# The generalisation effects of Picture Exchange Communication System (PECS) training for children with autism and language delay

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ABSTRACT

The Picture Exchange Communication System (PECS) has been widely used in intervention programs to develop functional communication for children who have no or little vocal communication. Studies have shown that PECS training is effective in developing communication and social interaction (Carr & Felce, 2006; Ganz, Simpson, & Corbin-Newsome, 2007) for children with autism. However, most research on the effectiveness of PECS has been limited in several ways. Firstly, few studies have evaluated the entire PECS program; secondly, little research has been carried out on generalisation of PECS skills across different settings and individuals. The aim of the present study was to evaluate the generalisation effects of the PECS program on communication and social play for two children with autism and one child with language delay. The study considered the entire PECS program across a variety of settings and individuals (e.g., home, inclusive kindergarten, siblings, parents, and teachers). The study used a single subject changing criterion design to evaluate the effect of PECS intervention on communication and social play behaviours for the participants. All three participants acquired functional communication and mastered PECS training over periods of between nine and 20 weeks. The two children with autism and the child with language delay increased significantly in spoken communication (e.g., intelligible vocalization and new spoken words). The study demonstrated that incorporating motivating operations is critical to the successful use of PECS by children with autism.

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**General Declaration**

In accordance with Monash University Doctorate Regulation 17/ Doctor of Philosophy and Master of Philosophy (MPhil) 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 zero original papers published in peer reviewed journals. The core theme of the thesis is an exploration of the generalisation effects of Picture Exchange Communication System (PECS) training for children with autism and developmental delay. 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.

**Signed:** ………………………………

**Date:** ………………………………

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# CHAPTER ONE

## INTRODUCTION

Autism is a neurodevelopmental disorder in the category of pervasive developmental disorders that affects some parts of the central nervous system, particularly the way that information is processed (Dodd, 2005; Levy, Mandell, & Schultz, 2009). Autism is arguably one of the most mystifying mental disorders affecting how individuals understand the world around them. Different symptoms of autism may occur by themselves or in association with other conditions such as mental retardation and epilepsy (Dodd, 2005).

Autism occurs in families of all ethnic, racial, and social backgrounds around the world (Dodd, 2005). The incidence of pervasive developmental disorders, including autism has increased, from 62.6 per 10,000 in 1992 to 85.9 per 10,000 in 2005 (Chakrabarti & Fombonne, 2005; Frombonne, 2005).

Various causes of autism have been proposed including theories based on neurological, genetic and environmental factors (Levy, Mandell, & Schultz, 2009). Neurobiological evidence suggests that many children with autism display a lower level of cognitive functioning, which generally indicates some damage or dysfunction of the brain (Schopler & Mesibow, 1986b; Zager, 2005). However, what might trigger the neurological or genetic impairment in children with autism is as yet unknown (Hertz-Piccitto, Croen, Hansen, Jones, Water, & Pessah, 2006; Volkmar & Pauls, 2003). It also has been suggested that autism may be associated with environmental factors affecting children pre or post birth such as exposure to pesticides or alcohol. However, the exact cause of autism is not known (Levy, Mandell, & Schultz, 2009).

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), the main characteristics of autism are impairments in communication and social interaction and restricted, repetitive and stereotypical patterns of behaviours, interests and activities (American Psychiatric Association, 2000). Communication deficits that affect speech, sign and body language, gestures, and vocal sounds are among symptoms attributed to autism (Sternberg, 1991). There may be delay in or total lack of the development of vocal communication. Some children with autism who have vocal communication may be impaired in their ability to initiate a conversation with others and may often be immature in developing specific aspects of speech including pitch, intonation, and rhythm. Their speech may also be abnormal in grammatical structures, frequently for example involving the repetition of words and sentences (American Psychiatric Association, 2000). Further, these children who can speak using words or sentences may not use this skill functionally to achieve a purpose.

Some children with autism never develop spoken communication. They may use other forms of communication such as gestures or pointing to communicate with others (Ruble & Dalrymple, 2002). For example, when a child is hungry he or she may rely on gestures such as pulling his or her mother's hand towards the fridge. However, some of the nonvocal communication used by these children is also dissimilar to that used by typically developing children (Keen, 2003). For example, the use of eye-gaze may be absent or inconsistent.

In addition, despite the fact that there are many children with autism who do have good language skills, even these children may have difficulties in using these skills functionally to communicate with others (e.g., requesting). These communication problems may result in inappropriate behaviours such as self-injury and tantrums (Bloch & Weinstein, 2010), which are thought to reflect a child's attempt to communicate their needs (e.g., requesting objects or foods) (Calloway et al., 1999). Due to their limited communication skills, children with autism may experience isolation from typically developing peers as well as from members of their immediate families. Parents and other family members may also experience stress, pain, and emotional difficulties as they face these various communication challenges with their children with autism (Bloch & Weinstein, 2010).

Providing appropriate educational interventions is crucial for developing communication abilities such as requesting skills for both nonvocal and vocal children with autism (Onzonoff & Cathcart, 1998). By developing such interventions the aim is to improve their capacity to communicate so that they participate more fully in family and community life. This in turn may reduce frustration and stress for families and communities as these children begin to play a bigger part within daily social life.

There are several intervention approaches to assist children with autism's communication and language skills. These approaches include augmentative/alternative communication systems (AAC) as well as other approaches based on applied behaviour analysis (ABA) and Skinner's verbal behaviour.

AAC systems are widely used in language intervention programs (Malandraki & Okalidou, 2007) to develop functional communication skills for nonvocal individuals. An AAC system is a total functional communication system for an individual that may be aided (e.g., electronic voice output communication aides, pictures or line drawings) or unaided (e.g., hand signs such as waving of the hand for "good bye") (Sigafoos & Drasgow, 2001).

Some studies suggest that AAC systems can increase the communicative interactions and language of children with autism and enable them to exercise control over their environment (Beukelman & Mirenda, 1998; Foley & Staples, 2003; Marckel, Neef, & Ferreri, 2006; Millar, Light, & Schlosser, 2006; Sigfoos & Drasgow, 2001; Wilkinson & Hennig, 2007). However, despite the benefits of AAC, they are not widely used by professionals, advocates and families of children with autism. This may be due to there being limited access to meaningful training opportunities, high costs involved with implementation (e.g., electronic voice output) and the degree of complexity involved with the implementation of new technologies (Stoner, Beck, Bock, Hickey, Kosuwan, & Thompson, 2006). In addition, the manual gestures learnt by children through AAC may be difficult to understand or may be misinterpreted by others not familiar with them (Wilkinson & Hennig, 2007). Aided systems such as voice output device systems often have difficulties in generalisation to different communicative partners and settings (Bondy & Frost, 2001b; Sigafoos, O'Reilly, Seely-York, Were, Son, Green, & Lancioni, 2004)

A number of interventions to promote communication are based on applied behaviour analysis (ABA) (e.g., picture exchange communication systems and pivotal response training). ABA is a scientific approach for improving and changing human behaviour which is based on principles of operant conditioning (Cooper, Heron, & Heward, 2007; Skinner, 1957b). Operant conditioning describes the functional relationships between behaviour and context. Consequences, which are the events that immediately follow a behaviour, affect the future probability of that behaviour so that we can change, increase, and decrease behaviours by manipulating the environment. Reinforcement and punishment are two kinds of consequences, and they are functionally defined; that is they are defined by the effect they have on the behaviour they follow.

There are two forms of reinforcement and punishment. These are *positive* and *negative* reinforcement and punishment. *Positive reinforcement* is said to have occurred if the behaviour increases in the future as a result of the consequence of presenting a situation or object after the behaviour as a reinforcer. For example, if a child cleans a table and receives praise from his or her mother the child is more likely to clean the table in the future as a result of the mother's praise (with the praise acting as a reinforcer). *Negative reinforcement* occurs if the future probability of the behaviour increases as a consequence of the withdrawl a situation or object. For example, a child may be encouraged to study by being promised exemptions from family chores. If the child's devotion to study increases into the future as a result of not having to do chores the behaviour (study) has been reinforced negatively (that is, through the removal of the chores). *Positive punishment* is related to the decrease of future probability of a behaviour as a result of consequence of presenting a situation or object after the behaviour. For example, if a child keeps eating sweets from the cupboard this behaviour may decrease as a result of mother's criticism (e.g., as a consequence of yelling). *Negative punishment* occurs when the future probability of the behaviour diminishes as a result of the consequence of the removal of a reinforcer. For example, if a child is eating sweets from the cupboard the child's mother may take away the child's favourite doll as a punishment to have the behaviour decrease in the future. This punishment is negative because the child experiences the removal of the the doll as a way to decrease the behaviour (eating the sweets).

Researchers often mention the three-term contingency (A-B-C): antecedent (A), behaviour (B) and consequence (C) to explain reinforcement operations. Increasingly, the literature reflects the use of a four-term contingency (MO-A-B-C): motivating operation (MO), antecedent (A), behaviour (B) and consequence (C) in educational settings (Cooper, Heron, & Heward, 2007; Tapper, 2005). The following example shows positive reinforcement as described within a three-term contingency. If a mother says to her child "what's your name?" (A) and the child responds by saying "Jenny" (B) then the mother may praise her child with "good girl!" (C). If a child receives the mother's praise, the child is more likely to say her name in the future as a result of the previous experience. The fact that the child is *motivated* to respond to the granting of praise i.e., the child wants this praise to continue in the future, means that motivation is essential for understanding ABC contingency (Cooper, Heron, & Heward, 2007).

Motivating operation in the four-term contingency (MO-A-B-C) is a critical concept involving the effectiveness of consequence and behaviour in operant conditioning. Motivating operations are described as having two main effects, these being value- and behaviour- altering effects. The value-altering effect is associated with an increase (establishing operation: EO) or decrease (abolishing operation: AO) of the value of a situation or object as a reinforcer. The behaviour-altering effect is associated with increases or decreases in the likelihood of behaviour that has produced a specific reinforcer in the past (Frost & Bondy, 2007b; Michael, 1993b). The motivating operation creates the conditions or context that explains how the antecdent will produce the behaviour that in turn leads to a particular consequence in the future.

The following example describes an EO (representing an MO) within the four-term contingency (MO-A-B-C) in positive reinforcement. If normally readily available water is removed from a fridge for a period of time (MO), then a child will experience water deprivation. When the water becomes available in the fridge (A), the child opens the fridge and takes the water (B). The consequence of this is that, having drunk, the child is no longer thirsty (C). The deprivation of water increases the value of water as a reinforcer while it also increases the behaviour of drinking the water and is likely to do so in the future. MO simply determines what an individual wants and, to make the consequence effective, the individual should already want the reinforcer (Cooper, Heron, & Heward, 2007). The AO (representing an MO), as the opposite of the establishing operation, is used to diminish the value of an event or object as a reinforcer (or punisher) thus decreasing the future probability of a behaviour as a result of consequences (Tapper, 2005). For example, if a child has readily available water this availability will lower the value of water as a reinforcer while simultaneously decreasing the behaviour of water drinking in the future.

Skinner not only described operant conditioning including reinforcement but also described verbal behaviour, where the consequences that control behaviours are socially mediated by the behaviour of another person (Skinner, 1957b). For example, a child is hungry (antecedent). The child says “hungry” to his or her mother (verbal behaviour), the mother goes to kitchen to get the bread (behaviour), and the child eats the bread (consequence).

In common English, the term verbal behaviour implies spoken communication. However, Skinner's use of the term verbal behaviour is different and refers to behaviour of any form that has a communicative function or purpose (Cooper, Heron, & Heward, 2007). Skinner's analysis of verbal behaviours focuses on the function or purpose of communicative acts (e.g., requesting), regardless of their form (e.g., spoken language or gestures) (Skinner, 1957b). He identified a number of "verbal operant" units to describe the functional relationship between verbal behaviours and environment. Verbal operants are defined by the effect they have in the environment. A mand for example is a request e.g., a child saying "apple" to someone when he or she wants to eat the apple. A tact is a comment, and describes the moment when a speaker identifies or names objects, events, or actions e.g., when a child says "apple" when he or she sees an apple on the table, but is not requesting the apple (Skinner, 1957b).

Skinner's analysis of verbal behaviours is used in communication intervention programs for children with autism and other communication disabilities (Bondy, Tincani, & Frost, 2004; Sundberg & Michael, 2001). One of the interventions utilised by teachers and speech therapists in communication intervention programs is called the picture exchange communication system (PECS). PECS is an AAC system based on applied behaviour analysis (ABA) and principles of verbal behaviour to teach functional communication to children with autism and other communicative disabilities. The PECS program consists of six distinct phases: (a) physical exchange (b) distance and persistence (c) discrimination training (d) sentence structure (e) responding to "what do you want?" (responsive requesting) and (f) answering "comment" questions such as "what do you see?". The PECS program relies heavily on principles developed from Skinner's analysis of verbal behavior (Frost & Bondy, 2002a). In particular PECS emphasises teaching requesting skills and generalisation from the early stages of the training through the learner's spontaneous initiations, utilising knowledge about the learner's preferred items. For example, a child is taught to exchange a picture card depicting his or her preferred item to obtain that item from a communicative partner (Bondy & Frost, 1994a).

A growing body of research has shown that children with autism can learn functional communication through PECS (Anderson, Moore, & Bourne, 2007; Charlop-Christy, Carpenter, LeBlanc, & Kellet, 2002; Ganz, Simpson, & Corbin-Newsome, 2008; Malandraki & Okalidou, 2007). Some studies however have reported that children with autism had difficulties learning functional communication successfully with the visual symbols of the PECS program (Angermeier, Schlosser, Luiselli, Harrington, & Carter, 2008; Ganz, Cook, Corbin-Newsome, Bourgeois, & Flores, 2005). Further studies have shown that PECS assists children with autism to interact socially (Howlin, Gordon, Pasco, Wade, & Charman, 2007; Kravits, Kamps, Kemmerer, & Potucek, 2002) and reduces problematic behaviour such as aggression and frustration (Charlop-Christy et al., 2002; Frea, Arnold, & Vittimberga, 2001; Malandraki & Okalidou, 2007). In addition, a large number of children with autism and other communicative disabilities who learn the PECS program develop spoken communication such as words (Adkins & Axelrod, 2002; Bondy & Frost, 1994a; Bondy & Frost, 2001b; Carr & Felce, 2006b; Ganz, Simpson, & Corbin-Newsome, 2008; Simpson et al., 1996; Schwartz, Garfinkle, & Bauer, 1998; Stoner et al., 2006).

Although research studies have attributed many positive improvements for children with autism to PECS training, these studies have been limited by a number of factors. For example, most of the previous research on the effects of PECS has not tested the program in its entirety but has been largely restricted to phases one to three or four. While some studies have considered all six phases of the PECS program little research has been done regarding the generalisation or maintenance effects of the training beyond the training setting. Of the few studies that have reported generalisation effects across settings and individuals for all six phases of PECS, none to date have based their reports on systematic measures of speech and vocalisation attributable to PECS training (Charlop-Christy et al., 2002; Liddle, 2001; Malandarki & Okalidou, 2007; Magiti & Howlin, 2003). Although there are several studies of PECS intervention involving typically developing children (e.g., peers) as communication partners with children with autism (Kravits et al., 2002; Schwartz et al., 1998), none of these studies have involved siblings in the home environment. Finally, there have been only limited studies on PECS training conducted in the home environment (Anderson, Moore, & Bourne, 2007; Ganz, Simpson, & Corbin-Newsome, 2008; Jugens, Anderson, & Moore, 2009).

**Aim**

The present series of studies aimed to investigate the effects of the entire PECS program on vocal and nonvocal communication (e.g., PECS mand, vocal mand, vocal initiation, and nonvocal mand) and social play (e.g., solitary and parallel play) across all six PECS phases. The series of studies not only explored the development of children's functional communication through PECS training but also investigated the issue of generalisation of PECS training involving various situations (e.g., home, kindergarten, and intervention centre) and individuals (e.g., sibling, parent, researcher, and teacher).

Ultimately, the aim of this thesis is to contribute to a better understanding of the PECS program by providing additional empirical data that will inform improvements to the program and better application of the intervention in real-life situations. This is so that for those families who use PECS as an alternative communicative method, there will be a long term improvement in their quality of life, not only to reduce the social isolation of these families or the inappropriate behaviour of children with autism but also to increase positive opportunities for these children to have more normal lives.

## Outline of thesis

The next chapter, Chapter 2, reviews the literature on communication and language development, autism, AAC, applied behaviour analysis, verbal behaviour and the PECS program. Chapter 3 details the research method that describes a single subject changing criterion design, including the values and benefits of this design method for the research program. The next three chapters provide three individual PECS studies for two children with autism and one child with language delay, respectively. The final chapter, Chapter 7, provides a general discussion about the results of the three studies including the acquisition of the PECS program, limitations of the current study and recommendations for further studies.

# CHAPTER TWO

## LITERATURE REVIEW

### Introduction

Autism is a pervasive developmental disability affecting an increasing number of young children. Children with autism exhibit a variety of behavioural characteristics that result in a range of associated social challenges. Core deficits faced by children with autism are in the areas of communication and language skills. Approximately 50 per cent of children with autism fail to develop functional speech and they may rely on nonvocal means of communication such as gestures to communicate with others (Ruble & Dalrymple, 2002). Further, many show impairment of function and intention to communicate with others as well as demonstrating stereotyped use of language. These communication problems rank as among the most serious challenges faced by children with autism and their families, and are thought to lead to the development of behaviour problems (e.g., self-injury) due to frustration from the inability to communicate their wants and needs. As noted previously, this also in turn increases stress or anxiety for their families with relationships between the child and his or her parents or siblings frequently strained (Schopler & Mesibov, 1984a). Therefore communication and language skills are an important target for intervention in children with autism. The development of effective intervention requires an understanding of language and communication development in typically developing populations and how this differs for children with autism. This chapter provides an overview of the literature concerning stages in communication and language development for typically developing children and for children with autism. Further, this chapter also reviews the literature on theory-based interventions that have been used to improve communication and social interaction skills for children with autism. These include language interventions such as augmentative and alternative communication systems (AAC) that attempt to develop functional communication, and behavioural interventions based on applied behaviour analysis (ABA) for children with autism. Special attention is given to reviewing an AAC system, the Picture Exchange Communication System (PECS). PECS is designed to develop functional communication for children with autism and other communicative disabilities. Finally, research is reviewed that investigates the importance of family involvement (e.g., parents and siblings) in intervention programs for children with autism.

## Communication and language development

Communication is a socially shared activity that allows humans to develop relationships with each other and convey meaning or messages to others (Carrow-Woolfolk & Lynch, 1982; Eisenson & Oagilive, 1983; Haslett & Samter, 1997). Communication is a two way process that requires both *expressive* and *receptive* communication skills. Expressive communication is the process of sending the message such as using speech or other forms of communication (e.g., body language). Receptive communication is the process of interpreting the message that is sent by someone else (e.g., understanding or responding to other's questions) (Dodd, 2005).

Communication is also multimodal (Haslett & Samter, 1997); it combines vocal and nonvocal means to convey meaning to others. Children learn that messages can be conveyed in different ways using different combinations of nonvocal and vocal means (Buckley, 2003). Nonvocal communication includes gestures, eye-gaze, facial expression and body language. Vocal communication involves the use of spoken or written language. Messages can also be conveyed through symbols, pictures, and signs. Most communicative interactions between humans involve a combination of nonvocal and vocal messages and multiple modalities: visual, auditory, or tactile (Buckley, 2003).

Four stages of development of early communication skills have been described (Haslett & Samter, 1997). The first stage is recognising the interpersonal basis of communication (zero to 60 weeks). The second stage is creating communicative effects (four month to three years), occurring in three substages. First, there are prevocal routines in which children acquire an understanding of dialogue such as turn taking. Second, communicative intentionality begins in which children commence signaling their wants or needs. Thirdly, linguistic communication commences in which children demonstrate a functional mastery of language to achieve social goals. The third stage of development begins when children are around three years of age using communicative strategies. They increase linguistic forms to accomplish a variety of communicative goals. The final stage is monitoring communication (around five years of age). Children develop the ability to evaluate messages appropriately and to repair messages in conversation with others (Haslett & Samter, 1997). This stage of communication development is discussed in more depth in the next section.

Fundamentally the purpose of communication is to develop and maintain social relationships and cooperation between individuals (Haslett & Samter, 1997). Only through communication are individuals able to express their needs, share or exchange information or coordinate their activities. Consequently, communication is critical for establishing social relationships between people.

Language is a system that can take different forms such as written symbols, sounds or signs for the purpose of communication (Bochner, Price, & Jones, 1997; Haslett & Samter, 1997). Language plays a vital role in social life and helps speakers to communicate or exchange information, ideas or feelings in social contexts through interactions between listeners and speakers (Eisenson & Oagilive, 1983). Language is:

> …a complex and dynamic system of conventional symbols that is used in various modes for thought and communication. Contemporary views of human language hold that (a) language evolves within specific historical, social, and cultural contexts …(d) effective use of language for communication requires a broad

> understanding of human interaction including such associated factors as nonvocal cues, motivation, and socio-cultural roles (Kamhi 1989 cited in Buckly, 2003, p.3).

To better understand the concept of language, it is important to be aware of the components of language. The five main language components are phonology, morphology, syntax, semantics, and pragmatics (Bernstein & Tigerman-Farber, 1997; Eisenson & Oagilive, 1983).

First, phonology describes the sound system of a natural language (Crystal, 1995) and comprises consonants, vowels and diphthongs organised into intelligible units called phonemes (Eisenson & Oagilive, 1983). The phoneme is the smallest linguistic unit of sound that can signal a difference in meaning (Kuder, 2003).

Second, morphology describes the structure of words and how they are formed (Bernstein & Tigerman-Farber, 1997; Crystal, 1995). In English, it means devising ways of describing the properties of such disparate items as *a*, *dog*, *took* and *washing dishes* (Crystal, 1995). A *morpheme* is a minimal unit that carries meaning. For example, *quick* consists of four phonemes: / k/, /w/, / í/, and /k/. Since all four phonemes are needed to make a unit that carries meaning, *quick* is a morpheme which stands alone and is accordingly a *free morpheme*. When *-er, -s, -ed, -ness, -ship, un-, de, anti-, super-* is added to a free morpheme then it becomes two morphemes in one word. For example, the word “dogs” has two morphemes that are *dog* and *s,* the word stopp*ed* has two morphemes, *stop* and *ed*.

Third, syntax is the sentence structure of words (Crystal, 1995). The use of syntax allows individuals to combine words into phrases and sentences. For example, a small child might say “Chris help” or “mom balloon blow” both sentences express the child’s wants or needs but not in accordance with the syntactic rules of English. Eventually children develop more advanced syntactic skills such as *why* or *how* questions and constructing sentences such as *I go home* (Eisenson & Oagilive, 1983). Syntax specifies the order of words (the grammar of an utterance) and the organisation of different sentence types.

Fourth, semantics is the study of meaning in language (Crystal, 1995; Hoff, 2009). It is the meaning or interpretation of words, phrases, sentences and an individual’s knowledge of objects, events, situations and people (Bernstein & Tigerman-Farber, 1997). For example, words such as “no”, “more” and “this” express a variety of semantic meaning relations such as rejection, existence, recurrence, etc., in social contexts (Layton, 1987). As children develop their semantic skills increase. They learn, for example, that “couch” and “sofa” represent the same object but with different sounds whereas some words have the same sound but different meanings (e.g., “buy” and “bye”) (McCormick, Loeb, & Schiefelbusch, 1997).

Finally, one of the most critical components of language is pragmatics that is the use of language in social contexts (Hoff, 2009; McCormick, Loeb, & Schiefelbusch, 1997). It involves conversational rules such as turn-taking, relevant responses, and maintaining a topic using cohesive sentences (Scott, Clark, & Bradt, 2000). Pragmatics not only focuses on the phonological, morphological, syntactic and semantic components but also on the child’s ability to understand his or her intended message in relation to the social context. Context includes social, physical, linguistic, and historical context, which in turn affects the way language is used by a speaker (Layton, 1987).

In this section, communication and language have been defined. The main language components including phonology, morphology, syntax, semantics and pragmatics were described. These basic concepts of communication and language provide the context for our understanding of both typical and non-typical children's development. In the following section, the development of communication and language for typically developing children is discussed further in order to fully understand the context of communication for children with autism.

## Communication and language development for typically developing children

Infants communicate their wants and needs before they acquire language or even utter their first words, demonstrating intentional communication through their voice sounds (e.g., crying when sick or hungry). Prevocal communication continues to develop in parallel with the beginning of language acquisition (Bochner, Price, & Jones, 1997).

The development of speech, language and communication in children is influenced by a combination of environmental and internal factors (Buckley, 2003). Internal factors are based largely on various needs, such as children's need to communicate, their need for social interaction and their awareness of what communication is for. For language to develop, there are a number of biological prerequisite factors including intact senses such as hearing and vision and intact cognitive, neurological, fine motor capacities, and mental processing for speech, language and learning (Buckley, 2003). Environmental factors for children's language development include, for example, the opportunities to interact with adults and peers in order to hear expressive, spoken language. Further, children's communication and language acquisition is dependent on the amount and quality of social interaction. For example, Hart and Risley (1995) investigated the language acquisition skills of typically developing children in 42 American families. The children from upper class heard several times more encouraging words from their parents than children from middle and working class families. The children from working class families heard several times more discouraging words than children from upper class families. The study showed that the amount of time in parenting, and the quality of the utterances parents speak to their children were strongly related to the social class status, language and communication acquisition of the children.

For typically developing children, there are three main stages of communication development: the *pre-intentional primitive*, *intentional conventional,* and *symbolic conventional* stages (Linfoot, 1994).

Only those who frequently interact with the child are capable of understanding the *pre-intentional primitive stage* of communication (Linfoot, 1994). The communication partners, such as parents or siblings, interpret the meaning of the idiosyncratic or non-conventional behaviours. It is often the case that in the early stages of communication the behaviours are not necessarily directed at a specific partner. As a result communication depends on those nearby interpreting the intention. For example, significant others interpret a child waving his or her hands as having a message. The interpretations may vary, even if, for example, the mother understands that the behaviour simply indicates the child’s excitement. The child is not conveying intent through their behaviour.

By contrast, the child who has reached the *intentional conventional stage* makes his or her intentions known to a partner (Linfoot, 1994). The child starts using increasingly mature behaviour to the extent that they may point to an object, use eye contact, or take a partner’s hand and place it on the object that he or she desires. With intentional communicative forms, the behaviours, purpose and communication process are more immediately and widely understood. Children use a variety of communicative behaviours in the form of signals for various purposes and these intentional signals of interaction are called “speech acts” (Layton, 1987). The communicative behaviours combine vocal and gestural performances such as pointing, eye contact, and utterances.

The *symbolic conventional stage* involves words and gestures (Linfoot, 1994). The child may initially use a combination of vocalisation and gestures to convey a range of primitive speech acts. The child then uses a symbolic system that consists of speech rather than gestures to achieve a purpose or function. As the child matures in the use of the symbolic system, the child is able to refer to objects, people, or events and use a multimodal-system of symbols, gestures and/or vocalisation to interact with others in social contexts. In addition to recognising the communication process stage, parents or teachers need to understand the functions intended by the child’s behaviours. The function intended is the purpose of the communicative behaviours such as requesting assistance, objects or attention, grettings and farewells, responding to one’s names, protesting, and requesting information about objects or events (Linfoot, 1994).

Given the above, intentionality cannot be ascribed exactly to particular behaviours as being either “present” or “absent”. For example, a child who bites her hand may or may not have the intention to gain attention based on the intentional thinking: “they are not paying attention to me, so I’ll just hurt myself” (Wickstrom-Kane & Goldstein, 1999). A complex learning history may be the basis for the on-going repetition of certain behaviours such that intention gradually develops in repetitive and familiar interactional situations. As such, intention is itself a “skill” that can be “taught” (Layton, 1987). These findings have profound implications for the role of teachers in the design of intervention programs (Linfoot, 1994). Rather than simply interpreting intention passively, assuming it as a pre-existing condition, the interpretation of the behaviour *as if it were intentional* may help to expand the child’s range of communicative function; this is, of course what happens during a child’s pre-intentional primitive stage when parents ascribe intentionality to their infant’s idiosyncratic behaviour. In turn, this knowledge can be used as the basis for developing innovative and systematic intervention programs for children with communication delays or disorders.

## Communication and language development for children with autism and other disabilities

This section begins with general communication and language development in typically developing children. This is followed by an overview of the development of children who have communication and language disorders such as autism so that this development can be compared to that of typically developing children. Finally, this section describes difficulties faced by children with autism who have spoken language but who nonetheless have limited pragmatics skills in social contexts.

Typically developing babies at the end of their first year, around 9 to 12 months, make sounds such as humming noises communicating intentionally to interact with others as well as using eye contact; they also begin to use single spoken words at this time (Haslett & Samter, 1997). These children between 12-18 months understand nonvocal communicative cues such as gestures, facial expressions and directed eye gaze. They develop single words that more explicitly signal their intention and gradually achieve communicative functionality, using some words for objects. Around 24 months, typically developing children follow simple requesting and use two-word sentences for various pragmatic functions (Bernstein & Tiegerman-Farber, 1997). Typically developing children between three to five year olds use a wide range of communicative strategies including functions and behaviours to sustain conversation with others. They initiate and maintain conversation, understand messages from others, and role play creatively with peers in social contexts (Bogdashina, 2005).

For many children language and communication does not develop normally when compared to communication development milestones of typically developing children (Bernstein & Tiegerman-Farber, 1997). Children with autism, for example often lack the skills needed to communicate functionally with others (e.g., requesting) around 24 months (Bernstein & Tiegerman-Farber, 1997). Children with autism often do not display the same amount of communicative strategies exhibited by typically developing children. Frequently, they do not display eye-gaze, motor and vocal imitation, and have difficulties seeking play with peers in contrast to the play behaviour displayed by typically developing children (Bogdashina, 2005).

In addition, approximately 35 % of children with autism never develop functional speech (Gerenser, 2009) and of those some children display echolalic or stereotyped speech (Bernstein & Tiegerman-Farber, 1997). Many children with autism have difficulties with communication and language skills in social contexts. They do not show variability or flexibility of communication (Quill, 1995) and lack spontaneous vocal and nonvocal communicative initiations (Koegel, 2000; Warren & Reichle, 1992). They primarily use non-conventional communicative behaviours as a way to request objects or to control the behaviour of others and they rarely communicate with others for social purposes such as sharing ideas (Koegel, 2000).

A number of studies show that children with autism have difficulties with language including morphology, syntax, and semantics (Botting & Adam, 2005; Eigsti, Bennetto, & Dadlani, 2007; Hubbell, 1981; McCormick, Loeb, & Schiefelbusch, 1997). For example, semantic and inferencing abilities in children with language difficulties and pragmatic disorders such as autism were investigated by Botting and Adams (2005). The results showed that children with language difficulties as well as pragmatic difficulties performed significantly lower than typical children in the semantic task. For inferencing tasks, children with language difficulties performed below the levels shown by the typically developing peers. All children with autism performed significantly below when compared to all the other groups. The study suggests that children with autism need appropriate intervention programs to develop communication and language skills including semantic and inferential skills.

Some children with autism have well-developed spoken language including good grammar with words and phrases (Bogdashina, 2005). However, these children may still have difficulties in pragmatics to communicate functionally and to initiate or sustain a conversation with others (American Psychiatric Association, 2000). They may use words out of context, display echolalic speech or make up words for a particular object in social contexts. Further, children with autism have difficulties not only in expressive communication but also in receptive communication. For example, they have difficulties in interpreting nonvocal cues such as gestures or facial expressions in order to understand the intentions of speaker (Bogdashina, 2005). As discussed in the previous section, pragmatics involves the use of language across a variety of social situations, providing for a listener's accurate interpretation of the speaker's intentions and for a variety of functions or acts (Philofsky, Fiddler, & Hepburn, 2007). Pragmatics may be critical in developing children's communication and social interactions including communicative function and behaviours.

Children with autism show their dysfunction in regard to pragmatics through inappropriate use of communicative behaviours including eye-contact, lack of vocal inflection, apparent unawareness of use of interpersonal space, deficits in turn taking and an inability to take the listener's point of view and conversational needs into account (Layton, 1987). Some studies indicate that children with autism demonstrate limited communicative behaviours and functions (Chiang, Soong, Lin, & Rogers, 2008; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997). For example, Stone et al., (1997) investigated nonvocal communication in children with autism. Fourteen children with autism and developmental delay and/or language impairment aged between two and three participated in the study. Nonvocal communication was assessed using the Prelinguistic Communication Assessment (PCA), which consists of sixteen situations with each situation creating opportunities to obtain requesting behaviours or commenting behaviours. The results indicated that children with autism request more often but comment less often than the other groups. Children with autism were less likely to point, show objects or use eye gaze to communicate than other groups, but more likely to directly manipulate the examiner's hand than other groups. The children with autism used less complex combinations of behaviours to communicate. This study suggests that children with autism use particular nonvocal communicative behaviours, such as directly manipulating the hand, to communicate intention with clarity and certainty. Another study investigated nonvocal communicative behaviours for young children with autism (Chiang et al., 2008). The study participants were 23 children with autism, and these children were compared to 23 children with developmental delay and 44 typically developing toddlers and infants. The study methodology was based on an abbreviated version of the Early Social Communication Scales as developed by Mundy *et al.,* (1996). The Scales were used to compare three types of nonvocal communicative skills: joint attention (e.g., eye-contact while holding a toy, pointing to toys within reach, showing toys); requesting (e.g., eye contact when objects are out of reach, giving a toy and pointing to a toy); and social interaction (e.g., turn taking, songs, smiles, and responding to social interactions such as eye-contact when tickled). The results indicated that when compared to typically developing children, the frequency and proportion of communicative behaviours in children with autism showed deficits on initiating joint attention, such as pointing and showing, as well as in low levels of response to social interaction (e.g., turn taking). They also showed lower scores in most categories of nonvocal communication and displayed unusual forms of nonvocal communication, compared to typically developing children. In addition, children with autism revealed deficits in both initiating and responding to joint attention compared to the other two groups.

While children with autism and other disabilities display limited pragmatics including communicative behaviours and functions, the range and type of communicative functions can differ as a function of the context or situation in which communication takes place such as home to school (El-Ghoroury & Romanczyk, 1999). Observations made by parents and teachers show that certain situations encourage communication. Light, Collier, and Parnes (1985) investigated the communicative functions in children who were nonvocal and who also had physical disabilities. The children were videotaped in two different situations; one was freeplay interaction with their primary caregiver, the other was structured contexts with a familiar clinician. The result showed that children produced a limited range of communicative functions in freeplay interactions with their caregivers. Most of the children's communicative turns were yes/no responses or provisions of specific information requested by the caregivers. The children seldom requested information, requested clarification or produced social conventions such as greetings. They produced a greater range of communicative functions in the structured situations with the clinician than in the freeplay situation with their mother. This study suggests that for children with communication disability, structured situations help to facilitate pragmatic performance.

Children with autism and other disabilities have difficulties with communication and language skills in a variety of social contexts; they lack variability or flexibility of communication. Some children with autism who have spoken language skills might have difficulties in pragmatics including communicative behaviours and functions. If caregivers, such as parents and teachers of children with autism can recognise and understand these children's difficulties with pragmatics it may be possible to develop communication and language skills for children with autism by providing these children with alternative means of communication. In next section the general definition, cause, prevalence and the main symptoms of autism including social interaction and communication difficulties are discussed in more detail.

## Children with autism

Autism, according to the DSM-IV-TR (American Psychiatric Association, 2000) is defined as a condition characterised by impairments in reciprocal social interaction, communication, and with restricted, repetitive, and stereotyped patterns of behaviour, interests and activities. Autism is classified within the umbrella term of Autism Spectrum Disorder (ASD). ASD includes five heterogeneous pervasive developmental disorders on a continuum that includes autism, Rett's disorder, childhood disintegrative disorder, Asperger's disorder, and an associated disorder described as pervasive developmental disorder, not otherwise specified. Autism is usually apparent at 30 months of age and the diagnosis can be made accurately in children as young as two years of age (Coonrod & Stone, 2004).

Autism is a life long developmental disorder that impacts on many domains of cognitive and social development such as difficulties in acquiring and using conventional communication and language abilities, social interaction and social relatedness, and behavioural organisation (Aldred et al., 2004; Dawson, Caver, Meltzoff, Panagiotides, McPartland, & Webb, 2002; Prizant, Wetherby, Rubin, & Laurent, 2003; Vig & Jedrsek, 1999). Autism was first described by Leo Kanner, as *early infantile autism* when conducting research based on observations of 11 children in 1943. He characterised the symptoms of autism in children under the age of three as the inability to develop social relationships, a delay in language acquisition, a lack of communicative intent in speech, echolalia, pronominal reversal, stereotyped and repetitive activities and an obsession with environmental sameness (Layton, 1987). Autism has since been described as autistic aloneness, a desire for sameness and an innate inability to form relatedness with people (Lawson, 2003; Schoenbrodt, 2004).

The exact cause of autism is unknown, though likely associated with multiple genetic and environmental factors (Pelio & Lund, 2001; Hertz-Piccitto et al., 2006; Volkmar & Pauls, 2003). The relative genetic risk of a second child having autism is 20-50 times higher than the population base rate. Family and twin studies suggest that autism is closely linked to genetic factors, making autism the neuropsychiatric disorder most affected by genetic inheritance (Levy, Mandell, & Schultz, 2009). According to Caglayan (2010) the cause of autism can be attributed variously to genetic abnormalities, single gene defects (i.e., in the RELN and UBE3A genes) and to known environmental agents such as prenatal infections or smoking (Hertz-Piccitto et al., 2006).

