixteen respondents answered the open hand prompt error and incorrect 4-step error correction questions (94.12%). All 17 responses indicated engagement in or incorrect use of at least one of the identified implementer errors. Figure 2 presents the percentage of responses demonstrating engagement in or use of each of the identified implementer errors.

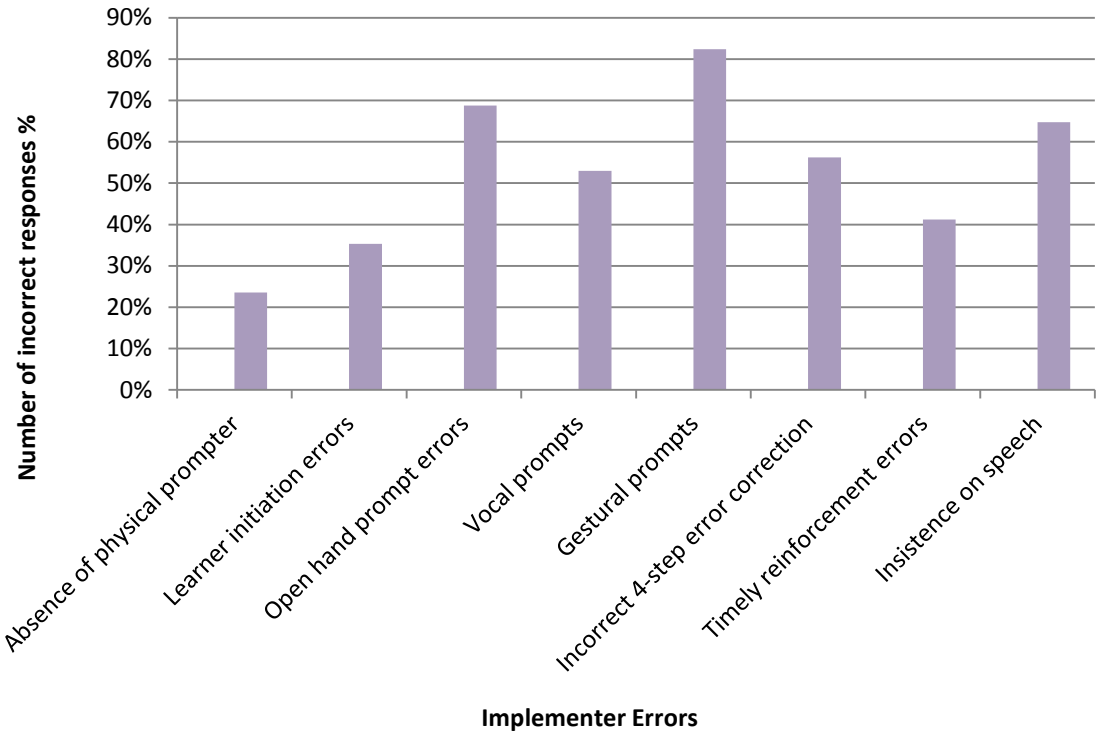

Figure 2. Percentage of responses demonstrating engagement in or incorrect use of each of the identified implementer errors.

From Figure 2 it can be seen that of the 17 respondents, the use of gestural prompts during phases I to IV of the PECS program was indicated most frequently in 82.35% (*n* = 14) of responses. Untimely or incorrect use of the open hand prompt in PECS phases I and II was reported in 68.75% (*n* = 11) of the 16 responses received, while insistence on speech throughout all phases of the PECS program was reported by 64.71% (*n* = 11) of the 17 respondents. Of the 16 responses received, 56.25% (*n* = 9) reported incorrect use of the 4-step error correction procedure in phase III of the PECS program, and 52.94% (*n* = 9) of the 17 responses indicated the use of vocal prompts during phases I to IV of the PECS program. In contrast, 41.18% (*n* = 7) of the 17 respondents reported failing to provide timely reinforcement, while 35.29% (*n* = 6) of the 17 respondents indicated failure of the physical prompter to wait for the student's initiation before providing the physical prompt to pick up

the picture, reach, and release the picture into the communicative partner's hand during phases I and II of the PECS program. Lastly, 23.53% (n = 4) of the 17 respondents indicated that they did not have a physical prompter present when implementing phases I and II of the PECS program.

Social Validity

Parents responded to the likert-type scale questions regarding the social validity of the PECS program in all 17 submissions (100%). Table 5 presents the percentage of parent responses to questions regarding the social validity of the PECS program.

Table 5

Percentage of parent responses to questions regarding the social validity of the PECS program

Question	Percentage of Responses		
Overall feeling about PECS	Positive or very positive	Neutral	Negative or very negative
	94.12%	0.00%	5.88%
Recommend PECS to others	Yes	No	
	94.12%	5.88%	
Effort put into PECS worth the outcome	Completely or mostly worthwhile	Neutral	Not at all worthwhile
	94.12%	0.00%	5.88%
Effectiveness of PECS improving communication skills	Effective or very Effective	Neutral	Ineffective or very Ineffective
	94.12%	0.00%	5.88%
Effect of PECS on vocal language	Increased	No change	Decreased
	70.59%	29.41%	0.00%
Effect of PECS on other skills/behaviours	Better or much better	About the same	Worse or much worse
	88.24%	11.76%	0.00%
PECS straightforward to implement	Straightforward or very straightforward	Neutral	Complicated or very complicated
	70.59%	17.65%	11.76%
PECS difficult to implement	Not difficult or not at all difficult	Neutral	Difficult or very difficult
	47.06%	29.41%	23.53%
PECS stressful to implement	Not stressful or not at all stressful	Neutral	Stressful or very stressful
	41.18%	17.64%	41.18%

The data in Table 5 demonstrates that the majority of parents felt positive or very positive about the PECS program (n = 16), would recommend the PECS program to other families in similar situations (n = 16), and felt that the effort that they put into the PECS training was worth the outcome (n = 16). One respondent indicated that they felt very negative about PECS, that they would not recommend PECS to others, and that they did not feel that the effort they had put into the training was worth the outcome.

Table 5 also demonstrates that the majority of respondents (n = 16) stated that they believed PECS to be an effective or very effective method for increasing their child's communication skills. One respondent stated that they believed PECS to be very ineffective method for improving their child's communication skills. Parents were also asked to specify the extent to which PECS had influenced their child's vocal language and other aspects of their child's behaviour and skills. The majority of respondents indicated that PECS has increased their child's vocal language (n = 12), while five respondents indicated no change in their child's vocal language. None of the respondents stated that PECS had decreased their child's vocal language. The majority of parents (n =15) also stated that their child's behaviour and skills were better or much better following PECS training, and two parents stated that their child's behaviours and skills remained the same. None of the respondents stated that PECS had worsened their child's behaviour and skills. When asked to describe the improvements in their child's behaviour and skills, parents stated that the improvements included less frustration and anxiety for the children, reduced tantrums and screaming, and reduced violent behaviours.

The data in Table 5 also depicts that the majority of respondents (n = 12) stated that they found PECS to be straightforward or very straightforward to implement. Three parents indicated a neutral response, and two respondents stated that they found PECS complicated or

very complicated to implement. Similarly, when asked to indicate how difficult they found PECS to implement, most of the parents (n = 8) indicated that they did not find PECS difficult to implement, while five parents indicated a neutral response, and four respondents stated that they found PECS difficult or very difficult to implement. Those that indicated that they found PECS difficult to implement recorded the difficult aspects as including the storage and maintenance of icons, maintaining the consistency of items and icons available, correct implementation of the error correction procedures, and having a second person available to prompt.

When asked to state how stressful they found PECS to implement, Table 5 demonstrates that, an equal number of respondents indicated that they found PECS to be stressful or very stressful to implement (n = 7), and not stressful or not at all stressful to implement (n = 7). Three parents indicated a neutral response. Those parents that indicated that they found PECS stressful or very stressful to implement stated that the aspects they found stressful included making and maintaining icons, loss of icons, having to ensure that the PECS book is taken with them everywhere, having another person available to prompt, and needing to be careful of correct prompting procedures. Parents were also asked to describe what they really liked about the PECS program. Respondents indicated that they liked that PECS is easy to use and understand, that it stops parents needing to guess what their child wants, that it gives children a mode of communicating independently and shows children the reason for and benefit of communicating, and that it eases frustration for children. Parents also responded that they liked the portability of the system, the ease of expanding vocabulary as the child's vocabulary grows, the ability to communicate with anyone, the focus on initiations, that PECS teaches reading skills, and that PECS incorporates vocal modelling of words.

Finally, parents were asked to provide suggestions to improve the PECS program. Responses included exploring ways to transition from icons to other AAC devices, easier to use icon software (PICS for PECS), and advancing with technology and using handheld devices for PECS rather than icons and communication books. Parents also suggested ensuring that professionals implement PECs according to the manual, lower cost or funding opportunities and more training for parents, providing easy to understand guidelines and downloadable videos of each PECS phase and teaching strategy for parents to follow to implement PECS training, and more parent support user groups.

Discussion

The present study aimed to assess the procedural integrity and social validity of parent-implemented PECS utilising an internet survey distributed to parents via national and international PECS and ASD organisations. The results suggest that while the majority of parents believe PECS to be an effective and acceptable intervention, and despite the majority of respondents indicating that they learnt to use PECS and received ongoing support to use PECS from a professional and/or their child's early intervention centre or specialist school, all respondents demonstrated engagement in at least one of the identified implementer errors.

While timely reinforcement errors, student initiation errors, and absence of a physical prompter were reported less frequently, the results of the present study demonstrated a high occurrence of parents engaging in the use of gestural and vocal prompts, and the incorrect use of the open hand prompt. The use of gestural prompts was reported most frequently by 82% of respondents. Incorrect use of the open hand prompt during phases was indicated by 69% of respondents, whilst the use of vocal prompts was demonstrated by 53% of the sample. The importance of the accurate use of prompts specified in the PECS protocol, and not

introducing or using prompts that are not specified, is primarily that the student remains motivated to engage in self-initiating communicative interactions rather than becoming dependent on prompts to complete communicative exchanges (Sundberg, 2008). Gestural and vocal prompts are not used in phases I to IV of the PECS training protocol, and accurate timing of the open hand prompt during phases I and II is essential, to reduce prompt dependency (Frost & Bondy, 2002).

Incorrect implementation of the 4-step error correction procedure during phase III of the training protocol was also reported frequently, by 56% of respondents. Correct use of the error correction strategy is also essential in teaching students to independently discriminate between pictures (Frost & Bondy, 2002, 2008). While it may be easier for the trainer to simply show the student the correct picture and provide access to that item, this is likely to result in the student learning that he only has to wait for the trainer to point to the correct picture and then give that picture to the trainer, a prompted response, to gain access to the item. The student would not be learning independent picture discrimination.

The results of the present study also demonstrated a high occurrence of parents' insistence on children's vocal language production, being reported by 65% of the sample. Within the PECS training protocol, the production of vocal language by a student is in no way required and withholding access to a requested item until the student attempts to say or imitate a word may undermine the student's communication effort (Frost & Bondy, 2002). While the PECS program aims to teach students functional communication, it does not disregard the development of vocal language. Through vocal modelling, time delay, and differential reinforcement strategies, it addresses the development of speech (Bondy & Frost, 2008; Frost & Bondy, 2002).

These results highlight a need for parent education and ongoing support in the delivery of PECS with their children, to ensure accurate implementation of the training protocol and to ensure a positive learning experience for parents and children, as well as improving children's communication skills. This is particularly important in light of the results of the present study indicating that only a small percentage of the sample had read the PECS training manual or attended a PECS training course provided by a practitioner or Pyramid Education Consultants, and that several respondents indicated that they did not receive any ongoing support in the delivery of PECS with their children.

The results of the present study also provide support for the social validity of the PECS program. Almost all respondents indicated that they felt positive or very positive about PECS and would recommend PECS to others in a similar situation. The majority of respondents indicated that they felt that the effort that they put into the PECS training was worth the outcome. Only one respondent indicated feeling very negative about PECS and would not recommend the program to others. This respondent was not happy with the use of food as a reinforcer for her child, who she described as food obsessed, and felt that her wish to not use food as a motivator was not respected by the speech therapists implementing her child's formal PECS training.

Consistent with previous studies documenting the effectiveness of PECS in teaching functional communication skills (Anderson, et al., 2007; Bondy & Frost, 1994; D. Carr & Felce, 2007a; Charlop-Christy, et al., 2002; Jurgens, et al., 2009; Liddle, 2001; Schwartz, et al., 1998), the results of the present study demonstrated that the majority of respondents believed that PECS was a very effective method for improving their children's communication skills. Further, 70% of respondents indicated that their child's use of vocal language had increased in conjunction with PECS training. This is consistent with previous

research that has demonstrated that PECS may in fact promote the development of independent vocal language (Bondy & Frost, 1994; Cannella-Malone, et al., 2010; D. Carr & Felce, 2007a; Charlop-Christy, et al., 2002; Ganz & Simpson, 2004; Jurgens, et al., 2009; Kravits, et al., 2002; Liddle, 2001; Magiati & Howlin, 2003; Schwartz, et al., 1998; Tincani, et al., 2006; Travis & Geiger, 2010; Yoder & Stone, 2006a). Despite the recognized benefits of AACs, some parents and professionals continue to be hesitant to implement an AAC intervention due to concerns that AAC will inhibit vocal language development (Millar, et al., 2006; Schlosser & Wendt, 2008). Several research reviews, however, have demonstrated that AAC interventions do not appear to impede vocal language development and many studies demonstrated that there is potential for gains in vocal language (Millar, et al., 2006; Schlosser & Wendt, 2008). Consistent with these findings, none of the respondents indicated a decrease in their child's vocal language skills following PECS training.

The results of the present study also provide support for the effectiveness of PECS in improving other behaviours or skills. Eighty-eight percent of respondents indicated an improvement in other areas of their child's behaviour or skills, and none of the respondents indicated a worsening of their child's behaviour or skills. This is consistent with previous research that has demonstrated increases in social-communicative behaviours and decreases in problem behaviours in association with PECS training (Anderson, et al., 2007; Charlop-Christy, et al., 2002; Frea, et al., 2001; Jurgens, et al., 2009; Magiati & Howlin, 2003). The improvements noted by parents in the current study include reduced child frustration and anxiety, reduced tantrums and screaming behaviours, and reduced violent behaviours.

An interesting finding in the current study is that despite the high occurrence of implementer errors, including the use of gestural and vocal prompts, incorrect use of the open hand prompt, insistence on speech, and incorrect implementation of the 4-step error

correction procedure, the majority of respondents indicated that they did not find PECS difficult to implement but rather found the program straightforward. This suggests that the PECS program may appear deceptively simple. Forty-one percent of respondents did, however, report that they found PECS to be stressful to implement. Aspects reported as stressful included producing and maintaining icons, ensuring the PECS folder is transported everywhere with the child, losing icons, correctly implementing the error correction procedures, and having a second person available to prompt in the early phases of PECS training.

Parents in the present study provided several suggestions to improve the system, including exploring ways to transition from icons to other AAC devices, easier to use icon software (PICS for PECS), and advancing with technology and using handheld devices for PECS rather than icons and communication books. Parents also suggested ensuring that professionals implement PECs according to the manual, lower cost or funding opportunities and more training for parents, providing easy to understand guidelines and downloadable videos of each PECS phase and teaching strategy for parents to follow to implement PECS training, and more parent support user groups. Given the high occurrence of implementer errors reported by the respondents, these suggestions of lower cost and more parent training opportunities, and ongoing support in the delivery of PECS with their children, are pertinent to ensure accurate implementation of the training protocol and ascertain a positive learning experience for parents and children.

The results of the current study should be interpreted in the context of several methodological limitations. The main limitation is the low response rate and small sample size, despite the survey being active for an extended period of time, which impacts on the external validity of the results. The sampling strategy of the present study was to limit the

advertisement of the survey to forums that would likely attract participants who were using or had previously used PECS and had a thorough understanding of the PECS program rather than general use of pictures to support communication and routines, e.g. picture schedules. While the survey was advertised on such national and international ASD, parent-forums, and PECS websites, future research needs to consider making connections with larger parent groups and a greater number of industry bodies, to advertise through a greater number of outlets, including early intervention centres, specialist schools and PECS practitioners. In addition future studies should consider the use of alternative more targeted methods of solicitation, such as invitations, and the use of alternative survey formats, such as paper-based questionnaires. Internet surveys require respondents to have internet access, and may restrict participants to internet literate parents.The current survey question set incorporated 48-questions and commenced with the collection of demographic data. Given that the majority of respondents who commenced the survey did not finish it, with numerous respondents ceasing during the demographic questions, future research should consider minimising the number of questions asked, being mindful of the amount of demographic data sought, and commencing the survey with social validity questions, rather than demographic information, to increase participation and engagement of respondents and likelihood of survey completion.

A further limitation of the present study is that the sample may not be representative as evidenced by the lack of variability in the location, gender, marital status, and education level of the respondents, and the gender and diagnosis of their children. The majority of respondents were from the United States of America and Australia, and all respondents were mothers who were predominantly tertiary level educated and married. The children these mothers were responding about were all male and had a diagnosis of ASD or developmental delay. Ensuring representative samples in an internet survey is difficult as once an internet survey is launched, the researcher loses control over its distribution (Bourque & Fielder,

2003). The sample was, however, representative of children having completed a range of the PECS training protocol phases.

Despite the small sample, the current study contributes to the literature on the social validity of the PECS program and the procedural integrity of parent-implemented PECS training with children in naturalistic settings. The findings demonstrated that despite parents indicating feeling overwhelmingly positive about the PECS program (including the program's effectiveness and ease of implementation), parents still largely reported engagement in implementation errors. This highlights that the PECS program may appear deceptively straightforward to implement, and that there is, therefore, a definite need for greater parent education and support in the delivery of PECS with their children to ensure a positive learning experience for the child and parents, as well as to successfully improve the communication skills of children with communication difficulties. The findings also provide support for the social validity of the PECS program. Additional research is needed to further explore the social validity of PECS, particularly the maintenance of treatment gains over time, as interventions that are perceived as having high social validity are more likely to be sustained by parents and carers in the long term (Flippin, et al., 2010; S. L. Hart & Banda, 2010; Maglione, et al., 2012; Preston & Carter, 2009).

CHAPTER FIVE

LONG TERM FOLLOW UP

While the evidence is growing for the effectiveness of PECS in improving children's communication skills in the short term (Angermeier, et al., 2008; Bondy & Frost, 1994; Cannella-Malone, et al., 2010; Charlop-Christy, et al., 2002; Conklin & Mayer, 2011; Gordon, et al., 2011; Greenberg, et al., 2012b; Heneker & MacLaren, 2003; Howlin, et al., 2007; Malandraki & Okalidou, 2007; Park, et al., 2011; Rosales & Rehfeldt, 2007; Travis & Geiger, 2010; Yoder & Stone, 2006a), insufficient evidence is available to determine whether PECS results in the long term maintenance of communication and vocal language gains. Recent reviews and meta-analyses of the PECS literature have identified a need for further follow up research (Flippin, et al., 2010; S. L. Hart & Banda, 2010; Preston & Carter, 2009).

Clinically this lack of research is of concern as the long term maintenance of communication and vocal language gains, acquired through PECS training, is intrinsically entwined with the social validity of the intervention (R. A. Baer, 1989; Kennedy, 2002). The maintenance of behaviour change is defined as "the continuing durability in levels of behaviour once operational goals, procedures, and outcomes of an experiment have been achieved" (Kennedy, 2002, p. 595). It is widely acknowledged that an effective behaviour change intervention not only provides solutions to a behavioural problem in the short term, but remains effective for a significant period of time (D. M. Baer, Wolf, & Risley, 1987; R. A. Baer, 1989). Incorporation of maintenance measures provides information not only on how social contexts affect and are affected by interventions, but also the ecological variables within that social context that sustain or do not sustain those behaviour changes (Kennedy,

2002), and thereby provide information on the social validity of an intervention. Interventions that contain goals, methods, and outcomes that are perceived as socially valid (in addition to being objectively valid) are also those that are most likely to be adopted by parents and carers, and will result in more widespread continued use (J. E. Carr, et al., 1999; Rapoff, 2010; Schlosser, 1999). Assessment of the long term maintenance of behaviour change following the departure of the researchers in behavioural research is, however, rare. It is possible that once researchers depart, the intervention is no longer implemented or used by parents, which may result in subsequent loss of improvements gained during the intervention (R. A. Baer, 1989). An active strategy for programming for maintenance of treatment gains in any intervention is teaching the learning principles that underlie the procedures to relevant adults in the child's life, for example parents. Maintenance of child behaviour change is often dependent on the continued use of intervention procedures and provision of opportunities for the child to use and practice learned skills by relevant adults in the child's environment (R. A. Baer, 1989; Kennedy, 2002).

Teaching parents to implement and use PECS with their child in the home and community environment is an important component of the program to reinforce generalised use and promote social validity, through functional use of the skill (Frost & Bondy, 2002). The PECS training protocol refers to the unstructured training environment and stop, drop, and talk approach (that is, whenever a communicative opportunity arises the communicative partner must stop what they are doing, drop to the student's eye level, and do a PECS trial) to encourage the use of PECS in daily life at every opportunity (Frost & Bondy, 2002). This approach, therefore, necessitates the involvement of parents to use the intervention in a child's daily routines outside of formal structured PECS training sessions. The PECS is, however, a highly complex manualised program utilising a variety of technical teaching procedures and parents who have difficulties with the program's implementation may not

experience the best outcomes for their child and may be likely to discontinue its use (Tincani & Devis, 2011).

Numerous studies in the PECS literature, including case reports, experimental studies using single subject research designs, and randomised group experiments, have monitored the maintenance of skills acquired through PECS training ranging from one week to one year post intervention (Angermeier, et al., 2008; Bondy & Frost, 1994; Cannella-Malone, et al., 2010; Charlop-Christy, et al., 2002; Conklin & Mayer, 2011; Gordon, et al., 2011; Greenberg, et al., 2012b; Heneker & MacLaren, 2003; Howlin, et al., 2007; Malandraki & Okalidou, 2007; Park, et al., 2011; Rosales & Rehfeldt, 2007; Travis & Geiger, 2010; Yoder & Stone, 2006a). The expectation at follow-up is that the participant's PECS and/or vocal language skills and concomitant behaviours would be at least at the same level or further improved compared to the last phase of the PECS training conducted.

Several studies have demonstrated the maintenance of PECS use for requesting with participants of varying age groups. Park et al. (2011) collected maintenance data once a week for one month for three children with ASD (aged two-years) and demonstrated that all three participants maintained independent PECS exchanges post-intervention. Conklin and Mayer (2011) also demonstrated continued use of PECS, as well as an increase in icon vocabulary, and reduced levels of problem behaviours six months post intervention for two adult participants with intellectual disabilities who had completed phases IV and VI of the PECS training protocol. In a more recent study, Greenberg et al. (2012b) gathered maintenance data for four participants, one month post intervention for two of the participants, 12 months post intervention for one participant, and 18 months post intervention for the other participant. All participants (aged four- to eight-years) demonstrated the maintenance of PECS use at follow-up.

Other studies have demonstrated the maintenance of vocal language skills following PECS training. One of the first studies to gather follow up data, by Charlop-Christy et al. (2002), demonstrated maintenance of spontaneous vocal language and imitation, increased mean length of utterance, increased requests and initiations, and increased amount of time engaged in eye contact, joint attention and play, 10 months post intervention for a 12- year old boy with ASD who had completed all six phases of the PECS training protocol. At one month post intervention, Rosales and Rehfeldt (2007) also found adult participants vocally requesting during maintenance probes. A randomised control trial by Gordon et al. (2011) further demonstrated a maintenance effect of PECS training on children with ASD (aged four- to ten-years) spontaneous vocal language for requesting objects, nine months post intervention. This long-term effect was, however, not maintained for their spontaneous use of picture cards for requesting. Follow up research needs to account for the possibility that children's use of vocal communication, particularly manding, may surpass their need to use PECS for requesting.

Other research studies have, however, demonstrated mixed findings in relation to the maintenance of skills acquired through PECS training. Travis and Geiger (2010) demonstrated the maintenance of requesting using PECS at follow up for one nine-year old participant with ASD, three months post intervention, while a decrease in effect was observed for the other nine-year old participant with ASD. It was suggested that this was most likely due to the difficulties the parent had in maintaining PECS use at home during the three month period. A randomised control trial by Howlin et al. (2007) also demonstrated that for one treatment group positive effects on outcome measures were not maintained once consultations ceased. It is unclear whether this was due to less reliable or frequent PECS use as procedural integrity measures were not taken. Further follow up research, therefore, needs to examine not only the extent to which the children are still engaging in target behaviours

post intervention, but also monitor contextual variables on children's PECS use, including the extent to which parents are continuing to support the behaviour change (R. A. Baer, 1989; Greenberg, et al., 2012b).

To date research on the long term maintenance of communication and vocal language gains acquired through PECS training remains inconclusive and further research is required that extends beyond 12 months post intervention follow up (Flippin, et al., 2010; S. L. Hart & Banda, 2010; Preston & Carter, 2009) and monitors contextual variables on children's PECS use (Greenberg, et al., 2012b). The present study therefore aims to conduct a long-term follow-up of the maintenance of a participant's PECS and vocal communication skills 3years 7months post intervention/training of all six phases of the PECS training protocol, and investigate the effects of contextual variables on a child's PECS use.

Method

Participant

The Participant (pseudonym Sophie) was aged 7 years 10 months at the commencement of this study. At the time of diagnosis, when Sophie was 4 years 4 months of age, she obtained a score of 41 on the Childhood Autism Rating Scale (CARS; Schopler, et al., 1988), indicating a severe level of autism. In addition, Sophie's age equivalent scores on the Bayley Scales of Infant Development III (BSID-III; Bayley, 2006) were 21, 17 and 25 months respectively for receptive language, expressive language, and cognitive skills.

Sophie lived at home with her parents and older brother, aged 11 years. Both of Sophie's parents obtained university qualifications, and worked full time during the course of

this study. Her older brother was diagnosed with mild autism at the age of 3 years 6 months and attended a mainstream primary school at the time of the present study.

Sophie first received intervention services at the age of four years when she commenced attending a university-based early intervention program weekly and a mainstream inclusive kindergarten twice weekly. In addition, Sophie had been receiving speech therapy on a fortnightly basis for approximately three years. At the time of the present study, Sophie attended a special school five days a week.

At the age of 4 years 3 months Sophie participated in a Monash University research study (Yoon, 2012), in which she successfully acquired the mastery criterion for Phases I to VI of the PECS training protocol over a period of five months, in a total of 46 sessions and 723 trials. This PECS training resulted in an increase in Sophie's PECS and vocal communication skills and a decrease in inappropriate and stereotypical behaviours. There was, however, a decrease in some aspects of Sophie's communication skills during the maintenance phase of the Yoon (2012) study, three weeks after completing Phase VI of the PECS training protocol. In addition, Sophie's communication skills acquired in PECS training did not generalise to non-training settings (Yoon, 2012).

Settings

All observation sessions were conducted in Sophie's home. In 20-minute free-play observations, Sophie was free to move in and outside the house and to choose her own activities. Her PECS folder was available on the dining room table in the open plan kitchen, dining and living area. During the intervention condition, Sophie's motivating toys/items were also placed on the dining room table.

Materials

In order to provide background information required for the present study, the following assessment tools were used: A Pre-Intervention questionnaire, The Critical Communication Skills Assessment (Frost & Bondy, 2002), and The Behavioural Language Assessment Form (Sundberg & Partington, 1998).

The pre-intervention questionnaire was conducted with Sophie's mother and aimed to gather information about the family's composition and background, diagnoses and assessments, as well as details of all therapies and intervention services accessed. The questionnaire also aimed to gather information on Sophie's current communication skills (PECS and vocal), opportunities for communication, and the presentation of problem behaviours. In addition, it aimed to gather the parent's perspective of the social validity and procedural integrity of the PECS training previously undertaken. Lastly, the questionnaire aimed to highlight items or activities that Sophie enjoyed that could be used in the current study as reinforcing items (see Appendix E).

The Critical Communication Skills Assessment (Frost & Bondy, 2002) assesses a child's current functional communication skills. The checklist contains nine categories: requesting reinforcers; requesting help/assistance; requesting break; rejecting, affirming/accepting; responding to "wait"; responding to directions including visual and oral directions; transitions between activities; and the ability to follow a visual schedule. The therapist establishes whether the child's current communication response for each of the nine categories is age appropriate or not (Frost & Bondy, 2002).

The Behavioural Language Assessment Form (Sundberg & Partington, 1998) is designed for use with children with limited vocabulary as a tool to provide a brief overview of a child's language abilities and aid the design of intervention programs. It contains 12

different sections that cover a variety of early language skills and related areas, namely: cooperation with adults, requesting (mands), motor imitation, vocal play, vocal imitation (echoic), matching-to-sample, receptive language, labelling (tacts), receptive by function, feature and class, intraverbals, letters and numbers, and social interaction. The task of the assessor is to determine which of five levels of each section most accurately represents the child's current abilities. Most typically developing children aged two- to three- years old receive a score of five on each of the areas in the assessment. Children with severe language delays, who have failed to acquire the simplest levels of communication, receive scores in the one to two range. Other children with language delays fall in between these two ends of the continuum (Sundberg & Partington, 1998).

A yellow communication binder (produced by Pyramid Educational Consultants) served as Sophie's PECS folder. The standard communication book is a 3-ring binder (23.5cm X 20cm) that contains several large insert pages and one sentence strip with Velcro strips. A variety of laminated colour picture cards, sized between 2.5cm^2 and 3cm^2 of preferred items were stored on the insert pages in the PECS folder. The pictures were produced from the Pics for PECS software (Pyramid, 2011).

Sophie's preferred concrete reinforcers, including toys and foods, were used. Smaller items were placed in transparent containers that were sealed with a padlock as depicted in Figure 3. Sophie's mother held the keys to the padlocks in all observation sessions. Larger toys and games that encourage interaction with others and that Sophie was unable to use independently were also utilised. These were strategically placed on the dining room table where Sophie was required to request access or parental support to use the item.

A digital video recorder was utilised to record all free-play observation sessions.

Figure 3. Locked transparent containers containing the participant's identified reinforcing items

Operational Definitions of Dependent Variables

During each free-play observation session, the occurrence of child and parent-related behaviours were observed (See Appendix F for Observation Charts).

Child Behaviours

Eleven variables, relating to the child's vocal communication, non-vocal communication and concomitant behaviours, were recorded. The occurrence of independent PECS mands, other non-vocal mands, other non-vocal initiations, vocal mands, other vocal initiations, immediate echolalia, vocal labelling, and non-word vocalisations were recorded using an event recording procedure; while inappropriate and stereotypical behaviours were documented using duration recording. In addition, a list of words, sentences, and phrases spoken by the child was maintained for each session to calculate Mean Length of Utterance (MLU). Table 6 provides operational definitions of each of the child related variables.

Table 6

Operational Definitions of Child Behaviours

Event recording		Duration Recording
Non-vocal communication	*Vocal communication*	*Concomitant Behaviours*
Independent (non-prompted) PECS mand: defined as any request for an activity, object or other reward using PECS (with or without vocalisation) without an adult's prompt.	**Vocal mand**: defined as any occurrence of a child vocally asking for an activity or object using intelligible words, without PECs.	**Inappropriate behaviour**: defined as behaviours that are challenging or inappropriate, displayed in response to unmet needs, desires or demands, such as aggression, tantrum (crying & screaming), hitting, throwing and pushing.
Other non-vocal mand: defined as any occurrence of a child requesting an activity or objects non-vocally without using PECS. (e.g., pointing, or pulling adult's hands)	**Other vocal initiation**: defined as any spontaneous intelligible vocalisation that is clearly directed at another person, that is not a mand or a response to another person's initiations (e.g., commenting about object or action).	**Stereotypical behaviour**: defined as continuous behaviours that have no communicative function or intent to engage in appropriate behaviour, such as banging toys together, echolalic singing, spinning body or head, and flapping or twisting hands.
Other non-vocal initiation: defined as any non-vocal behaviours directed at another person that are not mands and are not a response to another person's initiations (e.g., non-vocal commenting or showing behaviours, such as a child bringing and showing a toy to his or her mom)	**Immediate Echolalia**: defined as copying someone else's word or phrase that has previously been repeated more than two times, and within two speaking turns of the original utterance.	
	Vocal Labelling: defined as any occurrence of a child vocally naming/labelling an item, object, or activity, which is not an immediate imitation of another person's vocal label, and it is unclear whether this is directed towards another person**.** E.g. upon seeing a baby on the TV, the child says "baby".	
	Non-word Vocalisations: Defined as an utterance of unintelligible words or phrases.	
	Mean Length of Utterances (MLU): defined as the average (calculated using the mean) number of intelligible morphemes spoken in an unbroken succession such as a phrase or sentence. (MLU recorded for all word utterances other than echolalia).	

Parent Behaviours

Four variables relating to parent behaviours that impede child-initiated communication and the amount of parent-child interaction were observed. Parent vocal prompting, gestural prompting, insistence on speech, and responsiveness errors were documented using an event recording system. The amount of parent-child interaction (calculated only for the 10 minute free play component of each session, not the prompted parent-child interaction component) was recorded using a duration recording system. Table 7 provides operational definitions of each of the parent related variables.

Table 7

Operational Definitions of Parent Behaviours

Event recording	***Duration Recording***
Parent Errors	*Parent-Child Interaction*
Vocal Prompting: defined as an audible stimulus by the parent that raises the probability of the child exchanging a picture card or speaking a word or utterance. E.g. the parent vocally requests the child to show or give them the picture. E.g. "give me the picture", "show me..." Does not include prompts of "Do you want more..." or "what do you want? or "what's this?"	**Amount of Parent-Child Interaction**: defined as the amount of time a parent physically engages in interaction with the child, including conversation, play, and during daily routines
Gestural Prompting: defined as a physical movement by the parent that raises the probability of the child exchanging a picture card. E.g. the parent moves the PECS folder closer to the child; the parent points to or touches a picture to indicate a correct response.	
Insistence on Speech: defined as the parent insisting on the child producing speech.e.g. the parent says "Say..."	
Responsiveness Errors: defined as any occurrence of a parent being unresponsive to the child's communicative initiation or mand (vocal and/or using PECS) within 5 sec of the child's initiation.	

Research Design

An alternating-treatments design (ATD; A. E. Kazdin, 1982) enabled direct and temporally contiguous comparison of the differential effects of two different treatment conditions (the intervention condition described below, and a continuation of baseline procedures) relative to each other, on the dependent variables. The alternating treatments design consisted of a baseline phase, an alternating treatment phase, and an optimal condition only phase. The baseline phase consisted of observation sessions to assess the maintenance of skills acquired through the participant's previous PECS training (Yoon, 2012). In the alternating treatment phase, the treatment conditions were randomly assigned to sessions by the toss of a coin. A rule was applied that one of the first two sessions was required to be an intervention condition. In addition, the alternating treatments phase consisted of five repetitions of the alternating sequence to ensure adherence to the standards for single-case design (Kratochwill et al., 2010).