The prevalence of autism spectrum disorders since the 1960s has increased greatly. In the 1960s prevalence rates in the USA and Europe ranged from 5 to 72 cases per 10,000 children; this rate today is at 116 per 10,000 children for all autism spectrum disorders (Levy, Mandell, & Schultz, 2009). According to the Autism Council of Australia in 2007 62.5 per 10,000 Australian children between the ages six and 12 years had autism. This means that on average in this age group there is one child in every 160 with autism, which represents 10,625 children (MacDermott, Williams, Ridley, Glasson, & Wray, 2007). Between 1994 and 2003, the number of children being diagnosed with autism increased six-fold from 22,664 to 141,022 in the USA (Thompson, 2007).

The increase in prevalence could be due to a number of factors. One explanation is the changing diagnosis of autism criteria over time or the broadening of the definition of autism (Novella, 2008). Another factor might simply relate to higher detection levels of children with autism through rising awareness of autism amongst parents and the medical profession. Nonetheless, autism is a critical social health problem that requires significant interventions for these individuals and their families. Moreover, autism occurs three to four times more commonly for boys than girls (Croonenberghs, Deboutte, & Maes, 2002; Lauritsen & Ewald, 2001).

There are three mains symptoms of autism including impairments in social interaction, repetitive or stereotyped patterns of behaviour, and lack of communication skills (American Psychiatric Association, 2000; Lawson, 2003; Talay-Ongan, 2000).

First, impairment in social interaction manifests in a lack of empathy or disinterest in the thoughts and feelings of others and an inability to establish friendships. Research using experimental cognitive tasks shows that children with autism have a deficit in comprehending the emotions of others. They have difficulty matching emotional expressions and comprehending terms of affection, understanding the appropriate contexts of emotions, and in recognising how facial expressions, vocalisations and gestures are related (Bacon, Fein, Morris, Waterhouse, & Allen, 1998). Furthermore, they exhibit deficits in imitation of gross motor movement and in actions involving objects (Ingersoll, Schreibman, & Tran, 2003; Williams, Whiten, & Singh, 2004).

Children with autism are also limited in their social play skills (e.g., pretending or imaginative play, preferring solitary play activities) (American Psychiatric Association, 2000; Jarrold, 2003). For example, Williams, Reddy, and Costall (2001) compared functional play in three groups of children: children with autism, developmentally matched children with Down syndrome, and typical infants. The results indicated that although there was no difference in total playtime spent in functional play, the functional play in the autism group was less elaborated, less varied and less integrated than the other two groups. The functional play in children with autism mainly consisted of very simple acts involving playing with a single object such as bringing a cup to the mouth or pushing a car on the ground. Another study investigated symbolic play in children with autism (Libby, Powell, Messer, & Jordan, 1998) also comparing them to Down syndrome and typically developing children. The results indicated that children with autism produced less symbolic play behaviours than the other two groups. However, interestingly five among the total of nine children with autism demonstrated some symbolic play, although the frequency of symbolic play was low.

Play in early childhood is critical as it provides various contextual opportunities for developing social, cognitive and communication skills through interaction with others (Groden & Grace-Baron, 1988). In typically developing children in their first and second years of life, play involves several levels including practice play, exploratory play, functional play, and symbolic or pretend play (Groden & Grace-Baron, 1988). The first level of play skill is practice play in which children focus on touching, throwing and mouthing objects or items. The second level of play is exploratory play in which children begin to explore and manipulate objects and toys in their environment. The third level of play is functional play, where children from twelve months of age begin using objects for what they are intended, such as building with wooden blocks or pushing a toy car. The final stage of play skill that appears at around twenty months of age in typical children is symbolic play. It involves treating an object or situations as if it is something else (Groden & Grace-Baron, 1988). For example, a child pretends to make a pizza or pretends playdough is a chocolate cake.

Researchers have investigated the relationship between symbolic play and language development with both typically developing children and children with autism. For typically developing children, some studies suggest that there is a positive relationship between language ability and play, such that play may facilitate language development (Charman, Baron-Cohen, Swettenham, Baird, Cox, & Drew, 2000; Lewis, Boucher, Lupton, & Watson, 2000; McCune, 1995). For example, Ungerer and Sigman (1984) investigated the relation of functional play and sensorimotor behaviours to language in the second year of typically developing children. They found that functional play correlated positively to the sequence of functional and symbolic behaviours at 13 and 22 months of age. Also, correspondence between play and language was related to children's ability to experience symbols that are used as a means of interacting and communicating with others. For example, for children with autism, Mundy, Sigman, Ungerer, and Sherman (1987) studied functional and symbolic play, showing that they are correlated with language skills. The results showed that spontaneous symbolic and functional play behaviours were correlated with expressive or receptive language skill. Furthermore, Carter (2001) assessed the effects of play using choice to increase language skills and interactive behaviours for children with autism. The results showed that children's inappropriate behaviours were reduced, levels of social play and pragmatic skills increased when choice was permitted during language intervention within a play context. This study suggests that providing choice through play situations is critical to increase social interaction and language skill for children with autism.

The second set of symptoms exhibited by children with autism involves repetitive or stereotyped movements, such as hand flapping, finger flicking, odd hand positioning, body rocking or spinning, and engaging in interests and activities that are abnormally intense or narrow (Lawson, 2003). These repetitive body movements may be self-stimulatory on some occasions, but might also be used to obtain a desired item, escape a difficult task, or indicate emotions such as happiness or distress (Scott et al., 2000). A study by Bodfish, Symons, Parker, and Lewis (2000) investigated varieties of repetitive behaviours in autism. Thirty-two adults with autism and mental retardation participated in the study. The Autism Behaviour Checklist (ABC) and the Repetitive Behaviour Checklist (RBC) were used to identify specific behaviours such as self-injury and compulsions. The results showed that all individuals with autism displayed some form of abnormal, restricted repetitive behaviours, which may be labelled as stereotypes, rituals, compulsions, echolalia, or self-injury. The study found that individuals with autism have significantly greater ratings than mentally retarded children for compulsions, stereotypes and self-injury.

Repetitive or stereotyped behaviours of children with autism are often regarded as inappropriate because they are challenging and confusing to others (Keen, Sigafoos, & Woodyatt, 2005). These behaviours are frequently labelled as inappropriate, aberrant, idiosyncratic, problematic, maladaptive or disruptive. Challenging or inappropriate behaviours describe destructive, harmful, disruptive or otherwise unacceptable behaviour that occurs with sufficient frequency and/or severity to be of major concern (Sigafoos, Arthur, & O'Reilly, 2003). Many of these inappropriate behaviours may serve a communicative function such as requesting or commenting (Conroy, Asmus, Ladwig, Sellers, & Valcante, 2004; Nungesser & Watkin, 2005). Inappropriate behaviours may occur because of the limitation of the individual's language and social development (Horner, Carr, Stain, Todd, & Reed, 2002). These behaviours may allow individuals to interact with others socially as well as express themselves to others, such that the challenging or inappropriate behaviours serve a communicative function (Layton, 1987; Sigafoos, Woodyatt, Keen, Tait, Tucker, Robert-Pennel, & Pittendreigh, 2000).

While children with autism have difficulties in social interaction and show repetitive and stereotyped patterns of behaviour, the main symptom of autism is impairment in communication and language skills. Communication, as described earlier, is a social process that transmits information or exchanges ideas (Bogdashina, 2005). Language is a tool and structured symbolic form for communication. The difference between language and communication is that language is the tool and communication is the purpose or function for which language is used. Some children with autism, with well-developed speech, may not able to use these skills functionally. They can utter words or sentences, but do not use these skills to obtain desired outcomes. Difficulties in pragmatics include such examples as one-sided conversations or not being able to adjust their style of language according to the different situation (Dodd, 2005). They may use echolalia, and repetitive and stereotyped communication (e.g., repeating the same questions many times). Also many of these children's speech has unusual prosodic features such as idiosyncratic rhythm and intonation to communicate with others. Further, they may have difficulties interpreting a speaker's intention or attitude as expressed by the speaker's intonation

(Bogdashina, 2005). Children with nonvocal communication may also use imitation, eye-contact, facial expression and gestures such as pointing to communicate with others. However, these nonvocal communicative behaviours are often inappropriately exhibited. Many children with autism have difficulties in functional communication that is using communication purposefully, to have their needs met. They have functional difficulties in requesting, protesting, initiating or responding to, and maintaining interactions with others. Further, they have restricted functions in directing others' attention to an object, event or commenting on social interactions (McCormick, Loeb, & Schiefelbush, 1997; Dodd, 2005).

Children with autism need assistance to learn how to comment, request and to imitate words or sounds to communicate with others meaningfully in everyday life. This is especially the case for children with autism who are nonvocal or lack any functional communication. These children need critical intervention in order to help them develop basic functional communication. An example of an intervention program to develop functional communication is the augmentative and alternative communication system (AAC) described in the next section.

## Language interventions

Augmentative and Alternative Communication (AAC) is an area of clinical and educational practice that provides a compensatory technique to assist individuals who are unable to communicate functionally through spoken language (Stoner et al., 2006). Augmentative communication is used as a supplementary technique to enhance communication of individuals who are not capable of independent vocal communication. For some individuals, such as those who are severely neurologically impaired, these communication techniques may be viewed as alternatives to speech as opposed to being supplementary only (Shane & Sauer, 1986). The object of using AAC with vocal and nonvocal children with autism is to assist them in developing functional communication and spontaneous (oral or sign) language. The acquisition of functional communication is considered a primary prognostic factor for assisting in providing long-term communicative outcomes (Malandraki & Okalidou, 2007).

An AAC system is the total functional communication system of an individual that may be both aided and unaided. An aided system involves the use of specific pieces of equipment or other auxiliary materials such as electronic voice output communication aides, photographs, line drawings and other graphic symbols affixed to a communication board, and miniature objects serving as referents for real objects (e.g., a toy miniature car can be used to represent a real car). In contrast, an unaided system does not involve the use of any external materials, and may include sign language and natural gestures (e.g., waving a hand for "good bye") (Sigfoos & Drasgow, 2001).

A number of studies (Foley & Staples, 2003; Marckel, Neef, & Ferreri, 2006; Johnston, Nelson, Evans, & Palazolo, 2003; Sigfoos & Drasgow, 2001) suggest that AAC systems can increase the social communicative interactions of children with autism. The combination of visual and auditory components within AAC systems provides a more concrete means of representing language. For nonvocal individuals, active participation in social situations requires that they continue to communicate with other people as well as their families. The use of AAC increases the probability that these opportunities to interact with other people will be possible (Shane & Sauer, 1986). Several studies have demonstrated that the use of AAC systems for children with autism and other disabilities, especially those with a special emphasis on the use of visual support to provide opportunities for teaching social initiations, can be effective (Howlin et al., 2007; Johnston et al., 2003; Kranz & McClannahan, 1993). For example, Johnston et al., (2003) investigated the use of visual support for children with autism to initiate interactions based on using a graphic symbol of “Can I play?”. The results showed that all children successfully used visual symbols with teacher and peers to initiate social interaction. Most of the social interaction occurred between the teacher and students rather than between students. Also all children increased their use of vocal communication with their teacher compared to other untrained children with autism in the same class.

A number of studies suggest that aided AAC systems such as voice output communication aids (VOCA) and symbols may also have a positive impact on facilitating speech for children with autism (Drager, Postal, Carroulus, Castellano, Gagliano, & Glynn, 2006; Mirenda, 2003; Mirenda & Lacono, 2009; Romski & Sevick, 2005; Schlosser, Blischak, Belfiore, Bartley, & Barnett, 1998). For example, Schlosser et al., (1998) investigated the effectiveness of VOCA for a ten year old child with autism. The child was taught to spell words under three different conditions: auditory-visual, visual, and auditory. In the auditory-visual condition, the child received both synthetic speech (via the VOCA) and orthographic speech feedback. In the visual condition, the child received only orthographic feedback and in the auditory condition, the child had only synthetic speech. The results showed that the child’s performance on spelling words was slightly more effective in the auditory-visual condition and auditory condition than in the visual condition. Further, Drager et al., (2006) investigated the effects of aided language modelling (ALM) in increasing the number of AAC graphic symbols identified correctly (symbol comprehension) and in increasing the number of referents within an activity using symbols (symbol production) for two children with autism. The ALM intervention included engaging the child in interactive play and providing models of symbols during the natural play. The intervention consisted of three sections: (a) using an index finger to point to a referent in the environment (b) sequentially pointing within two seconds to a graphic symbol of the referent and (c) simultaneously vocalising the vocal symbol for the referent. During the intervention, both children increased their comprehension of new symbols and increased their ability to label the symbols (objects with line drawing). The study demonstrated that AAC symbols can be used in receptive and expressive communication and are effective for helping some children with autism acquire new symbol vocabulary.

Many AAC systems are used by families to communicate with children with autism. While families often report that the use of AAC in the home environment is positive for their children with communication disabilities such as autism there is, however, little evidence of the effectiveness of AAC in the home context (Granlund, Bjorck-Akesson, Wilder, & Ylven, 2008; Romski & Sevcik, 2005). One exception is found in Sigafoos, O'Reilly, Seely-York, Weru, Son, Green, and Lancioni (2004) who investigated an AAC intervention using voice-output communication aid (VOCA) in the home environment for a 12-year-old child with autism. The home based intervention by parents and families used two activities (e.g., snack and leisure activity such as music or drawing) based around the child requesting preferred foods or drawing activities in the home. The results showed that the intervention involving the family successfully taught the child to request in the home context as well as university setting using VOCA.

An AAC system provides a supplementary support to enhance communication for individuals who are unable to communicate functionally with others. The AAC system may also enhance the expressive skills of individuals who have good vocal communication but may have some barrier to producing it. Some of the positive aspects of AAC suggest that it not only enables expression of a variety of communication functions such as requesting but is also effective in increasing vocal communication. AAC intervention may provide a critical role as a communication mode for individuals with autism. However, many of these AAC approaches focus on mode of language or communication support, rather than teaching the purpose or function of communication as such. Many indiviudals with autism often simply do not know what the purpose of communication is and in this context explicitly teaching them this purpose may be critical for their on-going communication development. In the next section, other interventions are outlined which are based on applied behaviour analysis (ABA). These interventions may be useful for children with autism to develop communication and language skills.

## Behaviour treatment for children with autism

Significant advances in behaviour and language based intervention programs for children with autism and other disabilities have been achieved through the use of applied behaviour analysis. Applied behaviour analysis (ABA) is a natural science approach for understanding and changing human behaviour (Cooper, Heron, & Heward, 2007). ABA has been defined as:

> … the science in which tactics derived from the principles of behaviour are applied systematically to improve socially significant behaviour and experimentation is used to identified the variable responsible for behaviour change (Cooper, Heron, & Heward, 2007, p.20).

ABA has its origins in behaviourism, the science of behaviour that began in the early 1900s in psychology when the experimental analysis of behaviour was pioneered. From this beginning, behaviourism was used to develop techniques for improving or changing human behaviour, becoming in this way, applied behaviour analysis (Cooper, Heron, & Heward, 2007).

ABA is based on principles of operant conditioning. In 1938, B.F. Skinner published *The Behaviour of Organisms* describing operant conditioning that is an association is made between a behavior, an antecedent and a consequence for that behavior (Cooper, Heron, & Heward, 2007; Skinner, 1957b). This is known as a three-term contingency – *antecedent-behaviour-consequence* (“ABC”) – as the basic unit of analysis of operant behaviour. Operant conditioning is a method of learning that all behaviours are learned through experiences with consequence in the environment. For example, a person’s behaviour is more likely to occur again because of the consequence that followed in the past. An example of this might be where a child smiles and this behaviour is followed by the mother cuddling him, which the child likes. Given the consequence of the smiling behaviour (the enjoyable cuddle from mother), then the smiling behaviour from the child is more likely to occur in the future.

From the view of operant conditioning, functional consequences have an effect on the future probability of a behaviour so that we can change, eliminate, decrease or increase behaviours by modifying the causal and maintaining factors surrounding their occurrence. According to Skinner (1953a, p.65), “in operant conditioning, we ‘strengthen’ an operant in the sense of making a response more probable or, in actual fact, more frequent”. For example, if a student receives an award for writing an essay, he or she may be more likely to increase the frequency of writing an essay. When operant conditioning consists of an increase in response frequency, reinforcement has taken place, and the consequence of the response in this example, the award, would be called a reinforcer. Operant conditioning also involves the principle of punishment. Punishment occurs when the likelihood of certain behaviour decreases as the result of the presentation (positive punishment) or removal (negative punishment) of a consequence after the behaviour. In the above example, if an award resulted in a decrease in the frequency of writing an essay, punishment has occurred and the award would be called punisher.

Approaches based on the principles of ABA are currently recognised as being evidence based treatment for individuals with autism (Fortunato, Sigafoos, & Morsillo-Searls, 2007; Rosenwasser & Axelrod, 2001). Early ABA intervention programs based on operant principles such as Discrete Trial Training (DTT) were developed in the 1970s by behaviour analyst, Ivar Lovaas at the University of California. They are highly structured programs that provide focused one-on-one training (Cowan & Allen, 2007; Daversa, 2001). DTT involves breaking down complex skills and teaching each sub-skill through a series of teaching trials. The learning environment focuses on individual behaviours one at a time and is controlled by a teacher or therapist. DTT with 40 hours per week for at least two years has proved effective for children with autism in improving intellectual functioning and behaviour. Forty-seven percent of children were able to participate in normal classrooms with typical children following this treatment (Lovaas, 1987).

In DTT training, fluency is considered an important factor requiring practice of the skill. Fluency is defined as the combination of speed, accuracy and functionality (Kerr, Smyth, & McDowell, 2003; Kubina & Wolfe, 2005; Weiss, 2001). The term fluency is traditionally associated with language learning and encapsulates the pace, smoothness and lack of hesitation of a learner for example, once they have mastered a new language (Binder, Haughton, & Bateman, 2002). Many children with autism have difficulties in fluency and fail to respond in a timely fashion to initiations from others (Weiss, 2001). In relation to DTT intervention programs fluency also relates to the measured effects of the program, describing how well a child has learned a certain skill and when she or he can use these skills automatically (Kerr, Smyth, & Mcdowell, 2003).

While DTT provides intensive intervention for children with autism, the improvements through DTT can be slow and children often exhibit a general lack of spontaneity in their use of newly learned skills (Francis, 2005; Koegel, Koegel, Harrower, & Carter, 1999). Furthermore, behaviours are often not generalised to other settings (Charlop-Christy & Carpenter, 2000). As a result of the limitations of programs such as DTT, researchers have focused on the need to develop generalisation in their intervention treatments and to develop strategies that improve the clinical impact of behavioural interventions. An example of an ABA based program that seeks greater generalisation of behavioural improvements across settings is natural environment training (NET). NET includes the incidental teaching method and pivotal response training (PRT) that aim to provide opportunities for learning within the context of the child's natural environment (Koegel & Koegel, 2006b). The incidental teaching method, for example, depends on the learning opportunities provided by the child's natural environment and each child's existing behaviours. These methods generally incorporate the children's preferred toys or materials as a means of increasing the child's motivation to respond to the learning context (Stahmer, Ingersoll, & Carter, 2003). The incidental teaching method, as the name suggests, seeks learning opportunities from available “incidents” in natural settings. The method seeks to increase spontaneous language and response generalisation for the acquired target behaviour (LeBlanc, Esch, Sidener, & Firth, 2006). However, learning rates through the incidental teaching method tend to be slower than those through DTT because of its dependence on incidental opportunities rather than a structured program (Charlop-Christy & Carpenter, 2000).

Pivotal Response Training (PRT) was developed by Koegel, Schreibman, Good, Cerniglia, Murphy, and Koegel at the University of California and was designed to facilitate skill generalisation and maintenance (Koegel & Koegel, 2006b; Stahmer, 1999). In PRT training, some behaviours are thought to be pivotal behaviours or pivotal responses/areas (Koegel & Koegel, 2006b). Pivotal behaviours (e.g., motivation and self-initiation) are those central to broad areas of functioning, such that a change in a pivotal behaviour will result in improvement across a number of other non-targeted areas of behaviour (Koegel et al., 1999). It is child directed as opposed to therapist or parent directed, giving children the opportunity to initiate (Baker-Ericzen, Stahmer, & Burns, 2007). PRT is a naturalistic training method that relies on naturally occurring consequences and teaching opportunities. It is based on the principles of ABA in that children’s impairments may be improved with environmental manipulations of antecedents and consequence and by directly teaching skills to address skills deficits (Baker-Ericzen, Stahmer, & Burns, 2007). PRT involves a number of strategies, including: the use of clear instructions and questions presented by the therapist; child choice of stimuli; interspersal of maintenance tasks and direct reinforcement; reinforcement of purposeful attempts at correct responding; and turn taking to allow modelling and appropriate pace of interaction (Stahmer et al., 2003).

Research evidence exists for the effectiveness of PRT strategies to improve communication such as speech (Baker-Ericzen, Stahmer, & Burns, 2007; Koegel & Koegel, 2006b; Stahmer, 1999), social behaviour skills (e.g., eye-contact, social initiation and sharing joint attention) (Baker-Ericzen, Stahmer, & Burns, 2007; Burke & Cerniglia,1990; Pierce & Schreibman, 1995; Pierce & Schreibman, 1997) as well as play skills (Koegel & Frea, 1993) for children with autism. For example, children with autism had PRT training (Koegel & Koegel, 2006b). The results showed that children with autism gained words rapidly and they were able to use new words spontaneously. Further, Baker-Ericzen et al., (2007) investigated the efficacy of a community and parent based PRT program for children with autism. The results indicated that all children had significant improvement in daily living skills, social interaction and communication regardless of gender, age or race.

This section focused on intervention approaches based on ABA to improve or change individual's behaviours. Some approaches based on ABA such as pivotal response training are effective in improving communication for children with autism. ABA is based on Skinner's principles of operant conditioning which suggests that behaviours are learned through experiences in context. In the next section Skinner's analysis of verbal behaviour is examined in more detail. This is because in Skinner's view language is a learned behaviour; this analysis has implications for developing communication interventions which utilise the functional relationship between language (as verbal behaviour) and the environment in which the behaviour takes place.

## Verbal behaviour

In 1957, B.F Skinner published the book *Verbal Behaviour* providing a behavioural analysis of language with an emphasis on the role of “verbal behaviour” which he defined “as behaviour reinforced through the mediation of other persons’ needs” (1957b, p.2) in broader human behaviour. Skinner saw language as learned behaviour caused by the same environmental variables that he had analysed as causing nonverbal behaviours (Cooper, Heron, & Heward, 2007).

Skinner’s verbal behaviour is distinct from operant behaviour. Operant behaviour is any behaviour that is “operant” in the environment, and is related to a consequence. Operant conditioning affects consequences on behaviour and includes reinforcement and punishment. Consequences following a behaviour lead to an increase (reinforcement) or decrease (punishment) in the future probability of that behaviour. The three-term contingency is the basic unit in the analysis of operant behaviour and describes the functional relationship between antecedent, behaviour and consequence (ABC).

Unlike operant behaviour, verbal behaviours occur through another person’s mediation. Verbal behaviour consists of Antecedent (A)- Verbal Behaviour (VB)- Behaviour (B)- Consequence (C). For example, if a child is hungry (A), the child goes to mother and says “I’m hungry” (VB), the mother opens the fridge and pours a glass of orange juice (B) and then the child is no longer hungry (C). In verbal behaviour, the consequence is socially mediated by another person (in this example, the mother) doing something for the speaker (Skinner, 1957b).

Skinner’s analysis of verbal behaviour focuses on the function of communication rather than the form. For example, a child saying, “mom, give me an apple juice”, is a request and categorised as a “mand” by Skinner. The request could be made using a variety of forms e.g., spoken language, pictures or hand gestures. So long as it still has the same purpose, to request something, the communicative act would remain a mand regardless of what form it took. In Skinner’s verbal behaviour, the term “verbal” is distinct from the common meaning in English that implies spoken communication. The term nonverbal behaviour implies nonvocal communication in English. However, Skinner’s use of the term “verbal” includes both vocal and nonvocal behaviours and it refers to any behavioural form that has a communicative purpose or function (Cooper, Heron, & Heward, 2007). Given the differnce between the term “verbal” in everyday English and as used by Skinner, for the purpose of clarity, the word “vocal” is used in this paradigm to refer to spoken words or utterances while “verbal” is used to refer to behaviour of any form that has a communicative function.

While Skinner acknowledges that language is an important tool for communication, his analysis of verbal behaviour focused on the function or purpose of communication rather than its formal linguistic structure e.g., phonemes, morpheme, and syntax (Cooper, Heron, & Heward, 2007; Skinner, 1957b). For example, a baby’s crying would be regarded as “verbal” when it prompts a listener such as the baby’s mother to provide milk. Under this schema verbal behaviour can include initiations and responses such as pointing, gestures or hand waving. As such, verbal behaviour includes vocal-verbal behaviours and nonvocal verbal behaviour and must involve a social interaction between a speaker and a listener (Cooper, Heron, & Heward, 2007).

Skinner defined a number of fundamental verbal operants that relate to specific antecedent and consequent events (Kelly et al., 2007). Verbal operant units are determined by identifying functional relations between verbal behaviour and the environment. Verbal operants include mand, tact, echoic, intraverbal and autoclitic. These terms are widely used in the development of early language intervention programs that are based on verbal behaviour (Bondy, Tincani, & Frost, 2004; Cooper, Heron, & Heward, 2007; Kelly et al., 2007; Sautter & LeBlanc, 2006).

The term mand is derived from *command*, *demand* and *countermand*. A mand is asking or requesting things that you want to have (e.g., a child saying “chips” to its mother because he or she wants to eat the chips). Common examples of mands include requesting items, assistance, and rejecting offered items or activities (Bondy, Tincani, & Frost, 2004; Shafer, 1994). A mand is a verbal operant in which the response is reinforced by a consequence that is under functional controlled conditions such as deprivation or aversive stimulation (Skinner, 1957b). In this way, as a verbal operant the mand is under the functional control of motivating operations and specific reinforcement (Laraway, Snycerski, Michael, & Poling, 2003). For example, food becomes effective as reinforcement through deprivation. A child that is hungry and wants chips will produce behaviours such as the mand “chips” if this behaviour has resulted in chips on previous occasions.

Mands also play an important role in the early development of language. They are the first verbal operants of children, beginning as crying as a mand for food, attention or from fear of pain or cold and heat (Cooper, Heron, & Heward, 2007). Manding in the form of crying is replaced by words or signs in typically developing children. Critically, manding helps children understand the speaker and listener roles that are the basis for their future verbal development.

A tact is defined as “a verbal operant in which a response of given form is evoked by a particular object or event or property of an object or event” and comes from the word contact (Skinner, 1957b, p.82). For example, when a child says “cup” because the child sees a cup on the table, the naming of the object is a tact.

Echoic is a verbal operant that is “under the control of other verbal behaviour” (Skinner, 1957b, p. 55). It occurs when a speaker repeats words, phrases and the verbal behaviour of another speaker. Examples of such behaviour are when a mother says “banana” and the child repeats or imitates this word, or again if a mother says, “moo” with holding toy cow, and the child says, “moo” in turn as well. The echoic operant is controlled by a verbal discriminative stimulus that has point-to-point correspondence between the stimulus and the response so that the utterances are very similar, sharing the same sense mode with physical resemblance between gestures as well (e.g., finger pointing). Furthermore, the echoic behaviour produces generalised reinforcement including praise and attention (Cooper, Heron, & Heward, 2007). For example, if a mother says to her child: “this is bread, can you say ‘bread’?” and the child says “bread” in reply then the mother may praise the child’s response by saying “good!” and smiling at the child. The child’s ability to repeat the word “bread” is reinforced by the mother praising her child by saying “good” and smiling, rather than simply providing bread to the child (Cooper, Heron, & Heward, 2007).

The term intraverbal is used to define a verbal operant in which the listener's response to another person's verbal behaviour is not simply an echo of the speaker (Cooper, Heron, & Heward, 2007). In other words, the form of an intraverbal does not have direct point-to-point correspondence to the form of the preceding verbal stimulus (Skinner, 1957b, p.71). An intraverbal operant can be answering simple questions e.g., when a mother says "what is your name?" and the child says "Chris".

Autoclitic is a verbal operant that signifies the speaker's conviction about his or her own verbal behaviour and serves to make a subtle impact on the listener (Frost & Bondy, 2007b). Skinner (1957b, p.313) defines autoclitic operants as occurring when a speaker talks about him or herself talking or when a speaker refers to the responses he is currently making, has made in the past or will make in the future. For example, when a speaker says, "I think it is going to rain" the phrase "I think" is an autoclitic which indicates to the listener that the speaker has a level of conviction that it will soon rain (Lowenkron, 2004).

Skinner's verbal behaviour approach may be useful for children with autism (LeBlanc et al., 2006; Michael, 1988a) in that verbal behaviour focuses on the function or purpose of communication (Michael, 1988a). This is because many children with autism, even those with good language skills, have difficulties in the functional use of such skills to achieve their needs (e.g., requesting). Further, the use of motivating operation, especially verbal opeant of manding might prevent prompt dependence, which is a common problem of children with autism. Prompt dependence comes when a child needs a prompt (e.g., vocal or physical guidance) from others in order to carry out his or her performance (Cooper, Heron, & Heward, 2007). For example, if a child is hungry and the child waits for the mother to prompt him or her to eat an apple, the mother may realise that her child relies on her verbal prompts before eating. In this example, if the mother provides motivating operation (e.g., deprivation of the apple), the child may be more likely to make the effort to request an apple in the future without waiting for the mother's prompt. The use of motivating operation for focusing on functions such as requesting skills (using a verbal behaviour approach) may therefore be beneficial for children with autism in developing functional communication (Sunberg, 2004).

A number of studies have confirmed the potential effectiveness of the verbal behaviour approach for children with autism with communication difficulties (Barbera & Kubina, 2005; Carr & Firth, 2005a; Egan & Barnes-Holmes, 2009; Kodak & Clements, 2009; Sunberg, Endicott, & Eigenheer, 2000; William, Carnereo, & Perez-Gonzalez, 2006). For example, manding training for children with autism resulted in the emergence of other types of verbal operant such as tacts in the form of adjectives (Egan & Barnes-Holmes, 2009). Other studies investigating the acquisition of mands and tacts with concurrent echoic training for a child with autism showed that manding and tacting increased to relatively high levels for a child with autism (Kodak & Clements, 2009). Further, intraverbal training for children with autism helped children to acquire non-imitative verbal responses and transferred to tacts successfully (Sunberg, Endicott, & Eigenheer, 2000). These studies suggest that interventions based on a verbal behaviour approach may be effective to develop functional use of communication for children with autism. Application of verbal operant training, such as mand and tact training incorporating relevant motivating operations can be beneficial for children's language and communication development (Bondy, Tincani, & Frost, 2004; Cooper, Heron, & Heward, 2007; Sundberg & Michael, 2001).

For example, reinforcing a variety of social behaviours such as responding to names, objects, pointing at pictures, and asking questions may accelerate children's initiations and therefore provide opportunities for language use (e.g., words or phrases) and social interaction with others. They therefore have an important role to play in the development of communication and language intervention programs (e.g., the picture exchange communication system).

## The Picture Exchange Communication System

The picture exchange communication system (PECS) is a skill-based AAC intervention program for developing functional communication for individuals with language delays or disabilities (Bondy & Frost, 1994a). The program combines both behavioural and developmental perspectives of learning theory. PECS relies on the principles of applied behaviour analysis, incorporating nonvocal prompting in training conducted through a set of six phases (Bondy & Frost, 2001b).

The PECS program is based on principles developed from Skinner's analysis of verbal behaviour, focusing on the function of language rather than on form. The main focus of the PECS program is teaching function or purpose to communicate such as manding skills through the learner's spontaneous initiations. As discussed earlier, even those children with autism who have language skills such as words or sentences may have difficulties in using these skills functionally to communicate to obtain desired outcomes. For these children, learning the functional use of language is as critical in social contexts as it is for children who do not have vocal communication. Consequently, the PECS program may be useful for vocal and nonvocal children with autism. PECS focuses on the functional importance of manding to underpin the communication training. For example, in the early PECS phases, children learn to request particular items (e.g., chips or toys) by grasping the picture and then exchanging the picture with an item held by a communicative partner. They later learn to mand when a choice is given from an array of two to five pictures. Further, once a child learns to use the sentence structure of the “I want” picture plus the wanted item, they continue learning to mand by responding to a question of “what do you want?” with a communicative partner.

In addition to manding, other verbal operants (e.g., intraverbal and tact) are mixed in each PECS phase to “address how an understanding of mixed verbal operants can assist in the rapid acquisition of complex verbal behaviour in children who display marked deficits in their verbal repertories” (Frost & Bondy, 2002a, p. 311). For example, if a child looks at a banana on the table (antecedent conditions) and then says “banana!” (behaviour), then this is pure “tact”. However, if an adult shows a banana to a child and asks “what is it?” and the child then responds with “banana!”, this can be described as a mixed verbal operant, namely, an “intraverbal-tact”.

PECS is designed to teach non-speaking individuals functional communication skills (Bondy & Frost, 2001b; Kravits, Kamps, Kemmerer, & Potucek, 2002). PECS uses symbol-based pictures and powerful reinforcers to facilitate functional communication in a variety of settings and situations with both familiar and unfamiliar individuals. PECS seeks the outcome of getting the child to initiate communication or social interaction rather than having adults lead initiation in social contexts. Rather than simply responding to questions, through PECS children learn to initiate requests for preferred items from a communicative partner by exchanging the picture symbol with the preferred item held by the communicative partner (Browne, 2006). In addition, generalisation strategies are embedded from the beginning of the PECS intervention as indicated in the PECS manual. For example, children from Phase 2 are taught to request preferred items with more than two different communicative partners and settings. In particular, to increase the frequency of communication opportunities for learners, motivating operations such as putting toys out of reach (but within a child's view, for example) are used throughout the training.

The PECS program consists of six distinct phases that use teaching strategies such as fading prompting, time delay and backward chaining to build on skills mastered in the previous phase (Frost & Bondy, 2002a). In Phase 1 (physical exchange), children are taught basic communication by encouraging them to give a single picture to a communicative partner. The children learn to approach another person (reach towards), direct an action (give a picture card) and receive a desired outcome. In Phase 2 (distance and persistence), the children are taught to persist in their communicative attempts despite a variety of obstacles or changes during the training sessions. Generalisation from this phase is taught by systematically eliminating prompts that encourage the child to initiate communication with a communicative partner.  In Phase 3 (picture discrimination training) the child is taught to discriminate between multiple pictures in the PECS communication book. In Phase 3A, the children learn to discriminate between two preferred pictures. In Phase 3B the children learn to discriminate between preferred and non-preferred pictures. In Phase 4 (sentence structure), the children create a "sentence" on the sentence strip by combining the "I want" picture card and the card of a desired item (e.g., picture of an apple), travel to a communicative partner and give him or her the sentence strip to exchange with the item. The communicative partner reads the strip back to the child using progressive time delay between the words "I want" and the item label. Additional social praise is added when the children independently provide the vocal label during the delay. In Phase 5 (answering “what do you want?”), the children are taught to respond to the question, “what do you want?” within the frame of an intraverbal-mand. Forexample, a child responds with a picture of “I want” with a picture of a preferred object to answer the question. In Phase 6 the children learn to respond to commenting question such as “what do you see?”, “what do you hear?” within the frame of an intraverbal-tact. For example, in responding to the question, “what do you see?” children are encouraged to place a picture of “I see” alongside a picture card that corresponds to the object they see. As such, the children learn to discriminate between the sentence starters of “I want” and “I see” etc.

There has been research on the effectiveness of the PECS program for developing functional communication for children with autism and other language disabilities. Table 1 below summarises aspects of previous research on PECS such as diagnosis, research design, and findings.

***Table1. Description of Picture Exchange Communication System (PECS) Studies***

| *Researchers* | *Size* | *Diagnosis* | *Ages* | *Phase* | *Setting* | *Interventionist* | *RD* | *Length/ no. trials* | *Genea-lisation* | *Reliability* | *Maintenance* | *Outcome measures* | *Findings* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adkins & Axelrod (2002) | 1 | PDD | 7:0 | 1 | School | Researcher | ATD | N/A | Yes | N/A | N/A | Spontaneous response, physical prompting | Pecs was more effective than sign language |
| Almeida, Piza & Lamonica (2005) | 3 | Cerebral palsy | 6:9-11:9 | 1-5 | School | Researcher | MB | N/A | No | Yes | No | Behaviour change | Pecs is effective for changing behaviours |
| Anderson, Moore, & Bourne (2007) | 1 | ASD | 6:0 | 1-4 | Home | Researcher | ABCD | N/A | Yes | Yes | No | Language gain, concomitant changes in non target behaviours | Increases in manding, initiations cumulative word counts and positive behaviours |
| Angermeier et all., (2008) | 4 | ASD PDD | 6:0-10:0 | 1-3 | School | Researcher | ATD | N/A | No | Yes | No | A correct request | learned effectively to request desired objects |
| Ben Chaabane, Alber-Morgan, & DeBar (2009) | 2 | ASD | 5:0-6:0 | Descri-ptors | Home | Parents | MBD | N/A | Yes | Yes | No | Child responses in each trials across colors, shapes, & Functions | Parent can teach their children to use PECS and children showed improvisation of mands. |

*Note.* G = Generalisation. RD = Research Design. MBP: Multiple Baseline across Participants. RGD = Randomised Group Design. MDP = Multiple probe Design across Participants. MB = Multiple Baseline. MBS = Multiple Baseline across Settings. MBD = Multiple Baseline across Descriptors. CCD = Changing Criterion Design. ATD = Alternating Treatments Design. ASD = Autism Spectrum Disorder. DD = Developmental Delay. ADHD = Attention Deficit Hyperactive Disorder. MR = Mental Retardation. N/A = not available from the journal article.