Intervention Condition

The intervention involved restructuring Sophie's natural home environment to create a setting which provided optimal motivating conditions and maximized opportunities for communication, either independent PECS use and/or vocal communication.

Smaller motivating items were placed on the dining room table in transparent containers that were locked with a padlock. Sophie's mother held on to the padlock keys in all intervention condition sessions. As Sophie was unable to open the containers herself, she was required to request assistance to access the item. Larger toys and games that encourage interaction with others or that Sophie was unable to use independently were also utilised.

These were strategically placed on the dining room table where Sophie was required to request access or parental support to use the items. Once Sophie requested an item or support to use an item, using PECS and/or vocal communication, her mother opened the container or gave the item or help to Sophie.

Sophie's mother was given an instruction at the commencement of each session to control Sophie's access to the items, and to entice her using comments such as "wow, what can you see?", or "wow, look at this!", or "what do you want?" when Sophie showed an interest in a particular toy/item.

System of Observations

Each session in all phases and conditions comprised of 20-minutes free-play. In these 20-minute free-play observations, Sophie was free to move in and outside the house and choose her own activities. Her PECS folder was available on the dining room table in the open plan kitchen, dining and living area in all sessions. To obtain a realistic view of the quality of Sophie's communication skills and the quality of the parent-child interaction, Sophie's mother was prompted at the commencement of each session to interact with Sophie as she normally would for at least ten minutes of the session. All sessions were videotaped.

Procedure

Ethics approval for the present study was obtained from Monash University's Human Research Ethics Committee (approval project no: CF08/0997-2008000494; See Appendix G). In addition, the researcher had completed the PECS Level 1 training workshop, the PECS and

behaviour management workshop, and the Language of Emotions workshop, through Pyramid Educational Consultants in Melbourne, Australia.

The research procedure consisted of a baseline phase including pre-intervention measurements (sessions 1-14), an alternating conditions phase (sessions 15-27), and an optimal condition only phase (sessions 28-32). Observation sessions occurred between one to three times each week, at a time convenient to Sophie's family. The majority of sessions were conducted between 4:15pm and 5:30pm on weekdays. A total of 32 free-play observation sessions were conducted over a period of 17 weeks. Observation sessions did not occur for a period of six weeks between sessions 17 and 18 due to the family being away on vacation.

Baseline Phase

Pre-Intervention Measurements

During the Baseline phase, pre-intervention measurements were conducted with Sophie's mother at their home. These included a pre-intervention questionnaire, the Critical Communication Skills Assessment (Frost & Bondy, 2002), and the Behavioural Language Assessment Form (Sundberg & Partington, 1998). Each of these measurements was implemented in an interview format with Sophie's mother during the baseline phase. In addition to interviewing Sophie's mother on her perspective of Sophie's skill level on each of the 12 sections of the Behaviour Language Assessment Form, the researcher rated Sophie's ability by observing her during the baseline free play observation sessions, as well as probing through the use of items and toys.

Baseline Observations

Fourteen unobtrusive baseline observation sessions were conducted at Sophie's home to assess the maintenance of skills acquired through her previous PECS training (Yoon, 2012). During the baseline phase two probe sessions (sessions 8 and 11) were conducted to assess the effect of environmental enhancement on the dependent variables. In these probe sessions the researcher took novel toys that were established as motivating items for Sophie during the pre-intervention assessment and allowed Sophie free access to play with the items. The probe sessions were designed to enhance Sophie's environment with items of interest, and the nature of the toys required Sophie to seek adult assistance to use them; for example, assistance to use shapes on a magnetic drawing board, or assistance to blow up a balloon.

Alternating Treatments Phase

The alternating treatments phase consisted of a total of 13 observation sessions. The treatment conditions (Intervention Condition *A*, and Baseline Condition *B*) were randomly assigned to sessions by a coin toss. The resulting sequence *BABAABAABBAB* met the rule that one of the first two sessions was required to be an intervention condition, as well as the need for five repetitions of the alternating sequence (Kratochwill, et al., 2010). Due to the family being away on vacation for 6 weeks in the alternating conditions phase, Session 18 was a non-randomised baseline condition upon their return and continuation of data collection.

Optimal Condition Only Phase

The optimal condition only phase comprised of five free play observation sessions during which the most optimal condition (established in the alternating treatments phase) was implemented. At the commencement of the optimal condition only phase a parent training session was implemented, during which the child behaviour data from baseline and the alternating treatments phase was shown and discussed with Sophie's mother, and a summary sheet of strategies that her mother could use with Sophie to encourage her communication skills was provided and discussed (see Appendix H).

Observation Reliability

Measurement of the dependent variables was in the form of nonparticipant direct observations of digitally captured video recordings of all sessions. The reliability of the observations was evaluated by having second observers independently record the occurrence of the child and parent dependent variables during at least 30% of all sessions. Two fourth-year psychology students were provided with operational definitions and examples of the target child and parent behaviours. For all sessions, including both duration and event recording, agreement was calculated using a frequency ratio (smaller total/larger total, multiplied by 100) to produce a percentage of agreement (A. E. Kazdin, 2001). The mean interobserver agreement for the child behaviours was 94.72% for the event recording measures, 98.26% for the duration recording measures, and 97.92% for the mean length of utterance measure. The mean interobserver agreement for the parent behaviour event recording measures was 93.13%, and 95.31% for the duration recording measures. These interobserver agreement calculations all exceed the 80% criteria for interobserver reliability recommended by Kazdin (2001).

Results

The data for all observation sessions were collated and means calculated. The data were plotted and visually inspected to determine whether a functional relationship could be established between the intervention condition and the observed behaviours. Figures 5, 6, and 7 present the results for the child non vocal communication behaviours, while Figures 8, 9, 10, 11, 12 and Table 8 present the data for the child vocal communication behaviours. Figure 13 depicts the data for the child concomitant behaviours, and Figures 14 and 15 present the data for the parent dependent variable behaviours.

Pre-Intervention Assessment

Pre-intervention Interview

During the pre-intervention interview, the researcher obtained information about Sophie's family composition and background, her interests and reinforcers, Sophie's communication and social interaction skills, and the presentation of problem behaviours. The interview also gathered information on the social validity and procedural integrity of the PECS training previously implemented (Yoon, 2012).

The interview highlighted that Sophie was not using PECS to communicate unless she was prompted vocally to do so. If Sophie wanted an item or activity, she would take an adult by the hand to the location of the item or activity. Sophie occasionally used single words to request highly reinforcing items. Sophie's mother reported that she had approximately fifty words in her vocabulary but she did not use many of these words functionally. Her mother also reported that Sophie understood simple instructions clearly and that the use of the first/then strategy worked very well for Sophie. According to her mother Sophie was very

interested in and enjoyed listening to music, playing instruments, singing, playing with trains, trucks or the doll house, playing the Wii Game, and games that involve shapes. In terms of food items, Sophie liked ice cream, biscuits, chips, chocolate, lamingtons, and orange juice.

Sophie's mother reported in the interview that she felt that the PECS training that Sophie undertook a few years ago gave Sophie confidence in her communication and her vocabulary and use of sentences increased significantly. She reported that they felt that the effort they put into the PECS training was worth the outcome. To motivate Sophie to use PECS she ensured that the PECS folder was always available to Sophie in the home. The difficulties they experienced in using PECS were misplacing pictures and the folder, forgetting to use PECS in everyday interactions, lack of time in everyday routines, and difficulty with, or forgetting to take the PECS folder with them when leaving home.

Sophie's mother reported that she felt very competent using PECS with Sophie at home. She was taught the procedures and observed the researcher (Yoon, 2012) implementing PECS with Sophie. The researcher also observed her using PECS with Sophie and provided her with feedback on her technique. When presented with questions in the interview related to the procedural integrity of PECS use, however, Sophie's mother indicated that she engaged in five of an identified eight implementer errors, including incorrect timing of the physical prompt in phases I and II, use of vocal prompting, use of gestural prompting, incorrect error correction in phase III, and insistence on speech. She indicated correct use of the open hand prompt, presence of a prompter in phases I and II, and timely reinforcement.

Sophie's mother reported that she was initially apprehensive about PECS training as she did not think it sufficient that her daughter relied solely on pictures to communicate and it concerned her that using pictures would hinder Sophie's vocal language development. Several years after completing the PECS training, Sophie's mother stated that she now

realizes the importance of PECS for Sophie, particularly because her communication and language development have stagnated and she has regressed to using screaming behaviour, which her mother believes is because she is unable to communicate her needs/wants. She stated that she now understands that PECS has to be used consistently and properly to get the most out of it.

Critical Communication Skills Assessment

The Critical Communication Skills Assessment (Frost & Bondy, 2002) indicated that Sophie does not request reinforcers or help appropriately for her age. Sophie uses limited single words for known activities, takes an adult's hand leading them to the area where the wanted item/activity is located and points to the item/activity, or she climbs on a chair to access the item herself. The assessment also demonstrated that Sophie does not appropriately request a break, but rather leaves independently and if she is brought back she has a tantrum. Sophie rejects an item by pushing the item away with screaming or shouting which is also not considered appropriate for her age. Sophie appropriately accepts and affirms items and activities, responds to wait, and responds to visual and oral directions. She demonstrates difficulty transitioning between activities, particularly when leaving highly reinforcing activities.

Behaviour Language Assessment Form

Ratings of Sophie's level of performance on items of the Behaviour Language Assessment Form (Sundberg & Partington, 1998) are presented in Figure 4.

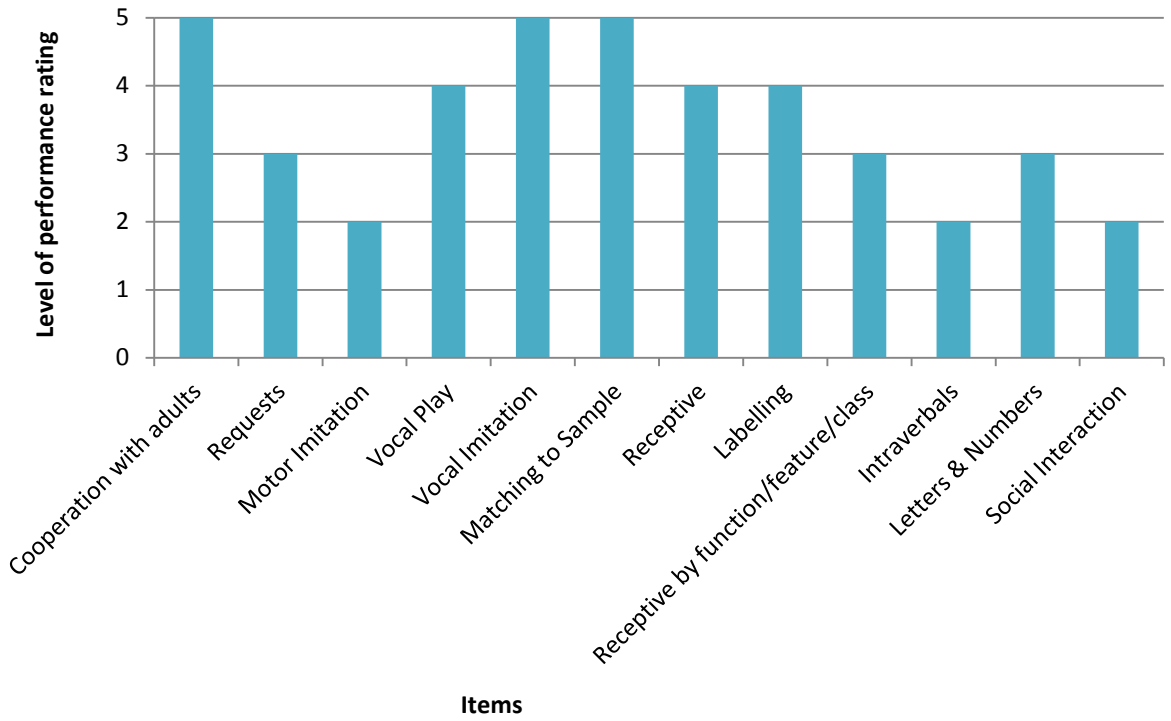

Figure 4. Ratings of Sophie's level of performance on items of the Behaviour Language Assessment Form (Sundberg & Partington, 1998).

Figure 4 demonstrates that Sophie is highly cooperative with adults (rating 5). Her lower performance rating on requesting (rating 3) indicated that she would benefit from mand training. Her rating on Matching to Sample (rating 5) indicated a well developed matching ability and that a picture communication system may be successful for Sophie. Sophie's low score on the Motor Imitation Item (rating 2) coupled with higher rating on Vocal Imitation (rating 5) suggested, however, that a focus on speech as a response form may be most appropriate for Sophie. In addition, Sophie's higher score on Vocal Play (rating 4) further suggested that she may be able to quickly acquire vocal language, provided appropriate training.

Child Behaviours

Non Vocal Communication

The data for non vocal communication are presented in Figures 5, 6, and 7.

During the original PECS training, Sophie acquired the mastery criteria for independent PECS exchanges in phases I to VI of the PECS training protocol in a total of 46 sessions with 723 trials (Yoon, 2012). Figure 5 shows Sophie's independent PECs manding skills at follow up 3years 7 months after training completed and the effect of the intervention condition on her use of PECS for independent manding.

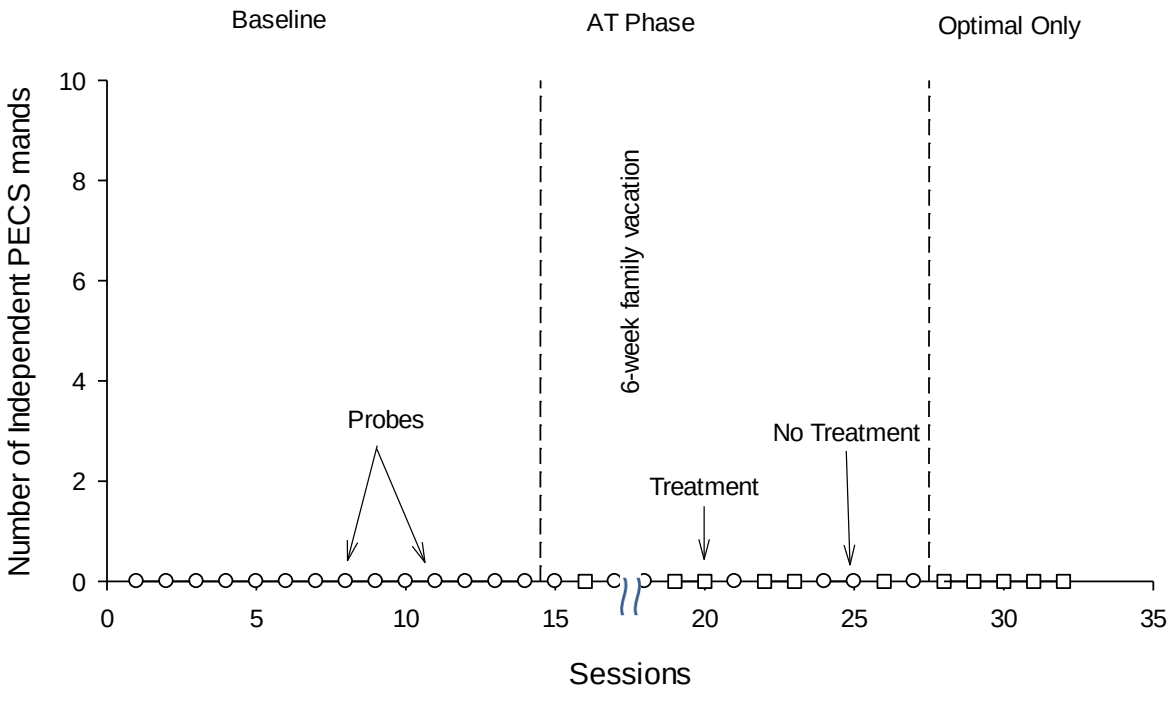

Figure 5. Total number of Independent PECS mands in each free-play observation session.

As can be seen from Figure 5, Sophie did not use PECS independently to mand in any of the free-play observation sessions during the baseline phase, or in either of the treatment conditions. The data for Sophie's use of other non-vocal mands and other non-vocal initiations are presented in Figures 6 and 7.

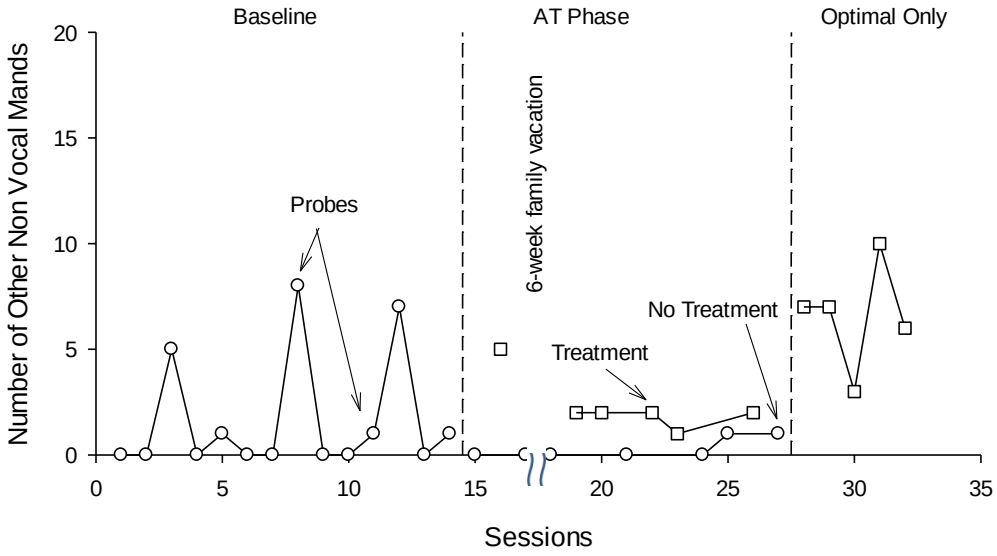

Figure 6. Total number of other non-vocal mands in each free-play observation session.

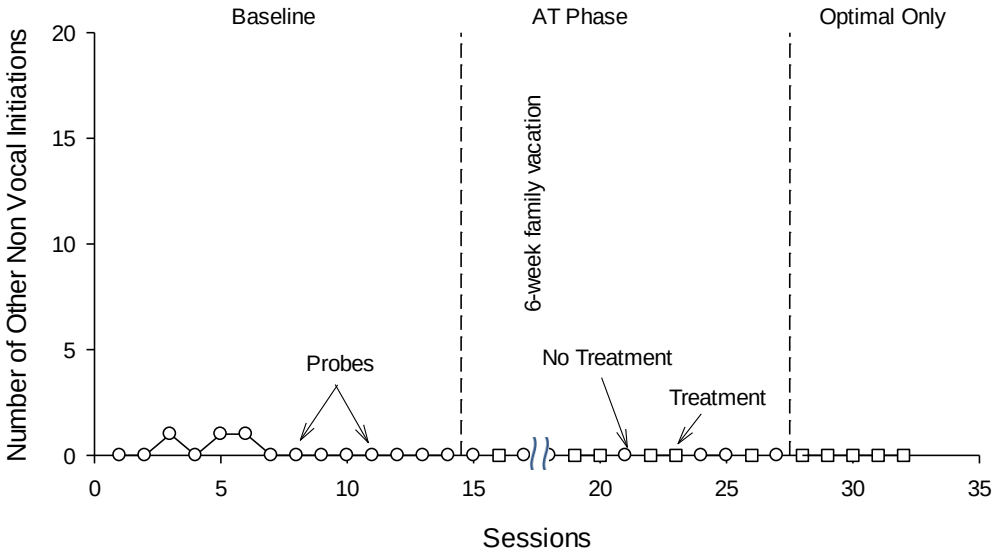

Figure 7. Total number of other non-vocal initiations in each free-play observation session.

During the original PECS training, in home generalisation measurements demonstrated that Sophie's average use of other non vocal mands ranged from 0 to 2 during baseline, PECS training and maintenance phases, while her use of other non vocal initiations ranged from 0 to 1.8 (Yoon, 2012). Figure 6 demonstrates that in the current study Sophie displayed other non vocal mands more frequently during the treatment condition of the alternating treatments phase (*M* = 2.30, range = 1.00-5.00) and the Optimal Only Phase (*M* = 6.60, range = 3.00-10.00), than during baseline (*M* = 2.26, range = 0.00-8.00) and the no treatment condition of the alternating treatments phase (*M* = 0.29, range = 0.00-1.00). Her use of other non-vocal initiations, as depicted in Figure 7, was minimal with an average of 0.21 (range = 0.00-1.00) in the baseline phase only.

Vocal Communication

The data for Sophie's use of vocal communication is presented in Figures 8, 9, 10, 11 and 12, and Table 8.

During the original PECS training, in home generalisation measurements demonstrated that Sophie's average use of vocal mands ranged from 0 to 1 during baseline, PECS training, and maintenance phases and her use of other vocal initiations ranged from 0 to 1.4 across all phases (Yoon, 2012). Figures 8 and 9 depict Sophie's use of vocal mands and other vocal initiations in baseline observations of the present study and the effect of the intervention condition on her use of vocal mands and other vocal initiations.

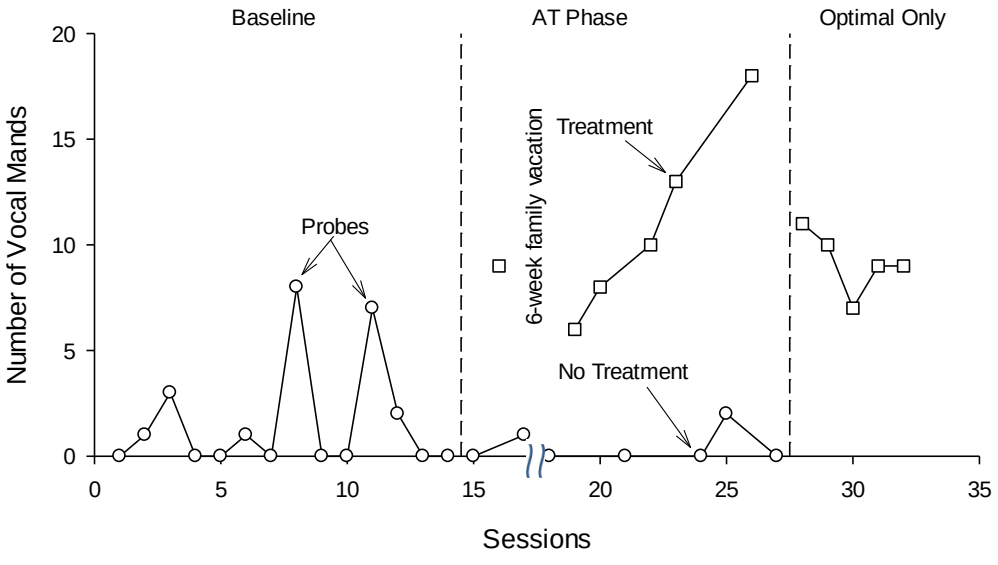

Figure 8. Total number of vocal mands in each free-play observation session.

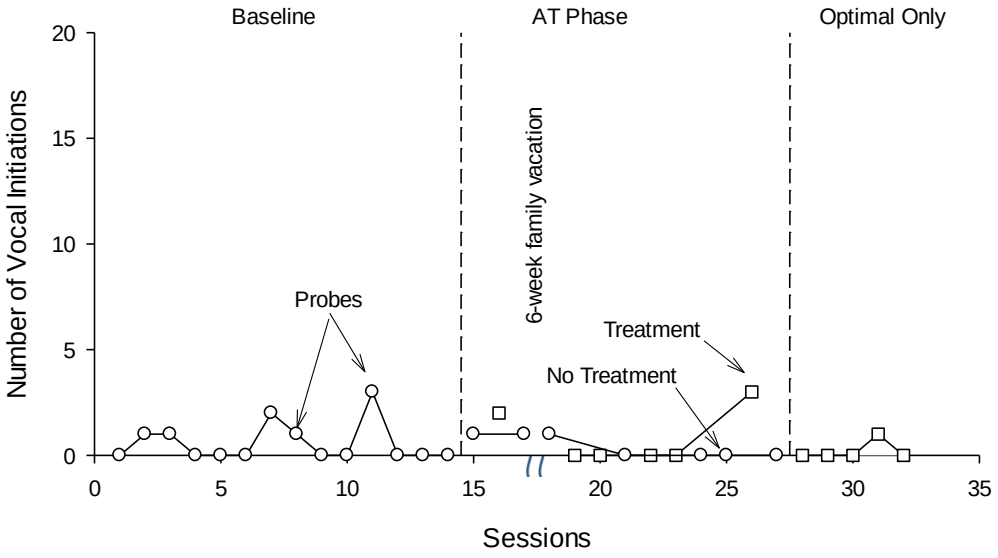

Figure 9. Total number of other vocal initiations in each free-play observation session.

As can be seen from Figure 8, Sophie's use of vocal mands was greater in the probe sessions (8 and 11), the treatment condition of the alternating treatments phase (*M* = 10.67, range = 6.00-18.00) and the optimal treatment only phase (*M* = 9.2, range = 7.00-11.00), than the baseline phase (*M* = 0.58, range = 0.00-3.00) and no treatment condition of the alternating treatments phase (*M*=0.43, range = 0.00-2.00); while Figure 9 demonstrates that her use of vocal initiations other than mands was minimal across all phases and conditions, occurring on average 0.33 (range= 0-2) in baseline, 0.83 (range = 0-3) in the treatment condition of the alternating treatments phase, 0.75 (range 0-1) in the no treatment condition of the alternating treatments phase, and 0.2 (range = 0-1) in the optimal condition only phase. Table 8 shows the data for Mean Length of Utterance.

Table 8

Mean Length of Utterance (MLU) spoken during each phase in free play observation sessions

Phase		MLU	Range
Baseline		1.93	1.00-3.07
Alternating Treatments Phase	Condition A	1.87	1.60-2.22
	Condition B	1.85	1.00-3.00
Optimal Condition Only		1.88	1.52-2.25

Table 8 displays the MLU of intelligible vocalisations during free play observation sessions. As can be seen from Table 8, Sophie's MLU remained stable across phases and conditions. Figure 10 presents the data for vocal labelling.

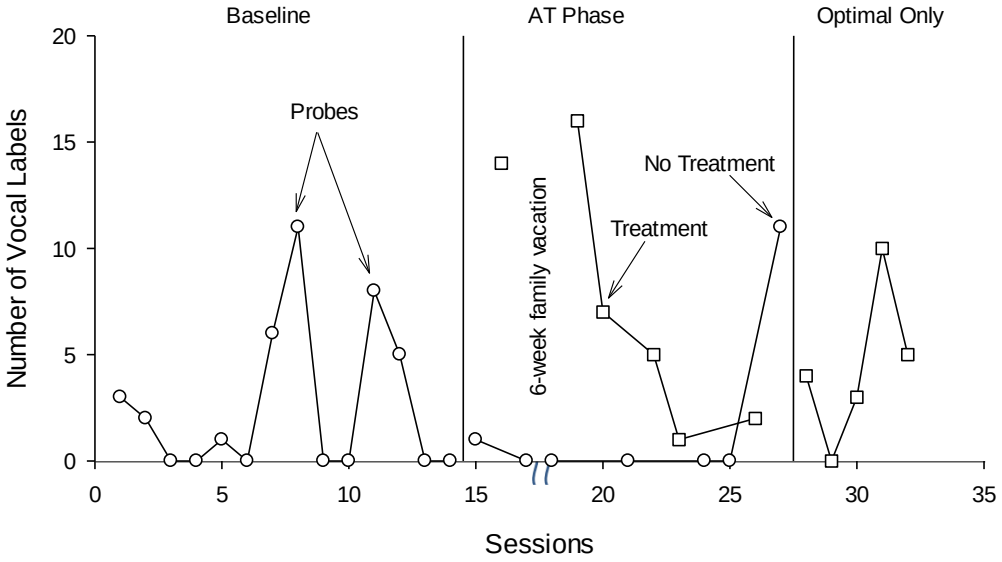

Figure 10. Total number of vocal labels in each free-play observation session.

As depicted in Figure 10, the data demonstrate an increase in vocal labelling during the probes sessions during baseline (sessions 8 and 11). On average vocal labelling occurred more frequently during the treatment condition of the alternating treatments phase (*M* = 7.50, range = 1.00 - 16.00) and the optimal condition only phase (*M* = 4.40, range = 0.00 – 10.00) than baseline phase (*M* = 1.42, range = 0.00-6.00) and the no treatment condition of the alternating treatments phase (*M* = 1.71, range = 1.00 - 11.00). The data for non-word vocalisations and echolalic speech are presented in Figures 11 and 12.

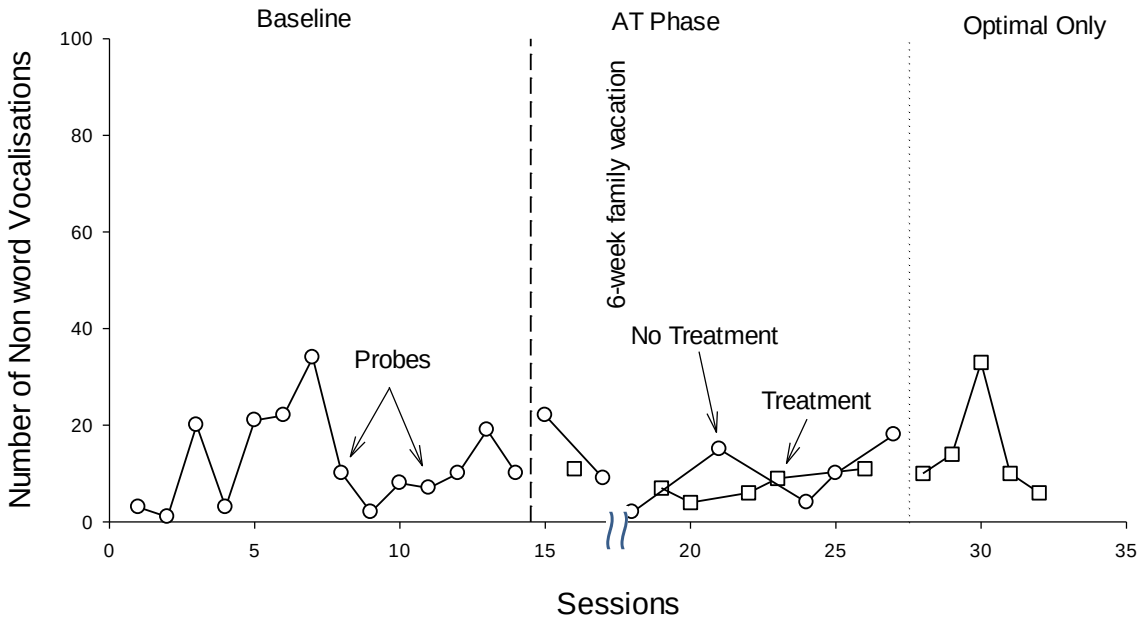

Figure 11. Total number of non-word vocalisations observed in each free play observation session.

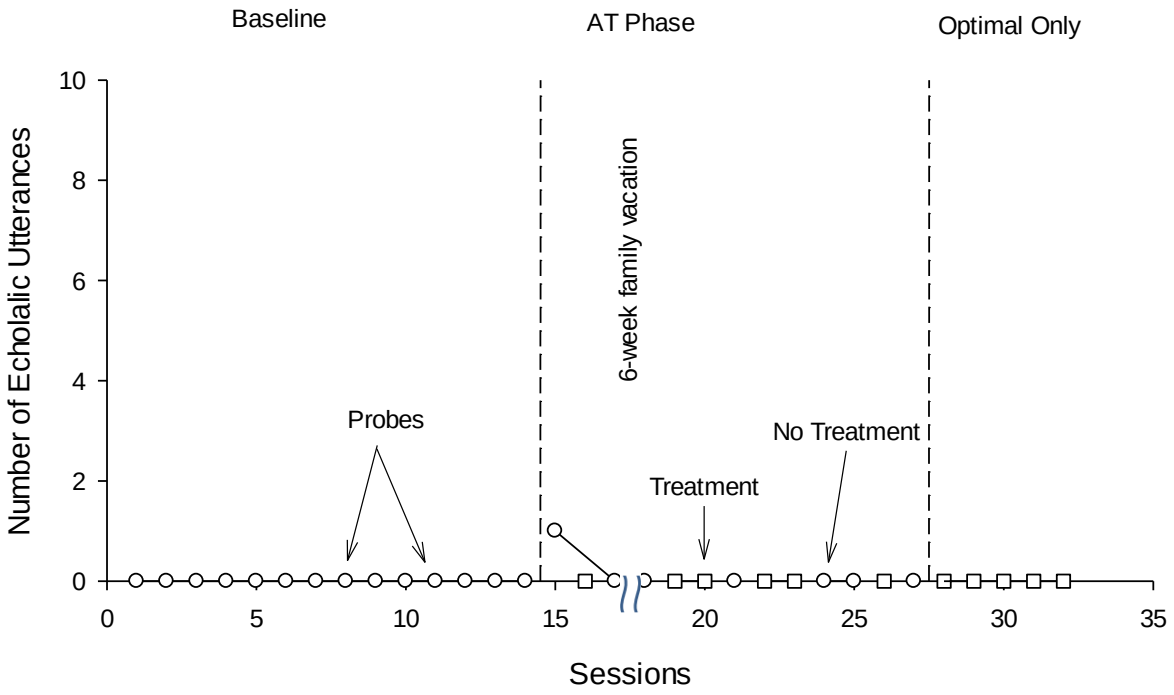

Figure 12. Total number of echolalia utterances observed in each free play observation session.

The data in Figure 11 depict that the occurrence of non word vocalisations was consistent across all phases and conditions, occurring at an average of 12.75 (range = 1.00 – 34.00) in baseline, 8.00 (range = 4.00 – 11.00) during the treatment condition of the alternating treatments phase, 11.43 (range = 2.00-22.00) during the no treatment condition of the alternating treatments phase, and 14.60 (range 6.00 – 33.00) during the optimal treatment condition only phase.

During the original PECS training, Sophie's use of echolalia ranged from an average of 0.00 to 0.42 during baseline, PECS training and maintenance phases during in home generalisation free play sessions (Yoon, 2012). Figure 12 demonstrates that Sophie did not engage in echolalic speech in baseline observations of the present study, and only

demonstrated one episode of echolalia during a no treatment condition in the alternating treatments phase.

Concomitant Behaviours

The data for inappropriate and stereotypical behaviour are presented in Figure 13.