*Table1. (continued)*

| *Researchers* | *No.of partci -pants* | *Diagno -sis* | *Ages* | *Phase* | *Setting* | *Interventionist* | *RD* | *Length/ no. trials* | *Genera-lisation* | *Relia-bility* | *Maintenance* | *Outcome measures* | *Findings* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carr & Felce (2006b) | 24 | ASD | 3:0-7:0 | 1-3 | Class-room | Researcher | None – equivale -nt control group | 6 weeks | Yes | Yes | No | Communication skills | Used functional communication<br>Successful generalisation to other objects, setting and people |
| Carre , LeGrice, Blampied, & Walker (2009) | 3 | ASD | 5:0-6:0 | 1-3 | School | Teacher, therapist, authors & Involving parent at home | MBA-S | N/A | Yes | Yes | No | Functional communication | All children acquired requesting skills.<br>No generalisation effects in the classroom and home setting |
| Chambers & Rehfeldt (2003) | 4 | MR | Adult | 1-3 | Class -room | Researcher | ATD | N/A | Yes | Yes | No | PECS vs. Manual sign :mand skills | Training with PECS is more effective in establishing mand skills than manual sign. |
| -Christy, Carpenter, Le, LeBlanc & Kellet (2002) | 3 | ASD | 3:8-12:0 | 1-6 | Home & school | Therapist | MBP | 10mths (246 trials) | No | Yes | Yes | Social-communicative behaviours,& problem behaviours | Social -communicative behaviours increased and joint attention, concomitant increased in verbal speech, decreased in problem behaviours |
| Charlop, Malmberg, & Berquisk (2008) | 3 | ASD | 5:2-9:11 | Braille-modified PECS | Therapy room | Visually impaired therapist | MB | N/A | No | Yes | No | The frequency of therapist's correct response, the participant's correct response to use PECS | Participants communicated using the modified pecs with visually impaired therapist , decreased problem behaivours |

*Table1. (continued)*

| *Researchers* | *No.of partci-pants* | *Diagnos-is* | *Ages* | *Phase* | *Setting* | *Interventionist* | *RD* | *Length/ no. trials* | *G* | *Reliability* | *Maintenance* | *Outcome measures* | *Findings* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frea, Arnold, & Vittimberga (2001) | 1 | ASD | 4:0 | 1-3 | Classroom | Researchers | MBS | N/A | No | Yes | No | Aggressive behaviour | Aggressive behaviours is eliminated |
| Ganz, Cook, Corbin-Newsome, Bourgeois, & Flores (2005) | 1 | ASD & DD | 5:1 | 1-3 | Home | Researchers | Case study | N/A | No | Yes | No | Pecs exchange | Unable to make picture exchange independently in phase one. Pecs alone would not provide with an effective means of communication. |
| Ganz, Simpson, & Corbin-Newsome (2008) | 3 | ASD | 3:1-5:1 | 1-4 | Home | Researchers | MBP | N/A | No | Yes | No | Independent PECS exchange, word approximations | Two participants mastered PECS, however, expressive speech did not significantly increase. |
| Ganz &Simpson (2004) | 3 | ASD & DD | 3:0-7:0 | 1-4 | School | Researchers | CCD | N/A | Yes | Yes | N/A | Picture exchange | Increased spoken words |

*Table1. (continued)*

| *Researchers* | *No.of partci-pants* | *Diagno -sis* | *Ages* | *Phase* | *Setting* | *Interventionist* | *RD* | *Length/ no. trials* | *G* | *Reliability* | *Maintenance* | *Outcome measures* | *Findings* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heneker & Page (2003) | N/A | Autism | 6:08-10:10 | 1-3 | Classroom | Staff & parent | N/A | N/A | Yes | N/A | No | Communicative functions & acts. Level of adult support | Increased in the number of communicative attempts & showed greater awareness of the importance of having somebody's attention before communicating. |
| Howlin et al., (2007) | 84 | ASD | 4:0-11:0 | 1-6 | Classroom | Staff & parent | RGD | 5 months | No | Yes | Yes | Initiations, spoken language, social reciprocity | modest effectiveness of PECS teacher training. Initiations, use of symbols, social reciprocity increased and no improvement in communication. Treatment effects are not maintained once intervention ceased. |
| Jurgens, Anderson, & Moore (2009) | 1 | ASD | 3:7 | 1-4 | Home | Researcher | CCD | 16 sessions (169 trials) | Yes | Yes | No | Spoken language ,social-communicative behaviours, functional play | Increase in spoken language, MLU, acquired functional Communication, increased time spent playing |
| Kravits et al., (2002) | 1 | ASD | 6:0 | 1-3 | Home & school | Therapist & Peers' involvement | MB | N/A | Yes | Yes | No | Spontaneous language and Social interaction | Increased in spontaneous language, intelligible verbalisation and social interaction |

***Table1. (continued)***

| *Researchers* | *No.of partciipan-ts* | *Diagn-osis* | *Ages* | *Phase* | *Setting* | *Interventioni-st* | *RD* | *Length/ no. trials* | *Gener-alisati-on* | *Reli-ability* | *Maintenance* | *Outcome measures* | *Findings* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Liddle (2001) | 20 | ASD & Severe learning difficulties | N/A | 1-6 | Classroom | Classroom teachers & parents' involvement for basic training: no control group | Progr-am evalu-ation | 11months | No | N/A | No | Requesting skill | Pecs is beneficial on requesting desired items. Increased spoken communication |
| Lund & Troha (2007) | 3 | ASD&blind with modified PECS | 12:0 - 17:0 | 1-3 | Classroom | Master level student & therapy assistant | MBP | N/A | No | Yes | No | To teach requesting using tactile symbols. | PECS may be an effective method to teach requesting using tactile symbols for individuals with visual impairments. |
| Magiti & Howlin (2003) | 34 | ASD | 5:0-12:0 | 1-6 | Classroom | Classroom staff | Single group | 10 months | Yes | N/A | No | Use of PECS spontaneous communication , adaptive behaviour | Improvement in children's general level of communication |
| Marckel, Neef & Ferreri (2006) | 2 | ASD | 4:0-5:0 | N/A | Home | Researcher | MBD | N/A | Yes | Yes | Yes | Requesting skill across descriptors: functions, colours & shapes. | Increased requesting and it generalised to novel items. |
| Malandraki & Okalidou (2007) | 1 | ASD & hearing loss with modified PECS | 10:0 | 1-6 | Home, Class & Therapy room | Undergraduate student & kindergarten teacher | Case study | 4-8 months | No | Yes | Yes | Communication skills | Learned to use a functional communication tool. |
| Pasco & Tohill (2010) | 23 | Autism | 5:0-6:0 | 1-3 | School | Staff | N/A | 36 sessions 204 trials | No | Yes | No | Total developmental age score | 16 children mastered phase 3 had total developmental age scores of 16 months or above |

*Table1. (continued)*

| *Researchers* | *No.of partci-pants* | *Diagnosis* | *Ages* | *Phase* | *Setting* | *Interventionist* | *RD* | *Length/ no. trials* | *Gene-ralisa tion* | *Reliabili -ty* | *Maintenance* | *Outcome measures* | *Findings* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rosales & Rehfeldt (2007) | 2 | Mental retardation | adult | 1-3 | Class-room & training centre | researchers | MDP | N/A | No | N/A | Yes 1 month | Percentage of correct response during derived mand and stimulus relation | Participants showed emergence of derived mands 2 adults vocally requested during maintenance probs |
| Rosales, Stone, & Rehfeldt (2009) | 3 | severe developme ntal disabilities | adult | 1-3 | University clinic | Undergraduate student | MBP | N/A | Yes | Yes | Yes with one Participant for 1 month | Effectiveness of PECS training | Participants mastered PECS and skills were generalised in novel setting |
| Schwartz et al., (1998) | 49 | Communic ation disorders | 3:0-6:0 | 1-4 | School classroom : snack/ activity | Therapists & Peers' involvement | Program evalu-ation | 14 month | Yes | Yes | No | Learning to use Pecs Spontaneous speech including communicative forms and function | Learned pecs effectively Used Pecs in generalised untrained settings and may have concomitant effects on untrained language functions. |
| Stoner et al., (2006) | 5 | Mental retardation | adult | 1-4 | Home | Researchers | ABAB | N/A | Yes | No | No | Develop functional communication | Three adults progressed functional communication effectively |
| Simon, Whitehair & Toll (1996) | 1 | ADHD & moderate mental retardation | 14:0 | 1-4 | School Classroom | Teacher & researchers | N/A | 6 months | No | Yes | No | | PECS isa more preferred mode than facilitated communication (FC) |

***Table1. (continued)***

| *Researchers* | *No.of partci-pants* | *Diagn-osis* | *Ages* | *Phase* | *Setting* | *Interventionist* | *RD* | *Length/ no. trials* | *Gene-ralisa tion* | *Reliability* | *Maintenance/ follow up* | *Outcome measures* | *Findings* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tincani (2004) | 2 | ASD | 5:10-6:8 | 1-3 | Classroom | Researchers | ATD | N/A | Yes | Yes | No | Mands comparing sign language and pecs | Acquisition of pecs and sign language may vary as a function of individual student characteristics |
| Travis& Geiger (2010) | 2 | ASD | 9:10-9:6 | 1-6 | Classroom | Researchers | MBD | N/A | No | Yes | Yes | Requesting,<br>Commenting<br>Length of vocal utterances | Increases in requesting, commenting and utteracnes |
| Yoder & Stone (2006) | 36 | ASD | 1:6-6:0 | 1-6 | University<br>Clinic<br>Home<br>Community | Professional teams & parents' involvement | RGD | 6 months | Yes | Yes | No | Responsive education Milieu teaching (RPMT) vs PECS<br>:turn-taking, requesting & joint attention | The RPMT facilitated the frequency of generalised turn taking & generalised initiating joint attention more than did the PECS. The PECS facilitated generalised requests more than the RPMT in children with very little initiating joint attention |

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. Studies on PECS as described in Table 1 above show that 13 out of 32 studies on PECS have been conducted from Phases 1 to 3 while another seven studies have been conducted from Phases 1 to 4 (Chambers & Rehfeldt, 2003; Ganz & Simpson, 2004; Frea, Arnold, & Vittimberga, 2001; Ganz, Simpson, & Corbin-Newsome, 2008; Kravits et al., 2002; Pasco & Tohill, 2010). In seven studies the entire PECS program from Phases 1 to 6 was taught (Charlop-Christy et al., 2002; Howlin et al., 2007; Liddle, 2001; Magiati & Howlin, 2003; Malandraki & Okalidou, 2007; Travis & Geiger, 2010; Yoder & Stone, 2006) and four of these followed the structure of the original PECS manual closely (Charlop-Christy et al., 2002; Howlin et al., 2007; Liddle, 2001; Magiati & Howlin, 2003). Approximately five studies out of 32 conducted PECS with various modifications, for example, as an adaptation for children with hearing loss or visual impairment (Malandraki & Okalidou, 2007; Charlop, Malmberg, & Berquist, 2008), using PECS in conjunction with objects of various colours and shapes (Ben Chaabane, Alber-Morgan, & DeBar, 2009), or by comparing PECS with other types of communication such as Responsive Education Milieu Teaching (RPMT) (Yoder & Stone, 2006).

Within the 32 studies, there were 325 participants in total who had limited or no functional communication skills as a result of various conditions such as autism, PDD, mental retardation, and communication disabilities. Most individuals with autism and other communication disabilities were preschool aged children between three to seven year olds (Anderson, Moore, & Bourne, 2007; Ben Chaabane, Alber-Morgan, & DeBar, 2009; Charlop-Christy et al., 2002; Frea, Arnold, & Vittimberga, 2001; Ganz, Simpson, & Corbin-Newsome, 2008). There were two studies that involved typical preschool aged children participating with the children with autism and other communication disabilities during the PECS training (Kravits et al., 2002; Schwartz et al., 1998). Several other studies on PECS included teenagers between 10 and 17 years old with autism or mental retardation (Lund & Troha, 2007; Malandraki & Okalidou, 2007; Simon, Whitehair, & Toll, 1996) or adults with mental retardation or severe developmental disabilities (Chambers & Rehfeldt, 2003; Rosales & Rehfeldt, 2007; Rosales, Stone, & Rehfeldt, 2009; Stoner et al., 2006).

Of the 32 studies, approximately 22 employed a single subject research design while several studies used a randomised group design (Yoder & Stone, 2006) or a non-equivalent control group design (Carr & Felce, 2006b). Those studies that used a single subject research design employed a variety of designs including ABAB (Stoner et al., 2006); ABCD (Anderson, Moore, & Bourne, 2007); multiple baseline design across participants (Charlop-Christy et al., 2002; Ganz, Simpson, & Corbin-Newsome, 2008; Rosales, Stone, & Rehfeldt, 2009); multiple baseline across settings (Frea, Arnold, & Vittimberga, 2001); alternating treatment design (Adkins & Axelrod, 2002; Angermeier et al., 2008; Chambers & Rehfeldt, 2003; Tincani, 2004); and unspecified single case design (Ganz et al., 2005; Malandraki & Okalidou, 2007). Several studies used a changing criterion design to eliminate the need to withdraw the intervention and included several distinct phases (Ganz & Simpson, 2004; Jugens, Anderson, & Moore, 2009).

Much of this research as described in Table 1 shows that participants successful learned functional communication skills through PECS training. Further, a number of studies have also shown that PECS may provide concomitant improvement in spoken communication such as words or sentences (Anderson, Moore, & Bourne, 2007; Ganz & Simpson, 2004; Kravits et al., 2002) as well as improvement in social interaction (Jugens, Anderson, & Moore, 2009; Kravits et al., 2002). However, most of these studies have assessed PECS only from Phases 1 to 3 or 4 (Carr & Felce, 2006b; Chambers & Rehfeldt, 2003; Ganz & Simpson, 2004; Frea, Arnold, & Vittimberga, 2001; Ganz, Simpson, & Corbin-Newsome, 2008; Kravits et al., 2002; Pasco & Tohill, 2010; Schwartz et al., 1998; Stoner et al., 2006).

While in these studies PECS was effective in teaching functional communication, vocal communication, and some social interaction, other studies have shown that there was either no functional communication acquired through PECS or no concomitant improvement in vocal communication (Ganz et al., 2005; Stoner et al., 2006). For example, Ganz, Simpson, and Corbin-Newsome (2008) studied three children with autism and developmental delay learning to communicate using PECS from Phases 1 to 4 in home settings. The results showed that one child failed to learn PECS. Two children acquired functional communication but with no significant increase in vocal communication. The children either exhibited no increase in spoken words or gained few intelligible words during Phases 3 and 4 training. A possible explanation for these findings is that acquiring either functional communication or vocal communication through PECS training may depend on particular individual characteristics of the participants. For example in this study the child who acquired a few spoken words displayed echolalic speech during pre-PECS training whereas the two children who gained no spoken words had no echolalic speech before training commenced. In addition, the child who failed to learn functional communication had some difficulties comprehending the PECS symbols. This may also suggest that modification of PECS may be necessary to adapt to an individual’s characteristic (e.g., using three dimensional objects instead of picture cards or photos for a child that cannot comprehend picture representation). This study was also limited by the fact that there was no data on generalisation or maintenance of the PECS program.

Even where PECS may have failed to teach functional communication for children with autism, the program may still have additional benefits in relation to inappropriate behaviours. Several studies have shown that PECS may assist children with autism to reduce problematic or aberrant behaviour, such as aggression and frustration (Charlop, Malmberg, & Berquist, 2008; Frea, Arnold, & Vittimberga, 2001). For example, Frea, Arnold, and Vittimberga (2001) examined the effects of the PECS from Phases 1 to 3 on a child who displayed highly aggressive behaviours such as biting, kicking and hitting. The PECS training was conducted in a preschool classroom during the daily routine. The results showed that the child's aggressive behaviour decreased immediately when picture communication was introduced to his play activities. This suggests that the child's problem behaviours had communicative function (Sigafoos et al., 2000) and that these behaviours occur because of communication limitations (Horner et al., 2002). Picture exchange communication can provide an effective strategy for the reduction of inappropriate behaviours such as tantrums, hitting, and biting by providing an alternative and effective means of communication, making the need for tantrums redundant. This study lacks external validity given that the findings may not apply to all other children with autism. A larger study or a series of systematic replications with more participants would help to increase the external validity applying to other children and to determine in a more robust manner the effectiveness on PECS in reducing inappropriate behaviours. Further, this study did not provide any data on either generalisation or post-intervention follow up to assess whether the participant's new skills had been maintained.

While a number of studies show that PECS training facilitates increasing vocal communication and social interaction as well as reducing some inappropriate behaviours, most of these studies were conducted in one setting such as a school (Adkins & Axelrod, 2002; Angermeier et al., 2008; Carre et al., 2009; Chambers & Rehfeldt, 2003; Schwartz et al., 1998). A small number of studies were conducted so that they included both the home and school setting (Kravits et al., 2002) or only in the home setting (Anderson, Moore, & Bourne, 2007; Ganz et al., 2005; Jugens, Anderson, & Moore, 2009). In particular, the few studies where PECS training was conducted in one setting such as at home confirmed that PECS training generalised to different settings and individuals. For example, Carr and Felce (2006b) investigated the effects of PECS on communicative interactions between children with autism and their teachers. Twenty four children with autism and a non-intervention control group of children with autism participated in the study. The results showed that communicative interaction between children with autism and their teachers increased significantly after PECS training. Spontaneous communicative initiations in children with autism were achieved within the first 15 hours of PECS training. Spontaneous initiations with PECS generalised to the use of objects, activities, settings, and people. There was, however, no maintenance data collected.

Although some studies have shown that PECS skills generalised with different settings or people, in other studies successful generalisation of PECS skill was not clearly evident (Carre et al., 2009; Tincani, 2004). For example, Carre et al., (2009) investigated generalisation of PECS training in a classroom setting for three children with autism. A variety of trainers including the researcher, teachers, teachers' aids and a speech therapist were involved in PECS training for facilitating generalisation of communication skills. The results showed that all children mastered the PECS program to request preferred items and activities using PECS. However, PECS requesting skills did not generalise as consistently or as frequently as expected in the original school setting or when generalisation was assessed in the home setting. The obvious limitation of this study is that all PECS training occurred in the school setting rather than at school and at home, with no maintenance sessions.

A number of studies (Carre et al., 2009; Carr & Felce, 2006b; Ganz, Simpson, & Corbin-Newsome, 2008; Jugens, Anderson, & Moore, 2009) demonstrated successful generalisation of PECS training as well as increasing vocal communication (e.g., vocal initiation, vocal manding, and new spoken words). None of these studies provide data on maintenance or follow up sessions, so critical for analysing a participant's overall performance. Further, most of these studies from Phases 1 to 3 or 4 state that they conducted their intervention treatment in accordance with the PECS manual or PECS workshop, thereby demonstrating treatment fidelity. However, none of these studies formally measured treatment fidelity except for Marckel, Neef, and Ferreri (2006) who provided a formal treatment integrity checklist. Without measurement of treatment fidelity it is difficult to know whether PECS was delivered in the appropriate manner. Furthermore, most of these studies also did not report social validity except for Marckel, Neef, and Ferreri (2006) and Tincani (2004). For example, Tincani (2004) provided social validity assessment to evaluate the PECS intervention using written questionnaires (e.g., "how did participation affect the study's participants?").

Most studies of PECS involve adults as the key trainers of the target children with disabilities (Carre et al., 2009; Carr & Felce, 2006b; Ganz, Simpson, & Corbin-Newsome, 2008). Only a few studies investigated the effects of PECS training involving typically developing children with the target children (Kravits et al., 2002; Schwartz et al., 1998). For example, Schwartz et al., (1998) conducted PECS training in an inclusive preschool setting with children with communication disabilities. All PECS training included six typically developing children with structured activities, snack time and freeplay. In this study, children with disabilities mastered PECS to Phase 4 (building sentence structure) and then learned to use PECS to request items from their typical peers. In order to encourage target children to communicate with their peers, teachers would re-direct requests to them from target children towards typical peers, using vocal or physical prompts which encouraged target children to direct the request to peers instead. The results showed that all 31 children acquired high levels of functional communication with adults and typical peers through PECS. On average mastering from Phases 1 to 4 took each child 14 months (range = 3-28 months) in their preschool classrooms. The results showed that PECS skills of children with disabilities generalised to different people including adults and typically developing children across a variety of settings. This study suggests that PECS training can be an effective method to encourage communication between typically developing children and children with disabilities in a natural setting. The involvement of typically developing children may increase communication opportunities and may enhance social communicative initiations for children with disabilities. Although this study addressed successful generalisation of PECS skills in the school, data on the acquisition of vocal communication, the use of PECS in the home, and maintenance sessions were limited.

Most studies of the PECS program described above were conducted from Phases 1 to 3 or 4. Though most showed some effects on increasing vocal communication and social interaction for children with autism, there were several limitations, including that not all six phases of the PECS program were implemented, that most were conducted in one setting only and finally that there was limited data on maintenance or follow up sessions as well as treatment fidelity.

Building upon previous research described above which examined PECS from Phases 1 to 4, the following seven studies are particularly important because they used all of the six phases of the PECS program. Four out of these seven studies (Charlop-Christy et al., 2002; Liddle, 2001; Magiati & Howlin, 2003; Travis & Geiger, 2010) followed the structure of the original PECS manual while two studies (Malandraki & Okalidou, 2007; Yoder & Stone, 2006) were conducted by comparing the PECS program with Prelinguistic Milieu Teaching (RPMT) (Yoder & Stone, 2006) or through modifying the PECS program for a child with hearing loss (Malandraki & Okalidou, 2007).

Each of the studies incorporating all six phases of the PECS program reported concomitant improvement in vocal communication (e.g., vocabulary, the mean length of utterance or the complexity of vocal utterances) for children with autism and other disabilities (Charlop-Christy et al., 2002; Howlin et al., 2007; Liddle, 2001; Magiati & Howlin, 2003; Malandraki & Okalidou, 2007; Travis & Geiger, 2010; Yoder & Stone, 2006). However, some studies such as Howlin et al., (2007) showed that there was no improvement in vocal communication, with similar results to a study by Carre et al., (2009) which showed that children with autism only learned functional communication through PECS. Other benefits attributed to PECS included improvements in children’s social communicative behaviours (e.g., joint attention and initiations) and decreased inappropriate behaviours such as tantrums (Charlop-Christy et al., 2002).

An example of one of the above studies is Charlop-Christy et al., (2002) which investigated the effects of PECS on speech, social-communicative behaviour and problem behaviour for three children with autism. The PECS training was conducted in the school classroom, university clinic and home setting to promote generalisation. The results showed that all children increased speech and social communicative behaviours and decreased inappropriate behaviours. In particular, children increased speech during Phases 4 and 5 when a time delay was introduced. Interestingly, the emergent speech occurred when a novel person participated in non-training settings. An increase in the children’s social communicative behaviours such as joint attention, initiations and requesting was concomitant with the PECS training. The most increased behaviours were initiation and requesting for all children. Furthermore, the children’s inappropriate behaviours such as tantrums were reduced. The results from this study are similar to results from a study by Frea, Arnold, and Vittimberga (2001) where PECS training was conducted for a child with autism whose inappropriate behaviours were also reduced.

Charlop-Christy et al., (2002), showed that in completing all six phases of the PECS program, children may take almost a year to master the program. This is in contrast to a study by Travis and Geiger (2010). The children with autism in Charlop-Christy et al., (2002) mastered all six phases in an average of 10 months with 246 trials. However, the children in the study of Travis and Geiger (2010) took only nine weeks to complete all six phases of PECS. Although Travis and Geiger (2010) provided no average number of trials for PECS training, the mastering time was in great contrast to Charlop-Christy et al., (2002). The results of Charlop-Christy et al., (2002) were similar to the study by Liddle (2001), and Magiti and Howlin (2003) where children took 10 to 11 months to master PECS. The differences in the mastering time period for all six phases of the PECS training suggest that the completion times for PECS training will vary and may depend on children's individual characteristics.

Most studies with PECS training from Phases 1 to 6 were conducted only in one setting such as at school (Howlin et al., 2007; Liddle, 2001; Magiati & Howlin, 2003; Travis & Geiger, 2010). A few studies on the other hand, such as Charlop-Christy et al., (2002) conducted PECS intervention in two settings (e.g., home and school) and showed successful generalisation (e.g., vocal communication occurred when a novel person participated in non-training settings).

Further, most studies from Phases 1 to 6 did not provide data on generalisation for PECS training whereas a few studies (Magiti & Howlin, 2003; Yoder & Stone, 2006) provided generalisation as an integral part of data collection. For example, Yoder and Stone, (2006) showed that PECS training successfully generalised to home and school. This study also compared the effectiveness of PECS with Responsive Education and Prelinguistic Milieu Teaching (RPMT) for facilitating, requesting and initiating joint attention for children with autism. Training sessions for both programs were conducted in a university clinic. RPMT is a training system used to facilitate intentional communication for primary pragmatic functions for young children with developmental delay (Yoder & Stone, 2006). In RPMT teachers encourage children to initiate joint attention by using modeling. The results showed that both PECS and RPMT increased children's initiating joint attention. In particular, RPMT provided greater initiating joint attention compared to PECS and this also applied to the frequency of generalised turn taking and initiating joint attention. However, generalisation in requesting was greater for children who had undertaken the PECS training compared to those who had used RPMT.

While Yoder and Stone (2006) discussed successful generalisation in PECS requesting, this study did not provide maintenance or follow up data. Most studies from Phases 1 to 6 did not provide data on maintenance or follow up (Liddle, 2001; Magiti & Howlin, 2003; Yoder & Stone 2006). Of those studies where follow up sessions occurred the time periods were approximately two weeks (Travis & Geiger, 2010), six months (Malandraki & Okalidou, 2007) and 10 months (Charlop-Christy, 2002) after the PECS intervention training.

In summary, the PECS program has been shown to develop functional communication, create improvements in vocal communication (e.g., vocal manding, initiation and an increase in mean length of utterances) and social interaction (Adkins & Axelrod, 2002; Bondy & Frost, 1994a; Bondy & Frost, 2001b; Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Kravits et al., 2002). Some studies reveal that PECS is associated with reductions in inappropriate behaviours (Charlop-Christy et al., 2002; Malandraki & Okalidou, 2007) and the use of PECS skills can generalise positively to different settings and individuals (Anderson, Moore, & Bourne, 2007; Carr & Felce, 2006b; Ganz, Simpson, & Corbin-Newsome, 2008; Marckel, Neef, & Ferreri, 2006).

Although many previous studies demonstrate positive improvements from PECS for children with autism, only one study where the entire PECS program was used provided successful generalisation for PECS training. However, they did not provide maintenance or treatment fidelity data for PECS intervention (Yoder & Stone, 2006). To provide effective generalisation and maintenance in PECS skills it may be critical to include significant communicative partners (e.g., sibling and parent) on a regular basis. In the next section, the value of involving families such as sibling and parents in intervention is outlined.

## Family involvement in intervention program

Generalisation and maintenance might be enhanced through increasing communication opportunities for children with autism. One way of increasing communication opportunities may be through inviting regular communicative partners (e.g., family members such as parents and siblings) to use PECS in natural contexts (e.g., home). Only a few studies have included parents in PECS training in the home (Anderson, Moore, & Bourne, 2007; Ben Chaabane, Alber-Morgan, & DeBar, 2009; Yoder & Stone, 2006). These studies found that parents can teach their children to use PECS and that children showed increases in manding and generalisation using PECS. A few studies also showed that typically developing peers involved in the PECS program successfully communicated with children with autism or communication disorders in school settings (Kravits et al., 2002; Schwartz et al., 1998). These children also increased PECS generalisation for requesting skills. These results suggest that typically developing siblings can also be effective communicators using PECS with their siblings with autism in the home. Interestingly, there are no studies of PECS involving siblings in the home setting. Consequently, in the next section, the issue of involving family members such as parent and sibling in intervention programs is considered. The involvement of family members may provide optimising opportunities to assist development and the potential for increased communication and social interaction for children with autism.

In supporting children’s learning, including social and communication development, families are recognised as a valuable resource in the design of early intervention for children with autism and other disabilities (Ingersoll & Dvortcsak, 2006; Mahoney et al., 1999; Moes & Frea, 2000a; Moes & Frea, 2002b; Rocha, Schreibman, & Stahmmer, 2007; Scott et al., 2000). Parents can provide comprehensive information about the values, circumstances and interactive relationships of children with disabilities in the family environment (Koegel & Koegel, 1995a). Consequently, parental involvement may increase potential for effective intervention. Whilst the extent to which parents are involved varies, parents may actively participate in the implementation of intervention programs as a therapist or co-therapist.

Furthermore, in addition to parents, siblings as typically developing children may also play an important role within education settings for children with disabilities (Bass & Mulick, 2007; Kern & Aldridge, 2006). Children with disabilities may benefit from exposure to a variety of natural learning experiences and opportunities through interacting with typically developing children (Kern & Aldridge, 2006).

Children with autism commonly display deficiencies in social relationships and this is exacerbated by the tendency of typically developing preschoolers to avoid interacting with children with autism. This situation can be mitigated if typical children are taught and encouraged to use special interaction strategies to assist children with autism develop social interaction (Harrower & Dunlap, 2001). In particular, interventions involving typical children have been advocated as a potentially useful approach for facilitating children with autism's participation in classrooms (Harrower & Dunlap, 2001). Intervention involving typically developing children operates on the basis that the social behaviours of children with autism will be improved when typically developing children are trained to initiate, prompt, and reinforce social interactions (Bass & Mulick, 2007; Egel, Richman, & Koegel, 1981; Goldstein, English, Shafer, & Ksczmarek, 1997; Jones & Schwartz, 2004; Kamps et al., 2002; Morrison, Kamps, Garcia, & Parker, 2001; Odom & Strain, 1986; Odom, McConnell, & McEvoy, 1992; Robertson, Green, Alper, Schloss, & Kohler, 2003; Strain, 1977). For example, a study by Strain (1977) investigated intervention involving typically developing peers working with children with behaviour disorders. He assessed the target behaviours of three preschool children with behaviour disorders in the training setting and during freeplay periods following training. The results showed that typically developing children could be trained to successfully implement peer-mediation activities that assist in the development of positive social behaviours for those with behavioural disorders. Further, positive social responding by the children with behavioural disorders in the treatment setting was generalised to the freeplay period. Robertson et al., (2003) also studied the effectiveness of peer intervention on children's performance in routine activities. Two children with developmental delay in an integrated family childcare centre participated. Two typical peers were invited to play in some form of cooperative manner or by engaging in some form of verbal and nonverbal interaction. Three skills were targeted during the intervention for children with developmental delay: engaging in on-task behaviour, interactive play with other children, and appropriate participation in group story time. The results indicated that peer intervention for the two children with developmental delay was successful in facilitating their participation in school activities (e.g., songs and finger play).

In addition, social initiation strategies (e.g., asking a child to play or to share a toy) have been particularly effective in intervention involving typically developing children (Odom, Chandler, Ostrosky, McConnel, & Reaney, 1992; Odom & Strain, 1986). For example, Lee, Odom, and Loftin (2007) examined the relationship between engaging in social interaction with peers and stereotypical behaviour of three children with autism. Two typically developing peers learned to direct social initiations to each participant during play activities. The results showed that the frequency of peer social engagement was increased in children with autism. Their stereotypical behaviour also decreased during the intervention and the results generalised to a proximal play setting. Another study by Odom and Strain (1986) compared peer-initiation and teacher-antecedent interventions for promoting reciprocal social interaction of preschool children with autism. Typical children were taught to initiate interaction with the children with autism. During teacher-antecedent interventions, teachers prompted the children with autism to initiate with peers who had been taught to reciprocate. The results indicate that the peer-initiation procedure reliably increased the social responses of the children with autism whereas the teacher-antecedent intervention increased both the initiation and the social responses. In addition, longer social interactions occurred during the teacher-antecedent intervention. This study suggests that different treatment procedures may affect different classes of behaviour of children with autism and the level of social reciprocity of interaction.

Whilst it has been demonstrated that involving typical children in intervention procedures produces positive effects such as social interaction and initiations for children with autism and other disabilities, research shows that the involvement of typical children requires ongoing adult assistance in order for the required intervention to continue (Roger, 2000). Goldstein et al., (1997) indicated that typically developing children as a peer involvement approach may not always be effective due to the limited maintenance and generalisation of peer interventions (Goldstein et al., 1997). One reason is that peers who serve as interventionists are often encouraged to interact at higher rates than they do with their typical peers. For example, some peers have been taught to interact with preschoolers with disabilities at rates that are five to ten times higher than normal rates. Such a high expectation for performance may be perceived by peers as too demanding to maintain or be generalised to other contexts. Another factor that may account for limited generalisation is that the intervention technique occurs in only one context such as freeplay, rather than during a variety of activities across the school day (Goldstein et al., 1997). Therefore, an intervention involving typical children in more than one context might increase generalisation, social validity, and provide opportunities to adapt this strategy to different situations.

Goldstein et al., (1997) also suggested that it may be possible to improve social interaction between preschool children with and without disabilities by sensitising typical peers to nonvocal communication behaviours. Preschoolers can be taught to recognise nonvocal behaviours, such as watching and handing over a toy, and this learning to recognise nonvocal behaviours can provide positive reinforcement for participating peers. They examined the effects of intervention involving typical children whereby typical children were made more aware of communicative attempts by their peers with disabilities. They were taught to use a small set of strategies ("stay, play, and talk") and to use them throughout the school day. The results showed that the intervention involving typical children across the day improved social-communicative interaction in children with developmental disabilities. During the intervention, the target children’s frequent communicative behaviours tended to be responses in vocal and nonvocal communication such as producing comments and requests. This study also suggests that this minimal training of typically developing children can be implemented across a variety of activities during a school day and can improve the communicative interaction and social integration of children with disabilities in generalised settings.

## Conclusion

This chapter has provided a background to the condition of autism, including definitions, history, associated impairments and characteristics. An outline of current intervention treatments for the condition has been provided, including language and behavioural approaches. Autism is associated with communication, social interaction, and behavioural impairments that significantly affect children’s learning and social communicative development. To improve social and communicative development for children with autism, a variety of intervention programs based on applied behaviour analysis and an augmentative/alternative communication system have been developed, such as the PECS.

PECS is an AAC system, based on ABA and principles of verbal behaviour to teach functional communication such as requesting skills and to provide positive outcomes for children with autism. These outcomes include increases in communication such as spoken words and mean length of utterances as well as social interaction behaviours such as social initiations. Other associated positive outcomes from PECS include reductions in inappropriate behaviours for children with autism and other communicative disabilities. These improvements greatly depend on the context of training, especially the involvement of a variety of significant others, ranging from teachers and other professionals to family members such as parent and sibling. This wider context of involvement provides additional intervention opportunities for these children and therefore more likelihood for generalisation and maintenance across all the settings and individuals for their social and communicative development.

## General aim of the present study

The concept of pragmatics has been applied as an explanation of the actual process of communication and language development in social contexts (Bernstein & Tigerman-Farber, 1997; Gerber, 2003). An understanding of these pragmatic factors is well developed before children learn to use expressive language (Bernstein & Tigerman-Farber, 1997). As a result, the pragmatics approach has become central to the study and understanding of children with communication disorders such as autism (Nicholas & Geers, 1997). We see, for example, that while some children with autism have fluent language skills they still have difficulties in pragmatics including communicative functions or behaviours. Their difficulties often centre on an inability to interpret others' intentions such as nonvocal gestures or facial expressions or to successfully request desired or preferred items. In such children, early nonvocal behaviours are critical in the development of communicative competence and potential language competence (Sigafoos et al., 2000).

Studies have shown that communication skills may be affected by context and the communicative partner (Layton, 1987; Pino, 1999; Sigafoos et al., 2000). The communicative function and behaviours used by children with autism vary depending on the context. For example, a child with autism may use a gesture such as pointing to a bowl to indicate that she or he wants to eat a cookie in a familiar home setting where the mother, for example, understands the child's communication behaviour and, critically, provides the cookie as requested by the child. However, in another context, such as at school, the same child may, for example, indicate that she or he wants to eat a cookie by hand flapping or other inappropriate behaviour because the setting has changed and there is absence of both the mother and the bowl. On the other hand, the opposite situation may occur whereby some settings have easy access to all desired materials and activities so that children have no need to request anything. Perhaps these environments need modification to support communication opportunities. For all these scenarios using pictures to represent desired objects may be effective in providing communication opportunities across different settings. In addition, the participation of parents and typical peers in different contexts provides the opportunity for children with autism to further develop communication and language skills given these communicative partners regularly spend more time with the children with autism than other carers. Furthermore, certain communicative partners such as parents may have a more thorough knowledge and understanding of their children's communicative behaviours and functions and may be able to assist teachers in developing appropriate learning programs (Loreman, Deppeler, & Harvey, 2005). Consequently, the involvement of a variety of communicative partners (parents and typically developing siblings) in different social contexts (e.g., home and preschool) during communication interventions may provide increased communication and social skills for children with autism and the potential for greater generalisation and maintenance.

The PECS program has been widely used to teach functional communication skills for nonvocal children with autism and other communicative disabilities. Most studies discussed in this chapter have shown that PECS intervention provides effective functional communication such as requesting skills (Carr & Felce, 2006b; Ganz, Simpson, & Corbin-Newsome, 2008; Kravits, et al., 2002; Paseco & Tohill, 2010; Jurgens, Anderson, & Moore, 2009). In addition, PECS has also been shown to provide other improvements for vocal communication skills such as words or mean length of utterances (Anderson, Moore, & Bourne, 2007; Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Kravits, et al., 2002), social behaviours (Howlin et al., 2007; Kravits et al., 2002; Jugens, Anderson, & Moore, 2009) and to reduce inappropriate behaviours for children with autism and other disabilities (Charlop-Christy et al., 2002; Malandraki & Okalidou, 2007).

While there have been many positive improvements attributed to PECS training for children with autism, as discussed previously in this chapter, many previous studies have been limited by not using all six PECS phases or diverse settings or have not conducted generalisation or maintenance sessions or adhered strictly to the treatment process.

Some of the PECS studies that examined Phases 1 to 3 or 4 demonstrated some positive effects on communication, social interaction and increases in vocal communication (Preston & Carter, 2009). However, other studies did not record improvements in spoken communication (Ganz et al., 2005; Ganz, Simpson, & Corbin-Newsome, 2008; Stoner et al., 2006). As already discussed, most of these studies from Phases 1 to 3 or 4 were limited to one setting such as school rather than including other settings (e.g., home) that may be critical for generalisation of PECS skills. Although several studies provide successful generalisation of PECS training (Carre et al., 2009; Carr & Felce, 2006b; Ganz, Simpson, & Corbin-Newsome, 2008; Jugens, Anderson, & Moore, 2009), none of these three studies provided maintenance or follow up data for the participant's performance in PECS intervention.  In addition, most studies conducted from Phases 1 to3 or 4 did not measure treatment fidelity formally, although they stated that PECS training was conducted in accordance with the PECS manual or training workshop.

Some studies have conducted all six phases of the PECS program. Some of these studies have findings that demonstrate positive effects on vocal communication from PECS on requesting and on decreasing inappropriate behaviors. However, studies such as Howlin et al., (2007) provide no evidence of improvement in vocal communication for children with autism. Most of these studies, as for the more limited PECS phase studies were also conducted only in one setting rather than in a variety of settings (Liddle, 2001; Magiati & Howlin, 2003; Howlin et al., 2007). Further, most studies from Phases 1 to 6 did not provide data on either generalisation or maintenance for PECS training (Liddle, 2001; Magiti & Howlin, 2003; Yoder & Stone, 2006). Of these studies only a few formally measured social validity (Magiti & Howlin, 2003; Yoder & Stone, 2006) and only one study (Magiti & Howlin, 2003) reported formal treatment integrity using a questionnaire.

Although previous PECS studies reported increases in vocal communication in Phases 3 or 4 through PECS training, none of these studies especially those assessing PECS from Phases 1 to 6 measured vocal communication (e.g., new spoken words) in a systematic manner.  This may be due to the time-consuming nature of the entire PECS training for participants. In addition, only a few previous PECS studies involved parents and no previous research has included siblings in the home setting.

Therefore, the present studies build upon previous research on PECS intervention but includes more settings and individuals, with a special focus on participating siblings and parents in the home context. By considering the impact of PECS in a wider context, this series of studies seeks to understand whether improvements in functional communication and social communicative interaction for children with autism are long lasting and generalised across a variety of settings.

The various studies discussed in this chapter provide limited empirical data on implementing only part of the entire PECS program in different training environments (e.g., home and school) with different individuals (e.g., parent and sibling). The present study addresses this limitation by implementing the entire PECS program from Phases 1 to 6 across different settings and with different individuals involved. These settings include PECS intervention in the home environment (Study 1), PECS training involving a sibling in the home and school (Study 2) and finally, PECS training involving a variety of settings and more individuals (Study 3). These different settings and individuals are used to allow for evaluation of better generalisation effects of PECS training of all participants in the study. The general aims of the study are:

- To teach functional communication skills and to conduct the entire PECS training from Phases 1 to 6 for children with autism or developmental delay in the natural environment (e.g., home and school)

- To explore the generalised effects of PECS intervention in terms of independent PECS use in freeplay settings outside of the training sessions

- To explore the generalised effects of PECS intervention on communication and social play of children across different individuals and settings.

# CHAPTER THREE

## METHOD

### Research design

The three studies used a single subject changing criterion design to evaluate the effect of PECS intervention on communication, social play behaviours and generalisation of independent PECS use for children with autism. The changing criterion design consists of an initial baseline phase followed by the implementation of a series of treatment phases (Cooper, Heron, & Heward, 2007). Each treatment phase is associated with a step-wise change in criterion rate for the target behaviour. Consequently, the changing criterion design corresponds with the PECS program in that each PECS phase aligns with the phases of the changing criterion design. When the target behaviours meet the successive phase criteria, the PECS intervention can be considered functionally related to the behaviour change. Consistent with prior PECS studies (Charlop-Christy et al., 2002; Ganz & Simpson, 2004), the criterion for the successful completion of a phase was a minimum of 80% correct trials across a minimum of three consecutive sessions. Successful trials were defined as independent PECS exchanges by the participant without an adult's vocal or nonvocal prompting. Each phase also required a minimum of five sessions, with the exception of the baseline, which required a minimum of seven sessions.

#### Participants

Three preschool children from English speaking households participated in this study. The children included one male (aged four years and two months) with severe language delay and two female participants (aged four years and three months, and four years and seven months respectively) with autism. All three participants were recommended for the study by the speech therapist from a University-based Early Childhood Intervention Centre.

Participants were selected according to the criteria below:

- Preschool aged (three to five years old) children diagnosed with autism or language delay
- Children enrolled part-time in an inclusive community environment (i.e., kindergarten or preschool) and/or intervention program
- Children with little or no functional speech
- Children with no previous formal PECS training
- Interest and consent from children's parents for participation to occur

***Table 2. Participants' background information***

| | *Study 1* | *Study 2* | *Study 3* |
|---|---|---|---|
| Participant | Angel (pseudonym) | Bee | Charlie |
| Ages | Four year & three months | Four year & seven months | Four year & two months |
| Diagnosis | ASD | ASD & Developmental delay | Severe language delay |
| | Childhood Autism Rating Scale (CARS): rating score of 41-severely autistic; | CARS: rating score of 42-severely autistic; | Diagnosis provided by therapist who did not use formal standardised assessment tool to make diagnosis |
| | Bayley Scales of Infant Development (BSID-III): | Bayley Scales of Infant Development (BSID-III): | |
| | test age equivalent scores of 21, 17 & 25 months for receptive, expressive language, & cognitive skills | | |
| Education | Enrolled in inclusive preschool & early intervention centre | Enrolled in early intervention centre | Enrolled in early intervention centre |

Table 2 Participants' background information.

**Settings**

PECS training for all participants was conducted either in the children's home as single site, in a combination of home and intervention centre, or in a wider combination of home, intervention centre and university clinic. PECS training sessions in the home were generally conducted at the kitchen table or on the floor in the living room. Freeplay observations after PECS training were conducted during baseline, PECS training and maintenance sessions in home, school or University setting. Additional generalisation probes were conducted in non-PECS training settings including indoor and outdoor settings in the children's preschool, early intervention classroom and university.

**Materials**

In order to provide background information for the studies, three assessment tools were used:The Critical Communication Skills Assessment; The Communication and Symbolic Behaviour Scales Development Profile; and The Assessment of Basic Language and Learning Skills-Revised (See Appendix A). The children's parents completed the assessments, guided by the researcher.

The Critical Communication Skills Assessment (CCSA) (Frost & Bondy, 2002a) assesses the children's current functional communication skills. The nine categories contained in the checklist are: request reinforcers; requesting help/assistance; request break; reject, affirm/accept; respond to "wait"; respond to directions including visual and oral directions; transitions between activities; and the ability to follow a visual schedule.

The Communication and Symbolic Behaviour Scales Development Profile (CSBS-DP) (Wetherby & Prizant, 2002) provides a checklist of critical communication skills the children use. The CSBS-DP consists of three composite categories: social, speech and symbolic. The social composite includes "emotion and eye gaze", "communication" and "gestures". The speech composite includes “sounds” and “words”, and symbolic composition includes “understanding” and “object use”. In the CSBS- DP, where an individual standard score is below 6, this demonstrates an area of *concern*. If the total score is below 81, the child should be referred for developmental evaluation.

The Assessment of Basic Language and Learning Skill-Revised (ABLLS-R) (Partington, 2006) is conceptually based on B.F Skinner’s analysis of verbal behaviour (1957b). It is used to identify the current language skills of children with language delay, particularly children with autism. The ABLLS-R outlines 25 skills for assessment. These skills are: cooperation and reinforcer effectiveness; visual performance; receptive language; motor imitation; vocal imitation; requests; labelling; intraverbals; spontaneous vocalisations; syntax and grammar; play and leisure; social interaction; group instruction; classroom routines; generalised responding; reading; math; writing; spelling; dressing; eating; grooming; toileting; gross motor; and fine motor.

Social validity criteria for PECS intervention were assessed for the parent and teacher once the intervention was completed. Social validation refers to “whether the focus of the intervention and the behaviour changes that have been achieved meet the demands of the society of which the client is a part” (Kazdin, 1982, p.19). Social validity was considered on three dimensions, as identified by Wolf (1978) and incorporated into the validity questionnaire. The three dimensions were the social significance of the goal (the specific behavioural goals), the social appropriateness of the procedures (the acceptability of the treatment procedure to the participants and caregivers) and the social importance of the effects (people’s satisfaction with the results).

This questionnaire consisted of 19 questions regarding the participant's social and communication skills following the PECS intervention, each with a 5-point Likert scale associated, ranging from 1 "very unimportant", to 5 "very important" (See Appendix B).

The key resource used for all three studies was the PECS Training Manual (Frost & Bondy, 2002a). The PECS manual details materials required for its effective use alongside instructional strategies, prompting strategies, and specified mastery criteria. The exact materials used with the PECS training, in addition to the manual itself, were:

- Optional picture cards designed for use with PECS produced by Pyramid Education Consultants (2007) that depict children's preferred items. The colour picture cards and corresponding words consist of 5 cm x 5 cm laminated picture cards with Velcro dots attached to the back of the cards;

- Additional laminated pictures were created by the researcher as the children progressed through the PECS phases. These were produced in order to give the children access to images of objects that were not included in the original PECS CD cards, such as pictures of their favourite toys, photographed with a digital camera;

- The communication PECS books produced by Pyramid Education Consultant Company were used as the standard communication book. The standard communication book is a 3-ring binder (23.5cm X 20cm) that contains two large insert pages and one sentence strip with Velcro strips. Extra insert pages were added before and throughout (as required) the PECS training.

- The children's preferred concrete referents, such as toys and foods, which corresponded with the laminated pictures were used throughout the studies;

- Mini communication books were made available when needed (10.2cm x 12.7cm). These mini-books, produced by Pyramid Education Consultant Company, were used by one of the participants (Study 2) to bring to their preschool or intervention centre. The mini-books are more convenient for carrying in a participant's bag or pockets than the standard communication book.

- Throughout the PECS training procedure, the researcher completed the PECS Implementer Skills Assessment Sheet in the PECS manual after each phase was completed (Frost & Bondy, 2002a). This sheet enables continual monitoring of the progress of the trainers. This sheet consists of ten titles with space for comments including a preliminary section on General Issues (see Appendix A).

- A Sony video recorder and a mini DVD-R disc were used to record the PECS training, freeplay observation situations at home and the preschool sessions.

- The Reinforcer Worksheet developed by Frost and Bondy (2002a) was used to gather information about the participant's preferred items. This sheet consists of simple tables that are ticked according to the following categories: reject; no reaction; reaches for; protests when taken away; shows signs of pleasure; and takes again.

**Dependent variables**

Three dependent variables for each PECS trial were recorded during PECS training using an event recording system for baselines, PECS training, and maintenance sessions (See Appendix C). The dependent variables were:

- *Independent PECS exchange* where the child responded correctly without any adult assistance and prompting;
- *Incorrect responses* where the child responded incorrectly with adult assistance or prompting according to each phase criterion.
- *Intelligible vocalisation* where the child vocalised with recognisable words (excluding echolalia).

In addition, other nonvocal, vocal communications and play behaviours were collected in PECS training and maintenance sessions (see Table 3 below). Other nonvocal mands, nonvocal initiations and vocal communication acts were recorded using an event recording system. *Social interaction and play* was measured based on Parton's (1932) play categories including unoccupied behaviour, onlooker behaviour, solitary play, parallel play and group play (a category which included cooperative and associative play) across settings using a momentary time sampling procedure at 10-second intervals (Anderson, Moore, Godfrey, & Fletcher-Flinn, 2004). The criterion level of 80 % was calculated for each session by dividing the total number of independent exchanges by the total number of trials in the session, and then multiplied by 100.

$$\frac{\text{Independent exchange}}{\text{Total trials}} \times 100$$

*Table 3. Dependent variables and concomitant behaviours and definitions*

| ***Event recording (frequency measure)*** | | ***Momentary 10 second interval time sampling*** |
|---|---|---|
| *Nonvocal communication* | *Vocal communication* | *Social interaction and play* |
| **Independent (non-prompted) PECS mand**; defined as when a target child hands over his or her PECS picture cards to request activities or objects without the adult's prompt | **Vocal mand**; defined as any occurrence of a target child vocally asking for an activity or object using intelligible words. | **Unoccupied behaviour**; defined as situations in which the target child is disengaged with any specific play activity (e.g. ,fiddling with his or her own body parts, wandering around). |
| **Prompted PECS mand**; defined as when a target child hands over his or her PECS pictured cards to request activities or objects according to an adult's prompt (e.g., adult says " What do you want? "Go to pick up the picture card") | **Other vocal initiation**; defined as any spontaneous intelligible vocalisation directed at another person that is not a mand or a response to another person's initiations (e.g., commenting about object or action). | **Onlooker behaviour**; defined as watching others but not entering into the play situation. |
| **Other nonvocal mand**; defined any occurrence of a target child's nonvocally asking for an activity or objects without PECS (e.g., pointing, pulling adult's hands) | **Echolalic speech**; defined as copying someonelse's word or phrase that has been repeated previously more than two times. | **Solitary play**; defined as playing independently with toys or materials without any interaction with others. |
| **Other nonvocal initiation**; defined as any nonvocal behaviours directed at another person that are not mands and are not a response to another person's initiations (e.g., nonvocal commenting or showing behaviours, such as a child bringing and showing a tree toy to his or her mom) | Any **new recognisable words** used by the target children will be added to a cumulative word list. | **Parallel play**; defined as playing independently with similar toys near other children, alongside but no attempts to play with others. |
| | **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). | **Group play**; defined as playing with other children or with one other child in a group situation with or without any role, assignment or organisation of activity. |
| | | **Inappropriate behaviour**; defined as behaviours that are challenging or may cause injury or hurt such as aggression, tantrum (crying & screaming), hitting, throwing and pushing. |
| | | **Stereotypical behaviour**; defined as repetitive behaviours without communicative intention or obvious function such as banging toys together, echolalic singing, spinning body or head, and flapping or twisting hands. |

## Procedures

Ethics approval for the present study was obtained from both the Monash University's Human Subjects Ethic Committee (approval project no: CF08/0997-2008000494) and the Victorian Government's Department of Education and Early Childhood Development (Ref no 2008/205) (See Appendix D). In addition, prior to the PECS training for the participants, the researcher had completed 13 hours of PECS training and 3.5 hours of training in PECS and behaviour management and the language of emotions through Pyramid Education Consultants in Melbourne, Australia.

The PECS training was conducted according to the PECS manual (Frost & Bondy, 2002a). The researcher followed the standard PECS procedure using the manual. The overall research process consisted of pre-intervention measurements, reinforcer assessment, an initial baseline, six phases of PECS training, freeplay generalisation observation and maintenance sessions. Sessions were conducted up to five times a week for 20 minutes each at the children's home, school or University setting.

### 1) Pre-intervention measurement

Prior to the PECS training, pre-intervention measurements were conducted at the child's home. These included the pre-intervention questionnaire, the Critical Communication Skills Assessment (Frost & Bondy, 2002a), the Communication and Symbolic Behaviour Scales Development Profile (Wetherby & Prizant, 2002), and the Assessment of Basic Language and Learning Skill-Revised (ABLLS-R).

- Questionnaire

The *pre-intervention questionnaire* was completed by the parents and teachers of the children (e.g. information regarding diagnosis, date of birth, likes and dislikes).

- Interview

The *Critical Communication Skills Assessment* was completed by the children's parents as recommended by Frost and Bondy (2002a).

The *Communication and Symbolic Behaviour Scales Development Profile* (Wetherby & Prizant, 2002) was completed by interviewing the children's parents to obtain pre-intervention age-equivalents of the children's social, speech, and symbolic abilities.

The Assessment of *Basic Language and Learning Skill-Revised* (ABLLS-R) was completed by the researcher with the help of parents to assist in assessing each child's language, motivation, social and motor skills development, and imitation.

**2) Reinforcer assessment**

For the three studies the parent interviewed was the mother of each child. The mothers were interviewed using the "pre-intervention questionnaire" and "vocabulary selection worksheet" (See Appendix E). Fathers were, however, asked to provide information via the mothers. The absence of the fathers from the interviews was a result of them being away at work during the day. As a result of the interviews, the parents indicated a number of preferred items that the children liked.  Subsequently, the researcher observed the children's freeplay in the natural environment in order to verify the parent's interview information. Once a list of potential preferred items was obtained, the formal *reinforcer assessment* using the "reinforcer worksheet" developed by Frost and Bondy (2002a) was completed at home. The worksheet helped determine which items the children liked more than others or which items were the most powerful reinforcers by establishing a reinforcer hierarchy as described in the PECS manual (Frost & Bondy, 2002a).

In completing the reinforcer worksheet, the researcher offered one of the preferred items (e.g., a toy) to the child and observed whether he or she took the item or not. If the child took the item the researcher allowed the child to play with the item for a few minutes. The researcher then took the item back and observed the child's reactions (e.g., protest). Finally, the researcher gave the item back to the child to observe his or her reaction once the item was back in their possession. Once all the preferred items had been identified and listed in the reinforcer sheet, the researcher established a hierarchy of preferred items. This involved a process of the researcher presenting two or three items from the list on a tray. The child was invited to take his or her preferred item. This process was repeated a number of times with different combinations of items. The items that were most frequently taken by the child would be the most preferred items.

**3) Baseline observations**

***Baseline***

Baseline observations were collected two to five times a week in the children's home and school settings. Twenty minutes of potential training time and 20 minutes of freeplay sessions were observed. During the potential training period, the parent or researcher provided simple activities (e.g., puzzle, drawing, or eating) at the table with presenting the picture cards. In addition, the researcher recorded any words spoken by the child in the anecdotal story diary. The children's parents were also asked to list the words that their child was currently using. In addition, the parents were asked to use SMS or email to inform that researcher of any new words used by the child throughout the studies.

Additional *generalisation probes* were conducted twice a week for two weeks (20 minutes) in the children's school during baseline data collection. These sessions served as a benchmark against which to assess the generalised behavioural effects of PECS training in a non-training setting. The target children took their standard PECS communication book or mini PECS communication book to the preschool settings.

An *Anecdotal Diary* was maintained by the researcher to reflect the qualitative dimensions of the target children's communicative and social play and to record relevant behaviours exhibited by the target children outside the 20 minutes freeplay observation.

**4) PECS intervention**

All three participants completed 20 minutes PECS intervention sessions conducted by the researcher from Phases 1 to 6 in the home or home/school or home/school/university room environment adhering strictly to the guidelines as laid out in the PECS training manual. Two to five PECS training sessions took place per week (depending on school or family holiday and attendance at the school), until the participant mastered all phases of the PECS program. The children only commenced the next PECS phase once the mastery criteria had been attained for the previous phase.

The criterion behaviour level for each PECS phase was determined by the PECS training manual for Phases 1 to 6 (Frost & Bondy, 2002a). The criterion behaviour level for each phase required that 80% of independent trials over three consecutive sessions were completed successfully (Ganz & Simpson, 2004). In addition, each phase required a minimum of five sessions. As explained above, the PECS training for each child was conducted in six phases as detailed in the following Table 4.

*Table 4. PECS training (Frost & Bondy, 2002a)*

| *Phases* | *Phase names* | *Description* |
|---|---|---|
| 1 | Physical exchange | The child is taught to initiate communication by reaching towards a preferred object held by the communicative partner, then giving a picture card of the object to the communicative partner to receive an object. The child and two trainers, as a physical prompter and communicative partner, are required to perform this phase. The physical prompter (e.g. researcher or parent) sits behind the child to provide physical assistance and the communicative partner sits in front of the child to provide the child's requested items. |
| 2 | Distance and persistence | The child is taught how to remove pictures from the front cover of the communication book and to find the communicative partner to make the physical exchange. This phase involves "shaping" an increasing distance between the child and the communicative partner or the communication book. This teaches the child new behaviours by making the child "travel" the extra distance in order to make the successful communication |
| 3A | Picture discrimination: discriminate between preferred and non-preferred items | The child is taught to discriminate between two pictures depicting a preferred item and a non-preferred item. |
| 3B | Picture discrimination: discrimination between two to five preferred items | Once the child has mastered Phase 3A, the child is taught to discriminate between two to five pictures of preferred items to exchange with the actual items held by the communicative partner. The training starts with two pictures of preferred items on the cover of the communication book and moves the pictures around the book. |
| 4 | Sentence structure | The child is taught to use a sentence strip e.g. "I want" plus the preferred item. The child finds the PECS communication book and creates a "sentence" on the sentence strip by combining the "I want" picture card and the card of a desired item. The child then finds the communicative partner in order to exchange the picture with the item held by the communicative partner. At the same time, the communicative partner reads the strip back to the child (e.g., "I want apple") while pointing at the relevant picture cards |
| 5 | Responding to "what do you want?" | The researcher asks the question "what do you want?"<br><br>The child needs to respond to this question by using, for example, a picture card to exchange with a preferred item. |
| 6 | Commenting | Once the child masters phase 5 ("What do you want?), the child is taught how to answer the question "What do you see? The child is also asked to discriminate between the request question of "what do you want" and the comment question of "what do you see?" In addition, the child is taught to respond to the comment questions of "what do you hear/ have?" and "what is it?". |

**5) Freeplay generalisation observation**

Upon completion of each 20-minute PECS training session, participants had a 20 minute freeplay session. The researcher observed participants' nonvocal and vocal communication along with other play behaviours (e.g., solitary and parallel play, stereotypical and inappropriate behaviours) during this session. One to two additional generalisation probes per phase were also conducted in the children's kindergarten or early intervention centre for 20 minutes once the children had mastered each particular phase during the PECS training periods.

**6) Maintenance**

Once children had mastered all six phases at home and/or school settings, they continued to use PECS at home or school without any further PECS training. During this period, the researcher continued to record the dependent variables and other behaviours for 20 minutes once a week for three weeks in both the home and/or kindergarten settings. Furthermore, in generalisation probe sessions, the dependent variables during the maintenance period were observed for 20 minutes, once a week in the children's non-training setting.

**Interobserver Agreement**

In order to ensure reliability of the observation data on dependent variables and other behaviours, additional observers were utilised for a minimum of 20% of all sessions, using the point-to-point agreement method. A postgraduate level kindergarten teacher was trained to make observations of the sessions using the same criteria as the researcher. The degree to which interobserver agreement occurred for the observation data was calculated by dividing the number of agreements with the combined total of agreements plus disagreements. This figure was then multiplied by 100 (Kazdin, 1982).

**Social validation**

All three participants' mothers and/or teachers completed the social validity questionnaire to evaluate the intervention on the completion of the PECS program. This questionnaire provided insights into the parents' views on any changes in communication and social play behaviours by their children following the PECS training.

**Treatment Fidelity**

If improvements in behaviours are to be attributed to particular intervention strategies it is important that there is precise documentation of the accuracy and extent to which intervention strategies are implemented as instructed or intended (Hwang & Hughes, 2000). To ensure the fidelity of PECS training, the PECS training sessions adhered to the PECS training manual as outlined by Frost and Bondy (2002a) and this was monitored using the PECS implementer skills assessment (Frost & Bondy, 2002a).

# CHAPTER FOUR

## STUDY ONE

### Introduction

Autism is a neurodevelopmental disorder in the category of pervasive developmental disorders (Levy, Mandell, & Schultz, 2009) and children with autism commonly display difficulties in language, communication, social interaction and repetitive behaviours (Greenspan & Wieder, 2006; Rehman, 2009). The importance of effective training to address the core deficits, including communication, for children with autism cannot be over emphasised. Rising incidence rates, the potential negative life outcomes for children, and the high stress levels for families with children with autism all underscore the urgency to identify effective and affordable treatments. Early intervention using behaviourally-based teaching methods to address the core deficits are currently considered best practice (Chakrabarti & Fombonne, 2005; Fortunato, Sigafoos, & Morsillo-Searls, 2007; Francis, 2005; Rosenwasser & Axelrod, 2001).

One of the core deficits in autism is a lack of or delayed development in communication. Some children with autism do not have spoken communication and may use gestures to communicate with others. Other children with autism who have fluent language skills may still have difficulties using these skills functionally to communicate. Therefore providing appropriate intervention programs is critical for these children to assist communication and language skills.

Several intervention approaches based on augmentative and alternative communication (AAC) systems and applied behaviour analysis (ABA) have been developed for children with autism. To develop functional communication skills, AAC has been used for children with autism and some studies suggest that AAC systems can increase the communicative interactions of children with autism, enabling them to exercise control over their environment (Marckel, Neef, & Ferreri, 2006; Wilkinson & Hennig, 2007). However, some aided AAC systems such as voice output devices have difficulties in generalisation to different settings and individuals.

Other interventions such as those based on ABA (e.g., verbal behaviour) are also utilised for children with autism. ABA develops skills based on Skinner's principles of operant conditioning to improve or change an individual's behaviour. These interventions usually focus on communication functions such as mands and tacts. One of the intervention programs often used by school teachers and speech therapists is called the Picture Exchange Communication System (PECS). PECS is an AAC system, based on Skinner's concept of verbal behaviour, focusing on teaching functional communication rather than a linguistic form (Frost & Bondy, 2002a).

PECS consists of six stepwise phases based on children initiating communication in a normal social environment with the use of various preferred items. Research studies have provided an empirical demonstration of the effectiveness of PECS to increase functional communication skills (Anderson, Moore, & Bourne, 2007; Carr & Felce, 2006b; Carre et al., 2009; Ganz, Simpson, & Corbin-Newsome, 2008; Frea, Arnold, & Vittimberga, 2001; Malandraki & Okalidou, 2007; Travis & Geiger, 2010) for children with autism and other disabilites. Further, some studies have shown that PECS may provide concomitant improvement in spoken communication such as spoken words (Anderson, Moore, & Bourne, 2007; Ganz & Simpson, 2004; Kravits et al., 2002; Liddle, 2001; Rosales & Rehfeldt, 2007), social interaction such as functional play (Jugens, Anderson, & Moore, 2009) and initiations (Howlin et al., 2007; Kravits et al., 2002), alongside decreases in stereotypical or aggressive behaviours (Charlop-Christy et al., 2002; Frea, Arnold, & Vittimberga, 2001).

Although previous studies on PECS have shown some improvement in communication and social interaction for children with autism, these studies have been limited by various factors. For example, most studies have assessed PECS only from Phases 1 to 3 or 4 (Carr & Felce, 2006b; Chambers & Rehfeldt, 2003; Ganz & Simpson, 2004; Frea, Arnold, & Vittimberga, 2001; Ganz, Simpson, & Corbin-Newsome, 2008; Kravits et al., 2002; Pasco & Tohill, 2010; Schwartz et al., 1998; Stoner et al., 2006). Further, most these studies from Phases 1 to 3 or 4 have been conducted in only one setting such as at school (Carr & Felce, 2006b; Howlin et al., 2007; Schwartz et al., 1998; Tincani, 2004) rather than the home setting.  There have been a few studies that have investigated all six phases of the PECS program (Charlop-Christy et al., 2002; Howlin et al., 2007; Liddle, 2001; Magiati & Howlin, 2003; Malandraki & Okalidou, 2007; Travis & Geiger, 2010; Yoder & Stone, 2006). Of these only four followed the structure of the PECS manual closely (Charlop-Christy et al., 2002; Howlin et al., 2007; Liddle, 2001; Magiati & Howlin, 2003); they also had limited data on generalisation (Charlop-Christy et al., 2002; Howlin et al., 2007) or maintenance sessions (Liddle, 2001; Magiti & Howlin, 2003).

The present study partly addresses the above limitations by implementing all six phases of the PECS program and assessing behaviour change across different settings (e.g., kindergarten and home) to allow for the evaluation of generalisation effects of PECS training of children with autism.

The aim of this study was to teach functional communication through all six phases and to assess the effectiveness of PECS training for a child with autism in the home, and then to observe the use of PECS by the child in the kindergarten setting where PECS training did not occur. In doing so, the following research questions were addressed:

### Research questions

1. After PECS training of a child with autism at home by the researcher, does PECS training result in increased or decreased nonvocal and vocal communication (e.g., independent PECS and vocal mands) in the home and non-training setting?

2. What are the effects of PECS training on social interaction of a child with autism in the home and a non-training setting (i.e., at the kindergarten)?

3. Does PECS training implemented by the researcher result in decreased or increased inappropriate and stereotypic behaviour of a child with autism in the home and non-training setting?

## Method

### Research design

A single subject changing criterion design was used in this study as described in Chapter 3.

## Participant

The female participant “Angel” (a pseudonym) was aged four years and three months when the PECS training commenced. She was formally assessed at four years and four months, independently of this study, by an educational and developmental psychologist and a paediatrician and met the diagnostic criteria for an autistic disorder with a score of 41 (severely autistic) on the Childhood Autism Rating Scale (CARS). Under the Bayley Scales of Infant Development III (BSID-III), her test age equivalent scores were 21, 17 and 25 months for receptive, expressive language and cognitive skills. Angel lived at home with her parents and one older brother (seven years and six months) who had also been diagnosed with mild autism. At the time of training, she attended an early intervention centre once a week and an inclusive kindergarten twice a week. She had little functional communication when the study started and had repetitive behaviours such as hand, body and head shaking.

## Settings

PECS training for Angel was conducted at the kitchen table in the child’s home. Freeplay observations following PECS training were conducted in the home as part of baseline, PECS training and maintenance sessions. Freeplay generalisation probes were conducted in the kindergarten including both indoor and outdoor settings and where other developmentally typical children were present.

## Materials

The materials used in this study were as described in the Chapter 3 Method section.

### Dependent variables

Dependent variables were as described in Chapter 3.

### Procedures

The study proceeded as described in the Chapter 3 Method section. Once the baseline information was gathered, including reinforcer assessments, PECS training and additional generalisation probes and maintenance sessions were conducted.

### Interobserver Agreement

A postgraduate level kindergarten teacher was trained to take independent observations of the sessions using the same criteria as the researcher. For this study, the mean interobserver agreement was 95% for PECS training across all phases. The mean interobserver agreements for vocal and nonvocal communication data for the home and kindergarten sessions were 99.5% and 99% respectively. Agreements for play and behaviour observational data were 89.1% and 92.3%.

## Results

### Pre-intervention measurement

During the pre-intervention interview using the questionnaire and vocabulary worksheet, the researcher obtained information about Angel’s family background including her communication and social interaction skills.

The results for assessments for critical communication skills (Frost & Bondy, 2002a) demonstrated that Angel had communication skills in accepting when items were offered and she appropriately engaged in visual directions. In contrast, she responded inappropriately in communication skills of requesting reinforcers, requesting help, requesting break, rejecting, responding to “wait”, “directions” and transition between activities as well as oral directions and following a visual schedule.

Through the Communication and Symbolic Behaviour Skills Developmental Profile (CSBS DP) (Wetherby & Prizant, 2002) Angel obtained scores of 14, 9, and 17 (total = 40) on the social, speech and symbolic composites, which equates to a developmental age of 24 months.

Results from the Assessment of Basic Language and Learning Skills-Revised Skill Tracking System (ABLLS-R) for Angel are summarised below (see Appendix F for more details).

Angel had some basic language and learning skills including: cooperation and reinforcer effectiveness (e.g., taking preferred items); visual performance (e.g., matching puzzle); receptive language (e.g., following instructions to select items); motor and vocal imitation; requests (e.g., requesting items or help by pulling an adult’s hand); play and leisure; eating; and gross and fine motor skills. However, Angel had skill deficits in using labelling; intraverbals; group instruction; classroom routine; social interaction; use of syntax and grammar; generalised responding; reading; maths; writing; spelling; and toileting.

**Reinforcer assessment**

The results of the reinforcer assessment (Frost & Bondy, 2002a) demonstrated that Angel's most preferred items as reinforcers were cooked rice, chips, plain bread, playdough and chocolate. These items were used for PECS training in the home environment.

**PECS intervention**

Table 5 below displays the total number of PECS training sessions and the number of trials conducted during any given session (within a phase). Angel acquired the mastery criteria for Phases 1, 2, 3, 4, 5, and 6 in a total of 46 sessions with 723 trials. Table 6 shows that for Phase 4, Angel required 11 sessions to complete the independent exchanges, a longer period than was required for the previous and subsequent phases. All other phases took five to six sessions.

***Table 5. The number of sessions and trials during the PECS training for Angel***

| *Phase* | *Sessions* | *Trials* | *Range of trials per session* |
|---|---|---|---|
| 1 | 5 | 118 | 12 - 41 |
| 2 | 6 | 93 | 8 - 23 |
| 3A | 5 | 90 | 15 - 22 |
| 3B | 5 | 85 | 16 - 19 |
| 4 | 11 | 131 | 8 - 20 |
| 5 | 6 | 86 | 11 - 20 |
| 6 | 8 | 120 | 12 - 19 |
| Total | 46 | 723 | 8 - 41 |

***Table 6. Percentage of successful independent PECS exchange trials for each PECStraining session***

| *% Independent PECS exchanges within phase and sessions* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *Mean %* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline | - | - | - | - | - | - | - | | | | | |
| Phase 1 | 83 | 82.3 | 83 | 75 | 87.5 | | | | | | | 82.6 |
| Phase 2 | 0 | 62.5 | 33 | 82.6 | 87.5 | 100 | | | | | | 60.9 |
| Phase 3A | 93.3 | 100 | 100 | 100 | 100 | | | | | | | 98.6 |
| Phase 3B | 94.7 | 94.4 | 93.7 | 87.5 | 100 | | | | | | | 94.0 |
| Phase 4 | 5 | 41.6 | 20 | 44.4 | 87.5 | 37.5 | 18 | 69.2 | 86.6 | 86.6 | 100 | 54.2 |
| Phase 5 | 68.7 | 75 | 75 | 100 | 85 | 100 | | | | | | 84.9 |
| Phase 6 | 0 | 0 | 76.9 | 25 | 73.6 | 100 | 100 | 100 | | | | 59.4 |
| Maintenance | - | - | - | | | | | | | | | |

***Figure 1.*** The percentage of independent PECS exchanges during each PECS training session across all the phases.

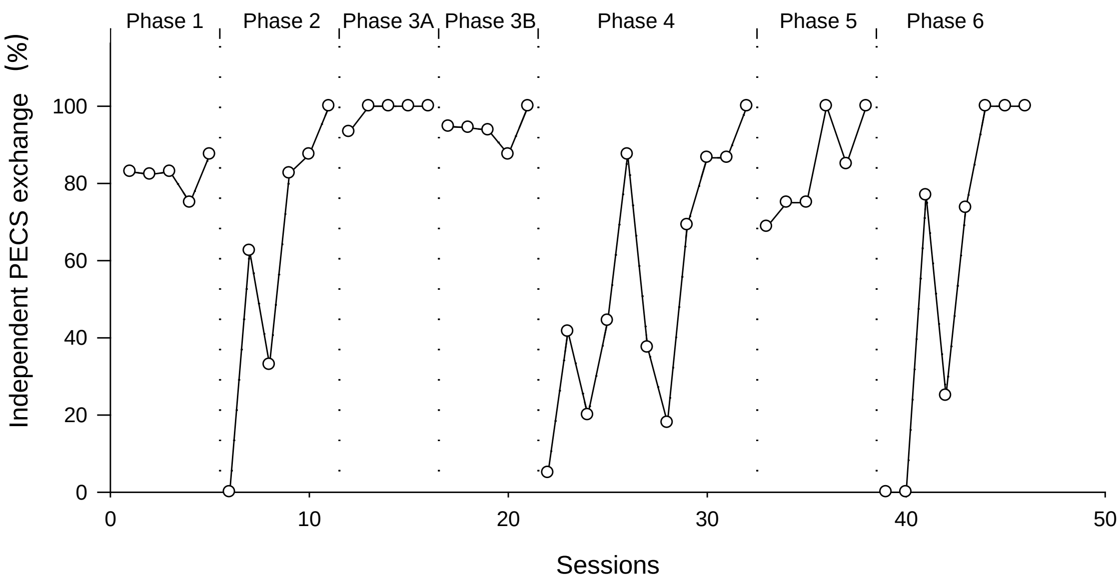



Table 6 and Figure 1 show the percentage of independent successful trials for each phase during PECS training. Angel took longer to complete Phase 4 whereas she took five to six sessions in other phases. Angel achieved the criteria level of 80% of correct independent exchanges within five sessions in Phase 1. In Phase 2, the independent exchange rate began at zero, then gradually increased to 100%. Phases 3A and 3B were completed at above the criteria level of 80%. In Phase 4, Angel gradually acquired the skill with variable rates of successful performance (range = 5 – 100%). In Phase 5 Angel gradually acquired the skill and demonstrated mastery within six sessions. In Phase 6, as in Phase 4 the skill was also acquired gradually as evidenced by initial low rates of correct responding and a high level of variability until mastery was acquired.