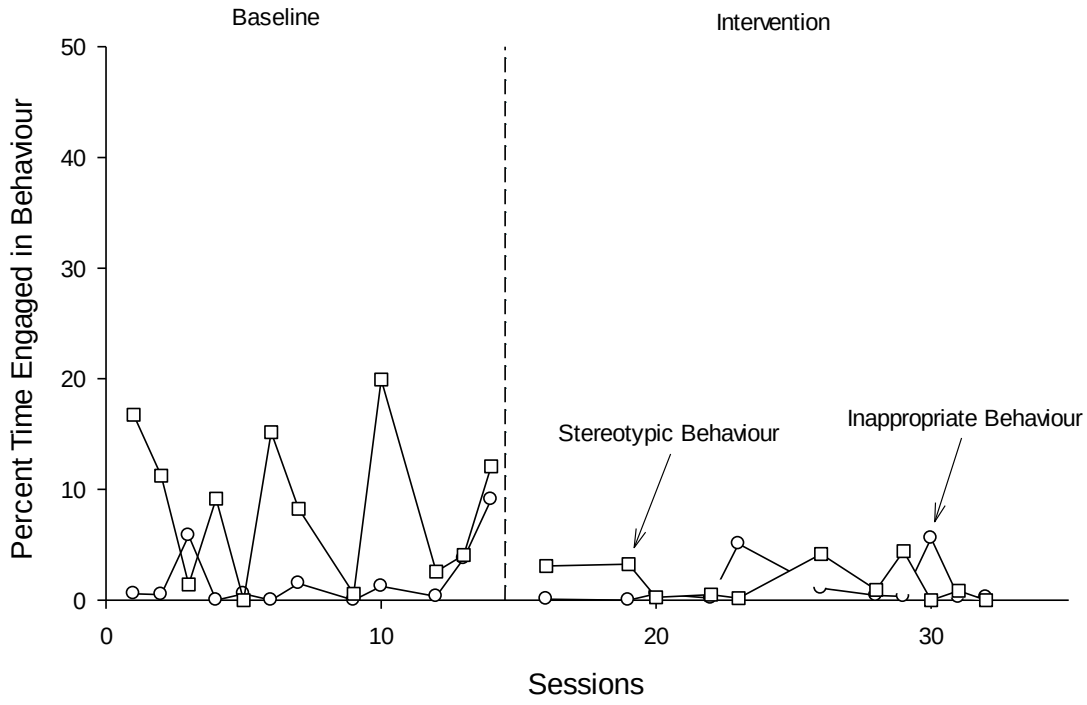

Figure 13. Percentage of each free play session time engaged in inappropriate and stereotypical behaviour.

During the original PECS training Sophie's engagement in inappropriate behaviour decreased from an average of 3.80 occurrences (range = 0.00 – 20.00) in baseline to 0.00 in the maintenance phase during in home generalisation sessions (Yoon, 2012). In baseline

observations of the present study, as depicted in Figure 13, Sophie engaged in inappropriate behaviour on average for 1.95% (range = 0.00% - 9.08%) of free play session time during the baseline phase (excluding the probe sessions), and 1.26% (range = 0.00% - 5.58%) of session time during the intervention (treatment condition of the alternating treatments phase and optimal condition only phase).

During the original PECS training Sophie's use of stereotypical behaviour also decreased from an average of 28.00 occurrences (range = 0.00 – 55.5) in baseline to 0.00 in the maintenance phase during in home generalisation sessions (Yoon, 2012). Figure 13 demonstrates that in baseline observations of the present study Sophie engaged in stereotypical behaviour on average 8.44 % (range = 0.00% - 19.98%) of free play session time during baseline, which decreased to 1.60% (range = 0.00% - 4.43%) of session time during the intervention (treatment condition of the alternating treatments phase and optimal condition only phase).

Parent Behaviours

Parent facilitative behaviours were recorded to occur at a rate of 0.41 per session (*N*=13, range = 0-6) across all phases of the study. During the baseline phase and no treatment sessions of the alternating treatment phase parent facilitative behaviours were not observed. In the treatment sessions of the alternating treatment phase and the optimal only phase facilitative behaviours were observed at a rate of 1.00 (*N*=6, range = 0-6) and 1.40 respectively (*N*=7, range = 0-2). Parent praises occurred at a rate of 6.72 per session (*N*=215, range = 0-16) across all phases of the study. During the baseline phase and no treatment sessions of the alternating treatment phase praises occurred at a rate of 5.36 (*N*=75, range = 0-16) and 8.43 per session (*N*=59, range = 3-14), respectively; while during the treatment

sessions of the alternating treatment phase praises occurred at a rate of 9.5 per session (*N*=57, range = 7-14), and during the optimal only phase at a rate of 4.8 per session (*N*=24, range = 1-8). Figure 14 shows the data for the amount of free play unprompted session time the parent engaged in interaction with her child and Figure 15 depicts the data for the rate of parent errors per session.

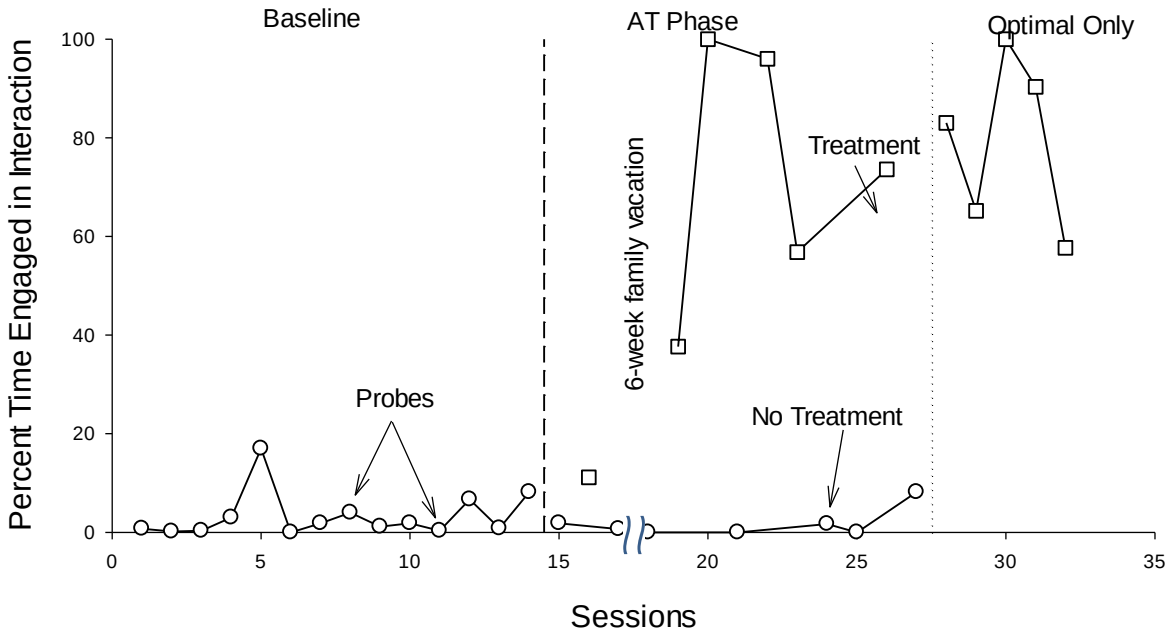

Figure 14. Percentage of parent-child interaction during the unprompted time of each free play session.

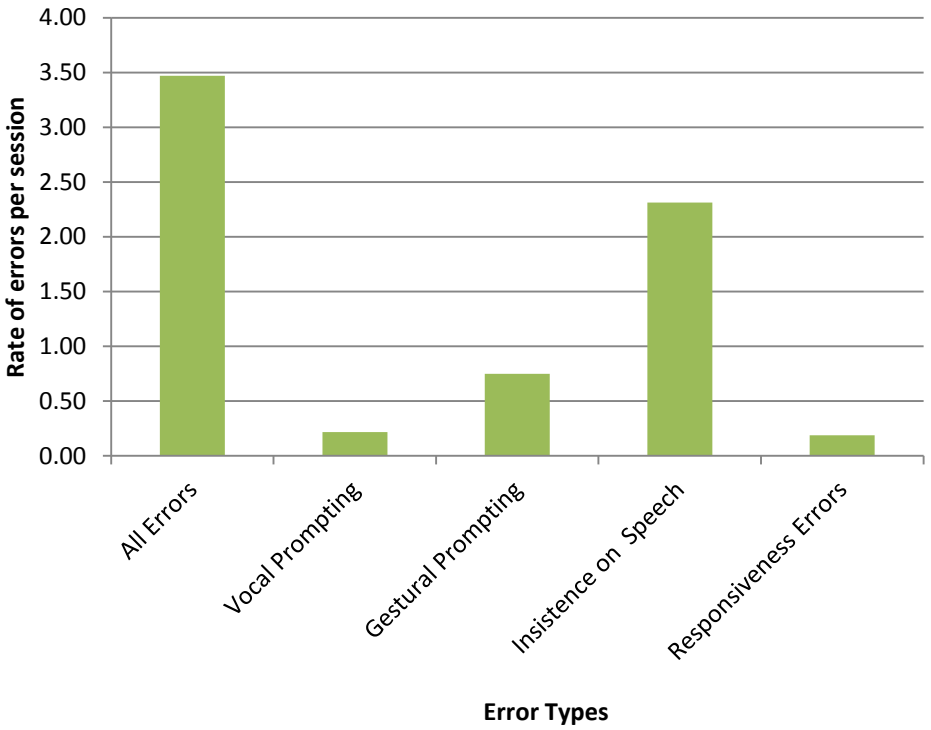

Figure 15. Rate of parent errors per session

The data in Figure 14 depicts that the amount of time Sophie's mother spent in interaction with her during the unprompted component of each free play session was on average greater in the treatment condition of the alternating treatments phase (*M*= 62.55%, range = 11.17% - 100.00%), and the optimal condition only phase (*M* = 79.23, range = 57.67% - 100%), than the baseline phase (*M* = 3.48%, range = 0.00% - 17.00%) and no treatment condition of the alternating treatments phase (*M* = 1.76%, range = 0.00% - 8.17%).

As can be seen from Figure 15, parent errors occurred at a rate of 3.47 per session (*N*=111, range = 0-17). Insistence on speech occurred at a rate of 2.31 per session and constituted 66.67% (*N*= 74, range = 0-17) of all observed errors. Gestural prompts occurred at a rate of 0.75 per session and formed 21.62% (*N*= 24, range = 0-5) of all observed errors. Vocal prompts occurred less frequently at a rate of 0.22 per session and comprised 6.31%

(*N*= 7, range = 0-2) of all observed errors. Responsiveness errors also occurred less frequently at a rate of 0.19 per session and represented 5.41% (*N*= 6, range = 0-3) of all observed errors.

Discussion

The present study aimed to conduct a long-term follow-up of the maintenance of a child's PECS and vocal communication skills 3 years 7 months post training of all six phases of the PECS intervention, and investigate the effect of contextual variables on a child's PECS use. The results, through baseline observations and pre-intervention assessments, demonstrated a decrease in the participant's PECS and vocal communication use and an increase in inappropriate and stereotypical behaviour, at 3 years 7 months follow-up, compared to the last phase of the original PECS training completed (Yoon, 2012). These results are inconsistent with previous follow-up studies which have demonstrated a maintenance or increase in PECS or vocal communication use, and a maintenance or decrease in inappropriate and stereotypical behaviour, one week to one year post intervention (Charlop-Christy, et al., 2002; Conklin & Mayer, 2011; Gordon, et al., 2011; Greenberg, et al., 2012b; Park, et al., 2011; Rosales & Rehfeldt, 2007; Travis & Geiger, 2010).

Maintenance of child behaviour change is, however, dependent on the continued use of intervention procedures and the provision of opportunities for the child to use and practice learned skills, by relevant adults in the child's environment (R. A. Baer, 1989; Greenberg, et al., 2012b; Kennedy, 2002). Baseline follow up assessments and observations of the participant's home environment highlighted the contextual variables impacting on the participant's use of PECS and vocal communication skills. Within the home environment there was no requirement or need for the participant to communicate her needs, as she had

free access to everything she required and wanted; and for items out of reach, she had learnt to manipulate furniture to gain access to these items, for example climbing on chairs. In addition, the participant's mother reported pre-empting what her child was going to want or need and provided access to that item to avoid problem behaviours. Therefore, the participant's environment did not support her to practice and build fluency in her PECS or vocal communication skills.

With the introduction of motivating operations and a restructure of the participant's environment to maximise communicative opportunities, results of the present study demonstrated not only a significant increase in the number of communicative mands the participant made in probe and intervention conditions, compared to baseline conditions, but further the participant's preference for vocal communication over PECS to mand. These results are consistent with the outcomes of the Behaviour Language Assessment Form, which indicated that with the appropriate environment and training the participant could quickly acquire vocal language. These results are also consistent with those obtained by Gordon et al. (2011), who demonstrated a long term maintenance effect (nine months post intervention) of children's spontaneous use of vocal language for requesting objects, which was not maintained for the spontaneous use of picture cards for requesting, and suggests that children's use of vocal language, particularly vocal manding, may surpass their need to use PECS for requesting. While no effect of the intervention condition on the participant's use of vocal or non-vocal initiations other than mands, were observed in the present study, it is possible that the participant requires further practice to build fluency in manding skills before other communicative functions are re-introduced or taught, particularly given the hypothesized progression in which children with ASD acquire communicative functions (individually) as opposed to typically developing children (concurrently; Wetherby, 1986).

An active strategy for programming for the maintenance of treatment gains is teaching the procedures and learning principles to relevant adults in the child's life, for example parents (R. A. Baer, 1989; Kennedy, 2002). This strategy was employed by Yoon (2012), who taught the participant's mother the technical PECS protocol procedures and provided in vivo feedback regarding her use of PECS with her child at home. Despite this training and the participant's mother reporting, in the pre-intervention interview of the present study, that she felt very competent in using PECS with her child at home; when presented with multiple choice questions related to the procedural integrity of PECS use, the participant's mother indicated that she engaged in five of the identified eight PECS implementer errors. These errors included incorrect timing of the physical prompt in phases I and II, incorrect error correction in phase III, use of gestural prompts, use of vocal prompts, and insistence on speech. Results of the present study further demonstrated, through direct observation, a high rate of the participant's mother insisting on her child's production of speech and the use of gestural and vocal prompts.

Within the PECS training protocol, the production of vocal language by a student is in no way required. Withholding access to a requested item until the student attempts to say or imitate a word has the potential to undermine a student's communication effort, and is therefore not used within the training protocol to promote the development of vocal language (Frost & Bondy, 2002). Rather, vocal modelling, time delay, and differential reinforcement strategies are employed to address the development of vocal language (Bondy & Frost, 2008; Frost & Bondy, 2002). The importance of the accurate use of these teaching strategies, as specified in the training protocol, and not introducing strategies or prompts that are not specified, is primarily that the student remains motivated to engage in self-initiating communicative interactions rather than become dependent on prompts to complete communicative exchanges (Sundberg, 2008). That vocal prompts, gestural prompts and

insistence on speech errors proved to be the most common errors reported and utilised, suggests that refraining from providing a prompt in order to help the student learn a skill may be a difficult behaviour to control among parents.

The results of the present study, therefore, highlight a need not only for parent education in the use of PECS with their children to ensure accurate implementation of teaching strategies and a positive learning environment for children and parents, but further highlight the importance of providing ongoing support to parents in the use of PECS with their children, as well as monitoring the ongoing procedural integrity of parent implemented PECS, to ensure the maintenance of gains acquired through PECS training. These results should, however, be interpreted in the context of several methodological limitations. The main limitation of the present study is limited external validity of the results due to small sample size. Future research examining the maintenance of gains acquired through PECS training, including the contextual variables impacting on that maintenance as well as ongoing monitoring of procedural integrity, is warranted with larger samples or in a greater number of single subject experimental designs. The result of the present study, indicating that on average the participant and her mother spent a greater amount of time during the unprompted component of each free play session interacting in the treatment conditions than in baseline or no treatment conditions, should be interpreted with caution. This result is likely an artefact of the intervention procedure rather than concomitant behaviour change observed in the parent, in that the intervention procedure necessitated the participant to interact with her mother to gain access to desired items in the treatment conditions. In addition, the present study incorporated only limited measures of parent behaviour and as such did not ensure that the parent did not change her behaviour on the "no treatment"condition days. This is a limitation of home-based interventions and a challenge of working in naturalistic settings, which do not afford the same degree of control as laboratory settings. Future research should incorporate more comprehensive measures of parent behaviour

across conditions. It is also important to note that in the initial study (Yoon, 2012) there was a reported decrease in some aspects of the participant's communication skills during the maintenance phase, three weeks after completing Phase VI of the PECS training protocol, which likely predicted the outcomes obtained in this follow- up study. Further research that extends beyond 12 months post intervention and incorporates multiple maintenance probes at set intervals is required.

Despite these limitations, the current study contributes to the literature on the social validity of the PECS program and the procedural integrity of parent-implemented PECS in naturalistic settings. The results provide support for the PECS training protocol requirement to utilise PECS outside of formal training sessions to promote generalisation and social validity, through functional use of the skill; as well as the need to rearrange the environment to maximise communicative opportunities. The results also demonstrate a definite need for parent education and ongoing support in the delivery of PECS with their children, to ensure accurate implementation of the training protocol, and therefore a positive learning experience for children and parents, as well as improvement in children's communication skills, and maintenance of those gains.

CHAPTER SIX

DISCUSSION

The present series of studies aimed to extend the PECS literature, and fill some research gaps concerning the social validity and procedural integrity of parent implemented PECS in naturalistic settings. This was accomplished utilising three approaches: an analysis of videos uploaded to YouTube by parents demonstrating PECS use with their children, an internet survey distributed to parents via national and international PECS and ASD organisations, and a long-term follow-up of the maintenance of a child with ASD's PECS and vocal communication skills 3years 7months post training of all six phases of the PECS training protocol. The results of these three studies have demonstrated that despite parents indicating that they feel overwhelmingly positive about the PECS program (including the program's effectiveness and ease of implementation), parents still largely reported or were observed engaging in procedural errors. In addition, there was a lack of the long-term maintenance of gains acquired through PECS training. These results are important as they arguably give an indication of the number of parents making errors using PECS with their children in non-research conditions, and they highlight the contextual variables that are likely to affect the maintenance of gains acquired through PECS training.

The results of the internet survey and follow up study provide support for the social validity of the PECS program. Almost all respondents in the internet survey indicated that they felt positive or very positive about PECS and would recommend PECS to others in a similar situation. The majority of respondents indicated that they felt that the effort that they put into the PECS training was worth the outcome. This is consistent with the parent report

in the pre-intervention interview of the follow-up study, in which the participant's mother stated that she felt that the effort they put into their child's PECS training was worth the outcome.

Consistent with previous studies documenting the effectiveness of PECS in teaching functional communication skills (Anderson, et al., 2007; Bondy & Frost, 1994; D. Carr & Felce, 2007b; Charlop-Christy, et al., 2002; Jurgens, et al., 2009; Liddle, 2001; Schwartz, et al., 1998), the results of the internet survey also demonstrated that the majority of respondents believed that PECS was a very effective method for improving their children's communication skills. Similarly in the follow-up study, the participant's mother reported in the pre-intervention survey that she believed that the PECS training her daughter had undertaken had given her confidence in her communication and her vocabulary and use of sentences increased significantly. In the internet survey, 70% of respondents also indicated that their child's use of vocal language had increased in conjunction with PECS training. This is consistent with previous research that has demonstrated that PECS may in fact promote the development of independent vocal language (Bondy & Frost, 1994; Cannella-Malone, et al., 2010; D. Carr & Felce, 2007a; Charlop-Christy, et al., 2002; Ganz & Simpson, 2004; Jurgens, et al., 2009; Kravits, et al., 2002; Liddle, 2001; Magiati & Howlin, 2003; Schwartz, et al., 1998; Tincani, et al., 2006; Travis & Geiger, 2010; Yoder & Stone, 2006a). Despite the recognized benefits of AACs, some parents and professionals continue to be hesitant to implement an AAC intervention due to concerns that AAC will inhibit vocal language development (Millar, et al., 2006; Schlosser & Wendt, 2008). Several research reviews have, however, demonstrated that AAC interventions do not impede vocal language development and many studies have demonstrated that there is potential for gains in vocal language (Millar, et al., 2006; Schlosser & Wendt, 2008). Consistent with these findings,

none of the respondents in the internet survey indicated a decrease in their child's vocal language skills following PECS training.

The results of the internet survey also provide support for the effectiveness of PECS in improving other behaviours or skills. Eighty-eight percent of respondents indicated an improvement in other areas of their child's behaviour or skills, and none of the respondents indicated a worsening of their child's behaviour or skills. This is consistent with previous research that has demonstrated increases in social-communicative behaviours and decreases in problem behaviours in association with PECS training (Anderson, et al., 2007; Charlop-Christy, et al., 2002; Frea, et al., 2001; Jurgens, et al., 2009; Magiati & Howlin, 2003). The improvements noted by parents in the internet survey include reduced child frustration and anxiety, reduced tantrums and screaming behaviours, and reduced violent behaviours.

Another method for assessing the social validity of interventions is the monitoring of procedural integrity (Gresham & Lopez, 1996). Several researchers have suggested that procedural integrity is the critical link between the acceptability of interventions (social validity) and their use, as interventions that are perceived by consumers to be effective and acceptable may be implemented with greater compliance and adherence to the protocol than interventions perceived as ineffective (Gresham, 1997; Gresham & Lopez, 1996; A. E. Kazdin, 1982). The results of this series of studies, however, demonstrated a high rate of observed and self-reported parent engagement in procedural errors, despite parents indicating that they feel overwhelmingly positive about the PECS program, including the program's effectiveness and ease of implementation.

The results of the YouTube analysis demonstrated that 43% of the videos contained errors and that 61% of the observed exchanges depicted parents incorrectly apply the specific teaching strategies incorporated in the PECS training protocol and engaging in techniques

that are not advised or actively discouraged in the training protocol. These results were corroborated by parent self-report in the internet survey where all of the parent respondents reported engagement in at least one of the identified implementer errors, and in the follow-up study in which the participant's mother reported that she engaged in 63% of the identified PECS implementer errors. The types of errors that parents were observed or self reported engaging in most frequently, however, differed across each of the three studies. In the YouTube analysis, parents were observed engaging in high rates of vocal prompting and incorrectly using the 4-step error correction strategy when using PECS with their children. In the internet survey, however, parent self-report demonstrated a high occurrence of gestural prompts, and incorrect use of the open hand prompt. While in the follow-up study the participant's mother was observed engaging in high rates of insistence on speech and gestural prompt errors. These varying results are likely due to the small sample size in each study.

Despite the differences in the type of errors that parents are most frequently engaging in, each of the studies demonstrated a high rate of procedural errors by parents when using PECS with their children in naturalistic settings. The importance of the accurate use of the teaching strategies, as specified in the PECS training protocol, and not introducing strategies or prompts that are not specified, is primarily that the student remains motivated to engage in self-initiating communicative interactions rather than become dependent on prompts to complete communicative exchanges (Sundberg, 2008). For example, vocal prompts are not used in phases I to IV of the PECS training protocol (Frost & Bondy, 2002). If the student were to give the picture to the communicative partner only after the communicative partner said "What do you want?" he would be responding to the question rather than learning to initiate communicative interactions (Frost & Bondy, 2008). Similarly, gestural prompts are not used in phases I to IV of the PECS training protocol, and accurate timing of the open

hand prompt during phases I and II is also essential, to reduce the likelihood of a student becoming prompt dependent (Frost & Bondy, 2002).

Correct use of the error correction strategy is also essential in teaching students to independently discriminate between pictures (Frost & Bondy, 2002, 2008). While it may be easier for the trainer to simply show the student the correct picture and provide access to that item, this is likely to result in the student learning that he only has to wait for the trainer to point to the correct picture and then give that picture to the trainer, a prompted response, to gain access to the item. The student would not be learning independent picture discrimination.

Within the PECS training protocol, the production of vocal language by a student is also in no way required and withholding access to a requested item until the student attempts to say or imitate a word has the potential to undermine a student's communication effort (Frost & Bondy, 2002). While the PECS program aims to teach students functional communication, it does not disregard the development of vocal language. Through vocal modelling, time delay, and differential reinforcement strategies, it addresses the development of vocal language (Bondy & Frost, 2008; Frost & Bondy, 2002).

The accurate use of each of these teaching strategies, and not introducing strategies or prompts that are not specified in the PECS protocol, is essential to ensure that the student remains motivated to engage in self-initiating communicative interactions rather than become dependent on prompts to complete communicative exchanges (Sundberg, 2008). That vocal prompts, gestural prompts and insistence on speech errors proved to be amongst the most common errors reported and utilised across these studies, suggests that refraining from providing a prompt in order to help a student learn a skill may be a difficult behaviour to control among parents. An interesting finding of the internet survey study is that despite the

high occurrence of implementer errors, the majority of respondents indicated that they did not find PECS difficult to implement but rather found the program to be straightforward to implement. This suggests that the PECS program may appear deceptively simple, and highlights a need for greater parent education and support in the delivery of PECS with their children, to ensure accurate implementation of the technical teaching strategies of the PECS protocol to effectively improve children's communication skills, and to ensure a positive learning experience for both parents and children. This is particularly important in light of the results of the internet survey study which indicated that only a small percentage of the sample had read the PECS training manual or attended a PECS training course provided by a practitioner or Pyramid Education Consultants, and that several respondents indicated that they did not receive any ongoing support in the delivery of PECS with their children.

An important component of the social validity of an intervention relates to the generalisation or maintenance of treatment effects over time. Incorporation of maintenance measures provides information not only on how social contexts affect and are affected by interventions, but also the ecological variables within that social context that sustain or do not sustain those behaviour changes (Kennedy, 2002), and thereby provides information on the social validity of an intervention. Within the PECS literature there is, however, a lack of maintenance data beyond 12 months post intervention. The long-term follow up study aimed to fill this research gap and investigated the maintenance of treatment gains 3years 7months post PECS intervention with one child participant. Contrary to hypothesized predictions, the results demonstrated a decrease in the participant's PECS and vocal communication use and an increase in inappropriate and stereotypical behaviour at follow-up, compared to the last phase of PECS training completed. These results are inconsistent with previous follow-up studies which have demonstrated a maintenance or increase in PECS or vocal communication use, and a maintenance or decrease in inappropriate and stereotypical behaviour, one week to

one year post intervention (Charlop-Christy, et al., 2002; Conklin & Mayer, 2011; Gordon, et al., 2011; Greenberg, et al., 2012b; Park, et al., 2011; Rosales & Rehfeldt, 2007; Travis & Geiger, 2010).

Maintenance of child behaviour change is, however, dependent on the continued use of intervention procedures and the provision of opportunities for the child to use and practice learned skills, by relevant adults in the child's environment (R. A. Baer, 1989; Greenberg, et al., 2012b; Kennedy, 2002). Baseline follow up assessments and observations of the participant's home environment highlighted the contextual variables impacting on the participant's use of PECS and vocal communication skills. Within the home environment, the presence of readily accessible desirable objects reduced the need for the participant to communicate her needs and desires for particular objects. In addition, the participant's mother reported pre-empting what her child was going to want or need and provided access to that item to avoid problem behaviours. The participant, in other words, had no motivation or reason to communicate her needs, with or without PECS, even though she demonstrated that she had the necessary PECS skills. Therefore, the participant's environment did not support her to practice and build fluency in her PECS or vocal communication skills.

Drasgow, Halle, and Sigafoos (1999) emphasised that a critical factor in facilitating communication growth is to ensure that learners have reason to communicate. One technique that increases this motivation to communicate is known as environmental arrangement, which entails manipulating the availability of activities and materials to create opportunities for communication in natural settings (Drasgow, et al., 1999). Within the follow-up study environmental arrangement of the participant's home was employed to maximise motivating operations and promote communicative opportunities. The results demonstrated a significant increase in the number of communicative mands the participant made in probe and intervention conditions, compared to baseline conditions, as well as the participant's

preference to use vocal communication over PECS to mand. These results are consistent with those obtained by Gordon et al. (2011), who demonstrated a long term maintenance effect (nine months post intervention) of children's spontaneous use of vocal language for requesting objects, which was not maintained for the spontaneous use of picture cards for requesting, and suggests that children's use of vocal language, particularly vocal manding, may surpass their need to use PECS for requesting.

The results of the follow-up study highlight the importance of environmental arrangement within naturalistic settings to promote motivating operations and communicative opportunities for learners to practice and build fluency in communication skills. These results also suggest, that in naturalistic settings such as the home environment, the approach of environmental arrangement requires greater attention, rather than relying solely on the use of incidental learning opportunities. This is supported by the results of the internet survey in which a large portion of respondents indicated that their child only used PECS with them between zero and five times each day. While incidental learning seeks to generate learning opportunities from available incidents in natural settings to increase spontaneous communication and generalisation (LeBlanc, Esch, Sidener, & Firth, 2006), a finding from this series of studies is that parents may not be skilled enough, or may not have enough time, to use incidental learning processes effectively in practice. Therefore, in order to optimise the benefits of PECS in natural settings, it may be necessary to teach parents, and provide them with clearer guidelines, to utilise more structured learning environments (and not just incidental ones) to provide better communication opportunities for their children.

The results of the follow up study also highlight the importance of providing ongoing support to parents in the use of PECS with their children, as well as the need to monitor the ongoing procedural integrity of parent implemented PECS. Since implementer's adherence to protocol may deteriorate over time, it is critical that procedural integrity checks are

conducted routinely (Salend, 1984). Although the current research focused on parent-implemented PECS, similar concerns may be valid among professionals and para-professionals taught to implement the PECS program. Complex interventions, such as PECS, which are delivered by parents, professionals, and para-professionals, may be at higher risk for implementation errors, and therefore require more rigorous procedures for ensuring procedural integrity of the intervention in practice (Gresham, 1997; McCall, 2009; Perepletchikova, 2011).

The results of this series of studies should be interpreted in the context of several methodological limitations. The main limitation is the small sample size in each of the studies, which limits the external validity of the results. To be able to generalise these outcomes to a larger population, future research needs to replicate the methodologies utilised in the present series of studies with larger sample sizes, and incorporate parents and children with diverse characteristics. Future research into procedural errors with a range of implementer populations, including parents, professionals and para-professionals, will provide further evidence for the types of errors occurring in naturalistic non-research conditions, and which phases of the PECS protocol these occur in most often. This knowledge will be beneficial in identifying strategies for preventing occurrence of errors by making adjustments to the way the PECS protocol is presented and taught to implementers and thereby also the positive behavioural gains associated with PECS when implementing with children with ASD and other developmental disabilities.

Future research should also consider expanding the type of errors monitored when examining the naturalistic use of PECS. Rather than limiting error measurement to the specific teaching strategies of the PECS protocol, as was employed in the current study, more appropriate errors for exploring the naturalistic use of PECS may include the lack of using PECS in a truly naturalistic fashion, for example not using the "stop/drop/talk" approach, not

making the child's PECS book available at all times, not setting up the environment for manding episodes, and not providing the child with questions to answer using their PECS sentence strip. These types of errors prevent the proper naturalistic use of PECS and as a maintenance issue, prevent the correct continued use of PECS and communication by the child. There is also a lack of published data which demonstrates a relationship between the presence or number of procedural errors and problems with children learning, or failing to learn, to use PECS to communicate. That is, does procedural integrity necessarily predict the failure of PECS in terms of children with ASD learning to use PECS to communicate? Procedural errors, while widespread, may not be a functional problem in the learning and use of PECS for children's communication. This is an area that requires further exploration.

Future research also needs to consider exploring the effectiveness and utility of strategies, such as verbal feedback, written performance feedback, rehearsal and practice sessions, and video modelling, to improve the accuracy with which parents and others implement PECS with children in naturalistic settings. Further research examining the long-term maintenance of gains acquired through PECS training that extends beyond 12 months and incorporates multiple maintenance probes at set intervals, is also warranted with larger samples or in a greater number of single subject experimental designs. This research needs to consider the contextual variables impacting on the maintenance of those gains as well as monitoring the ongoing procedural integrity of parent implemented PECS.

Despite the small sample sizes, the current series of studies has significantly contributed to the PECS literature by piloting research into, and using novel methodologies to explore, the social validity and procedural integrity of parent implemented PECS in naturalistic settings, thereby contributing to a better understanding of parents' use of PECS with their children in naturalistic settings. The results collectively demonstrate that despite parents indicating feeling overwhelmingly positive about the PECS program (including the

program's effectiveness and ease of implementation), parents still largely reported or were observed engaging in procedural errors. This highlights that the PECS program may appear deceptively straightforward to implement, and that a revision of the PECS manual to more clearly highlight "what not to do", in addition to the "what to do", in each phase of the training protocol may be warranted. Given the complexity of the training protocol and the results of these studies there is also a definite need for greater parent education, funding, and support in the use of PECS with their children to ensure a positive learning experience for the child and parents, successfully improve the communication skills of children with communication difficulties, and ascertain a long-term maintenance of the gains achieved.