***Figure 2.*** Cumulative counts of new spoken words across all sessions and settings

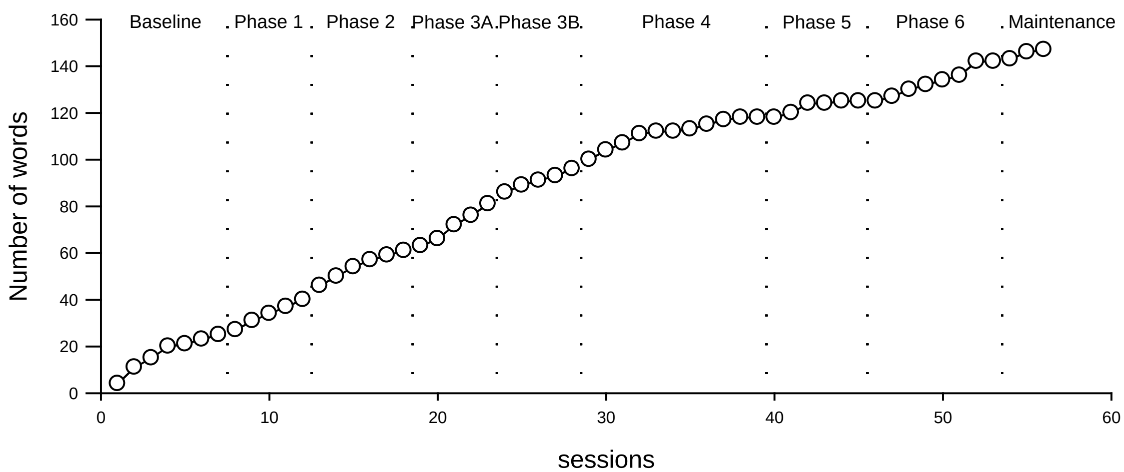



Figure 2 displays the number of cumulative new words used across all sessions and settings. The results show that the number of spoken words from Angel increased gradually at home for the duration of this study. At the end of baseline observation sessions, the total vocabulary of the child was 25 spoken words. Forty words were recorded at the end of Phase 1, 61 words at the end of Phase 2, 81 words at the end of Phase 3A, and 96 words at the end of Phase 3B. One hundred and eighteen words were noted at the end of Phase 4. One hundred and twenty-five words were recorded at the end of Phase 5 and 142 were recorded at the end of Phase 6. Finally, a total of 146 words were recorded during the maintenance sessions.

***Figure 3***. Intelligible vocalisations during PECS training sessions

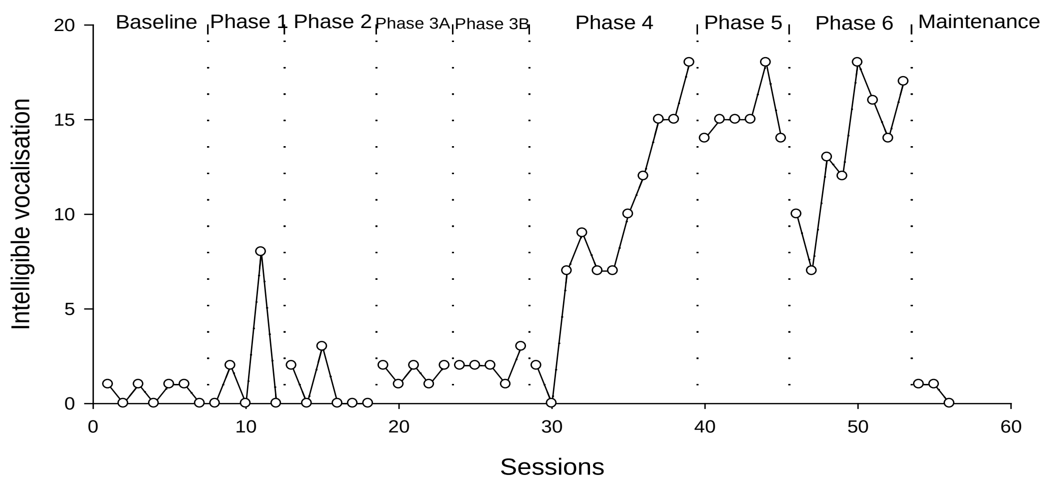



Figure 3 shows the number of intelligible vocalisations during PECS training in the home.  There were notable increases of intelligible vocalisations in Phases 4, 5 and 6. From the baseline to Phase 3B there were few intelligible vocalisations (range = 0-3) with one single exception in Phase 1 (range = 0-8). From Phase 4 onwards a gradual and steady increase occurred stabilising during Phase 5 (range = 14-18). In Phase 6, there was an initial reduction in intelligible vocalisations followed by a gradual increase that stabilised by the end of Phase 6 (range = 7-17). However, the number of intelligible vocalisations fell to the baseline level in the maintenance sessions (range = 0-1).

***Table 7. Mean Length of Utterance (MLU) spoken during PECS training***

| *Phase* | *MLU* |
|---|---|
| Baseline | 1 |
| Phase 1 | 0.5 |
| Phase 2 | 0.3 |
| Phase 3A | 0.5 |
| Phase 3B | 0.5 |
| Phase 4 | 3.5 |
| Phase 5 | 3.5 |
| Phase 6 | 3.8 |
| Maintenance | 1 |

Table 7 displays the MLU of intelligible vocalisations (range = 0.5-3.8) during PECS training. Angel's mean length of utterance was one during the baseline and maintained with less than one from Phases 1 to 3B. However the mean length of utterance increased to 3.5 in Phase 4 and 5 to a high of 3.8 in Phase 6.

***Figure 4***. *Number of 3-morpheme & 4-morpheme utterances per Phase during PECS training for Angel*.

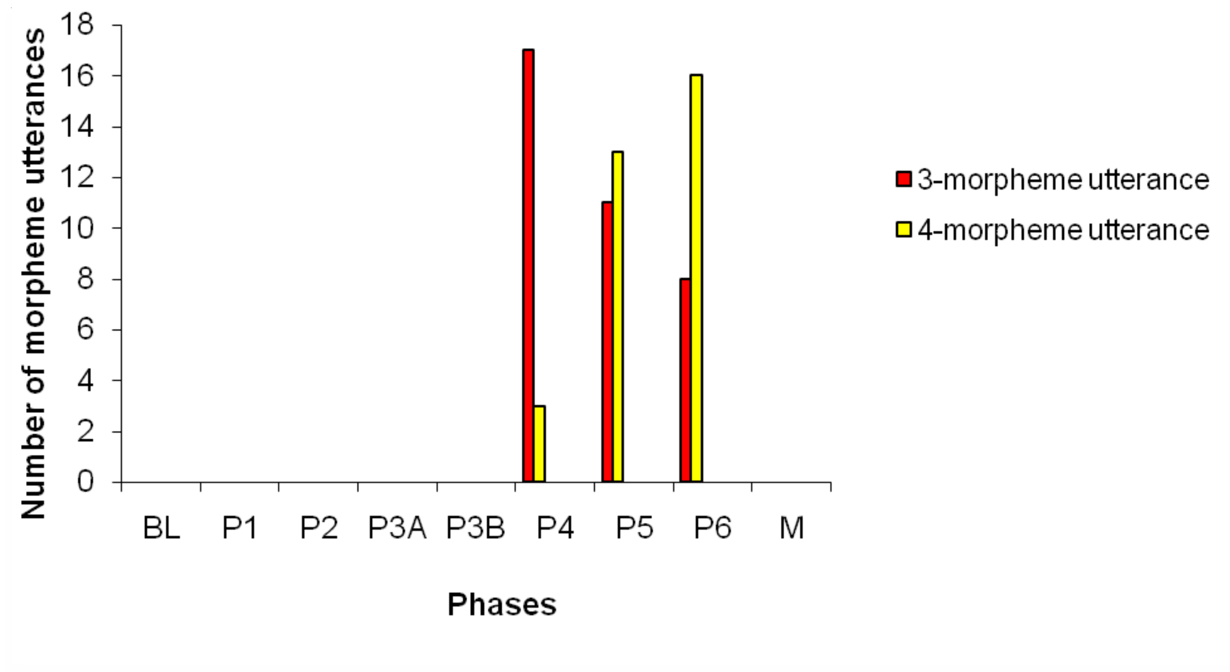



Figure 4 shows the number of three and four morpheme utterances during PECS training for Angel. The three and four morpheme utterances were zero from the baseline session to Phase 3B, as well as in the maintenance session. Angel's spoken utterances during training sessions became significantly more complex from Phase 4 onwards.

## *Table 8. Concomitant vocal and nonvocal communication in home and kindergarten freeplay settings*

| *Occurrence (%)* *Mean ( range)* | *Independent PECS mands* | | *Prompted PECS mands* | | *Vocal mands* | | *Other nonvocal mands* | | *Other vocal initiations* | | *Other nonvocal initiations* | | *Echolalic speech* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* |
| Baseline | 0 | 0 | 0 | 0 | 0.14 (0-1) | 0 | 2 (1-6) | 0.5 (0-2) | 0 | 0 | 0 | 0 | 0.42 (0-1) | 0 |
| Phase 1 | 0 | 0 | 1 ( 0-5 ) | 0 | 0.4 (0-1) | 0 | 1.6 (0-6) | 0 | 0.8 (0-1) | 0 | 1 (0-5) | 0 | 0.2 (0-1) | 0 |
| Phase 2 | 0 | 0 | 0 | 0 | 1 (0-2) | 0 | 0.8 (0-2) | 0 | 1 (0-3) | 1 | 0.8 (0-5) | 6 | 0.3 (0-1) | 0 |
| Phase 3A | 0 | 0 | 1.8 ( 0-8 ) | 0 | 0.4 (0-1) | 0 | 0.2 (0-1) | 3 | 1.4 (0-5) | 0 | 1.2 (0-3) | 0 | 0.2 (0-1) | 0 |
| Phase 3B | 0.4 ( 0-1) | 0 | 1 (0-4) | 0 | 0.2 (0-1) | 1 | 0 | 1 | 1.2 (0-3) | 1 | 1.8 (0-7) | 2 | 0.4 (0-2) | 0 |
| Phase 4 | 0 | 0 | 0.18 (0-2 ) | 0 | 0.36 (0-2) | 0 | 0.45 (0-1) | 0 | 0.9 (0-5) | 0 | 1.2 (0-12) | 0 | 0.27 (0-3) | 0 |
| Phase 5 | 0 | 0 | 0.16 (0-1 ) | 0 | 0.5 (0-2) | 0 | 0.16 (0-1) | 2 | 0.3 (0-1) | 2 | 0 | 2 | 0.33 (0-1) | 0 |
| Phase 6 | 0 | 0 | 0 | 0 | 0.12 (0-1) | 0 | 0 | 0 | 0 | 2 | 0 | 4 | 0 | 0 |
| Maintenance | 0 | 0 | 0 | 0 | 0 | 0.3 (0-1) | 0.3 (0-1) | 1.6 (0-4) | 0 | 0 | 0 | 0 | 0 | 0 |

*Note.* Kindergarten freeplay generalisation only occurred once in each phase.

Table 8 shows generalisation data of concomitant vocal and nonvocal communication for Angel in the home and kindergarten freeplay settings. Angel's independent PECS mands did not occur in either the home (except Phase 3B) or kindergarten. Prompted PECS mands and echolalic speech occurred in the home setting but not in the kindergaten. Vocal mands occurred only once during the PECS training in the kindergarten. Other vocal and nonvocal communication including nonvocal mands, vocal initiations and nonvocal initiations occurred more frequently than other behaviours in both settings.

***Table 9. Concomitant behaviours chanages in social play behaviours in the home and kindergarten freeplay settings***

| *Occurrence (%) Mean (range )* | *Unoccupied behaviours* | | *Onlooker behaviours* | | *Solitary play* | | *Parallel play* | | *Group play* | | *Inappropriate behaviours* | | *Stereotypical behaviours* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* | *Home* | *Kinder* |
| Baseline | 13.5 (3.3-33.5) | 5.25% (0-12.2) | 0 | 10.8 (4.4-22.2) | 58.7 (40-76.6) | 51.6 | 0 | 1.65 (0-4.4) | n/a | 2.2 (0-4.4) | 3.8 (0-20) | 0 | 28 (0-55.5) | 8.3 (0-28.8) |
| Phase 1 | 15 (1.1-51.1) | 24.4 | 0 | 1.1 | 45.7 (3.3-80) | 52.2 | 0 | 0 | n/a | 0 | 7.5 (0-21) | 0 | 7.5 (0-14.4) | 10 |
| Phase 2 | 5.5 (1.1-18.8) | 13.3 | 0 | 6.6 | 53.1 (25.5-67.7) | 57.5 | 0 | 0 | n/a | 0 | 2.9 (0-6.6) | 0 | 2.4 (0-17.7) | 4.4 |
| Phase 3A | 11.7 (5.5-17.7) | 27.7 | 0 | 11.1 | 61.9 (32-82) | 42.2 | 0 | 0 | n/a | 0 | 0 | 1.1 | 0 | 0 |
| Phase 3B | 8.6 (0-22) | 0 | 0 | 2.2 | 76.1 (56-91) | 86.6 | 0 | 0 | n/a | 0 | 1.5 (0-5.5) | 0 | 1.5 (0-5.5) | 5.5 |
| Phase 4 | 21 (0-37.7) | 41.1 | 0 | 2.2 | 44.5 (6.6-75.5) | 28.8 | 0 | 0 | n/a | 0 | 0.7 (0-4.4) | 0 | 0.7 (0-4.4) | 21.1 |
| Phase 5 | 9.4 (0-15.5) | 13.3 | 2.2 (0-13.3) | 0 | 63.2 (34.4-78) | 0 | 5.7 (0-34.4) | 41.1 | n/a | 0 | 0 | 4.4 | 0 | 17.7 |
| Phase 6 | 4.9 (0-15.5) | 2.2 | 0 | 0 | 71.2 (15.5-89) | 40 | 0 | 35.5 | n/a | 0 | 2.4 (0-18.8) | 0 | 2.4 (0-18.8) | 4.4 |
| Maintenance | 10.7 (0-18.8) | 17.3% (13.3-25.5) | 2.6 (0-7.7) | 5.1 (2.2-6.6) | 44.3 (0-91) | 40.7 (33.3-50) | 19.6 (0-58.8) | 7.7 (0-13.3) | n/a | 0 | 0 | 7.3 (6.6-8.8) | 0 | 3.6 (2.2-5.5) |

*Note.* Kindergarten freeplay generalisation only occurred once in each phase. n/a = not applicable (no opportunities for play were present).

Table 9 shows generalisation data of concomitant behaviours of social play for Angel in the home and kindergarten freeplay settings. Angel's unoccupied, onlooker behaviour, solitary play, inappropriate and stereotypical behaviours occurred both in the home and kindergarten setting; the exception was in group play when the teacher led group activities for music time. Angel generally played alone both in the home and kindergarten except in Phases 5 and 6 where her mother was available in the kindergarten to participate in activities such as at the playdough table where other children were present with Angel. Interestingly, Angel had higher stereotypical behaviours in Phases 4 and 5 in the kindergarten. These behaviours were exhibited when her favourite music was on in Phase 4 and when her mother was available in Phase 5. Angel's stereotypical behaviours in the home showed a steady reduction when compared to the baseline and the kindergarten sessions.

**Treatment fidelity**

All PECS training sessions adhered to the specifications of the PECS manual (Frost & Bondy, 2002a), as described in the method section.

**Social validation**

Angel's mother completed the social validity questionnaire on completion of the PECS intervention. The mother commented that Angel's communication and social interaction skills were "very important" and "desirable". The mother also felt that PECS training in the home environment was "effective" for increasing Angel's communication and social skills. Specifically, she commented that the time frame for the PECS training was "reasonable" and the program easy to implement and not stressful.

The social validity questionnaire for the kindergarten teacher was not completed as Angel changed her kindergarten after Phase 4 training. However, the kindergarten teacher was invited to provide written comments about the PECS training based on her observations of the change in Angel’s communication, social and intellectual behaviours between the baseline and completion of Phase 4. In her response the teacher commented that Angel showed signs of improvement during the period of the PECS training. Her specific comments were that before the PECS training, Angel used only a few words such as “bye” and “water”. After completion of the Phase 4 training, the teacher observed that Angel had increased her communication and social interaction skills. For example, Angel could recognise more words such as “orange” and “playdough”, showed more acceptance of her peers (allowing them, for example, to take her hand and walk outside) and displayed increased eye contact with adults.

## Discussion

The aim of Study 1 was to teach functional communication through all six phases of PECS and to assess the effects of the training on vocal and nonvocal communication, and on social play behaviours for a child with autism. In addition, the aim of the study was to evaluate the extent to which PECS use may be generalised to non-trained settings (e.g., kindergarten). PECS training resulted in mastery of all six PECS phases, increased vocal communication such as intelligible words, length of vocal utterances and new spoken words during the PECS training. However, there were no significant effects on Angel's social play behaviours (e.g., solitary and group play) through the PECS training. Also, Angel’s use of independent PECS skills did not generalise to non-training settings.

*PECS acquisitions*

Angel successfully acquired functional communication insofar as she mastered all of the six phases of the PECS program, with a total of 723 trials (range = 8-41per session) over a five month period. The time taken to achieve mastery of the PECS program corresponded to the time reported in some previous studies, which showed times of approximately four to eight months (Malandraki & Okalidou, 2007; Yoder & Stone, 2006). However, some other studies reported a longer period of time for mastery of the program, around ten months or more (Charlop-Christy, et al., 2002, Liddle, 2001; Magiti & Howlin, 2003). From this we can conclude that mastery time of the PECS program for children with autism may vary. Mastery time seems dependent on a range of factors such as individual characteristics and age.

For Angel, Phases 4 (sentence structure) and 6 (commenting) took a longer period of time to master (11 and 8 sessions; 131and 120 trials, respectively), compared to the other phases which required an average of five to six sessions (85-118 trials) to master to criterion level. This result is similar to that of Charlop-Christy et al., (2002), whose investigation showed that Phase 4 took a longer time and more trials to master (45-108 trials) when compared to other phases such as Phase 3 and 5 (range = 4-16 trials). The difficulties encountered at Phase 4 might be one of the reasons that most previous research on PECS has been conducted from Phases 1 to 3 only (Angermeier et al., 2008, Carr & Felce, 2006b). In other words, for preschool aged children with autism and other disabilities the discrimination training (Phase 3) might be relatively easy whereas moving into sentence structure provides many difficulties.

*Generalisation*

While Angel mastered all of the six phases of the PECS program, the mastered PECS skills did not generalise to the home or the kindergarten settings. Angel did not normally use independent PECS mands either in the home (except two sessions of Phase 3B, requesting apple and playdough, in the home) or kindergarten freeplay settings. PECS mands occurred only when her mother prompted Angel vocally at home to use PECS (e.g., saying "gets the picture"). By contrast there were no prompted PECS mands with teachers in the school. This result differed from previous studies (Anderson, Moore, & Bourne, 2007; Kravits et al., 2002; Schwartz et al., 1998) where the use of PECS icons not only increased but was generalised to the non-training setting (e.g., home or school).

This lack of generalisation in the inclusive kindergarten is likely to be the result of the fact that no PECS training occurred in the school setting. This suggests that PECS training should take place in as many settings as possible and include where possible the home, school or other natural settings.

It should be noted that while the PECS manual, as well as associated research, encourages the involvement of typically children in the use of PECS, this is not always practical even though there are many communicative partners in inclusive settings. In many natural settings, such as the Kindergarten, materials and activities are freely accessible for children, thereby reducing the need for children to communicate their desire for preferred items.

*Intelligible vocalisation and sentence structures*

Angel's mean length of utterance and intelligible vocalisations (e.g., "I want apple", "I see a car") increased significantly in Phase 4 (sentence structure), Phase 5 ("what do you want?") and in Phase 6 (commenting) during PECS training. In addition, her new spoken words gradually increased across the duration of the study. This result suggested that PECS training was associated with concomitant increases in spoken communication as reported in previous studies (Anderson, Moore, & Bourne, 2007; Bondy & Frost, 1994a; Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Kravits et al., 2002; Magiti & Howlin, 2003).

*Other vocal and nonvocal communication*

Angel's other vocal and nonvocal communication (e.g., commenting) occurred throughout Phases 1 to 6 in the home and kindergarten freeplay settings. While Angel's vocal commenting occurred more frequently from Phases 1 to 4, her use of gestures for commenting also occurred frequently at the same time (e.g., saying "chips" while eating with a pointing gesture). In addition, Angel displayed echolalia, a typical speech pattern for children with autism (Schopler & Mesibov, 1986b; Talay-Ongan, 2000), at low frequencies in the home setting from the baseline to Phase 5. However, Angel's echolalia disappeared at the end of Phase 6 and during the maintenance sessions. This may suggest that PECS training in the home may be associated with decreases in Angel's echolalia in the home setting.

*Social play behaviours*

The study did not demonstrate any positive effects on increasing Angel's play behaviours in the kindergarten and home settings. Angel's unoccupied behaviours and solitary play generally occurred in the home and kindergarten settings. However, Angel's onlooker behaviours, parallel and group play were limited. This result seems consistent with the literature where children with autism, in contrast to typical children, tend to have significantly impaired play skills and are more likely to play alone (Francke & Geist, 2003). Nonethless, although Angel's parallel play was limited, her parallel play increased from Phases 5 to the maintenance sessions across both the home and school settings. This result concurs with a previous study (Jurgens, Anderson, Moore, 2009). Onlooker behaviours generally occurred more in the kindergarten than the home setting. This may be because Angel had more opportunities to watch other children's play in the kindergarten, whereas there were few such opportunities in the home environment.

*Stereotypical and Inappropriate behaviours*

Angel frequently displayed stereotypical behaviours during baseline (e.g., banging two toys together or spinning her body with hand flapping) in the home. However, these behaviours decreased from Phases 1 to the maintenance sessions in the home (see Table 9). This finding suggests that PECS training may be associated with a decrease in stereotypical behaviours. This finding concurs with a previous study by Malandraki and Okalidou (2007), who found that PECS training was associated with decreases in the frequency of stereotypical behaviours for a deaf child with autism.

*Limitations and future study*

The structure of Study 1 limits some of the generalisation effects of the research. In this study PECS training was limited to Angel's home environment and did not take place in other relevant settings such as the early intervention centre or kindergarten. Angel showed no use of independent PECS mands in the kindergarten settings and Angel's PECS skills did not generalise across different settings or situations (e.g., kindergarten) or individuals (e.g., teachers). It might be that this lack of generalisation occurred because training only occurred at home.

In addition, the use of freeplay observation in the home environment as a means to assess the impact of PECS on social interaction was limited by the fact that there were fewer opportunities for interaction in Angel's home environment than in the kindergarten setting, where there were many children and adults available for interaction. PECS training should involve not just parents but also other adults (e.g., school teachers or child carers) and typically developing children (e.g., siblings) to provide greater generalisation opportunities for the use of PECS.

The limited use of independent PECS mands, particularly in the inclusive kindergarten settings, raises issues around the transition of Angel's PECS skills acquired in the home to the school setting. Although Angel obtained PECS skills in home training, her skills did not transfer to other settings. This may be due in part to the fact that all items and materials in the kindergarten setting were freely available, thereby reducing the need to request these items. This suggests that environmental modifications might be needed to increase communication opportunities and motivation for social initiations for children with autism in the natural environment (e.g., controlling materials to increase requesting).

## Conclusion

Study 1 demonstrated that Angel mastered all of the six phases of the PECS program in the home setting and acquired functional communication. The results showed positive effects on the child in relation to increases in vocal communication such as intelligible vocalisation, MLU and cumulative new spoken words along with a concomitant decrease in stereotypical behaviours in the home environment. However, the increase in spoken communication was not retained once the PECS training had been completed and the skills of PECS use did not generalise to non-training setting (e.g., kindergarten). The issue of generalisation effects to non-training settings will be addressed in Study 2 (e.g., by encouraging school teachers to communicate with a child using PECS).

# CHAPTER FIVE

## STUDY TWO

### Introduction

Study 1 was conducted in Angel's home environment to explore the effects of PECS intervention and to measure communication and social play in a generalisation setting (kindergarten freeplay setting). However, despite the training in the home Angel's use of PECS did not generalise at home, nor did it generalise to her kindergarten setting. One cause of this lack of generalisation may have been because Angel's PECS training occurred only in the home setting. In addition, Angel had limited social interaction opportunities in the home, in contrast to the kindergarten setting where there were many opportunities for social interaction with other children. However, despite these opportunities, Angel did not use PECS to communicate with others in the school.

As a result of the limitations in generalisation in Study 1, Study 2 was designed to provide PECS training in both the home and school setting. The participant, Bee (pseudonym), was a girl with autism, aged four years and seven months. In addition, PECS sessions were conducted with Bee's typically developing sibling, Judy (a pseudonym), six years old, collaborating from Phases 3A to 6. In these sessions, motivating operations were used with the older sibling controlling the reinforcers. This practice was adapted from Phase 3A onwards.

The PECS training conducted in Study 2 involved Bee's special school teacher from Phase 1 as well as the researcher and the mother. It should be noted that in Phase 2 (distance and persistence) the normal PECS practice is for generalisation to occur from room to room (Bondy

& Frost, 2002b). However, this could not occur in this study as the school teacher could not move out of the room due to her teaching obligations (i.e., her responsibilities to the other students in the class).

The basic aims of Study 2 were the same for Study 1, that is, to teach functional communication through all six phases of the PECS program. In particular, the aim of Study 2 was to assess the effects of PECS training involving a typically developing sibling in the home setting. The generalisation effects of PECS training on vocal and nonvocal communication, and social interaction were also evaluated. Specific research questions are outlined below:

**Research Questions**

1. After PECS training in two settings (e.g., home and school) of a child with autism with participation of a typically developing sibling in the home setting, does PECS training result in changes in nonvocal and vocal communication (e.g., independent PECS mands and vocal mands) in the home and school freeplay settings?

2. What is the effect of PECS training in multiple settings with participation of a typically developing sibling, on social play (e.g., parallel play) in the freeplay settings?

## Method

### Research design

A single subject changing criterion design was used in this study as described in Chapter 3.

### Participant

Bee's age was four years and seven months when the PECS intervention commenced. She lived with her parents and a six year-old sister. Bee did not attend an inclusive preschool or kindergarten program. She attended special school two times a week and a social skill group once a week when the baseline study started. She also had visits from typically developing children, who were neighbours or children of her mother's friends.

Bee was diagnosed with Autistic Disorder and developmental delay when she was approximately three years old. She was assessed with the Child Autism Rating Scale (CARS) by an independent paediatrician. She had a total CARS score of 45, which places her in the severe autistic range. In addition, Bee was given an independent psychological assessment at Monash University in 2009, when she was approximately four years old, using the Bayley Scales of Infants and Toddler Development -Third edition (BSID-III). This resulted in test age equivalent scores of 6, 9 and 25 months for receptive, expressive language, and cognitive skills.

### Settings

All sessions, including the baseline, PECS training, freeplay generalisation and maintenance observations sessions were conducted in Bee's home and school. The sibling involvement sessions were conducted in the home setting. The PECS training sessions occurred in both the home and the school. All sessions in the home were conducted at the kitchen table (100cm x 100cm). It should be noted that the family arranged to move to a new location during Phase 4 and moved to their new house during Phase 6 of PECS training. Bee had a break from PECS training for two weeks to allow her to settle into her new home and school settings.

**Materials**

All materials for PECS training were the same as for Study 1 (see Method section Chapter 3). It should be noted that the activity materials for the sibling involvement were assessed through interviews with Bee's mother and school teachers and through observation. The school teacher informed the researcher that Bee was particularly interested in brightly coloured toys with diverse shapes (e.g., puzzles and blocks). Furthermore, the researcher asked Judy (pseudonym for Bee's older sister) what activities she liked to do in the school and home. Judy indicated activities and objects that were similar to Bee's, such as blocks and painting. As a result, these became the activities conducted on the table for the two sisters. Figure 5 below shows activities used for the sibling involvement sessions. These activities involved the use of magnet books with animals, wooden train blocks, puzzle boards, decorating Christmas trees and pretend cooking through Phases 3A to 6. All materials were new and provided by the researcher to keep the children's interest in the activities high.

***Figure 5.*** Materials used during the sibling involvement activities

## Dependent variables

Dependent variables were the same as for Study 1, as described in Chapter 3.

## Procedures

The study proceeded according to the process discussed in Chapter 3, with the exception of the sibling involvement sessions where new procedures were added once Phase 2 of PECS training had been completed. Bee went through the process of pre-intervention measurement, reinforcer assessment, baseline sessions and then PECS training from Phases 1 to 6. The sibling involvement activities were introduced from Phase 3A (simple discrimination). The use of motivation operations during the sibling involvement began in Phase 3B (from Session 2). Freeplay observation and maintenance sessions were conducted in the school and home. The procedure for sibling involvement is discussed below.

### *Sibling involvement*

#### *Instructions for sibling involvement*

#### *1) Initial story about PECS*

A simple PECS story reproduced below in Figure 6 was read to Judy by the researcher and mother. The story, written by the researcher, was entitled “Talking with My Sister Using PECS”. Presenting this story provided the sibling, Judy with a general background to the use of PECS with Bee.

***Figure 6.*** Story for sibling involvement

***"Talking with my sister using PECS"***


There are many people who do not talk and my sister is one of them.

My sister Bee uses pictures to talk with me and my parents at home.

She has a book with many different pictures in it.

There is a picture of an apple and a grape in the book.

When my sister Bee wants to ask for something she gives me a picture of it.

Then I find what is showing on the picture and give it to her and return.

If Bee gives me a picture of an apple to me, then I know she wants an apple.

I can get an apple and give it to her.

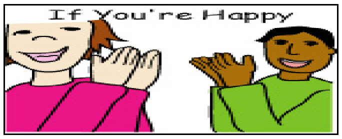
Isn't it wonderful my sister can get what she wants or needs using PECS?

I like to communicate with my sister, Bee using pictures.

I can give her what she is asking for using the pictures and she will be happy.

I will always look out for my sister as she uses pictures to talk to me.

If I do that, my parents will be very proud of me and Bee will be happy too because I am a good sister.



### *2) PECS DVD with role play*

Prior to each PECS intervention session, the sibling and mother watched a PECS DVD entitled "An Introduction to PECS" (Pyramid Educational Consultants, 2000), showing the PECS Phase relevant to that session. The sibling also completed a role-play with either the researcher or mother in order to practise the use of PECS with the participant. For example, the sibling would role-play being a communicative partner and the researcher would role-play a target child with autism. The sibling Judy, as communicative partner, would hold a preferred item, such as a rice cracker, and the researcher would make a request using a PECS picture card to get the rice cracker. Then the sibling would give the rice cracker to the researcher.

The following strategies were used by the researcher to train Judy to use PECS with the target child in the home setting.

Play-Exchange-Response strategies ("picture play time")

Judy was encouraged to use play-exchange-response strategies while using PECS with the target child. Judy would be told, "during picture play time you play with Bee".

i) Play

To ensure that Bee and Judy shared the same spatial area, Judy was encouraged to play on the same table as Bee during activities (e.g., block play or story books). Judy was also encouraged to wait for Bee's first initiation or entice Bee with the object during the table activity.

The researcher or parent provided consistent verbal prompts to remind Judy of how to interact. For example, the adult said "remember to play with Bee, if Bee gives a picture to you, exchange the thing she is asking for using the picture. So, if you have a pencil in your hand and she asks for it using a picture card, give the pencil to her”. If Bee went to an adult to request an object, either with or without PECS (e.g., requesting with PECS cards or gestures), the adult would direct the initiation to Judy by using vocal or nonvocal prompting (e.g., by saying: “ask your sister”), or by taking Bee’s hand and directing her to Judy, as per the method outlined in Garfinkle and Schwarz (1994).

ii) Exchange

Judy was told to exchange materials or objects she held when Bee handed over her picture. In particular, during Phases 5 and 6 training, Judy was encouraged in the following ways:

- In Phase 5, the researcher said, “whenever Bee wants to have something you have or come to talk to you, you need to say ‘what do you want?’. If Bee gives you a picture card and you have the thing on the card, then swap it for the card.”
- In Phase 6, the researcher said, “when Bee comes to talk with you, you need to ask ‘what do you want?’ or ‘what do you see?’. If she gives you the sentence strip of ‘I want’ and you have the thing on the card, then swap it with the card.” If Bee show you an ‘I see’ picture, then just show the thing on your part of the table, but don’t give it to her.”

iii) Response

Judy was encouraged to use vocal and nonvocal responses with her younger sister immediately after PECS exchanges occurred successfully. For example, Judy might respond by smiling or saying “good girl”. This approach was aimed at providing positive social interaction between the two sisters.

The adult present, either researcher or parent, provided verbal reinforcement to Judy when she successfully exchanged pictures with Bee. For example, by saying “you are doing a fantastic job, I can see you are a good sister”.

### *3) Additional strategy: token economy*

A token economy (Cooper, Heron, & Heward, 2007; Kazdin, 1989) was used from the first session in Phase 5 as an additional strategy when Judy was not interested in or declined to engage actively in the above “Play-Exchange-Response strategies” during the sibling involvement sessions.

The token economy was used as a reinforcer to reward Judy when she successfully completed a PECS exchange with Bee. This system involved giving Judy a felt flower in a pocket as a token reinforcer after each successful exchange. When Judy got ten flowers, the flowers were exchanged for a reinforcer, such as a little gift (e.g., baby doll and story book). The backup reinforcer was available at the end of each PECS phase. The backup reinforcer for Judy was identified through a reinforcer assessment (Frost & Bondy, 2002a).

## Interobserver Agreement

Interobserver agreement was calculated with the method outlined in Chapter 3. For this study, the mean interobserver agreement was 95 % and 100% respectively in the home and school for

PECS training across all phases. The mean interobserver agreements for vocal and nonvocal communication data for the home and school sessions were 95.4 % and 92.7 % respectively. Agreements for social play behaviours, and sibling involvement observational sessions were 86.9% and 91.4 % respectively.

## Results

### Pre-intervention measurement

As described in Chapter 3, the assessments showed that for critical communication skills (Frost & Bondy, 2002a) Bee was unable to request toys, activities, help, breaks, and not capable of rejecting and responding to "wait" and could not understand directions using gestures and vocal communication. Although she sometimes understood the vocal direction when her mother said "sit down", in general she had difficulty complying with visual and vocal directions in responding to "wait", "give it to me", "sit down" and in following a visual schedule.

The results indicated that Bee was classified at the level of "concern", as she obtained 13, five, and nine (total = 27) on the social, speech and symbolic composites of the Communication and Symbolic behaviours Scales Developmental Profile (CSBS DP), with an age equivalent of 24 months.

Results from the Assessment of Basic Language and Learning Skills-Revised Skill Tracking System (ABLLS-R) for Angel are summarised below (see Appendix G for more details). Bee showed some positive skills in basic language and learning skills. These skills include: cooperation and reinforcer effectiveness (e.g., taking reinforcer when offered); visual performance (e.g., matching simple puzzle); receptive language (e.g., following instructions to select item); motor imitation (e.g., imitating simple action); requests (e.g., requests items or help by pulling adult's hand); play and leisure; eating; gross motor; and fine motor. However, Bee showed a lack of skills in: vocal imitation; labelling; intraverbals; syntax and grammar; social interaction; group instruction; classroom routines; generalised responding; reading; math; writing; spelling; dressing; grooming; and toileting. Bee had no spontaneous vocalisation or spoken words.

**Reinforcer assessment**

The results of the reinforcer assessment (Frost & Bondy, 2002a) identified Bee's preferred items as chips, strawberries, rice crackers, grapes, apple juice, and icy poles. These items were used for Bee's PECS training.

**PECS intervention**

Table 10 below displays the total number of PECS training sessions and the number of trials during the PECS training sessions at home and school. Bee acquired mastery level for all PECS Phases. The total number of sessions was 52, which included 1,181 trials over a period of six months. In particular, Phase 6, with 19 sessions in total (334 trials), took more sessions compared to the previous phases which took five or eight sessions (ranging between 116-181 trials).

***Table 10. Total number of total sessions and trials during PECS training***

| *Phase* | *Sessions* | *Trials* | *Range of trials per session* |
|---|---|---|---|
| 1 | 5 | 146 | 12-40 |
| 2 | 8 | 126 | 9-25 |
| 3A | 5 | 181 | 18-61 |
| 3B | 5 | 149 | 21-39 |
| 4 | 5 | 129 | 15-37 |
| 5 | 5 | 116 | 17-30 |
| 6 | 19 | 334 | 6-32 |
| Total | 52 | 1181 | 6-61 |

***Table 11. Percentage of successful independent PECS exchange trials for each PECStraining session***

| *% Independent PECS exchanges within phases and sessions* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *12* | *Mean %* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline | - | - | - | - | - | - | - | - | - | - | - | - | **0** |
| Phase 1 | 87.1 | 75 | 96.3 | 100 | 95 | | | | | | | | 90.6 |
| Phase 2 | 8.3 | 53.8 | 0 | 20 | 24 | 84.6 | 94.4 | 88.8 | | | | | 46.7 |
| Phase 3A | 100 | 100 | 97.2 | 100 | 80.6 | | | | | | | | 95.6 |
| Phase 3B | 76.1 | 97.4 | 96 | 92.8 | 97.2 | | | | | | | | |
| Phase 4 | 0 | 90.3 | 97 | 84 | 86.6 | | | | | | | | 89.4 |
| Phase 5 | 92.8 | 90 | 95.4 | 89.4 | 100 | | | | | | | | 93.5 |
| Phase 6 | 51.6 | 47 | 50 | 78.5 | 27 | 0 | 46.6 | 0 | 88.8 | 41.6 | | | |
| (Session) *Phase 6 continued* | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | | | | |
| | 0 | 73.3 | 61.9 | 77.7 | 72.7 | 46.1 | 80 | 82.1 | 84.3 | | | | 53.1 |
| (Session) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| Maintenance | 95 | - | - | - | 100 | 100 | 100 | - | 60 | - | | | |
| (Session) | 11 | 12 | | | | | | | | | | | |
| Maintenance | 95 | - | | | | | | | | | | | 45.8 |

*Figure 7.* Percentage of independent PECS exchanges during each PECS training session across Phases 1-6 and Maintenance.