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APPENDICES

Appendix A

Internet Survey Question Set

Appendix B

Monash University Human Research Ethics Committee approval no. CF12/1729-2012000947

Appendix C

Internet Survey Explanatory Statement

Appendix D

Internet Survey Advertisement

Appendix E

Long Term Follow Up Pre-Intervention Questionnaire

Appendix F

Long Term Follow Up Study Observation Charts

Child Behaviours- Baseline and Generalisation Observation Chart

Mean Length of Utterance Observation Chart

Parent Behaviours- Baseline and Generalisation Observation Chart

Parent-Child Interaction Observation Chart

Appendix G

Monash University's Human Research Ethics Committee approval project no: CF08/0997-2008000494

Explanatory statement

Consent form

Appendix H

Parent Training Strategy Tip Sheet

Appendix A. Internet Survey Question Set

1. **Demographics**
   - **a.** In which Country do you live?
     - _____
   - **b.** What is your marital status?
     - *Single*
     - *Married*
     - *In a relationship*
     - *Separated/Divorced*
     - *Other, please specify*_____
   - **c.** What is the highest level of education you have reached?
     - *Did not complete primary school*
     - *Completed primary school*
     - *Up to, but not including year 10*
     - *Completed year 10 or equivalent*
     - *VCE or equivalent*
     - *TAFE or community college education*
     - *University*
   - **d.** How many children do you have?
     - _____
   - **e.** What is your relation to these children?
     - *Mother*
     - *Father*
     - *Other*
   - **f.** How old is/are your child/children (years: months)?
     - _____
     - _____
     - _____
   - **g.** Do any of your children have a diagnosis of an Autism Spectrum Disorder or Developmental Delay or other?
     - *Autism Spectrum Disorder*
     - *Developmental Delay*
     - *Other, please specify*_____
   - **h.** If yes, at what age did your child/children receive this diagnosis?
     - _____
     - _____
     - _____
   - **i.** What is the gender (male/female) of your child/children that have these diagnoses?
     - _____
     - _____
     - _____

Instruction- If you have more than one child using PECS, consider only your child with the highest communication needs in answering the remainder of the questions

2. **Training in PECS use/ Support in using PECS**
   - **a.** How did you find out about PECS?
     - *My Child's early intervention centre/school*
     - *A friend*
     - *A professional (speech therapist/psychologist)*
     - *Other, please specify*_____
   - **b.** How did you learn to use PECS with your child?
     - *Read the PECS manual*
     - *A friend taught me*
     - *A professional (e.g. speech therapist/psychologist) taught me*
     - *The Internet*
     - *Attended a training course provided by a practitioner(e.g. speech therapist/psychologist)*
     - *Attended an accredited PECS training course*
     - *Other, please specify*_____
   - **c.** Who provides you with support in relation to ongoing PECS use with your child?
     - *My Child's early intervention centre/school*
     - *A friend*
     - *A professional (speech therapist/psychologist)*
     - *The internet*
     - *Nobody- I do not receive any ongoing support*
     - *Other, please specify*_____

3. **Application/Use of PECS**
   - **a.** At what age did your child commence training in PECS?
     - _____
   - **b.** What phase of PECS training has your child acquired?
     - *Phase 1- How to communicate*
     - *Phase 2- Distance and Persistence*
     - *Phase 3- Picture Discrimination*
     - *Phase 4- Sentence Structure*
     - *Phase 5- Answering Questions*
     - *Phase 6- Commenting*
   - **c.** Who implements/implemented the structured PECS training sessions with your child?
     - *A professional, such as speech therapist, teacher, psychologist*
     - *Myself*
     - *Other, please specify*_____
   - **d.** How often do you use PECS to communicate with your child **each day** (outside of structured training sessions)?
     - *0- 5 times*
     - *5-10 times*

- *10-15 times*
- *More than 15 times*

e. How often does your child use PECS to communicate with you **each day** (outside of structured training sessions)?
- *0- 5 times*
- *5-10 times*
- *10-15 times*
- *More than 15 times*

f. Does your child use PECS to communicate with people other than you?
- *Yes*
- *No*

g. If yes, with whom?
- *Siblings*
- *Teachers/ Trainers*
- *Peers*
- *Other Family*
- *Other Adults*

h. In which environments does your child use PECS to communicate (outside of structured training sessions- select all that apply)?
- *Home*
- *Early intervention Centre/ Specialist School*
- *Mainstream Kindergarten/School*
- *Community*
- *Other, please specify*_____

i. How large is your child's PECS vocabulary?
- *0- 20 icons*
- *21-50 icons*
- *51-80 icons*
- *81-100 icons*
- *More than 100 icons*

j. Does your child speak any words to request items or activities they want or to comment on things in their environment, with or without using PECS?
- *Yes*
- *No*

k. If your child does speak a word/s, can you recall the first word you heard your child speak?
- _____

l. How many words does your child use in a purposeful way (either to ask for things he/she wants, or to tell somebody about things he/she sees)?
- *0-20 words*
- *21-50 words*
- *51-80 words*
- *81-100 words*
- *More than 100 words*

Instruction- When answering the following questions think only about the times that YOU train and use PECS with your child, not sessions that a professional (if you access one) trains PECS with your child

m. Thinking of Phase 1 and 2 of the PECS program only: do you/did you usually have another person (a physical prompter) help physically assist your child when they were learning to exchange the picture card for their desired item/activity?
- *Yes*
- *No*

n. Thinking of Phase 1 and 2 of the PECS program only: when does/did the person who is prompting your child (the physical prompter) start helping your child to exchange the picture (tick all that apply)?
- *As soon as the communicative partner holds up the item my child wants*
- *As soon as my child picks up the picture*
- *As soon as my child reaches for the item*
- *We do/did not have a physical prompter to help*

o. Thinking of Phase 1 of the PECS program only: when does/did the person who is communicating with your child (the communicative partner) open their hand to receive the picture from your child (tick all that apply)?
- *From the beginning, when they are holding the item my child wants*
- *As soon as my child reaches for the item*
- *As soon as my child picks up the picture*
- *The communicative partner does not open their hand*

p. Thinking of Phases 1 to 4 of the PECS program: do you/did you sometimes say any of the following statements to your child (tick all that apply)
- *Give me...*
- *Show me...*
- *Point to....*
- *Do you want more...*
- *What do you want?*
- *What's this?*

q. Thinking of Phases 1 to 4 of the PECS program: do you/did you sometimes point to, touch or tap on the pictures to help your child/children know what they need to do with the picture?
- *Yes*
- *No*

r. Thinking of Phase 3 of the PECS program, when teaching your child to discriminate between icons/pictures, what do you do when your child gives you the incorrect picture (the distracter picture of an item you know they don't like)?
- *I give them the item that they really want*
- *I show them/point to the right picture and then get them to choose again*
- *I give them the item of the wrong picture, show them the right picture, help them to give the right picture to me, get them to do another task like touch their nose, and then get them to choose again.*

- *I give them the item of the wrong picture and then get them to choose again*

s. Thinking of all the phases of the PECS program: how soon did/do you give your child what they want after they have given you the picture?
- Immediately
- Within 5 sec
- More than 5sec after my child gives me the picture

t. Also thinking of all the phases of the PECS program: do you/did you sometimes ask your child to say the name of the item or say the sentence after you say it? For example, if your child gives you a picture of a balloon, do you ask your child to "say balloon".
- *Yes*
- *No*

4. PECS experiences

a. Do you believe that PECS training was an effective method to increase your child's communication skills?
- *Very Effective*
- *Effective*
- *Neutral*
- *Ineffective*
- *Very Ineffective*

b. To what extent has PECS training affected your child's spoken language?
- *No change in the amount my child speaks*
- *Decreased the amount my child speaks*
- *Increased the amount my child speaks*

c. To what extent has PECS training helped with other aspects of your child's behaviour, skills or problems?
- *Much worse*
- *Worse*
- *About the same*
- *Better*
- *Much better*

d. If improved or considerably improved in Q4.c, can you briefly describe these changes and/or give examples?
- _____

e. Do you think the effort you have put into PECS training is/was worth the outcome?
- *Completely worthwhile*
- *Mostly worthwhile*
- *Neutral*
- *Somewhat worthwhile*
- *Not worthwhile at all*

f. Do you think the PECS program is reasonably straightforward to implement?
- *Very complicated*
- *Complicated*
- *Neutral*

- *Straightforward*
- *Very straightforward*

g. How stressful was the PECS program to implement?

- *Not at all stressful*
- *Not stressful*
- *Neutral*
- *Stressful*
- *Very stressful*

h. If stressful or very stressful in Q 4.f. can you state which aspects of the PECS program were the most stressful for you to implement?

- _____

i. What did you really like about the PECS program (please describe)?

- _____

j. Your overall feeling about the PECS program for your child is:

- *Very Negative*
- *Negative*
- *Neutral*
- *Positive*
- *Very Positive*

k. How difficult was the PECS program to implement?

- *Not at all difficult*
- *Not difficult*
- *Neutral*
- *Difficult*
- *Very Difficult*

l. If difficult or Very difficult in Q 4.j. can you state which aspects of the PECS program you had difficulty in implementing?

- _____

m. Would you recommend the PECS program to other families in a similar situation?

- *Yes*
- *No*

5. Suggestions

a. Have you got any suggestions in which the PECS program could be improved or made easier to use?

- _____

b. Have you got any further comments?

- _____

Appendix B. Monash University Human Research Ethics Committee approval no. CF12/1729-2012000947

MONASH University

Monash University Human Research Ethics Committee (MUHREC)
Research Office

Human Ethics Certificate of Approval

Date:	**25 June 2012**
Project Number:	**CF12/1729 – 2012000947**
Project Title:	**Treatment fidelity of parent implemented Picture Exchange Communication System (PECS) training**
Chief Investigator:	**Prof Dennis Moore**
Approved:	**From: 25 June 2012** **To: 25 June 2017**

Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation. **Failure to provide permission letters to MUHREC before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research**.
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

[redacted]

Professor Ben Canny
Chair, MUHREC

cc: Dr Angelika Anderson, Miss Anneke Jurgens

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Building 3E, Room 111, Clayton Campus, Wellington Road, Clayton
Telephone [redacted] Facsimile +61 3 9905 3831
Email [redacted] www.monash.edu/research/ethics/human/index/html
ABN 12 377 614 012 CRICOS Provider #00008C

Appendix C. Internet Survey Explanatory Statement

MONASH University

8 June 2012

Explanatory Statement

Title: *Treatment fidelity of parent implemented Picture Exchange Communication System (PECS) training*

My name is Anneke Jurgens and I am completing a Master of Psychology (Educational & Developmental)/PhD at Monash University. A research project is an important component of this course and I am undertaking this research under the supervision of Professor Dennis Moore and Dr Angelika Anderson of the Department of Education at Monash.

I am inviting parents/carers, who are over the age of 18, whose first language is English, and have children who use or have used the Picture Exchange Communication System (PECS) to participate in the research.

I am conducting this research to find out more information on when and how parents use PECS with their child/children in their daily lives. I am also interested in learning more about parents' perspectives on the usability of PECS and the usefulness of PECS in improving their child's communication skills. The results of this study will assist researchers and clinicians to better understand the usefulness of PECS in improving children's communication skills and other behaviours, as well as inform if and how PECS can be made more useful for parents to use with their children in their daily lives.

The study involves answering the survey questions that will take approximately 20-30 minutes to complete. This task is considered to be low risk, and the questions in the survey are not anticipated to cause any distress. We are not offering any payment or reward, financial or otherwise for involvement in this research.

Being in this study is voluntary and consent is implied when you submit the survey. You are under no obligation to participate. If you do consent to participate, you may withdraw this consent at any time, by not completing the survey, up until you submit the survey.

To protect your confidentiality, surveys cannot be identified as no names or contact details will be requested. Only group data will be published, and a summary of results will be provided on request. I stress that no individual can be identified from this research.

Data collected will be stored in accordance with Monash University regulations, kept on University premises, in a locked filing cabinet for 5 years, after which it will be destroyed. Only myself and my supervisors will have access to the data.

A report of the study may be submitted for publication and presentation at a conference. Individual participants will not be identifiable in any such report. We wish to also advise that your anonymous data may be used for other research projects in the future but because it is anonymous data, nobody will be named and you will not be identified in any way. Please keep in mind that it is sometimes impossible to make an absolute guarantee of confidentiality/anonymity.

If you would like to be informed of the aggregate research finding, please contact Anneke Jurgens on [redacted] or at [redacted] The findings will be accessible at the completion of the study. Please note that the study will not be complete until December 2012.

If you would like to contact the researchers about any aspect of this study, please contact the Chief Investigator:	If you have a complaint concerning the manner in which this research CF12/1729 2012000947 is being conducted, please contact:
Professor Dennis Moore Faculty of Education Building 5 Monash University Clayton Victoria Australia 3800 [redacted]	Executive Officer Monash University Human Research Ethics Committee (MUHREC) Building 3e Room 111 Research Office Monash University VIC 3800 [redacted]

Thank you.
Anneke Jurgens

PhD candidate

Appendix D. Internet Survey Advertisement

MONASH University

Parents' perspectives of the usability and usefulness of PECS

Are you a parent/caregiver of a child or adult who uses or has used the Picture Exchange Communication System (PECS)?

We are from Monash University (Melbourne, Australia) and we are conducting a study about parents' use of PECS with their child during daily routines. We need your help. We want to find out about the usefulness of PECS in improving children's communication skills, as well as understand when and how parents use PECS with their children. It is important that we gain a greater understanding about PECS use so that we can make recommendations that may improve the usability of PECS.

We would very much appreciate you taking the time to complete our survey and to forward this message to other people you may know who can complete the survey. If you agree to participate, you will be asked to complete a questionnaire that will take approximately 20-30 minutes and can be done in your own time. Your involvement is voluntary and your responses are completely anonymous. If you would like to participate in this important study, you can go directly to the survey by clicking the following link:
http://monasheducation.qualtrics.com/SE/?SID=SV_bmGXePLQ8zH6Xkg

A copy of group findings will be made available to participants upon request.
If you wish to obtain further information about this research, please contact Anneke Jurgens via email: [redacted]

Appendix E. Long Term Follow Up Pre-Intervention Questionnaire

1. What is your child's gender? F M
2. How old is your child? _____years _____months
3. What is your nationality?
4. What is your marital status?
   - *Single*
   - *Married*
   - *In a relationship*
   - *Separated/Divorced*
   - *Other, please specify*
5. What is the highest level of education you have reached?
   - *Did not complete primary school*
   - *Completed primary school*
   - *Up to, but not including year 10*
   - *Completed year 10 or equivalent*
   - *VCE or equivalent*
   - *TAFE education*
   - *University*
6. How many children do you have?
7. What is your relation to these children?
   - *Mother*
   - *Father*
   - *Other*
8. How old is/are your child/children (years: months)?
9. Do any of your children have a diagnosis of an Autism Spectrum Disorder or Developmental Delay or other?
   - *Autism Spectrum Disorder*
   - *Developmental Delay*
   - *Other, please specify*
10. If yes, at what age did your child/children receive this diagnosis?
11. What is the gender (male/female) of your child/children that have these diagnoses?
12. What kind of developmental delay has your child been diagnosed with?
13. What age was your child diagnosed as having a developmental delay?
14. Who diagnosed your child with the developmental delay?
15. What formal assessment has your child undertaken and what was the score on each respective assessment?
16. At what age did your child first receive any intervention services to address this developmental delay?
17. Does your child receive any intervention services at the moment? If any, how long have these services been used and have there been improvements in your child's behaviour with the use of these services?
18. What problem behaviours (if any) does your child exhibit that are of a concern to you?
19. Does your child have any particular habits, hobbies or activities that he or she is particularly interested in or spend more time doing?

20. What kinds or types of toys, food or other items does your child like or enjoy and find highly motivating?
21. How does your child behave or respond to new situations eg. new toy or friend's house?
22. Which indoor and outdoor places or areas does your child like the most? Which ones does he or she dislike the most?

Communication

23. In what way do you communicate with your child now, after PECS training? Are there differences compared to the way of communicating before the PECS training? If yes, what are those differences?
24. Does your child let you know that he/she needs help or want an object out of reach? If yes, in what way?
25. What was the easiest part of implementing PECS into your daily life?
26. Did you have any difficulties implementing the PECS training into your daily life after the training?
27. Do you still use PECS to communicate with your child? If not, could you please explain why and since when (and skip questions 36-41)

For the following questions, think only about the times that <u>you</u> did train and use PECS with your child

28. Thinking of Phase 1 and 2 of the PECS program only: do you/did you usually have another person (a physical prompter) help physically assist your child when they were learning to exchange the picture card for their desired item/activity?
    - *Yes*
    - *No*
29. Thinking of Phase 1 and 2 of the PECS program only: when does/did the person who is prompting your child (the physical prompter) start helping your child to exchange the picture (tick all that apply)?
    - *As soon as the communicative partner holds up the item my child wants*
    - *As soon as my child picks up the picture*
    - *As soon as my child reaches for the item*
    - *We do/did not have a physical prompter to help*
30. Thinking of Phase 1 of the PECS program only: when does/did the person who is communicating with your child (the communicative partner) open their hand to receive the picture from your child (tick all that apply)?
    - *From the beginning, when they are holding the item my child wants*
    - *As soon as my child reaches for the item*
    - *As soon as my child picks up the picture*
    - *The communicative partner does not open their hand*
31. Thinking of Phases 1 to 4 of the PECS program: do you/did you sometimes say any of the following statements to your child (tick all that apply)
    - *Give me...*
    - *Show me...*

- *Point to....*
- *Do you want more...*
- *What do you want?*
- *What's this?*

32. Thinking of Phases 1 to 4 of the PECS program: do you/did you sometimes point to, touch or tap on the pictures to help your child/children know what they need to do with the picture?
    - *Yes*
    - *No*
33. Thinking of Phase 3 of the PECS program, when teaching your child to discriminate between icons/pictures, what do you do when your child gives you the incorrect picture (the distracter picture of an item you know they don't like)?
    - *I give them the item that they really want*
    - *I show them/point to the right picture and then get them to choose again*
    - *I give them the item of the wrong picture, show them the right picture, help them to give the right picture to me, get them to do another task like touch their nose, and then get them to choose again.*
    - *I give them the item of the wrong picture and then get them to choose again*
34. Thinking of all the phases of the PECS program: how soon did/do you give your child what they want after they have given you the picture?
    - Immediately
    - Within 5 sec
    - More than 5sec after my child gives me the picture
35. Also thinking of all the phases of the PECS program: do you/did you sometimes ask your child to say the name of the item or say the sentence after you say it? For example, if your child gives you a picture of a balloon, do you ask your child to "say balloon".
    - Yes
    - No
36. How often do you use PECS to communicate with your child each day?
37. How often does your child use PECS to communicate with you each day?
38. Does your child use PECS to communicate with people other than you?
39. In which environments does your child use PECS to communicate?
40. Are there any specific situations in these environments in which your child use PECS?
41. How large is your child's PECS vocabulary? (How many picto's?)
42. How large is your child's vocabulary? (How many words/sentences/is he/she fluent?)
43. Does your child use echolalia? If yes, are there any words or phrases that you recall that are common for your child to repeat?
44. Do you think the vocabulary of your child improved because of PECS? Did the amount of using words still increase after PECS training?
45. Have you tried to motivate your child to use PECS? If yes, in what way?
46. Have you got any further comments about the PECS training?

PECS training

47. How did you find out about PECS?
48. How did you learn to use PECS with your child? (use of internet?)
49. Who provided you with support in relation to ongoing PECS use with your child?
50. When you think about the PECS-training a few years ago, how do you feel about it?
51. Did you consider PECS to be an effective training program for your child, if so, why?
52. Did you feel capable of doing the PECS training with your child? Was the procedure of the training clear and acceptable to you?
53. What did you find easy of implementing the training?
54. Did you think it was stressful to implement PECS?
55. Could you describe in what way you were involved in the training?
56. Do you think the effort you put into PECS was worth the outcome?
57. What are your expectations and concerns about your child in the future? (eg. social interaction, communication)?
58. What are your expectations about your child, concerning this particular study?
59. Do you have any concerns, queries or questions regarding the purpose of the present research project?

Thank you for your time.

Appendix F. Long Term Follow Up Study Observation Charts

BASELINE AND GENERALISATION OBSERVATION CHARTS- CHILD BEHAVIOUR

OBSERVATION DATE:
OBSERVER NAME:
OBSERVATION LOCATION (ROOM):

Instructions- Event Recording*: Record the occurrence of each of the following behaviours with an X, within the total observation period. Record the occurrence of each behaviour in a new column corresponding with the row of the behaviour.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Independent PECS mand																					
Prompted PECS mand																					
Other non-vocal mand																					
Other non-vocal initiation																					
Non-word Vocalisation																					
Vocal Mand																					
Other Vocal Initiation																					
Immediate Echolalia																					
Vocal Label																					

	22	23	24	25	26	27	28	29	30		
Independent PECS mand										**Independent PECS mands Session Total:**	
Prompted PECS mand										**Prompted PECS mand Session Total:**	
Other non-vocal mand										**Other non-vocal mands Session Total:**	
Other non-vocal initiation										**Other non-vocal initiations Session Total:**	
Non-word Vocalisation										**Non-word Vocalisations Session Total:**	
Vocal Mand										**Vocal Mands Session Total:**	
Other Vocal Initiation										**Other Vocal Initiations Session Total:**	
Immediate Echolalia										**Immediate Echolalia Session Total:**	
Vocal Label										**Vocal Labels Session Total:**	

***Instructions- Duration per Occurrence Recording**: Time the duration of each occurrence of the following behaviours using a stopwatch and record, in minutes and seconds, the time of each behaviour occurrence. In addition, record the specific behaviour displayed during the recorded episode.*

INAPPROPRIATE BEHAVIOUR

e.g. Screaming, aggression, tantrum, hitting, throwing and pushing

Episode	Duration (min/secs)	Behaviour
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Total no. of inappropriate behaviour episodes displayed during session =_____

Total duration of episodes displayed during session (secs) = _____

Total % of session during which inappropriate behaviours were displayed =_____

*(duration of behaviours in secs * 100 / total duration of session in secs)*

STEREOTYPIC BEHAVIOUR

e.g. reciting books and films, echolalic singing, rocking, running up and down, lining up toys and banging toys together.

Episode	Duration (min/secs)	Behaviour
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Total no. of stereotypic behaviour episodes displayed during session =_____

Total duration of episodes displayed during session (secs) = _____

Total % of session during which inappropriate behaviours were displayed =_____

*(duration of behaviours in secs * 100 / total duration of session in secs)*

MEAN LENGTH UTTERANCE OBSERVATION CHART

Instructions: *Record each intelligible utterance (word/phrase/sentence) vocalised by the child during the observation session. If words are separated by non-words, they are recorded as separate utterances. Do not include echolalic utterances. Use instruction Sheet to calculate no. of morphemes in the utterance.*

#	CHILD'S UTTERANCE	NO. OF MORPHEMES	NOTES
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

Total Number of morphemes: _____ ÷

Total Number of utterances: _____ =

Session MLU: _____

BASELINE AND GENERALISATION OBSERVATION CHARTS- PARENT BEHAVIOUR

OBSERVATION DATE:
OBSERVER NAME:
OBSERVATION LOCATION (ROOM):

Instructions- Event Recording*: Record the occurrence of each of the following behaviours with an X, within the total observation period. Record the occurrence of each behaviour in a new column corresponding with the row of the behaviour.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Compensatory Behaviours																						
Facilitative Behaviours																						
Verbal Prompts																						
Gestural Prompts																						
Insistence on Speech																						
Responsiveness Errors																						
Praises																						

	23	24	25	26	27	28	29	30	31	32	33		
Compensatory Behaviours												**Compensatory Behaviours Session Total:**	
Facilitative Behaviours												**Facilitative Behaviours Session Total:**	
Verbal Prompts												**Verbal Prompts Session Total:**	
Gestural Prompts												**Gestural Prompts Session Total:**	
Insistence on Speech												**Insistence on Speech Session Total:**	
Responsiveness Errors												**Responsiveness Errors Session Total:**	
Praises												**Praises Session Total:**	

***Instructions- Duration per Occurrence Recording**: Time the duration of each occurrence of the parent and child engaged in interaction using a stopwatch and record, in minutes and seconds, the time of each occurrence. In addition, record the specific activity/action displayed during the recorded episode, e.g. during play.*

AMOUNT OF PARENT-CHILD INTERACTION DURING 10min FREEPLAY OBSERVATION

Episode	Duration (min/secs)	Activity/Action
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		

Total no. of parent-child interactions displayed during session = _____

Total duration of episodes displayed during session (secs) =_____

Total % of session during which the parent and child were interacting = _____

*(duration of episodes in secs * 100 / total duration of session in secs)*

Appendix G. Monash University's Human Research Ethics Committee approval project no: CF08/0997-2008000494; Explanatory Statement; Consent Form

MONASH University

Anneke Jurgens [redacted]

Amendment application: CF08/0997 - 2008000494: Peer mediated picture exchange communication system (PECS) training for a child with autism: Follow-up

MRO Human Ethics Team [redacted] **8 November 2011 16:48**
To: Dennis Moore [redacted]
Cc: Annie Yoon [redacted], Anneke Jurgens [redacted], Dr Angelika Anderson [redacted]

PLEASE NOTE: To ensure speedy turnaround time, this correspondence is being sent by email only. MUHREC will endeavour to copy all investigators on correspondence relating to this project, but it is the responsibility of the first-named investigator to ensure that their co-investigators are aware of the content of the correspondence.

Dear Researchers

Thank you for submitting a Request for Amendment to the above named project.

This is to advise that the following amendments have been approved and the project can proceed according to your approval given on 6 June 2008:

1 Change in title FROM Peer mediated picture exchange communication system (PECS) training for a child with autism TO Peer mediated picture exchange communication system (PECS) training for a child with autism: Follow-up

2 Addition of student investigator- Anneke Jurgens.

3 The proposed procedure aims to observe the maintenance of participants' skills acquired through PECS training, through unobtrusive observations of the participant with autism within their home and school (Group 1). No further training/observations of typically developing peers (participants in Group 2 of the approved study) is to be undertaken.

In the event that the follow-up data demonstrate a reduction in the use of acquired skills, the parents/guardians of participating children will be offered further PECS training utilizing the PECS training protocol outlined in this study, as a therapeutic intervention to assist and benefit their child. This PECS intervention will take place within the participant's home.

4 Participants that are currently involved in the current study will be invited to participate in the follow up component. Participants will be asked to allow up to two hours each week for up to two months, for these follow up observations and further PECS therapy. This is a shorter time frame than that of the approved procedure.

5 The data collection procedures, methodologies, and feedback processes utilized will be in accordance with that stated in this study.The proposed procedure aims to observe the maintenance of participants' skills acquired through PECS training in this study.

Please forward an annual report to comply with the Terms of Approval.

Thank you for keeping the Committee informed.

Professor Ben Canny
Chair, MUHREC

Human Ethics
Monash Research Office

MONASH University

8 September 2011

Explanatory Statement – Parents of child participant

Maintenance and generalisation of skills acquired through PECS training in preschoolers with Autism: A follow-up study

This information sheet is for you to keep.

Dear Parent or Guardian

My name is Anneke Jurgens and I am completing a Master of Psychology (Educational& Developmental)/PhD at Monash University. A research project is an important component of this course and I am undertaking this research under the supervision of Professor Dennis Moore and Dr Angelika Anderson of the Department of Education at Monash.

This project is being conducted in association with the Elwyn Morey Centre at Monash where your child is attending an early learning program. You and your child's names and contact details have been obtained from the Elwyn Morey research database which expresses your interest to participate in research and indicates your previous involvement in research involving PECS training/intervention. You are being invited to participate in this study.

The aim of my project is to assess the maintenance of communication and other skills acquired through previous PECS training, and investigate whether providing individuals with further opportunities to learn and use PECS in a variety of settings results in greater generalisation of skills and how these skills or training may influence other areas of behaviour.

PECS is widely used in teaching communication skills to children with Autism Spectrum Disorders (ASD) and is recognised as being an effective communication system. Furthermore, PECS is unique in that it teaches children to self-initiate communication rather than just responding to prompts. Recent studies have indicated that self-initiations may be a 'pivotal' behaviour that can lead to broader changes in other areas of behaviour (e.g. increases in spoken language and play behaviour and decreases in problem behaviour). Parental involvement in teaching such skills has also been shown to improve the outcomes for children with autism.

This project aims to assess the maintenance and long term gains of previously trained PECS skills, and if needed, reintroduce PECS training to improve the functional communication skills of participants. I hope that this project will benefit your child directly by improving his/her communication skills and other behaviours, and that by documenting the evidence of long term outcomes of PECS training, the findings will be of further use to other families and the future improvement of communication systems for children with autism.

I am seeking the participation of three children aged 2 to 5 years, who have a diagnosis of autism and/or developmental delay and demonstrate the associated speech and communicative delays, whose home language is English, who have previously undertaken PECS training/intervention and who have a parent who is prepared to participate in three formal training sessions per week as well as conducting additional home-based training on the non-training days.

The study will involve observing the children in their natural environments to determine their use of PECS and other communication skills since they have completed PECS training, and if determined beneficial for the children will provide participants with further opportunities to learn and use PECS through an additional training period. It is anticipated that the study will be conducted over a period of ten weeks. The observation period will entail a minimum of three 30 minute sessions each week of observations in your child's home, as well as an additional 30 minute session at the Elwyn Morey Centre and your child's mainstream kindergarten for ten weeks. Following this observation period, if determined to be needed/useful/helpful, in consultation with you, additional PECS training will be undertaken to provide your child with further opportunities to learn and to use PECS to improve their functional communication skills. During the training phase of the research study three formal training sessions (of approximately 15- 30 minutes) will be conducted in your home each week. Following each of the training sessions your child will be observed in a free play observation session (of approximately 30 minutes duration). In addition, a further observation session will be conducted at the Elwyn Morey Centre and your child's mainstream kindergarten each week. Your child will be video recorded for all training and free play observation sessions. The student researcher, Miss Anneke Jurgens, will conduct the PECS training sessions and all observation sessions.

You will be required to use the PECS program during regular home activities outside of training sessions. I will not supervise these sessions but you will be required to complete a daily home training checklist. At the conclusion of the study, you will be asked to complete a Social Validity Questionnaire which will be used to assess the social significance/importance of the PECS program to your child and your family.

While no negative effects are anticipated from this research it is possible that this study may not be successful in improving your child's communication skills. We endeavour to conduct this research in an entirely professional and ethical manner, as bound by Monash University ethical guidelines. It is not foreseen that the participant or people related to the participant should suffer any distress as a result of this research. However, should there be a need for services to discuss concerns, the staff at the Elwyn Morey Centre and Professor Dennis Moore, the director of the Elwyn Morey Centre, may be contacted. If however, these contacts are not available, the following telephone counselling and referral service is available: Parentline: 13 22 89 (local call). Your child's participation will not involve payment of any kind, however it is expected that your child will benefit from the training by acquiring functional communication skills and potential improvements in other areas of behaviour.

Participation in this research is entirely voluntary and should you agree for your child to participate, you will remain free to withdraw from the study at any time, with no negative effects on your child or yourself. Should you wish to withdraw please contact myself by email or telephone or my supervisors Professor Dennis Moore and Dr Angelika Anderson by post, email or telephone.

I will endeavour to protect the confidentiality of your child's results by the use of a pseudonym in any reporting and no names will be recorded on any observation sheets. Data must be stored for at least five years according to university regulations upon which it will be destroyed and only myself and my supervisors will have access to this data and video recordings. A summary of your child's results and

a copy of the final report will be made available to you at the conclusion of the study. Should you not wish to receive a summary of your child's results and/or a copy of the final report please advise the student researcher. It is hoped that beyond the assessment requirements, this study may be reported in a psychological journal or oral presentations.

Should you have any inquiries about this research please contact the researcher, Anneke Jurgens on [redacted] or you may contact my supervisors Professor Dennis Moore or Dr Angelika Anderson either by telephone, email, or mail:

If you would like to contact the **researchers** about any aspect of this study, please contact the Chief Investigator:	If you have a **complaint** concerning the manner in which this research **<insert your project number here, i.e. 2006/011>** is being conducted, please contact:
Professor Dennis Moore **Building 5** **Monash University** **Clayton Campus** **Wellington Rd** **Clayton** **3800** [redacted] **Dr Angelika Anderson** **Building 5** **Monash University** **Clayton Campus** **Wellington Rd** **Clayton** **3800** [redacted]	Executive Officer Standing Committee on Ethics in Research Involving Humans (SCERH) Building 3e Room 111 Research Office Monash University VIC 3800 [redacted]

Thank you.

Anneke Jurgens

MONASH University

Consent Form – Parents of child participant

Maintenance and generalisation of skills acquired through PECS training in preschoolers with Autism: A follow-up study

NOTE: **This consent form will remain with the Monash University researcher for their records**

I/We _____ (Parent's/Guardian's name/s) of

_____(address)

Voluntarily consent to my/our child _____ (child's name) participating in the Monash University research project specified above.

I have had the project explained and I have read and understood the Explanatory Statement, which I will keep for my records. ☐ **Yes** ☐ **No**

I understand that my child's participation is voluntary and that I am free to withdraw my child at any stage of the project without being penalised or disadvantaged in any way. ☐ **Yes** ☐ **No**

I further understand that any information provided by myself or my child is strictly confidential, and that any reports from the study will not, under any circumstances, contain any personally identifiable information. ☐ **Yes** ☐ **No**

I agree to be interviewed by the researcher ☐ **Yes** ☐ **No**

I agree to allow the interview to be audio-taped ☐ **Yes** ☐ **No**

I agree to make myself available for a further interview if required ☐ **Yes** ☐ **No**

I agree to complete questionnaires asking me about my experiences with PECS ☐ **Yes** ☐ **No**

I understand that my child's participation will require three formal PECS training sessions of 30 minutes each per week, that these sessions will be conducted in my own home, and that the training sessions will be followed by an additional observation session of 30 minutes duration. ☐ **Yes** ☐ **No**

I understand that and consent to an additional observation session being conducted at the Elwyn Morey Centre once per week. ☐ **Yes** ☐ **No**

I understand that and consent to an additional observation session being conducted at my child's mainstream kindergarten once per week. ☐ **Yes** ☐ **No**

I consent to my child being video recorded during training and observation sessions in my home, at the Elwyn Morey Centre, and in my child's mainstream kindergarten *(If applicable, cross out the location that you do not wish your child to be video recorded at).* ☐ **Yes** ☐ **No**

I understand that the researcher will endeavour to conduct these sessions at a mutually convenient time, but that two sessions per week is a minimum requirement of participation in this study. ☐ **Yes** ☐ **No**

I further understand that my involvement as a parent is an important part of this training and that I will be required to participate during the formal training sessions as well as to conduct shorter daily practice trials with my child at home. ☐ **Yes** ☐ **No**

I understand that data from the study will be kept in a secure storage and accessible only to the research team. I also understand that the data will be destroyed after a 5 year period unless I consent to it being used in future research. ☐ **Yes** ☐ **No**

I consent for my child's data from this research study to be used in future research studies and/or reports. ☐ **Yes** ☐ **No**

Name of parent and/or guardian: (please print) _____

Signed_____(parent) _____(date)

Name of parent and/or guardian: (please print) _____

Signed_____(parent) _____(date)

Appendix H. Parent Training Strategy Tip Sheet

STRATEGIES TO HELP SOPHIE PRACTICE COMMUNICATION AND LANGUAGE SKILLS

1. Create opportunities for Sophie to practice her communication and language skills in everyday routines:
    - Restructuring the environment physically (Placing favourite items out of reach or locked away).
    - Withholding something she wants or needs until she has asked for it, including during daily routines and with things she really wants and likes.

2. Give Sophie time to respond to a question you have asked before repeating the question or giving her the answer:
    - Once you have asked Sophie a question, count to five slowly before saying anything else.

3. Avoid asking Sophie to 'say...' something, e.g. 'say thank you':
    - Rather provide the model, e.g. thank you, look expectantly at Sophie, and when she does say thank you give her lots and lots of praise. If she doesn't say thank you when you look expectantly at her wait for the next opportunity to practice again. Reinforce positive responses with lots of praise.

4. Avoid asking Sophie to give you the PECS sentence strip, tapping on the PECS pictures, or moving the PECS folder closer to Sophie:
    - Rather continue using appropriate prompting questions such as 'what do you want' to encourage Sophie to request using either PECS or spoken words.
    - Sophie does not have to use PECS if she doesn't want to. She knows how to use PECS if she needs to.

5. Reinforce Sophie's appropriate communicative initiations with quick access to what she is requesting and with lots of praise.

6. When Sophie is screaming, prompt her with 'no shouting, talking' and then ask her 'what do you want?'. When she tells you what she wants in an appropriate way, give her access to that item/activity quickly to reinforce her appropriate response.

7. Continue to interact and play with Sophie using activities and games that she enjoys playing; and modelling communication and language to Sophie during these activities.