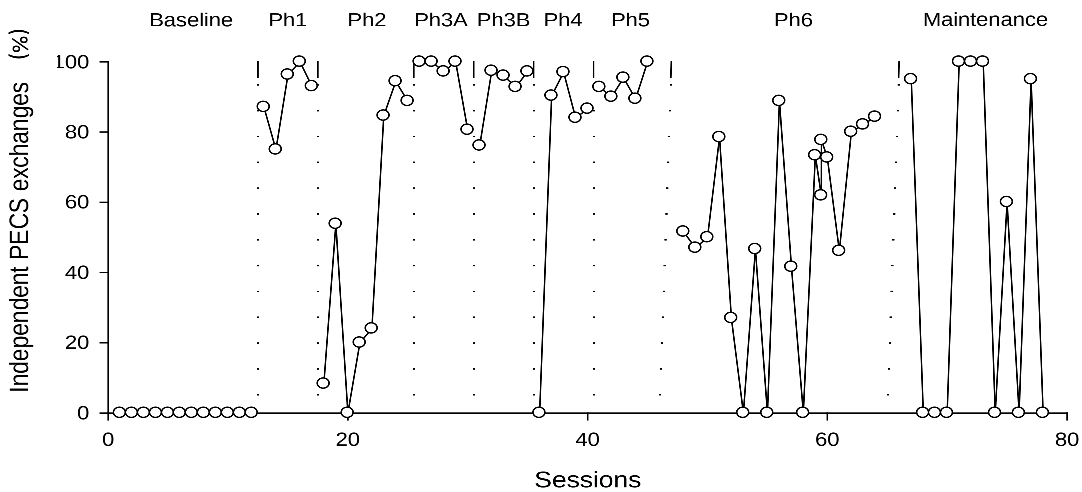



Table 11 and Figure 7 show the percentage of independent successful exchange trials for each phase during PECS training. Bee took longer to complete Phases 2 and 6 with eight and 19 sessions respectively whereas she took five to six sessions in other phases. Bee achieved the criterion level of 80% of correct independent exchanges within five sessions in Phase 1. In Phase 2, the independent exchange rate was initially low, followed by a gradual and stable skill acquisition. Bee acquired the various skills from Phases 3A to 5 at a consistent rate except for an initial rate of zero in Phase 4 (sentence structure). In Phase 6, the skill was acquired gradually with a high level of variability until mastery was acquired at the end (range = 0-88.8). During the maintenance sessions, Bee’s independent exchanges ranged from zero to 100%.

***Figure 8.*** Cumulative counts of new spoken words across all sessions and settings

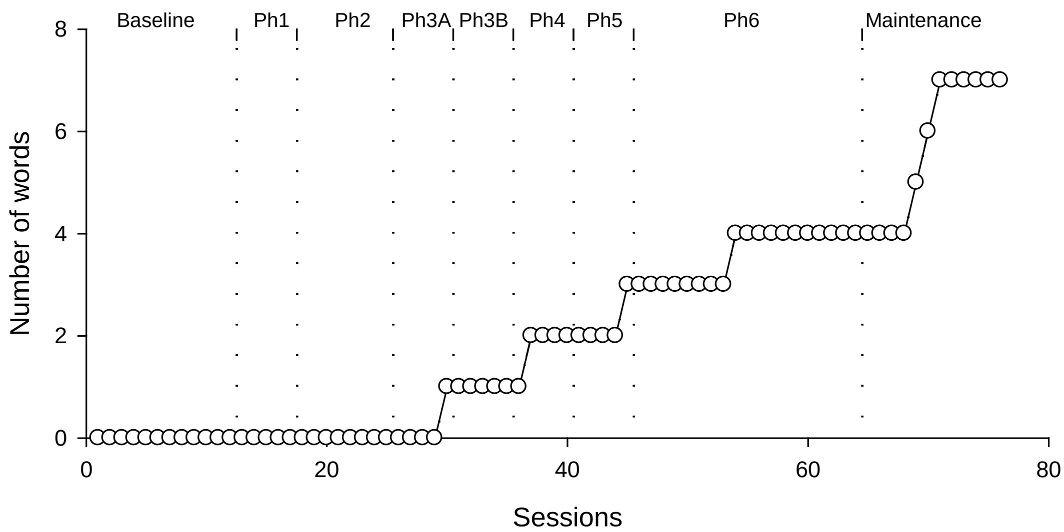



Figure 8 displays the cumulative number of new words used across all sessions and settings. The results show that the number of words spoken by Bee increased over the duration of the study. The total vocabulary of the child was zero during the baseline to Phase 2. One word was recorded at the end of Phase 3A, no words in Phase 3B, then two words at the beginning of Phase 4. The number of spoken words then consistently increased, with three words at the end of Phase 5, four words in the middle of Phase 6 and finally seven words at the end of the maintenance sessions. The seven words used by Bee were: “ok”, “yum”, “look”, “book”, “good”, “girl”, and “boy”.

***Figure 9.*** Total number of independent PECS mands in the home and school settings

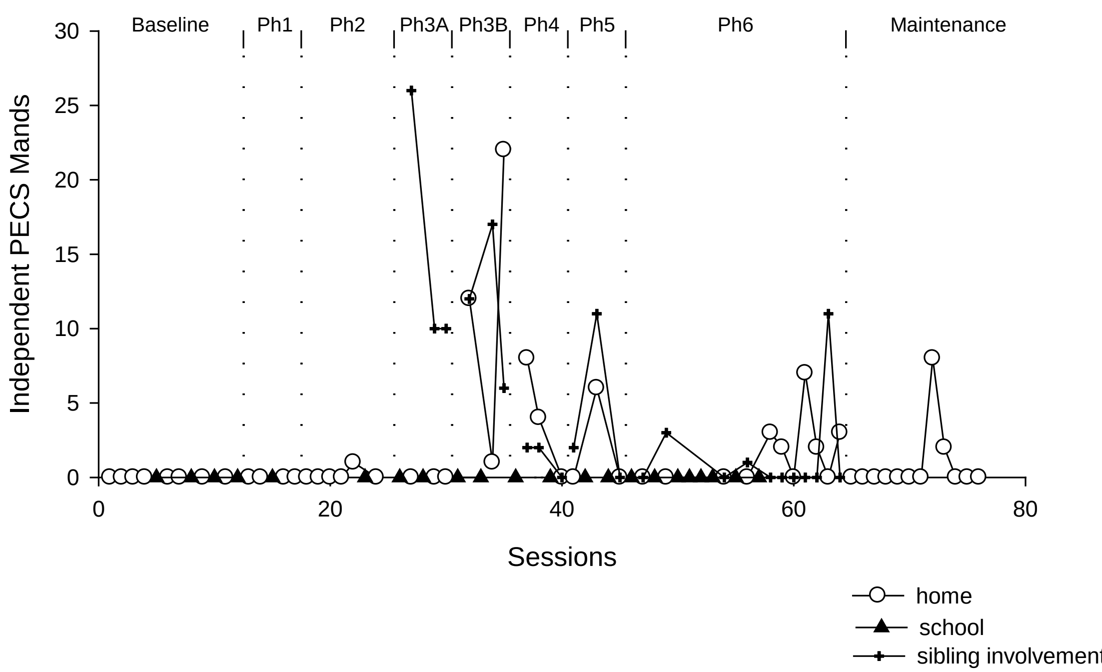



Figure 9 shows the number of independent PECS mands during the home and school freeplay settings. Bee's independent PECS mands occurred from Phases 3A to 6 at the time when sibling involvement sessions were introduced in the home setting. Bee's use of independent PECS mands significantly increased and generalised within the home setting when compared to the Study 1 where independent PECS mands did not occur in the home and school freeplay settings.

Once the sibling involvement sessions were introduced in Phase 3A, Bee's independent PECS mands significantly increased from the first session in Phase 3A. Bee's independent PECS mands started to generalise from Phases 3B to the maintenance sessions after the sibling involvement was introduced in the home setting. Independent PECS mands during the sibling involvement from Phases 3A to 6 occurred at a mean rate of 4.9 exchanges per session (range = 0 -26) when compared to the home and school freeplay settings where the mean number of independent PECS mands was 1.5 and zero respectively from the baseline to the maintenance sessions.

***Figure 10.*** Total number of prompted PECS mands in the home and school settings.

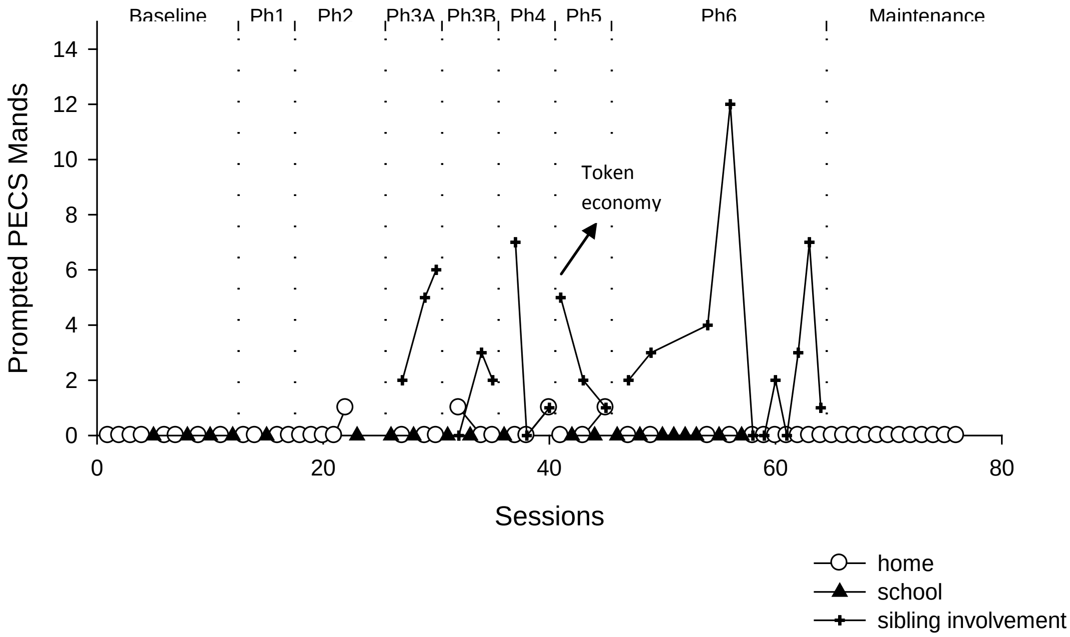


Figure 10 shows the number of prompted PECS mands displayed by Bee during the home and school freeplay settings.

Prompted PECS mands occurred as soon as the sibling involvement sessions were introduced from Phase 3A in the home. When compared to the home and school freeplay settings prompted PECS mands from Phases 3A to 6 significantly increased with a mean of 2.9 (range = 0-12). Prompted PECS mands in school and home settings were almost non-existent with a mean of 0.075 (range = 0-1) from the baseline to the maintenance sessions. The token economy for Judy was introduced from the first sessions of Phase 5. However, it had no impact on reducing Judy's prompting (e.g., pointing to the PECS book or vocal prompting) although she continued to maintain the sibling activities with Bee.

*Table 12. Concomitant vocal and nonvocal communication in home, school freeplay settings and sibling involvement sessions*

| Occurrence (%) Mean (range) | Independent PECS mands | | | Prompted PECS mands | | | Vocal mands | | | Other nonvocal mands | | | Other vocal initiations | | | Other nonvocal initiations | | | Echolalic speech | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Home | S | SI | Home | S | SI | Home | S | SI | Home | S | SI | Home | S | SI | Home | S | SI | Home | S | SI |
| Baseline | 0 | 0 | - | 0 | 0 | - | 0 | 0 | - | 1.1 (0-3) | 0.25 (0-1) | - | 0 | 0 | - | 0 | 0 | - | 0 | 0 | - |
| Phase 1 | 0 | 0 | - | 0 | 0 | - | 0 | 0 | - | 0.2 (0-1) | 0 | - | 0 | 0 | - | 0 | 0 | - | 0 | 0 | - |
| Phase 2 | 0.14 (0-1) | 0 | - | 0.14 (0-1) | 0 | - | 0 | 0 | - | 0.42 (0-2) | 0 | - | 0 | 0 | - | 0 | 0 | - | 0 | 0 | - |
| Phase 3A | 0 | 0 | 12 (10-26) | 0 | 0 | 4.3 (2-6) | 0 | 0 | 0 | 0.3 (0-1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phase 3B | 11.6 (1-22) | 0 | 11.6 (6-17) | 0.3 (0-1) | 0 | 1.6 (0-3) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phase 4 | 4 (0-8) | 0 | 1.3 (0-2) | 0.3 (0-1) | 0 | 2.6 (0-7) | 0 | 0 | 0 | 0 | 0.5 (0-1) | 0.3 (0-1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phase 5 | 2 (0-6) | 0 | 4.3 (0-11) | 0.3 (0-1) | 0 | 2.7 (1-5) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phase 6 | 1.54 (0-7) | 0 | 1.36 (0-12) | 0 | 0 | 3.1 (0-12) | 0 | 0 | 0 | 0.36 (0-2) | 0 | 0.36 (0-3) | 0 | 0 | 0 | 0 | 0 | 0.09 (0-1) | 0 | 0 | 0 |
| Maintenance | 0.83 (0-8) | 0 | - | 0 | 0 | - | 0 | 0 | - | 0.4 (0-4) | 1 (0-5) | - | 0 | 0 | - | 0 | 0 | - | 0 | 0 | - |

*Note.* S = School. SI = Sibling Involvement.

Table 12 shows the generalisation data of concomitant vocal and nonvocal communication in the home, school freeplay settings and during the sibling involvement sessions. There were no significant changes in vocal and nonvocal communication, except independent and prompted PECS mands during PECS training. Vocal mands, other vocal initiations, and echolalic speech did not occur in either the home or school freeplay settings.

***Table 13. Concomitant behaviours changes in social play behaviours in the home and school freeplay settings***

| *Occurrence (%) Mean (range )* | *Unoccupied behaviours* | | *Onlooker behaviours* | | *Solitary play* | | *Parallel play* | | *Group play* | | *Inappropriate behaviours* | | *Stereotypical behaviours* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Home* | *School* | *Home* | *School* | *Home* | *School* | *Home* | *School* | *Home* | *School* | *Home* | *School* | *Home* | *School* |
| Baseline | 33.9 % (16.6-71.1) | 21.3 (11.1-34.4) | 0.28 (0-2.2) | 0 | 33.9 (8.8-66.6) | 71.0 (46.6-85.5) | 8.4 (0-40) | 0.27 (0-11.1) | n/a | 0 | 3.45 (0-10) | 9.95 (2.2-28.8) | 0.55 (0-3.3) | 0 |
| Phase 1 | 23.8 (13.3-38.8) | 26.6 | 0 | 0 | 45.2 (0-64.4) | 65.5 | 13.0 (0-41) | 0 | n/a | 0 | 4.7 (0-14.4) | 4.4 | 0 | 0 |
| Phase 2 | 15.8 (3.3-32.2) | 20.5 (10-31) | 0.47 (0-2.2) | 0 | 46.2 (17.7-74.4) | 76.6 (65.5-87.7) | 8.0 (0-41.1) | 0 | n/a | 0 | 0.47 (0-2.2) | 1.65 (1.1-2.2) | 0 | 0 |
| Phase 3A | 30.7 (8.8-51.1) | 28.8 (8.8-48.8) | 0 | 0 | 41.8 (17.7-36.6) | 66.1 (40-92.2) | 0 | 0 | n/a | 0 | 5.1 (0-12.2) | 1.1 (0-2.2) | 0.73 (0-2.2) | 0 |
| Phase 3B | 14.7 (7.7-21.1) | 17.1 (16.6-17.7) | 1.8 (0-4.4) | 0 | 34.0 (20-57.7) | 68.2 (67.7-68.8) | 4.0 (0-11.1) | 0 | n/a | 0 | 4.4 (0-8.8) | 9.4 (6.6-12.2) | 0 | 0 |
| Phase 4 | 21.8 (13.3-33.3) | 20.5 (20-21.1) | 0.73 (0-2.2) | 0 | 14.0 (0-38.8) | 57.1 (45.5-68.8) | 18.1 (10-33.3) | 0 | n/a | 0 | 16.2 (11.1-20) | 12.2 (0-24.4) | 0.36 (0-1.1) | 0 |
| Phase 5 | 58.4 (28.8-87.7) | 8.85 (12.2-15.5) | 2.9 (0-8.8) | 0 | 10.7 (0-32.2) | 77.7 (74-88.1) | 5.9 (0-14.4) | 0 | n/a | 0 | 11.1 (10-21.1) | 4.4 (3.3-5.5) | 0 | 0 |
| Phase 6 | 39.2 (18.8-60) | 28.1 (6.6-57.7) | 0.8 (0-5.5) | 0 | 27.4 (0-77.7) | 56.4 (33.3-85.5) | 13.8 (0-51) | 0 | n/a | 0 | 5.8 (0-24.4) | 8.4 (0-33.3) | 0.1 (0-1.1) | 0.4 (0-2.2) |
| Maintenance | 46.1 (23.3-73.3) | - | 0 | - | 25.7 (1.1-55.5) | - | 0.1 (0-1.1) | - | n/a | - | 4.1 (0-28.8) | - | 0 | - |

*Note*. n/a = not applicable (no opportunities for play were present).

Table 13 shows the generalisation data of concomitant behaviours of social play in the home and school freeplay settings. There were no significant concomitant changes in social play through PECS training, except for parallel play in the home setting. Unoccupied behaviours, solitary play and inappropriate behaviours occurred both in the home and school settings. Onlooker behaviours, parallel and stereotypical behaviours occurred in the home rather than school. Interestingly, Bee's onlooker behaviours increased from Phases 3B to 6 once the sibling involvement was introduced in Phase 3A. Inappropriate behaviours increased significantly in Phases 4 and 5 in the home when Bee's family prepared to move to a new location.

**Social validation**

Social validity assessment involving Bee's special school teacher and mother occurred once the entire PECS training was mastered. The teacher and mother commented that Bee's communication and social interaction skills were very important and desirable. They also indicated that the treatment procedure in the home and school environment was very suitable and stated that it was very important to incorporate PECS into activities for Bee. They also believed that the twenty minutes time frame for the PECS intervention in the home (two to four times a week) and school (twice a week) was very reasonable. They also indicated that PECS intervention was very straightforward not stressful to implement. Both the teacher and mother indicated the PECS intervention was very positive for Bee and that Bee had improved in functional communication as a result of the study. Specifically, Bee showed improvement while they had family and friends in their house, with the child giving other people PECS pictures (e.g., rice cracker). The teacher and mother indicated that PECS intervention helped to improve Bee's behaviour skills, specifically, Bee seemed calmer, made better eye contact, seemed happier to participate in PECS activities and played with her older sister more than she had before PECS training.

### Treatment fidelity

PECS training adhered to procedures as outlined in the manual (Frost & Bondy, 2002a) to ensure the treatment fidelity. However, one of the problems encountered was that Judy often prompted Bee to use PECS during the sibling involvement sessions. This may affected the accuracy of the treatment fidelity because this prompting is likely to have reduced Bee's independent PECS mands.

## Discussion

The aim of Study 2 was to teach functional communication through the PECS program for a child with autism and to assess the effects of PECS training involving a sibling on communication and social interaction in the home setting. Sibling involvement was incorporated into Study 2 after it was found in Study 1 that Angel's use of independent PECS in both the home and school freeplay settings was very limited. Consequently, Study 2 promoted generalisation actively and extended the communicative opportunities for PECS by introducing sibling involvement. During the sibling involvement sessions, motivating operations were used where the sibling, Judy, controlled the activity materials.

The results showed that Bee acquired functional communication through all six phases of the PECS program in the home. Using motivating opportunities with sibling involvement increased the use of independent PECS mands in the home. Bee's use of independent PECS mands significantly increased when the sibling involvement sessions were introduced in Phase 3A. Bee's independent PECS mands also generalised from Phase 3B in the home setting.

*PECS acquisitions*

Bee successfully mastered all 6 PECS phases, through 52 sessions with a total of 1181 trials (range = 6-61) over a five month period. Although the total time period was similar to Angel's in Study 1, nevertheless Bee took longer to complete sessions and trials than Angel (who had 47 sessions with 723 trials). These results are similar to findings from previous research with children with autism, which have shown that mastery of PECS Phases took between four to ten months or more (Charlop-Christy et al., 2002; Liddle, 2001; Magiti & Howlin, 2003; Malandraki & Okalidou, 2007; Schwartz et al., 1998; Yoder & Stone, 2006).

Mastery of Phase 2 (distance and persistence) and Phase 6 (comments) took Bee longer than had the other phases, with a total of eight sessions (126 trials) and 19 sessions (334 trials) respectively. In learning Phase 2, Bee was reluctant to move from her chair and travel to a communicative partner when the communicative partner held the reinforcer (e.g., rice cracker), and Bee showed tantrums on several occasions. She did, however, eventually travel successfully to the communicative partner to get the preferred foods without tantrums. This process of learning to travel to the communicative partner increased the overall length of time taken to complete Phase 2. Charlop-Christy et al., (2002) also found that Phase 2 generally took longer (range 45-108 trials) for children with autism to master.

Learning commenting skills was particularly difficult for Bee, but this is a common problem for children with autism (Frost & Bondy, 2002a). Bee had some difficulties initially in discriminating between the sentence starters “I want” and “I see” where she used the “I see” card in replying to the researcher’s question of “what do you want?”. She eventually learned to discriminate between the two sentence starters but the initial difficulties led to a longer overall session time.

*Generalisation*

Bee showed increases in use of independent PECS mands in the home setting, in contrast to Angel in Study 1 who showed no increases. Previous studies have also shown effective generalisation across different settings and individuals (Anderson, Moore, & Bourne, 2007; Carr & Felce, 2006b; Marckel, Neef, & Ferreri, 2006; Rosales, Stone, & Rehfeldt, 2009). Interestingly, Bee’s use of independent PECS manding increased significantly from Phase 3A when the sibling involvement activities were introduced in the home. In addition, Bee’s use of independent PECS mands generalised in Phase 3B to the home setting with her mother once the sibling involvement sessions were introduced. Bee’s use of independent PECS continued in the home freeplay settings from Phases 3A to 6.

Bee’s relatively frequent use of PECS use in the home setting may be attributable to the involvement of her sibling. The sibling involvement sessions provided Bee communication opportunities within a structured natural environment. On the other hand, Bee did not use PECS in the school setting. As occurred with Angel in Study 1, in the school setting all toys, materials, and activities were freely available to Bee, lessening her need to communicate with others to get the preferred items. As suggested by Frost and Bondy (2002a), it may have been beneficial for teachers to encourage children to use PECS by putting materials out of reach or controlling activity materials, in order to motivate children to communicate.

Bee's parents reported that Bee not only used PECS independently at home with her parents (e.g., PECS mands) but did so with relatives and friends who came to visit. This anecdotal evidence from Bee's parents outside of the formal generalisation observation sessions may indicate that PECS can be generalised to non-training settings with new people and items. Similar findings have been reported in previous studies (Anderson, Moore, & Bourne, 2007; Carr & Felce, 2006b; Rosales, Stone, & Rehfeldt, 2009; Marckel, Neef, & Ferreri, 2006).

*Sibling involvement*

The structured sibling involvement in Study 2 provided positive effects on increasing the use of PECS manding for Bee. Sibling involvement commenced in Phase 3A, and this coincides with Bee beginning to use the PECS cards effectively until Phase 6 when involvement with her sister concluded in the formal home setting sessions. Bee's independent PECS use also generalised from Phase 3B in the home freeplay setting (e.g., requesting rice crackers or juice). Schwartz et al., (1998) also found that children with autism can be supported by typically developing children in using and increasing PECS manding opportunities. Bee often used independent PECS mands with either Judy or the mother during the maintenance sessions.

During the sibling involvement with motivating operations, Bee's sister Judy controlled all the reinforcers so that Bee could request items from her using PECS.  Typically developing children such as siblings can be trained to become effective “mediators” in increasing the involvement of children with autism with their typical peers, as suggested by Strain (1977) and Goldstein et al., (1997). However, it should be noted that sibling involvement activities for PECS require an adult’s on-going assistance (in this case to encourage Judy not to prompt Bee to use PECS).

It was difficult to prevent Judy from prompting Bee in using PECS pictures during the sibling involvement sessions. Given the study’s focus on independent PECS mands, this experience with Judy suggests that for sibling involvement more attention needs to be paid to training siblings or typically developing peers to learn “non-prompting”. Another outcome was that when the token economy was introduced from Phase 5, Judy seemed to pay closer attention to her younger sister’s communicative behaviours. However, it was still difficult for Judy not to prompt Bee to use PECS. Nevertheless, the token economy seems a useful method for maintaining a sibling or typically developing child’s interest in PECS for a child with autism.

*Intelligible vocalisations and sentence structures*

In contrast to Study 1 where Angel showed increases in vocal communication (e.g., intelligible vocalisation), Bee showed much less increase in overall spoken communication during the PECS training sessions. However, Bee’s new spoken words began to increase from Phase 3A when the sibling involvement session was introduced (e.g., “ok”, “yum”, “look”, and “book”). Bee’s new spoken words increased to the point where Bee had three words in Phase 5 and four words in Phase 6. The increase continued with the addition of three new words at the end of maintenance sessions with seven words in total. This gradual increase in spoken words has been found in previous studies (Jurgens, Anderson, & Moore, 2009).

Of interest is that five months after the study was completed the researcher spoke to Bee's mother who reported that her use of these words had been maintained without acquiring any further new spoken words in the interval since ending the PECS training. It is significant to note that during the baseline Bee had no vocal words or utterances at all. However, Bee spoke the first words of her life during the period of PECS training in the home setting. This suggests that PECS training may help increase spoken communication for children with autism.

*Other vocal and nonvocal communication*

Angel in Study 1 demonstrated frequent other vocal and nonvocal communication (e.g., vocal and nonvocal commenting) in the freeplay settings (e.g., home and school). By contrast, Bee's other vocal communication did not occur in the home and school freeplay settings. Nonvocal mands occurred more often than other nonvocal initiations in the home and school for Bee.

*Social play behaviours*

There were no significant differences in the social play behaviours (e.g., unoccupied behaviours, solitary, and group play) over time in the home and school freeplay settings. However, Bee's parallel play in the home increased in Phases 1, 4 and 6. Also, Bee's onlooker behaviours increased form Phase 3B once the sibling involvement was introduced in Phase 3A. These increases may be an outcome of the sibling involvement sessions where Bee had more opportunities for communication with her older sibling and family.

*Inappropriate behaviours*

While there were no stereotypical behaviours observed for Bee in the home and school freeplay settings, Bee's inappropriate behaviours such as tantrums were often observed from Phases 4 to 5 in the home setting. At this time the family was in the process of moving to a new location and Bee continued to attend the original school where the PECS training occurred during Phase 4, while at the same time she had to adapt to a new school once a week as well. Up until Phase 4, Bee's school teachers had reported a reduction in Bee's inappropriate behaviours from the commencement of PECS training, with fewer tantrums and incidence of biting etc.

Bee's parents and teachers agreed that the change of environment had caused Bee stress and had led to an increase in her inappropriate behaviours. As a result, it was decided to give Bee a break from PECS training for two weeks to allow her to settle into her new home and school setting. After this break, Bee's inappropriate behaviours began to decrease in the new home setting.

*Limitations and future study*

The results showed that sibling involvement had a positive effect on increasing Bee's independent PECS use. However, her PECS skills did not generalise to the school setting although PECS training was conducted in both settings. The critical difference between the two settings was that the home setting sessions involving Bee's sister were controlled around preferred items and motivation. By contrast the school setting was unstructured with all preferred items and activity materials freely available, greatly lessening the child's need to communicate with PECS. This lack of a need to communicate with PECS meant that it was not possible to effectively measure PECS use given that the environment was not conducive to communication. Therefore in Study 3, a new motivational context was implemented to assess generalisation in an environment where there was stimulation, thereby creating a desire to communicate. This, in turn, would help determine whether PECS use would generalise in freeplay settings.

## Conclusion

Study 2 demonstrated that Bee mastered all six phases of the PECS program both in the home and school settings. The results showed that Bee's independent PECS mands increased quickly once the sibling involvement sessions were introduced from Phase 3A. In addition, Bee's independent PECS mands were generalised from Phase 3B with sibling involvement where Judy controlled all items in the home setting. However, Bee did not display any independent PECS mands in the school even though the PECS training was also conducted in the school setting. This absence of independent PECS use seems attributable to the fact that all materials were freely accessible for the child in the school. This meant that the child had very few or no opportunities to communicate in the natural school environment because there was little need to communicate given the accessibility of preferred items. Given that the environment did not support communication opportunities it can be argued that this environment does not facilitate valid generalisation assessment of PECS use and other concomitant behaviours. Therefore, to address the measurement issue, Study 3 created a new motivational context, called a situational probe, designed to maximise opportunities for communication for generalisation assessment.

# CHAPTER SIX

## STUDY THREE

### Introduction

Some studies on generalisation effects of PECS have reported that children with autism have used PECS in non-training settings (Carr & Felce, 2006b; Ganz et al., 2008; Marckel, Neef, & Ferreri, 2006; Schwartz et al., 2009; Jungens, Anderson, & Moore, 2009) while also increasing spontaneous initiations (Anderson, Moore, & Bourne, 2007; Ganz, Simpson, & Corbin-Newsome, 2008; Howlin et al., 2007). However, these studies were mostly conducted in school; few studies have looked at generalisation effects where children have received PECS training at home (Anderson, Moore, & Bourne, 2007; Jungens, Anderson, & Moore, 2009; Ganz et al., 2005).

The results of Study 2 showed that Bee completed the PECS training from Phases 1 to 6 and used PECS relatively frequently during activities that included sibling involvement in the home setting from Phases 3A to 6. Bee's independent PECS mands increased notably once the sibling involvement was introduced in Phase 3A; use of these mands was generalised to the home setting in Phase 3B. However, as for Angel in Study 1, Bee in Study 2 rarely used the PECS in the school generalisation setting even though PECS training was conducted with the teacher as well as the researcher in the school setting. One explanation for this is that in school and home generalisation settings all materials and activities were accessible for the children providing little motivation for them to communicate with others.

In other words, the environment did not support the need for communication and as such it can be argued that this did not provide a valid context for measuring generalisation. This is because in the absence of opportunities for communication PECS use becomes unnecessary for the participant and therefore PECS use cannot be subject to generalisation assessment.

Consequently, the view was taken that generalisation measurements are more valid when the environment supports opportunities for communication. As such, in order to address this measurement issue an artificial generalisation environment was created to maximise opportunities for communication and to eliminate the natural variation in communication opportunities that occurs in natural settings. This new generalisation context was called a situational probe. The situational probe was used to standardise control of preferred items under motivating operations. The situational probes were also standardised across probe observations (e.g., free play and standard generalisation observation). An array of toys was available when adults were present during the situational probes. The participant's preferred items were visible but not accessible. Toys were placed out of reach motivating the child to communicate his needs for the objects. The situational probes involved three to four communicative partners, including one novel communicative partner who was not previously involved in the PECS training sessions.

The aim of Study 3 was to assess the generalisation effects of PECS training in vocal, nonvocal communication and social play, through various settings and individuals for a child with language delay. Independent PECS use and vocal communication were evaluated during the situational probe sessions and standard generalisation sessions.

### Research questions

1. After PECS training of a child involving different settings and individuals, does PECS training result in changes in nonvocal and vocal communication (e.g., independent PECS mands and vocal mands) in the training and non-training settings?

2. What is the effect of PECS training on the child's social play (e.g., parallel play) in non-training settings?

3. Does PECS training implemented by different individuals and conducted in different settings result in changes in inappropriate and stereotypic behaviours in non-training settings?

## Method

### Research design

A single subject changing criterion design was used in this study as described in Chapter 3.

### Participant

The participant “Charlie” (a pseudonym) was four years and two months when the PECS training commenced. Charlie was an only-child and lived with both his parents. He had limited vocal communication using basic words such as “Mom/Mummy”, “Daddy”, and “no”. Charlie’s mother reported that he showed some tantrum behaviour, which she attributed to his frustration at being unable to communicate. Charlie did not display any echolalia or stereotypical behaviours. He attended an early intervention program once a week but normally stayed at home with his mother. He was formally assessed when he was three years and two months old by an Occupational Therapist and a Speech Pathologist at a community health service. The assessment showed that Charlie had severe language delay, limited concentration and displayed tantrum behaviours (associated with not being able to complete tasks on his own terms).

In Study 3, PECS training was conducted by two researchers (i.e., the current author and a postgraduate psychology student), and on a few occasions by an additional masters student and by the child's mother. The master's research student participated in the PECS training from Phases 1 to 4, while the author conducted training from Phases 1 to 6 and maintenance. The child's mother was also involved in training her child in PECS for Phases 1 and 2.

**Settings**

PECS training was conducted in the child's home, in a small room in an early intervention centre and in a university clinic room. Freeplay observations following PECS training were made at various times in all three settings during baseline, PECS training and maintenance phases. It should be noted that at the intervention centre, the freeplay generalisation probes were conducted outside the training room, where other children were present, including both indoor and outdoor settings.

**Materials**

The materials used in Study 3 were the same as those used in Studies 1 and 2, as described in Chapter 3.

## Dependent variables

Dependent variables were the same as for the study as a whole, as discussed in Chapter 3.

## Procedures

The study proceeded according to the process discussed in Chapter 3. However, in addition to the standard measurement procedure, 30 minute situational probes were conducted twice during the baseline, and once for each PECS training phase and during maintenance. The procedure for the use of situational probes is described below. It should be noted that there were school holidays at the intervention centre from Phases 3B to 5 during the period scheduled for the freeplay setting and the centre was therefore not available. As a result the sessions were conducted in the university room instead of at the school once only for each of Phases 3B to 5. These freeplay sessions in the university room replicated school activities as much as possible (e.g., puzzles, drawings, and books etc) and involved three adults. The university room was a different room from the situational probe setting, but the three adult participants were the same.

### *Situational probe: motivating operation*

## Participants

Three to four adults including the mother, two postgraduate psychology students and the researcher participated in the situational probe. One postgraduate student who had not previously been involved in the PECS training took part in the situational probe sessions.

**Setting**

Situational probes were conducted in a small room in a University-based clinic. The room had a big bookshelf where transparent toy containers were displayed. There were also small and big tables and chairs in the room where the participant could play with toys.

**Materials**

The standard PECS book was used during the situational probe. The child's preferred items (e.g., different colours and shapes of balloons, pumper, balls, cooking toys etc) as identified through the reinforcer assessment were used. These items were displayed inside different types of transparent container.

**Procedure**

The aim of the situational probe was to create a standardised setting in which to monitor changes in independent PECS use and vocal communication over time under optimal motivating conditions. Before Charlie entered the room, all toys were placed inside transparent containers or on a shelf out of reach from Charlie.

When Charlie showed interest in the toys or a particular toy, the adults present made a comment to the child such as "wow, what can you see?", or "wow, look at this!" The transparent containers were tightly closed so that Charlie could not open them himself and needed to request the items.

The toys were placed at different levels on the shelves; puzzles and books that were not in containers were on the higher shelves out-of-reach, and toys in containers were on the lower shelves. This meant that Charlie needed to request assistance either to reach the higher shelves or to release the preferred objects from the secured containers. Once Charlie requested an item, an adult to whom the request was directed, brought down the object or opened the container for the child. Charlie was then allowed to play with the preferred item for several minutes before it was returned to the container or to the shelves. The data was collected in the same way as described in Chapter 3.

### Interobserver Agreement

Interobserver agreement was calculated with the method outlined in Chapter 3. For this study, the mean interobserver agreement was 100 % in the home and school for PECS training across all phases. The mean interobserver agreements for vocal and nonvocal communication data for the home and school sessions was 86.3 %. Agreements for social play, generalisation and situational probe data for the three respective sessions were 96.8 %, 88 % and 100 %.

## Results

### Pre-intervention measurement

During the pre-intervention interview using the questionnaire and vocabulary worksheet, the researcher obtained information about Charlie's family background including his communication and social interaction skills.

The assessments showed that for critical communication skills (Frost & Bondy, 2002a) Charlie was able to request toys, activities, help, breaks, and was capable of rejecting and responding to “wait” and could understand directions using gestures and vocal communication. He also generally understood visual and vocal directions when adults requested him to come, stop, get items, go to something or put an object back in position or to come with others e.g., when his mother said “let’s go”. However, he generally had difficulties in understanding visual and oral directions in responding to wait, give it to me, sit down and in following a visual schedule.
In the Communication and Symbolic Behaviour Skills Developmental Profile (CSBS DP) (Wetherby & Prizant, 2002), Charlie obtained scores of 18, 10, and 16 (total: 44) on the social, speech and symbolic composites, which equates to a developmental age of 24 months.

Results from the Assessment of Basic Language and Learning Skills-Revised Skill Tracking System (ABLLS-R) for Charlie are summarised below (See Appendix H for more detail).
Charlie was able to take preferred objects and follow simple instructions from adults to select reinforcers, most of the time. Charlie had the ability to match simple objects and pictures, and he followed and imitated basic motor movements and simple vocal sounds. Charlie could vocalise spontaneously, play with toys, interact with others in groups, and follow simple classroom routines. Charlie demonstrated simple skills in dressing, eating, grooming, and basic gross and fine motor skills. However, Charlie exhibited no skills in the use of syntax and grammar, reading, math, writing, spelling, and toileting.

**Reinforcer assessment**

The results of the reinforcer assessment (Frost & Bondy, 2002a) demonstrated that Charlie had preferred items including slimes, balloons, cooking utensils, balls, and puzzles. These were used for the PECS training.

**PECS intervention**

Table 14 below displays the total number of PECS training sessions and the number of trials conducted during any given session (within a phase). Charlie acquired the mastery criteria for all of the phases in 38 sessions with 444 trials. Charlie generally required five to seven sessions to master the phases that ranged from 35 to 112 trials.

***Table 14. Total number of sessions and trials during the PECS training for Charlie***

| *Phase* | *Sessions* | *Trials* | *Range of trials per session* |
|---|---|---|---|
| 1 | 5 | 87 | 12-25 |
| 2 | 5 | 81 | 12-19 |
| 3A | 5 | 41 | 5-15 |
| 3B | 7 | 112 | 2-30 |
| 4 | 6 | 52 | 5-13 |
| 5 | 5 | 36 | 5-11 |
| 6 | 5 | 35 | 7-11 |
| Total | 38 | 444 | 2-30 |

***Table 15. Percentage of successful independent PECS exchange trials for each PECStraining session***

| *% Independent PECS exchanges within phases and sessions* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *Mean (%)* |
|---|---|---|---|---|---|---|---|---|
| Phase 1 physical exchange | 60 | 83.3 | 81.25 | 83.3 | 68.75 | | | 75.37 |
| Phase 2 persistence & distance | 93.75 | 82.3 | 94 | 89.4 | 83.3 | | | 88.6 |
| Phase 3A discrimination | 81.8 | 100 | 100 | 60 | 60 | | | 80.4 |
| Phase 3B discrimination | 100 | 100 | 100 | 50 | 0 | 91.6 | 100 | 77.3 |
| Phase 4 sentence structure | 0 | 55.5 | 28.6 | 100 | 84.6 | 100 | | 61.45 |
| Phase 5 what do u want | 80 | 81.8 | 85.7 | 100 | 100 | | | 89.5 |
| Phase 6 what do u see | 75 | 81.8 | 100 | 90.0 | 100 | | | 89.4 |
| Maintenance | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

***Figure 11.*** The percentage of independent PECS exchanges during each PECS training session

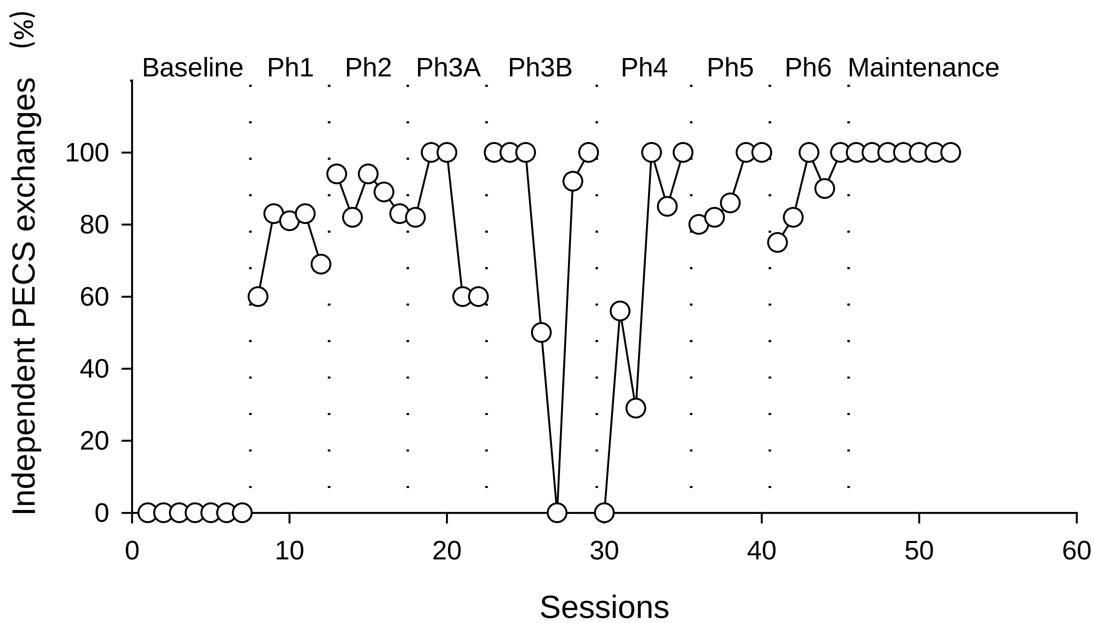



Table 15 and Figure 11 show the percentage of independent successful exchange trials for each phase during PECS training. Charlie completed the PECS program with relative ease although he had slightly longer sessions in Phases 3B and 4 than other phases.

Charlie achieved the criterion level of 80 % correct independent exchanges within five sessions in Phases 1 and 2. In Phase 3A the 80% mastery level was achieved in the first three sessions followed by decreases in the last two sessions. The exchange rate was initially achieved to the master criterion level for the three sessions in Phase 3B followed by a decrease to zero with a return to the mastery level for the last two sessions. In Phase 4, the exchange rate initially began at zero then gradually increased to the criterion level by the end of the sessions. In Phases 5 and

6 Charlie achieved the criterion level within five sessions; the exchange rate was then maintained at 100 % throughout the maintenance sessions.

***Figure 12.*** Cumulative counts of new spoken words across all sessions and settings

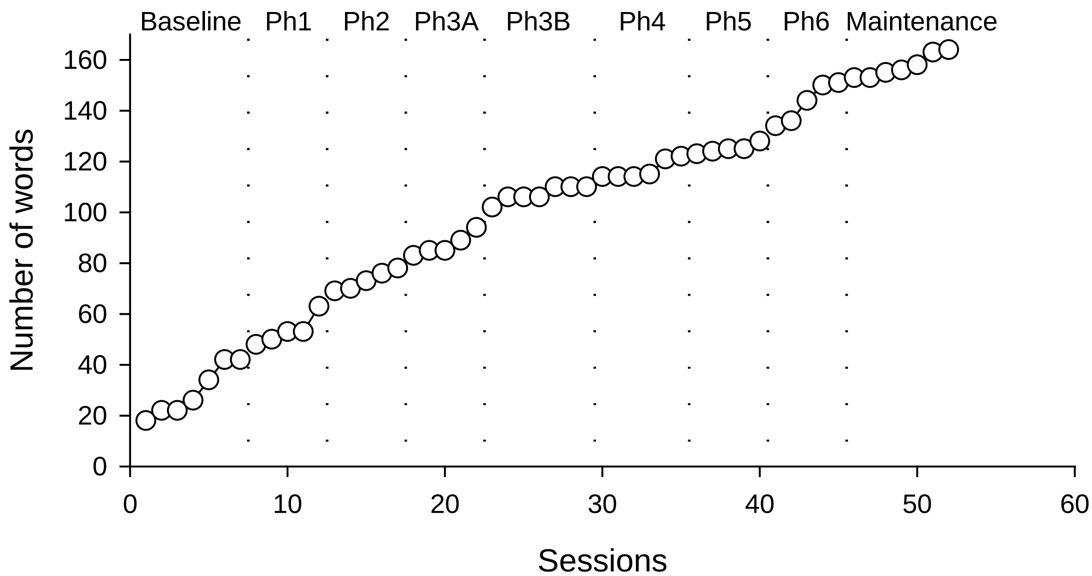



Figure 12 displays the number of new spoken words used across all sessions and settings. New spoken words were counted during the observation sessions by the researcher with additional reports from Charlie's mother. The results show that the number of spoken words from Charlie increased gradually for the duration of this study. At the end of baseline observation sessions, the total observed vocabulary of the child was 42 spoken words. Sixty-three were recorded at the end of Phase 1, 78 words at the end of Phase 2, 94 words at the end of Phase 3A, and 110 words at the end of Phase 3B. One hundred and twenty three words were noted at the end of Phase 4. One hundred and twenty-eight words were recorded at the end of Phase 5 while 151 words were recorded by the end of Phase 6. Finally 164 words were recorded by the completion of the maintenance sessions.

***Figure 13.*** Intelligible vocalisations during PECS training sessions

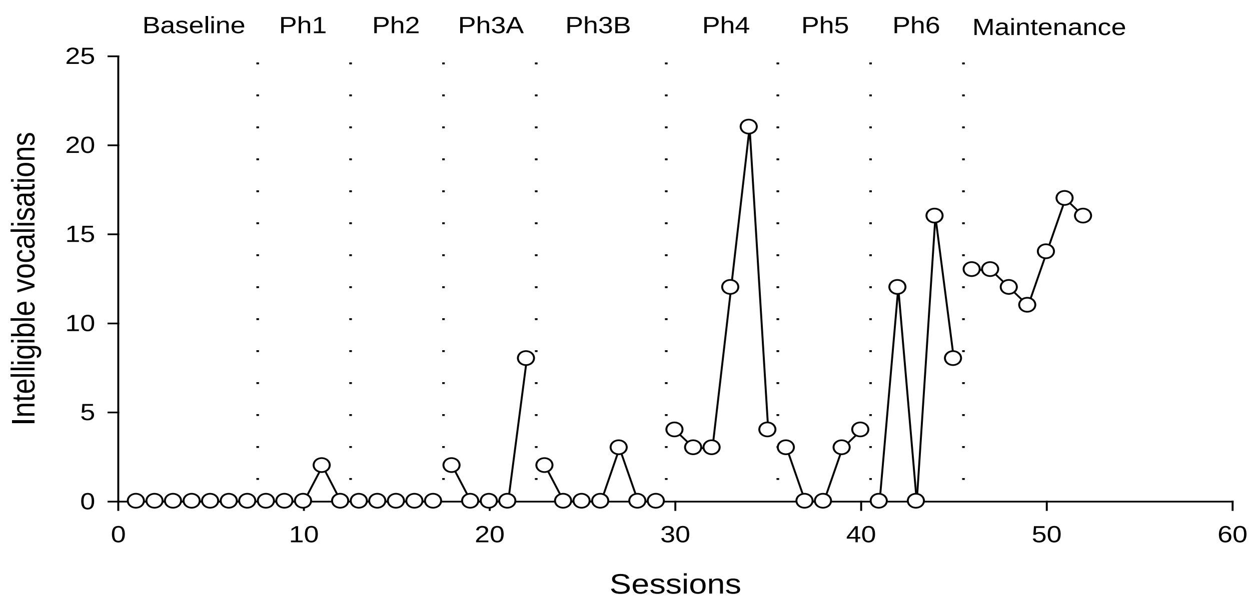



Figure 13 shows the number of intelligible vocalisations during PECS training sessions in a variety of settings. Charlie's intelligible vocalisation increased significantly in Phases 4 and 6 and during the maintenance sessions. From baseline to Phase 3B, Charlie had few intelligible vocalisations with one single exception (range = 0-8 in Phase 3A). Charlie's intelligible vocalisations increased during Phase 4 onwards gradually increased, followed by a decrease on the last session. In Phase 5, intelligible vocalisations were stable at a low rate, then increased in Phase 6 and in the maintenance sessions (range = 0-6.5).

**Table 16.** ***The Mean Length of Utterance spoken during PECS training***

| *Phase* | *MLU* |
|---|---|
| Baseline | 0 |
| Phase 1 | 0.4 |
| Phase 2 | 0 |
| Phase 3A | 0.8 |
| Phase 3B | 0.7 |
| Phase 4 | 3.2 |
| Phase 5 | 2 |
| Phase 6 | 1.9 |
| Maintenance | 4.8 |

Table 16 above displays the mean length utterance of morphemes during the PECS training. Charlie's mean length of utterance increased in Phase 4 and reached a high of 4.8 in the maintenance sessions.

*Figure 14.* Number of 2-, 3-, 4-, 5-, 6-, & 7-morpheme utterances per phase during PECS training

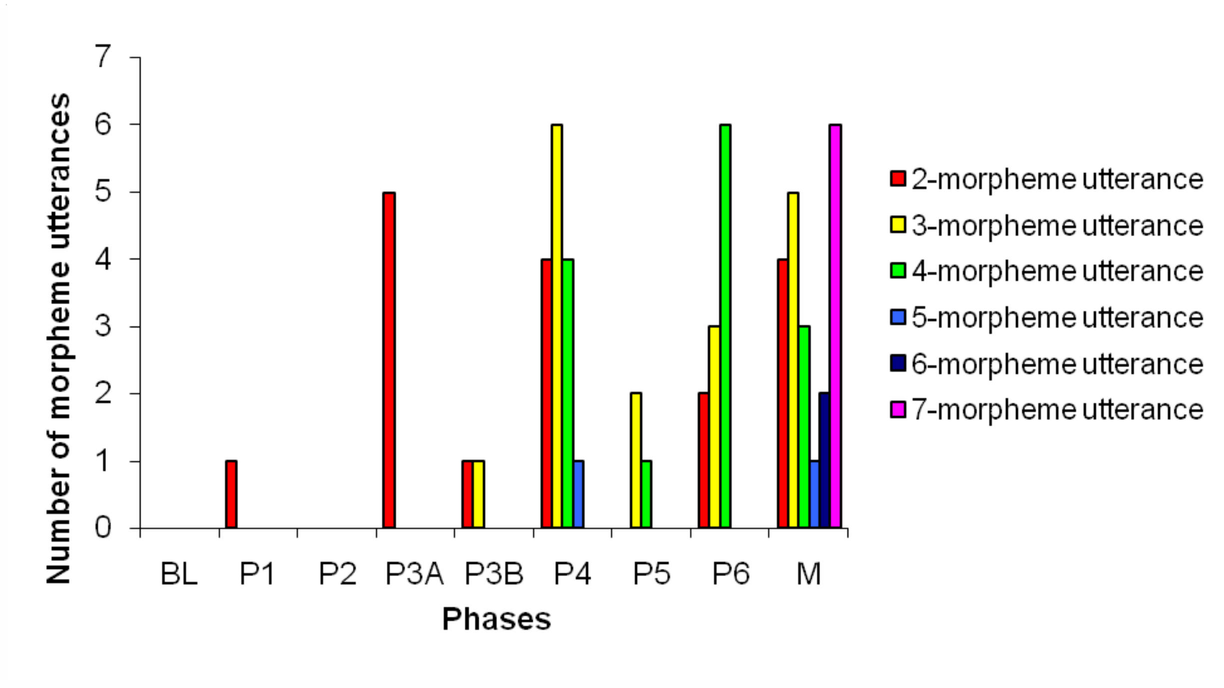



Figure 14 shows the number of two to seven morpheme utterances during PECS training for Charlie. Charlie's two morpheme utterances began in Phase 1 and increased from Phase 3A. Charlie's spoken utterances in Phases 4, 6, and during the maintenance session were more complex than in the baseline and Phases 1, 3B, and 5.

### *Table 17. Concomitant vocal and nonvocal communication in home, school and university freeplay settings*

| *Occurrence (%) Mean: (range)* | *Independent PECS mands* | | | *Prompted PECS mands* | | | *Vocal mands* | | | *Other nonvocal mands* | | | *Other vocal initiations* | | | *Other nonvocal initiations* | | | *Echolalic speech* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Home* | *S* | *U* | *Home* | *S* | *U* | *Home* | *S* | *U* | *Home* | *S* | *U* | *Home* | *S* | *U* | *Home* | *S* | *U* | *Home* | *S* | *U* |
| Baseline | 0 | - | 0 | 0 | - | 0 | 3.3 (1-6) | - | 3 | 2.6 (1-6) | - | 2 | 3.5 (2-8) | - | 0 | 3.5 (2-8) | - | 1 | 0 | - | 0 |
| Phase 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4.5 (1-8) | 0 | 7 (1-13) | 2.5 (0-5) | 1 | 5 (0-10) | 6.5 (5-8) | 0 | 2.5 (2-3) | 4.5 (4-5) | 0 | 2 (1-3) | 0 | 0 | 0 |
| Phase 2 | - | 0 | 1.75 (0-3) | - | 0 | 0.5 (0-1) | - | 1 | 4.5 (2-7) | - | 1 | 2.2 (1-5) | - | 1 | 3.5 (1-6) | - | 1 | 2.75 (1-5) | - | 0 | 0 |
| Phase 3A | 0.5 (0-1) | 0 | 0 | 0 | 0 | 0 | 4 (1-7) | 1 | 7 (3-11) | 2.5 (1-4) | 1 | 6 (2-10) | 4.5 (4-5) | 5 | 3 (2-4) | 3.5 (3-4) | 5 | 3 (2-4) | 0 | 0 | 0 |
| Phase 3B | 0 | 0 | 0.5 (0-1) | 0 | 0 | 0 | 5.75 (4-9) | 1 | 1.5 (1-3) | 4 (2-6) | 1 | 1.5 (0-3) | 2.25 (1-5) | 5 | 10 (7-13) | 2 (1-3) | 5 | 10 (7-13) | 0 | 0 | 0 |
| Phase 4 | - | - | 0.66 (0-3) | - | - | 0.16 (0-1) | - | - | 4.5 (1-9) | - | - | 2.1 (0-6) | - | - | 3.6 (1-8) | - | - | 2.8 (1-9) | - | - | 0 |
| Phase 5 | 0 | - | 0.66 (0-2) | 1.5 (0-3) | - | 0 | 9 (9-9) | - | 7.6 (6-9) | 6.5 (4-9) | - | 4.6 (3-7) | 2.5 (2-3) | - | 4.3 (2-7) | 3 (3-3) | - | 3.6 (1-6) | 0 | - | 0 |
| Phase 6 | 0 | 0 | 0.5 (0-1) | 0 | 0 | 0 | 11.5 (10-13) | 6 | 13 (10-16) | 9 (9-9) | 5 | 8.5 (3-14) | 8.5 (5-12) | 3 | 9.5 (7-12) | 9.5 (4-15) | 4 | 9.5 (4-9) | 0 | 0 | 0 |
| Maintenance | 0 | 0 | 0.5 (0-2) | 0 | 0 | 0 | 11 (10-12) | 3 | 11.5 (7-13) | 3 (2-4) | 2 | 4.5 (2-6) | 2 (1-3) | 4 | 7 (5-8) | 2 (1-3) | 3 | 5.5 (4-9) | 0 | 0 | 0 |

*Note.* School only occurred once in phase. S = School. U = University.

Table 17 shows generalisation data of concomitant vocal and nonvocal communication in the home, school and university freeplay settings. Independent PECS mands and all other vocal and nonvocal communication frequently occurred and increased in more than two settings (e.g., home and university). Independent PECS mands occurred more frequently in the university than in the home or school setting. Vocal mands and initiations increased both in the home and university, and occurred also more often in both these settings than at the school.

***Table 18. Concomitant behaviour changes in social playbehaviours in the home, school and university freeplay settings***

| *Occurrence (%) Mean : (range)* | *Unoccupied behaviours* | | | *Onlooker behaviours* | | | *Solitary play* | | | *Parallel play* | | | *Group play* | | | *Inappropriate behaviours* | | | *Stereotypical behaviours* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *H* | *S* | *U* | *H* | *S* | *U* | *H* | *S* | *U* | *H* | *S* | *U* | *H* | *S* | *U* | *H* | *S* | *U* | *H* | *S* | *U* |
| Baseline | 1.4 (0-3.3) | - | 0 | 0.7 (0-3.3) | - | 8.8 | 78.2 | - | 82 | 0 | - | n/a | 0 | - | n/a | 2.95 (0-11) | - | 1.1 | 0 | - | 0 |
| Phase 1 | 1.1 (1.1-1.1) | 0 | 0 | 3.8 (3.3-4.4) | 1.1 | 0 | 62.7 (64-90) | 5.5 | 77.2 (64-90) | 0 | 63.3 | n/a | 0 | 0 | n/a | 2.75 (0-5.5) | 5.5 | 0.5 (0-1.1) | 0 | 0 | 0 |
| Phase 2 | - | 1.1 | 1.37 (0-5.5) | - | 10 | - | - | 13 | 67 (37-82) | - | 13.3 | n/a | - | 0 | n/a | - | 1.1 | 5 (0-20) | - | 0 | 0 |
| Phase 3A | 8.3 (0-16.6) | 7.7 | 0.55 (0-1.1) | 1.65 (0-3.3) | 1.1 | 0.55 (0-1.1) | 72.2 (53-91) | 42 | 70 (70-70) | 0 | 26.6 | n/a | 0 | 0 | n/a | 0 | 5.5 | 0 | 0 | 0 | 0 |
| Phase 3B | 0.27 (0-1.1) | 3.3 | 0.55 (0-1.1) | 3.0 (0-6.7) | 11 | 1.1 (0-2.2) | 69 (45-83) | 38 | 90 (85-95) | 0 | 30 | n/a | 0 | 0 | n/a | 0.55 (0-2.2) | 0 | 0 | 0 | 0 | 0 |
| Phase 4 | - | - | 2.5 (1.1-7.7) | - | - | 0.91 (0-3.3) | - | - | 65.3 (40-80) | - | - | n/a | - | - | n/a | - | - | 2.9 (0-7.7) | - | - | 0 |
| Phase 5 | 0 | - | 1.46 (0-4.4) | 0.55 (0-1.1) | - | 0.36 (0-1.1) | 70.5 (62-78) | - | 69 (48-85) | 0 | - | n/a | 0 | - | n/a | 0 | - | 7.7 (0-20) | 0 | - | 0 |
| Phase 6 | 0 | 0 | 0 | 0 | 0 | 0 | 60 (53-67) | 14 | 71 (70-73) | 0 | 75.5 | n/a | 0 | 0 | n/a | 0 | 0 | 0 | 0 | 0 | 0 |
| Maintenance | 0 | 10 | 0 | 3.8 (0-7.7) | 8.8 | 0.8 (0-2.2) | 83 (75-89) | 0 | 74 (73-75) | 0 | 0 | n/a | 0 | 22.2 | n/a | 0 | 11.1 | 0.27 (0-1.1) | 0 | 0 | 0 |

Note. H = home. S = School (only occurred once in phase). U = university. n/a = not applicable (no opportunities for play were present).

Table 18 shows generalisation data of concomitant behaviours of social play in the home, school and university freeplay settings. All concomitant behaviours of social play occurred in all three settings except group play in the home and university settings where no other children were available for play. Stereotypical behaviours were not applicable for Charlie as these behaviours are not exhibited by him. Parallel play often occurred in the school from Phases 1 to 6; however, it should be noted that no baseline observation sessions were made at the school. Group play only occurred once in the maintenance sessions where Charlie's teacher led the small group activity (e.g., music time) in the school. Unoccupied behaviour increased in the university, and onlooker behaviour increased in the home, in contrast to the university where onlooker behaviours decreased.

***Table 19. Standard generalisation and situational probe data of PECS mands and vocal communication***

| *Occurrence* | *Independent PECS mands* | | *Prompted PECS mands* | | *Vocal mands* | | *Other vocal initiations* | |
|---|---|---|---|---|---|---|---|---|
| | *S G* | *S P* | *S G* | *S P* | *S G* | *S P* | *S G* | *S P* |
| Baseline 1 | 0 | 0 | 0 | 0 | 1 | 6 | 4 | 5 |
| Baseline 2 | - | 0 | - | 0 | - | 7 | - | 2 |
| Phase 1 | 0 | 8 | 0 | 0 | 0 | 7 | 6 | 10 |
| Phase 2 | 0 | 12 | 0 | 0 | 1 | 10 | 3 | 1 |
| Phase 3A | 0 | 7 | 0 | 1 | 5 | 14 | 3 | 6 |
| Phase 3B | 1 | 0 | 0 | 0 | 1 | 5 | 9 | 7 |
| Phase 4 | 2 | 3 | 0 | 1 | 3 | 15 | 11 | 4 |
| Phase 5 | 0 | 1 | 0 | 1 | 7 | 15 | 4 | 7 |
| Phase 6 | 1 | 3 | 0 | 0 | 5 | 21 | 6 | 2 |
| Means | 0.4 | 3.7 | 0 | 0.3 | 2.5 | 11.1 | 5.1 | 4.8 |
| Maintenance | 0 | 2 | 0 | 0 | 1 | 32 | 2 | 5 |

*Note.* SG = Standard Generalisation in the freeplay setting. SP = Situational Probe in the university setting. All sessions from Phases 1 to 6 only occurred once in each phase.

Table 19 shows the total number of PECS mands, vocal mands and other vocal initiations in the standard generalisation and situational probe settings. As all sessions occurred only once in each phase except for the baseline, there are no figures for mean or range provided in the table. The rate of changes in independent PECS and vocal mands was greater in the situational probes than in the generalisation setting. There were no significant differences in other vocal initiations between the two probes sessions.

***Figure 15.*** Total number of independent PECS mands in freeplay settings, generalization, and situational probe settings

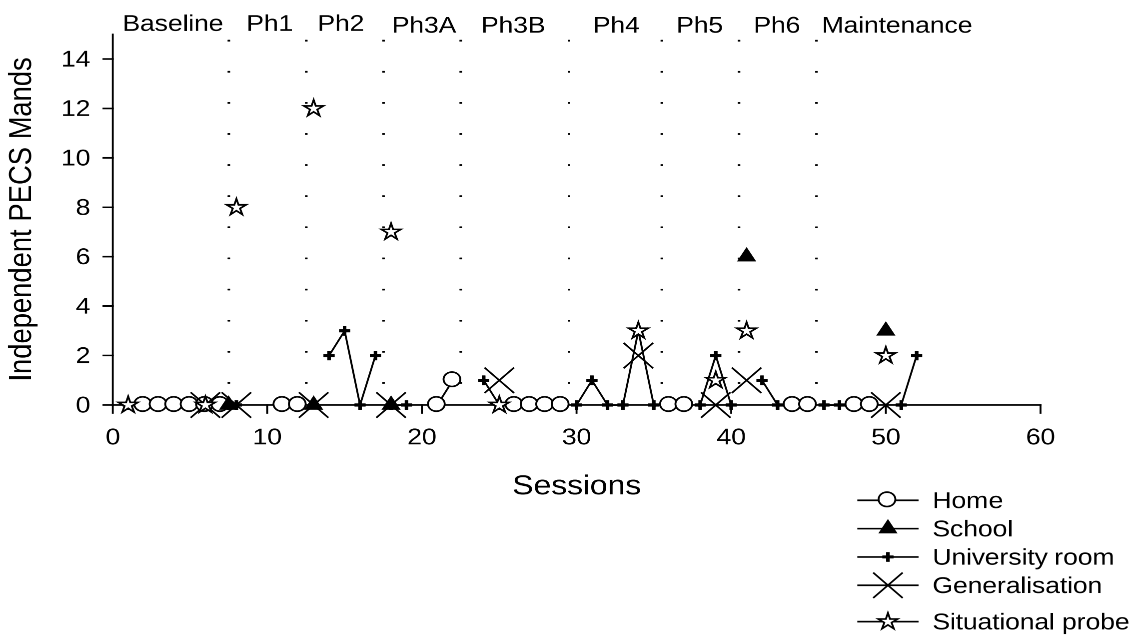



Figure 15 shows the number of independent PECS mands made by Charlie in the various freeplay settings. Independent PECS mands occurred more frequently in the university room than they did at home or in school. In the home, independent PECS mands generally did not occur at all except Phase 3A. Independent mands in school occurred only in Phase 6 and during the maintenance session. In the university room, independent PECS mands occurred occasionally in Phases 2, 3B, 4, 5, 6 and in the maintenance sessions. The independent PECS mands in the standard generalisation occurred only in Phases 3B, 4 and 6; in the other phases the rate was zero. Independent PECS mands in the situational probes occurred in Phases 1, 2, 3A, 4, 6, and maintenance sessions.

Independent PECS mands in all settings were zero in the baseline. During Phases 1, 2, and 3A independent PECS mands in the situational probes were higher than in the baseline and other phases. In the latter stages, from Phases 4 to maintenance, independent PECS mands in the situational probes were relatively low. These low numbers were, however, still higher than in the standard generalisation settings except in the school.

*Figure 16.* Total number of vocal mands in a variety of freeplay setting, generalisation, and situational probe setting

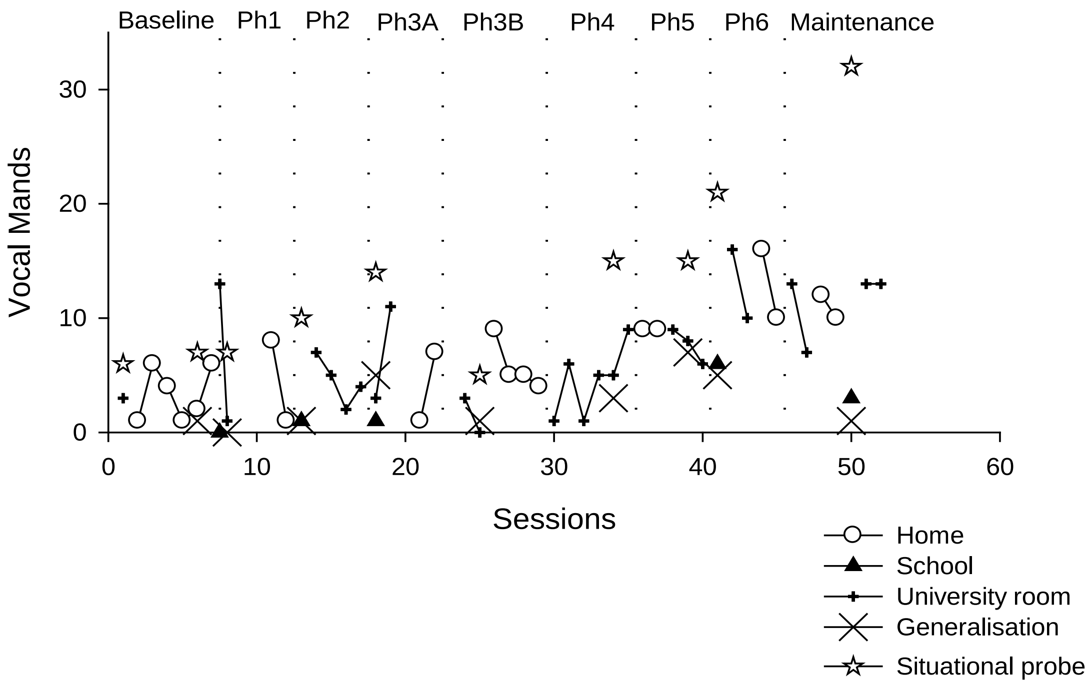



Figure 16 shows the number of vocal mands observed in the freeplay settings. Generally vocal mands occurred in all settings including home, school and in the university room. In the home, vocal mands occurred in all phases except in Phases 2 and 4. Vocal mands occurred across all the phases in the university room. During the standard generalisation probes, vocal mands occurred in all phases except for Phase 1. Interestingly, throughout the situational probe, from the baseline to the maintenance sessions, vocal mands increased steadily except for a brief decline during Phase 3B.

***Figure 17.*** Total number of independent PECS mands and vocal mands during the situational probe setting

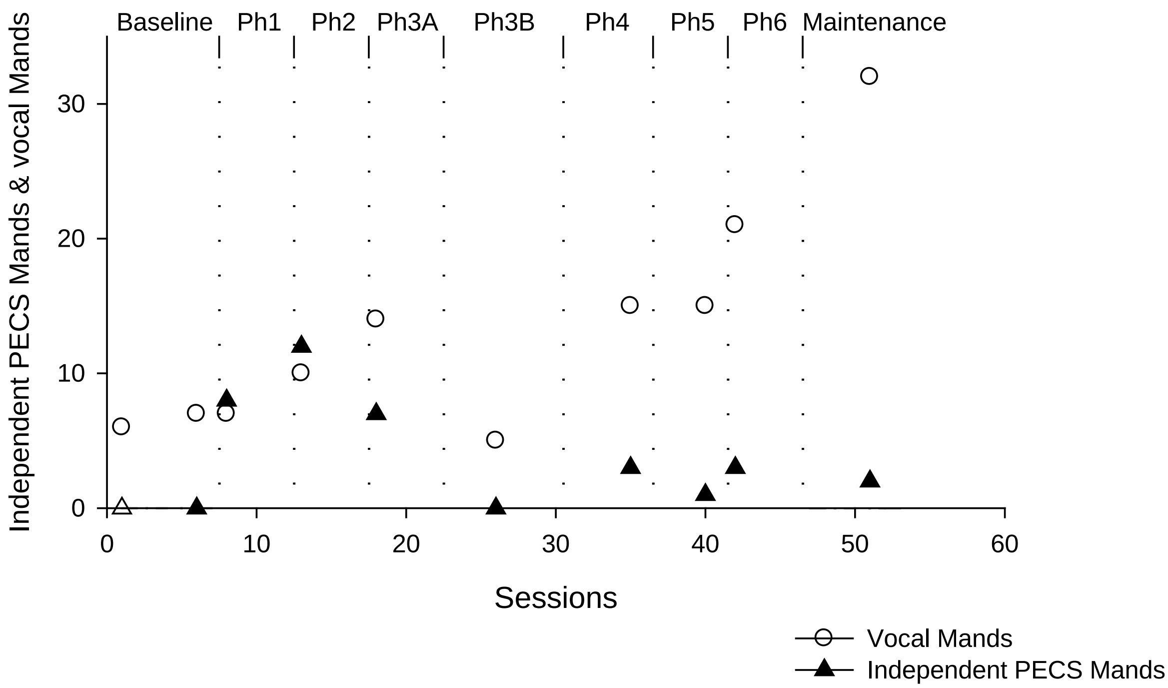



Figure 17 shows the total number of independent PECS mands and vocal mands during the situational probe sessions. The frequency of Charlie's independent PECS mands initially began with zero in the baseline, followed by an increase in Phases 1, 2, and 3A. From Phase 3B they then decreased to zero followed by a stable low rate to the maintenance sessions. At the same time, Charlie's vocal mands increased steadily from the baseline to the maintenance sessions except for a brief single decrease in Phase 3B.

***Figure 18.*** Total number of prompted PECS mands in a variety of freeplay settings, generalization, and situational probe setting

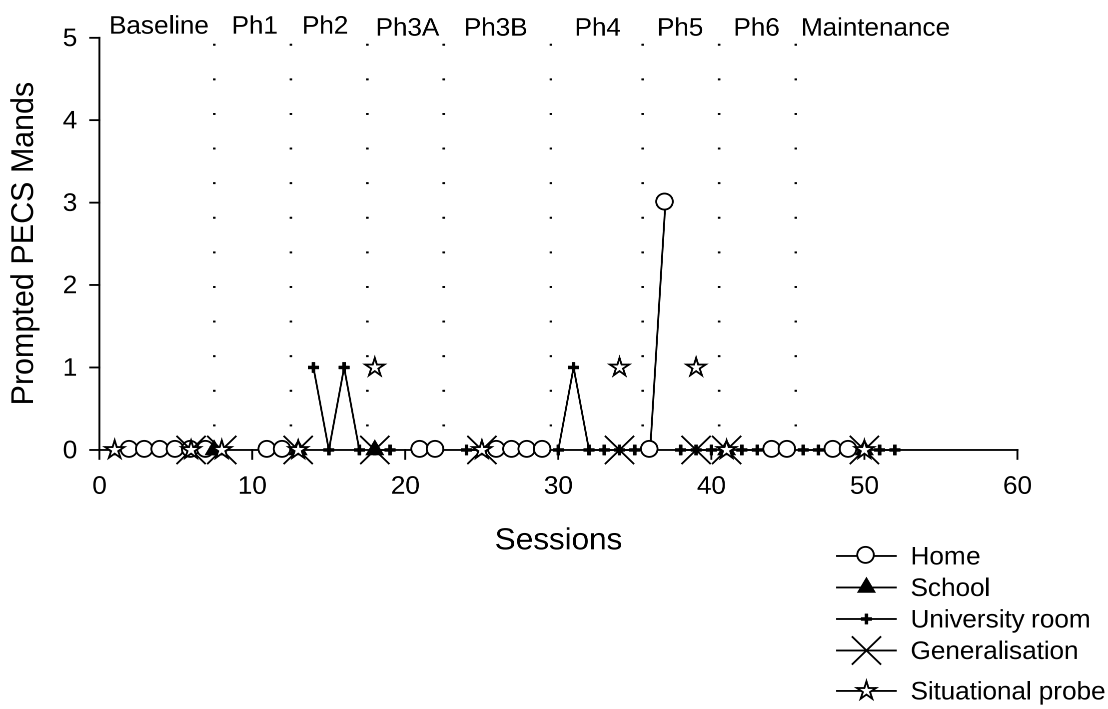



Figure 18 shows the number of prompted PECS mands during the freeplay settings. Prompted PECS mands only occurred in Phases 2, 3A, 4, and 5 while for other phases the score was zero. Prompted PECS mands during the standard generalisation were zero while prompted PECS mands in the situational probes occurred once in Phases 3, 4, and 5. Charlie's prompting was done by his mother in the situational probes. As this prompting was not made in accordance with the standard generalisation this lowered the treatment fidelity for Charlie's independent PECS use.

### Social validation

Once the PECS intervention finished, the mother completed the social validity questionnaire. The speech therapist resigned from the school in the middle of the PECS intervention and was therefore unavailable for the social validity questionnaire. The questionnaire showed that the mother felt that increasing communication and social interaction skills for her child was “very important”. The mother rated the home and school settings as “very suitable” for PECS training; she also rated her own participation in the PECS training as a parent as “very important”. The mother felt that the PECS intervention time (20 minutes per session per day) was “very reasonable” and implementation “very straightforward”. The mother also indicated that the PECS intervention was “very effective” in increasing the child’s communication and social interaction. The mother also indicated that after the PECS training Charlie's limited communication with his father greatly improved.

### Treatment fidelity

PECS training sessions adhered to procedures as outlined in the manual (Frost & Bondy, 2002a) to ensure treatment fidelity. However, similar difficulties to those encountered in Study 2 with regarding prompting. Charlie’s mother often prompted Charlie during the situational probe sessions and this may have lowered the accuracy of the treatment fidelity.

## Discussion

The aim of Study 3 was to evaluate the generalisation effects of PECS training on vocal and nonvocal communication and other concomitant behaviours (e.g., social play behaviours, and inappropriate behaviours). The aim was also to compare independent PECS use and vocal communication in the situational probe sessions with the standard generalisation probes.

PECS training resulted in increased vocal and nonvocal communication (e.g., intelligible words, sentences, vocal mands and vocal initiations) for Charlie. Charlie's independent PECS mands were also generalised to the university setting. However, Charlie's independent PECS mands and vocal mands were much higher in the situational probes than in the standard generalisation probes. In addition, while Charlie's vocal mands during the situational probes increased from Phase 2 to the maintenance sessions, at the same time, Charlie's independent PECS picture exchanges decreased in this setting from Phase 3A to the maintenance sessions.

*PECS acquisitions*

The results of Study 3 showed that Charlie successfully acquired functional communication by mastering all six phases of the PECS program, through 38 sessions with a total of 444 trials (range = 2-30 per session) over a nine week period. Charlie easily mastered the PECS program; mastery was much quicker than it was for Angel and Bee, where mastery of the program took approximately five months. Charlie, with language delay, took a much a shorter period to master the PECS program when compared to children with other language and communication disabilities such as autism who are usually reported to take as long as four to six months to master Phases 1 to 6 (Howlin et al., 2007; Yoder & Stone, 2006). However, a recent study by Travis and Geiger (2010) showed that two children with autism took only nine weeks to master all six phases, the same period of time as Charlie. The difference in time taken to master PECS training perhaps suggests that the time period required for mastering the PECS program depends on the child's initial communication level.

Charlie took five sessions in each PECS phase except Phase 3B (simple picture discrimination) and Phase 4 (sentence structure) where it took one to two more sessions. In Phase 3B, the second researcher inadvertently implemented the training without following the exact procedure in the home setting. As a result, the child's mastered criteria dropped to 50% and 0% in the fourth and fifth sessions whereas in the first three sessions with the principal researcher the success rate had been 100 %. Consequently the researchers decided to add two additional sessions (sessions 6 and 7) with the second researcher encouraged to follow the PECS manual more closely for proper implementation of the sessions. This experience suggests that the implementer's skills and training may affect the child's progress and ultimate mastery of PECS.

In learning sentence structure in Phase 4, Charlie had difficulties in the first three sessions, with some successful trials. The same situation had occurred with the other two participants in Study 1 and 2. However, Charlie progressed through Phase 4 (52 trials with 5 sessions) much more quickly than participants in Study 1 and 2 who took 129 and 130 trials each. This result was much quicker than a previous study by Ganz and Simpson (2004) where three participants took a mean of 75 trials within five sessions. Variation in the mastery rates of learning in Phase 4 seems to be the norm. For example, Charlop-Christy et al., (2002) showed that children achieved success in a range of between 45-108 trials. The time it takes to complete PECS training probably depends on individual differences.

*Generalisation and Situational probes*

While Charlie mastered functional communication through the PECS program, Charlie's use of independent PECS mands also occurred across a variety of settings including home, school, and university settings.

The situational probe was designed to assess changes in Charlie's independent PECS mands and vocal communication under optimal motivating conditions by way of contrast to the natural generalisation setting. Charlie's independent PECS mands during the situational probes increased from Phases 1 to 3A relative both to baseline and to the standard generalisation probe sessions. Charlie's vocal mands (e.g., "I want pump, balloon") also increased significantly in this setting from Phase 4 in the maintenance sessions; at the same time his use of PECS gradually decreased.

Light, Collier, and Parnes (1985) showed that children with disabilities produced greater communicative functions in a structured setting than in the freeplay setting. This suggested that structured situations may help to facilitate pragmatic performance for children with disabilities. In the situational probe under the motivational context, Charlie was limited to a small university room and his preferred toys or items were within view but out of reach or inside a container. As a result, Charlie had greater communication opportunities to request his preferred items than in the natural generalisation setting where he could easily access items and activities for himself. Natural settings may not provide a valid context for generalisation assessment because they provide limited and variable opportunities for communication and therefore do not allow for a standardised measurement of PECS use or of vocalisation. In the situational probe the environment was enriched with preferred items providing an optimally motivating context and this provided greater validity for measurement of spontaneous communication. However, the structured environment of the generalisation probe was similar in nature to structured interventions such as "antecedent interventions". (Roberts, 2003; Volkmar, Paul, Klin, & Cohen, 2005).

Interestingly, Charlie's mother outside of the formal data collection period confirmed that Charlie used PECS independently in his grandparents' home, with his grandparents, relatives, and other friends. Also, Charlie's use of PECS increased when his father was present in the home. The mother reported that Charlie made novel combinations of PECS pictures as well as new sentences in making a request to his mother. For example, he combined words to produce sentences such as "I want beans open" and "I want mum big mouth (kiss)". Charlie's on-going use of PECS might suggest that generalisation did occur in non-training settings with new people, settings and objects (e.g., beads and beans), either through request made with PECS or vocally without PECS. These results are similar to those from previous studies (Anderson, Moore, & Bourne, 2007; Carr & Felce, 2006b; Rosales, Stone, & Rehfeldt, 2009; Marckel, Neef, & Ferreri, 2006).

*Intelligible vocalisations and sentence structures*

Charlie's intelligible vocalisations and sentence structures (e.g., "I want balloon", "I want more balloon") during the PECS training increased significantly. In particular, his sentences increased considerably in Phase 4 (sentence structure) and in Phase 6 (commenting). This is a finding consistent with previous studies that showed that PECS training increases spoken communication including words, the mean length of utterances, and sentences (Anderson, Moore, & Bourne, 2007; Bondy & Frost, 1994a; Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Jurgens, Anderson, & Moore, 2009; Kravits et al., 2002; Magiti & Howlin, 2003).

Charlie's mean length of utterance for spoken sentences increased (from 2 at the baseline to 4.25 at the maintenance session) throughout the PECS training. In particular, Charlie displayed significant increases from simple two-word sentences (e.g., "no all", "Annie here") to more complex seven-morpheme sentences (e.g., "I want balloon, spider, pump, water, blow") in Phase 6 and maintenance sessions. Charlie began to talk with two words utterances in Phase 3A (simple picture discrimination); this is consistent with a previous study that suggested that children who learn PECS start to talk as early as Phase 3 (Ganz & Simpson, 2004). Charlie maintained his complex sentences and used all combinations of two to seven morpheme utterances in the maintenance sessions. The notable increases in complexity of vocal utterances in this study were higher than has been shown from previous studies (Travis & Geiger, 2010) where a majority of spoken utterances were between one to three words utterances.

Charlie's cumulative new spoken words gradually increased when PECS training took place. Jurgens, Anderson, and Moore (2009) had similar results where a child with autism increased cumulative new spoken words up until to Phase 4. However, as new words showed signs of increase during the baseline, it is not possible to ascribe causation to PECS for the increase. Nevertheless it seems that PECS training had an accelerating effect on vocal communication, primarily in increases in Charlie's overall complex intelligible sentences.

*Other vocal, nonvocal communication / Social play behaviours*

Charlie's other vocal (e.g., commenting) and nonvocal communication generally increased during the freeplay and standard generalisation setting, consistent with previous studies (Anderson, Moore, & Bourne, 2007; Carr & Felce, 2006b). Interestingly, other vocal and nonvocal initiations also increased in a similar fashion from Phases 3B to maintenance in the standard generalisation settings. For example, while gesturing pumping, at the same time he commented by saying "pump" while he was holding the pump to inflate the balloon.

There were no significant concomitant changes in social play (e.g., solitary, group play) for Charlie in the freeplay settings. Although parallel play occurred frequently from Phases 1 to 6 in the school, the data does not provide evidence to suggest the impact of PECS on increasing parallel play. Charlie's onlooker and unoccupied behaviours generally occurred in the home, school and university freeplay settings. The occurrence of these behaviours varied and it depended on different settings. For example, onlooker behaviour increased in the home while it decreased in the university setting. This increase might simply be explained by the fact that in the home setting there were more opportunities to make observations given the natural home context filled with objects from family life.

## Conclusion

Study 3 investigated the generalisation effects of PECS training on vocal, nonvocal communication and social play for Charlie involving a variety of settings and individuals. In particular, the situational probes were implemented to provide a more valid context for assessing generalisation. The changes in Charlie's PECS use and vocal communication were observed under an optimal motivating context. The situational probe contrasted with the natural freeplay settings where there were relatively few communicative opportunities for Charlie.

The findings demonstrated that Charlie acquired functional communication while his intelligible vocalisation also increased significantly during PECS training. There were no significant differences in other concomitant behaviours such as social play or inappropriate behaviours in freeplay settings. However, his mother reported decreases in inappropriate behaviours (e.g., frustration and tantrum) and increases in play with other children. In particular, unlike the Study 1 and 2, Charlie's spoken utterances increased significantly and maintained successfully, with combinations of two to seven words.

Although PECS training occurred in a variety of settins with different individuals, the use of independent PECS was limited in the freeplay settings where all toys were available. However, in the structured situational probes, where access to all items was controlled, Charlie's use of vocal mands notably increased. Interestingly, at the same time, the use of PECS exchanges (e.g., manding) decreased over time as vocal communication increased. This finding supports the view that incorporating motivating operations within PECS training might provide critical learning and communication opportunities for children with autism and other communicative disabilities.

The findings provide evidence that situational probes improved the validity of assessing generalisation. Future research should take note of the importance of creating valid environments for generalisation assessment, settings where communication opportunities are not limited. Furthermore, situational probes contribute to a therapeutic effect that may be useful in other natural settings such as home and school through extending children's communication opportunities. This possibility deserves further research.

Chapter 7 will bring together results from the three individual studies and discuss and analyse them as a whole. This will include an analysis of the generalisation effects of the PECS program in use of independent mands, vocal and nonvocal communication and other concomitant behaviours across different settings and individuals. Chapter 7 will also discuss the contribution to theory and implications for practice, future studies and limitations of the current study, followed by conclusions.

# CHAPTER SEVEN

## DISCUSSION

The aim of this series of studies was to evaluate the effects of the complete PECS program (Phases 1 to 6) on three children, two with autism and one with language delay. This evaluation included assessment of generalisation effects of PECS training in communication and social interaction across settings (e.g., home and intervention centre) and individuals (e.g., sibling, parent and teacher) for these children.

All three participants completed PECS training to criterion over periods of between nine to 20 weeks. These results correspond with similar findings from previous studies which have reported that children with autism take between nine weeks to eight months to master all six phases of PECS program (Travis & Geiger, 2010; Malandraki & Okalidou, 2007; Yoder & Stone, 2006). Charlie, who had severe language delay rather than autism, took a shorter period (nine weeks) than the two children with autism (20 weeks) to master all six phases. One of the children, Bee, began training with no functional communication at all and with self-injuring behaviour such as biting. Bee took the greatest number of trials to master PECS training (1181 trials). By contrast, Angel (Study 1) and Charlie (Study 3) took 723 and 444 trials respectively.

Angel and Bee (both with autism) had difficulties in mastering Phase 2 (distance and persistence), Phase 4 (sentence structure) and Phase 6 (commenting). A previous PECS study (Charlop-Christy et al., 2002) had similar findings, the researchers reporting that Phase 2 and 4 took a longer time and more trials to master (45-108 trials) when compared to other phases.

Interestingly, all three participants in the present study had some initial difficulties mastering Phase 4 (sentence structure) with almost no successful trials at the beginning of this phase. Angel and Bee had more trials (131 and 129 trials respectively) than Charlie, who after some early problems finished Phase 4 with only 52 trials. Children with autism commonly experience difficulties learning sentence structures (Charlop-Christy et al., 2002). As Phase 4 of PECS is based on sentence structure learning, Bee and Angel's difficulties with this phase was not unexpected. Specifically, they found it hard to master the step in Phase 4 of moving the "I want" icon plus the picture of a preferred item from the PECS book to the sentence strip to exchange with a communicative partner. These difficulties encountered at Phase 4 may be one of the reasons that most previous PECS studies have been restricted to Phases 1 to 3 (Angermeier et al., 2008, Carr & Felce, 2006b; Frea et al., 2001; Ganz, Simpson, & Corbin-Newsome, 2008; Kravits et al., 2002; Tincani, 2004).

In Study 1 with Angel, PECS training was conducted in the home setting. Angel's independent PECS skills and other concomitant behaviours (e.g., vocal, nonvocal communication, and social interaction) were observed in the home and kindergarten generalisation settings.

Angel's echolalic speech stopped at the end of Phase 6 and during the maintenance sessions. It is commonly understood that echolalia and other stereotypical behaviours may serve a communicative function (e.g., requesting and commenting) (Conroy et al., 2004; Nungesser & Watkin, 2005). Increases in Angel's spoken communication (e.g., manding and commenting) during PECS training may have had the effect of decreasing Angel's echolalic speech. More generally it has been found that echolalia decreases as language skills increase for children with autism (McEvoy, Loveland, & Landry, 1998; Schwartz et al., 1998).

Although there were positive effects of PECS training in increases of vocal mands and some other concomitant behaviours, the results showed that Angel displayed very limited independent PECS use in the home and school generalisation settings. This finding of limited generalisation raises questions about why Angel's PECS skill acquisition did not transfer to other natural settings. This lack of generalisation may have occurred for several reasons. Firstly, Angel's PECS training only occurred in the home setting. Secondly, Angel had limited social interaction opportunities in the home. This was in contrast to the kindergarten setting where many children and adults were present for social interaction. However, despite the presence of others, Angel did not use PECS to communicate with others in the school.

In Study 2 it was decided that generalisation should be more actively promoted. As a result, in Study 2 for participant Bee, training occurred both in the home and at Bee's special school involving her teacher. In addition, sibling involvement was included from Phase 3A of the PECS training in the home environment.

The major finding from Study 2 was that the sibling's control of motivating operations such as preferred items and activities was effective in stimulating Bee's interest and need to communicate. Bee's independent PECS mands increased quickly once the sibling involvement was introduced from Phase 3A. Subsequently, Bee's use of independent PECS mands also generalised relatively quickly from Phase 3B in the home. This suggests that within the structured setting of PECS activities involving the sibling, the frequency of social initiation between Bee and her sibling increased and was generalised to home freeplay settings. A previous study, though not including sibling involvement, also found that typically developing children can be effective communicative partners in the use of PECS mands and social initiations (Schwartz et al., 1998).

Bee, who had no spoken words in prior to the PECS training, showed some increases in new spoken words, with seven new words in total in the maintenance sessions. In addition, Bee's mother reported six months after the completion of the study that Bee continued to use these words in the home without, however, gaining any additional new words. This demonstrates that PECS training and sibling involvement can support the development of new spoken words.

Although Bee's independent PECS manding generalised to the home freeplay setting, the skill of independent PECS use did not generalise to the school setting. Studies 1 and 2 found that both children used PECS during the training sessions in the home or school setting. This means that while the PECS skills acquisition occurred, nevertheless, the use of PECS was not observed to generalise to school setting. The lack of generalisation from the two studies might raise questions about the social validity of the PECS training program. However, adults (e.g., parents and teachers) in natural settings were not actively involved in the use of PECS with the participants. Even though the PECS program suggests various strategies to facilitate communication with individuals with autism through the use of PECS (e.g., use of motivating operation), operationally many adults in this study did not follow these recommended strategies. In the case of teachers, both in the kindergarten and intervention school, they reported that they were mostly too busy with their normal class obligations to actively participate in the PECS training and seemed unsupportive of its role and benefits generally. This may raise questions regarding the social validity of the PECS program as a communication device in natural settings.

Interestingly, even though relevant pictures both in the home and school were available in the PECS communication book, the children did not use them in the natural settings. This may reflect the fact that in these natural settings all the children’s preferred materials or activities were generally available and accessible without communication. The presence of readily accessible desirable objects reduced the need for these children to communicate their needs and desires for particular objects. They had, in other words, no motivation or reason to communicate their needs with or without PECS even though they had the necessary PECS skills. Drasgow, Hall, and Sigafoos (1999, p.47) emphasised that “one of the first steps in facilitating communication growth is to ensure that learners have reasons to communicate and one technique that increases this motivation to communicate is known as environmental arrangement”. Environmental arrangement refers to manipulating the availability of activities and materials to create opportunities for communication in natural settings (Drasgow, Hall, & Sigafoos, 1999). Environmental arrangement is included in most naturalistic approaches to teaching communication because it can be used to promote motivation for children to learn and practice new communication skills in natural contexts.

The lesson from Study 1 and Study 2 was that the participants’ interest in communication was dependent on opportunities provided within their environment. This suggests that the lack of generalisation in the first two studies was not due solely to lack of PECS skills by the participants. Rather, it was because there was little by way of communicative motivation in their environment. Changing this situation required providing more motivating operations for the participants; this in turn required arranging the environment to provide opportunities to communicate, altering the motivating operations.

Therefore, Study 3 introduced a new standardised motivational context as a situational probe to assess generalisation. The aim of the situational probe was to assess under optimal motivating conditions changes in Charlie's independent PECS mands and vocal communication. In the situational probe, the motivating operation of environmental arrangement (e.g., putting toys out of reach or inside transparent containers) was combined with involvement of various communicative partners as another means to maximise communicative opportunities. The use of a situational probe differed greatly from the natural generalisation settings (e.g., home and school) where there were very few communicative opportunities and less stimulation for communication.

During the situational probes, Charlie's independent PECS mands increased initially in Phase 1 and 2 when compared to the baseline. Observation revealed that the situational probes were associated with a significant increase in the frequency of Charlie's vocal manding. At the same time, Charlie's independent PECS use gradually decreased from Phase 3B through to the maintenance sessions. This decrease in use of PECS coincided with a concomitant increase in the complexity and rate of vocal communication.

In addition, Charlie's independent PECS mands occurred from Phases 2 to the maintenance sessions in the other generalisation probe settings. This was in contrast to the two participants in Study 1 and 2 whose independent PECS use was very limited in the generalisation settings. This suggests that independent PECS use may vary between individuals perhaps dependent on individuals' different characteristics.

Charlie's spoken utterances increased significantly during PECS training. Specifically, the number of three to eight morpheme utterances was higher in Phases 4 and 6 and during the maintenance sessions. The total number of Charlie's vocal mands was also higher in the situational probes than in the other generalisation probe settings. This suggests that the provision of optimal communication conditions may be related to increased frequency of Charlie's vocal mands compared to his vocal manding in the natural generalisation settings.

The complexity of Charlie's intelligible utterances during PECS training (i.e., university and home) was also higher than those reported in a previous study where the majority of spoken utterances were three to four morphemes (Travis & Geiger, 2010). This difference may be attributable to the different diagnosed conditions of the participants. The participants from the study by Travis and Geiger were children with autism unlike Charlie who had a diagnosis of language delay. In addition, Charlie had higher rates of spoken words during the pre-PECS training than Angel and Bee. Charlie's pre intervention abilities with language are likely to have assisted his positive progress in PECS training and his subsequent increases in spoken communication. Findings by Ganz, Simpson, and Corbin-Newsome (2008) showed that a child who displayed some echolalic speech before the intervention, increased spoken words through

PECS training. This suggests that different levels of language and communication may be associated with differences in children's increases in vocal communication. By contrast the two other children in that study who had no improvement in spoken words after PECS training displayed no echolalic speech before PECS training.

The increase in spoken communication for the three participants is amongst the most critical findings of this study. Several features of the PECS program may contribute to the increase of spoken words and sentences. The PECS program is based on application of Skinner's verbal behaviour that focuses on the function of the response rather than its form (Frost & Bondy, 2002a). Verbal operant units (e.g., mands and tacts) are directly addressed in the PECS program (Frost & Bondy, 2002a; Kelly et al., 2007). This verbal behaviour approach involves communicative function (e.g., mands) between a listener and a speaker (Frost & Bondy, 2002a). There seems to be a relationship between PECS training - with its emphasis on teaching functional communication through a "listener" and "speaker" relationship - and an increase in spoken communication for some children with autism in different social contexts. As Sundberg and Michael (2001) have argued, the emphasis on teaching verbal operants such as mands in the PECS program may be critical for early development of language and social interaction for children and adults with communicative disabilities.

Charlie's and Angel's spoken utterances increased significantly from Phase 4 of learning sentence structure in the PECS program; a similar result was obtained by Charlop-Christy et al., (2002). The introduction of constant time delay in Phase 4 and 5 training may have positively affected the development of vocal communication for Charlie and Angel. When the time delay is used, the adult trainer physically prompts a child to point to each picture of “I want” and the picture of the preferred item. At first the trainer calls out the name of the item depicted on the picture while the child is still pointing at it. Over time, the trainer fades the physical prompting so that there are increasingly large gaps between the child’s pointing at the picture and the adult’s calling the name. The larger delays between pointing and naming provide a child with the opportunity and the time to speak during the exchange. The time delay may effectively increase children’s vocal communications (Halle, Marshall, & Spradlin, 1979), as was the case with Angel and Charlie. Interestingly, during this phase Bee was observed to open her mouth and used her mouth to form the words “I want” without vocalisation, in imitation of her trainer.

PECS training uses graphic symbols to facilitate communication for children with autism but does so by incorporating vocal mands at the same time. It seems that this combination of the symbols and spoken manding increases children’s overall spoken communication. For example, Drager et al., (2006) showed that AAC graphic symbols combined with vocal mands provided positive effects on increases of symbol use and new vocabulary for children with autism. The increases in spoken communication (e.g., vocal mands and comments) for the three children in this study may also derive from the features in PECS that target and improve pivotal behaviours such as self-initiations (Koegel et al., 1999).

## Contribution to theory and implications for practice

This series of studies has produced findings that add significantly to our understanding of how best to apply PECS in real-life situations. Firstly, in terms of the original aims of the study, all three children successfully completed PECS training from Phases 1 to 6. Most previous studies have not included all six phases. This study has therefore created a wider scope for observing and analysing the effectiveness of the PECS program in its entirety. However, this study only involved three children and there is, therefore, restricted generalisability for other children with autism. Analysis of the results has provided two key findings. These findings are, firstly, that the context in which PECS training takes place is extremely important and, secondly, that together with context, consistent use of motivating operations by parents and teachers in using PECS is required to promote fluent use of PECS exchanges for children with autism and other communicative disabilities.

The effects of PECS training for the three participants showed that these children’s independent PECS use was limited in the generalisation settings as well as with different individuals. All three children used PECS more frequently in the home settings with their mothers rather than in the school with their teachers. While PECS training occurred in both settings, Bee and Charlie, for example, showed almost no use of PECS with their teachers in observations taken in the school settings. This apparent lack of engagement with teachers could be a function of inadequate sampling within this setting due to the limited formal observation time (20 minutes per session). In other words, the participants may have had further unobserved communication with others in the school settings outside of observation times. Arguably of greater significance was the generally free access to materials these students were observed to experience in the school that meant that they had little need or motivation to communicate with others to obtain the materials they needed or wanted.

Communicative skills including the use of PECS are developed through social interactions with different individuals and in different contexts (Ghoroury & Romanczyk, 1999; Pino, 1999). All three children had more communicative opportunities in the home settings. An issue that needs addressing, therefore, is how to ensure that children’s PECS skills can be applied in multiple settings in real life. Even in home settings, maximising PECS use through arranging sufficient motivation and stimulation needs further attention.

The importance of motivation and stimulation as the basis for effective training in, and subsequent use of PECS, is reflected in the general absence of the use of incidental learning in natural settings. Incidental learning seeks to generate learning opportunities from available ‘incidents’ in natural settings to increase spontaneous language and generalisation (LeBlanc et al., 2006). A finding from this study is that parents and teachers may not be successfully skilled or may not have enough time to use incidental learning processing effectively in practice. Therefore, in order to optimise the benefits of PECS in natural settings, more structured learning environments (and not just incidental ones) might be necessary to provide better verbal behaviour outcomes for children. Natural environments can be arranged to create multiple motivating or stimulating situations for children to optimise their communication opportunities.

Motivating operations are critical in relation to communication and language for children with autism and other communication disabilities (Bondy, Tincani, & Frost, 2004; Cooper, Heron, &

Heward, 2007; Drasgow, Halle, & Sigafoos, 1999; Laraway, Snycerski, Michael, & Poling, 2003; Sundberg & Michael, 2001). More precisely, many authors argue that incorporating relevant motivating operations is significant for the development of important types of verbal behaviour (e.g., mands and tacts) and can, for example, be used for teaching manding skills (Sweeney-Kerwin et al., 2007). This has important implications for using PECS effectively because the PECS program focuses on teaching manding skills. For example, within Phase 5 of the PECS program, if communicative partners (e.g., parents) ask questions such as “What do you want?”, such questions will be more effective when used in conjunction with motivating operations. In this study, this effect was seen in the case of Charlie (Study 3), who showed significant increases in independent PECS mands under the structured motivating context when compared to the natural freeplay settings.

“Fluency” is an important concept for understanding successful training and application of ABA-based communication systems such as PECS. Fluency refers to the accuracy and speed of a child’s use of PECS; “flowing, effortless and well-practiced” (Weiss, 2001, p183). Given the acceleration of PECS use achieved through incorporation of motivating operations, it is likely that overall fluency will be greatly improved at the same time. Fluency is enhanced through practice, especially regular practice that relates to functional need in everyday life (Kubina & Wolfe, 2005). Laraway et al., (2003) indicated that motivating operations work in two ways, by initiating new behaviours while simultaneously affecting existing behaviours.

Motivating operations incorporated within the PECS program in natural settings will stimulate children’s need for manding and other language use thereby increasing communicative opportunities that lead to more use of PECS in natural settings. Motivating operations generally increase skill-learning rates and overall fluency in PECS use in natural settings.

Study 3 demonstrated that structured situational probes with motivating operations were effective in increasing PECS use by Charlie, providing increased opportunity to practise his communication skills. The situational probe in Charlie's case was implemented in a University research setting. Such a situational probe could be easily applied to natural settings and used to create consistent routine PECS practice in the home setting to ensure the development of fluency with PECS use.

At present, parents adopting the PECS program for use in the home may simply rely on incidental learning opportunities in the natural environment to facilitate PECS use by the child. This loose application of the PECS program occurs despite recommendations from the PECS program developers regarding the use of motivating operations to increase communication opportunities (Cooper, Heron, & Heward, 2007). Therefore, we might encourage parents to make better use of PECS and motivating operations by assisting them to create intensive and structured learning opportunities through optimal conditions. Given the importance of using motivating operations in natural settings, it may also be necessary for the PECS program to provide greater training support for parents to establish situational probes through workshops, on-line training etc. At the same time, parents should be encouraged to involve various communicative partners such as siblings, grandparents and family friends in the creation of optimal conditions. This will provide further intensive learning opportunities for children with autism.

## Future studies

The present study raises several questions that could be the basis for further research on the effects of the PECS program for children with autism and developmental delay. Children in the present study had limited use of PECS in natural settings. It may be important to gain a better understanding of how many times a day children who have undergone PECS training actually use PECS and at what stage it can be said that they are "fluent" in PECS use, measured in the rate and accuracy of picture exchanges. Research could focus on a group of children who have been trained in PECS and count how many times a day in natural settings they use picture exchanges before they achieve fluency. An additional flow-on study would then investigate whether fluency in PECS leads to increased spoken communication and at what stage, if any, the increase in spoken communication results in a reduction in the use of PECS. Such a study would effectively be examining whether PECS can be regarded as a transitional tool for helping children with autism to learn spoken language.

Future studies could also focus on PECS training in school settings with relevant school activities, materials and routines (e.g., glue and paper) made available. In addition, there are many other settings where PECS training and generalisation could be applied in practical, everyday life settings (e.g., various community environments such as swimming pools, church, or supermarket). The same principle applies to increasing the number of communicative partners such as grandparents, relatives, and participants' friends.  Finally, future studies should also consider gathering data through the use of interactive technology such as mobile phones and the internet. In Study 3 for example, parents were asked to report cumulative new words through

SMS messages or via email outside of formal observation sessions. This helped improve qualitative data gathering especially for assessing generalisation.

## Limitations

This study was limited in external validity inasmuch that while used in previous PECS studies (e.g., Ganz & Simpson, 2004), the use of a single subject within a changing criterion design, though providing good control of factors influencing the internal validity of the findings means the findings are of restricted generalisability to the wider population of children with autism and other communicative disabilities. External validity can be increased through systematic replication across participants and settings.

Further, the data on cumulative new spoken words in Study 1 and 3 showed an increase during the baseline sessions. As a result of these increases it is difficult to ascribe causation to the PECS program for increases in new spoken words; this is despite the fact that increases in new spoken words continued throughout the period of PECS training. In order to establish a possible link with PECS a longer period of observation and data collection (e.g., 10 weeks) should occur in the baseline sessions in future studies to the point where increases in new spoken words have stablised prior to PECS training.

This study adhered to the specifications of the PECS manual (Frost & Bondy, 2002a) in order to provide accurate treatment fidelity. However, Bee and Charlie, the participants in Studies 2 and 3 respectively, displayed prompted PECS mands during the sibling involvement and situational probe sessions. These promptings from the sibling or mother may have reduced the treatment fidelity. In order to provide more accurate fidelity to prevent prompting from others, researchers and parents need to be aware of the risk of inappropriate prompting.

## Conclusion

This study detailed the effects of the entire PECS program on communication and social interaction for children with autism and developmental delay. Various elements can be considered essential for successful PECS training. These elements relate strongly to the social and communicative context in which PECS training takes place. For example, communicative partners need to be available at an appropriate time for interaction. In addition, the on-going involvement of family members such as siblings should be included in PECS use within home settings. PECS training sessions should be designed to optimise the desire and need for children with autism to communicate through structured stimulation and motivation. This study recommends that motivating operations through optimal conditions should be used to facilitate intensive learning practice with PECS in natural settings for children with autism. This will lead in turn to sustained fluency with the PECS program for these children.

Optimising communication opportunities through motivating operations for children with autism and other communicative disabilities opens a window for these children to begin acquiring functional communication skills through PECS. This puts children with autism and other disorders on a pathway for expanded opportunities for practice and learning. These opportunities and outcomes will ultimately provide greater quality of life for children with autism and their families.

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# APPENDICES

**Appendix A**

Critical communication checklist

The Communication and Symbolic Behaviour Scales Development Profile (CSBS-DP)

PECS Implementer skill assessment

**Appendix B**

Social validity questionnaires for Study 1, 2 & 3

**Appendix C**

PECS training observation charts

Percentage of independent PECS exchange trials for each PECS sessions

Cumulative new spoken words

The number of mean length of utterance in home freeplay setting

Home/school/kindergarten freeplay settings & Situational probe

Intelligible vocalisation in PECS training

Social interaction & play in home /school/kindergarten freeplay settings

Event sampling

**Appendix D**

The ethics

The Explanatory statement & Consent form

**Appendix E**

Pre-intervention measurement questionnaire

Vocabulary selection worksheet

**Appendix F**

The Assessment of Basic Language and Learning Skill-Revised (ABLLS ) results for Study 1

**Appendix G**

The Assessment of Basic Language and Learning Skill-Revised (ABLLS ) results for Study 2

**Appendix H**

The Assessment of Basic Language and Learning Skill-Revised (ABLLS ) results for Study 3

# Appendix A Critical communication checklist

| Name: | Age | Date: |
|---|---|---|
| **SKILL** | **EXAMPLE** | **APPROPRIATE?** |
| 1. request reinforcers | | |
| Edibles toys activities | | |
| 2. Request help/assistance | | |
| 3. request break | | |
| 4. Reject | | |
| 5. Affirm/Accept | | |
| 6. Respond to “wait” | | |
| 7. Respond to directions | | |
| **VISUAL DIRECTIONS** | | |
| Orient to name being signaled | | |
| “Come here” “Stop” | | |
| “Sit down” | | |
| “Give it to me” | | |
| “Go get…” (familiar item) | | |
| “Go to…” (familiar location) | | |
| “Put it back/down” | | |
| “Let’s go/Come with me” | | |
| **ORAL DIRECTIONS** | | |
| Orient to name being called | | |
| “Come here” “Stop” | | |
| “Sit down” | | |
| “Give it to me” | | |
| “Go get…” (familiar item) | | |
| “Go to…” (familiar location) | | |
| “Put it back/down” | | |
| “Let’s go/Come with me” | | |
| **8. Transition b/w activities** | | |
| **9. Follow visual schedule** | | |

## Appendix A The Communication and Symbolic Behaviour Scales Development Profile (CSBS DP) Checklist

| Predictor | Raw score | | Standard score | Percentile rank | Concern |
|---|---|---|---|---|---|
| Emotional and eye gaze | | | | | |
| communication | | | | | |
| gestures | | | | | |
| SOCIAL COMPOSITE | | | | | |
| Sounds | | | | | |
| Words | | | | | |
| SPEECH COMPOSITE | | | | | |
| Understanding | | | | | |
| Object use | | | | | |
| SYMBOLIC COMPOSITE | | | | | |
| TOTAL | | | | | |

## Appendix A PECS Implementer skill assessment

**Implementer:** **Reviwer:** **Review date:** **Site:**

| | Pass | Redo | comments |
|---|---|---|---|
| **General issues:** | | | |
| Plans for PECS training to occur across a range of activities | | | |
| Plans for a variety of trainers to participate | | | |
| Planns for student to request a variety of reinforcers | | | |
| **Phase 1: Communicative Partner** | | | |
| Arranges training environment effectively-pictures available one at a time, trainers positioned appropriately, control of reinforcers | | | |
| No verbal prompting | | | |
| Entices appropriately | | | |
| Uses open hand prompts effectively-appropriate timing | | | |
| Reinforcers within ½ seconds and provides social praise | | | |
| No insistence on speech | | | |
| Returns pictures | | | |
| **Phase 1: Physical prompter** | | | |
| Waits for student to initiate | | | |
| Physically guides to pick up, reach, release | | | |
| Fades prompts effectively | | | |
| Interrupts student's interfering behaviours | | | |
| No social interaction with student | | | |
| **Phase II: Communicative partner** | | | |
| Plans for each student to have own communication book | | | |
| Arranges training environment | | | |

| | | | |
|---|---|---|---|
| appropriately | | | |
| Entice appropriately | | | |
| Gradually increase distance between student and communicative partner | | | |
| Teaches student to cross room to reach communicative partner | | | |
| Gradually increases distance between student and communicative book | | | |
| Teaches student to cross room to reach communication book | | | |
| Turns away from student eliminates body language cues | | | |
| Reinforcers appropriately | | | |
| Eliminates subtle trainer prompts | | | |
| Does not insist on speech | | | |
| **Phase II: Physical Prompter** | | | |
| Waits for initiation | | | |
| Prompts removal of picture from book if necessary | | | |
| Physically guides student to trainer if necessary | | | |
| Physically guides student to communication book if necessary | | | |
| Does not interact socially with the student | | | |
| Uses backstepping if necessary | | | |
| **PHASE IIIA High vs. Distracter discrimination** | | | |
| Arranges effective training environment | | | |
| Entices with both items | | | |
| Socially reinforces as soon as student touches correct picture | | | |
| Appropriate reinforcement with requested item | | | |
| Uses a variety of distracter items and a | | | |

| | | | |
|---|---|---|---|
| variety of target pictures | | | |
| Conducts error correction procedures correctly | | | |
| Moves pictures around on book | | | |
| No insistence on speech | | | |
| **Phase IIIB multiple preferred discrimination** | | | |
| Conducts error correction procedure correctl | | | |
| Moves pictures around on book | | | |
| Teaches 3,4,5 way discrimination | | | |
| Teaches looking inside book | | | |
| No insistence on speech | | | |
| **Phase IV** | | | |
| Begins with “I want” already on sentence strip | | | |
| Waits for initiation | | | |
| Physically guides student to put R+ picture on strip and exchange strip | | | |
| Fades physical guidance to put R+ picture on strip and exchange strip | | | |
| Verbal praise + turns strop around and “reads” sentence | | | |
| Teaches assembly of entire strip-backward chaining | | | |
| Reinforces new behaviour with ½ second | | | |
| Appropriate reinforcers with tangible item | | | |
| Uses physical assistance to teach student to point while strip is being “read” | | | |
| Use delay (3-5)seconds in reading strip | | | |
| Differentially reinforces if student speaks | | | |
| Avoids verbal prompting | | | |

| | | | |
|---|---|---|---|
| Conducts error correction for incorrect picture sequence | | | |
| Organize communication book appropriately | | | |
| Does not insist on speech | | | |
| **Phase V:** | | | |
| Uses delayed prompting to teach "what do you want?" | | | |
| Uses differential reinforcement if student beats the second prompts | | | |
| Reinforcers new behaviour within ½ second | | | |
| Creats multiple opportunities for spontaneous requesting and answering | | | |
| **Phase VI:** | | | |
| Uses delayed prompting to teach commenting in response to comment | | | |
| Continues to create opportunities for spontaneous requesting | | | |
| Defferentially reinforces commenting/requesting | | | |
| Teaches commenting question vs. "what do you want?" discrimination | | | |
| Uses error correction for incorrect discrimination between sentence starters | | | |
| Teachers commenting question vs. spontaneous requesting | | | |
| Creates lesions to elicit spontaneous commenting | | | |
| Fades commenting question to elicit spontaneous comment | | | |
| Incorporates attributes into comment lesions | | | |
| Teaches additional comments and "comment" questions | | | |

## Appendix B  Social validity questionnaires for Study 1, 2, & 3

### SOCIAL VALIDITY QUESTIONNAIRE

**STUDY 1**

Child's name: Completed by:

Date: Relationship to child:

---

This questionnaire is part of our evaluation of the treatment programme that your child has received. Your feedback will help use to evaluate and develop our programme goals and procedures. Please answer the questions as honestly as possible. Your assistance is greatly appreciated

---

1 Was increasing your child's communication skills important and desirable?

Very unimportant □ Unimportant □ Neutral □ Important □ Very Important □

2 Was increasing your child's social interaction skills important and desirable

Very unimportant □ Unimportant □ Neutral □ Important □ Very Important □

3 Is the home environment a suitable place for PECS training?

Very unsuitable □ Unsuitable □ Neutral □ Suitable □ Very suitable□

4 Is it important to incorporate a parent or teacher into the implementation of PECS training?

Very unimportant □ Unimportant □ Neutral □ Important □ Very Important □

5 Was the time frame chosen for intervention reasonable?

Very unreasonable □ Unreasonable □ Neutral □ Reasonable□ Very reasonable□

6 Was PECS intervention by researcher reasonably straightforward to implement?

| | | | | |
|---|---|---|---|---|
| Very complicated □ | Complicated □ | Neutral □ | Straightforward □ | Very straightforward□ |

7 Do you believe that the PECS intervention was an effective method to increase your child's communication skills?

Very ineffective □ Ineffective □ Neutral □ Effective □ Very effective □

7 Do you believe that the PECS intervention was an effective method to increase your child's social skills?

Very ineffective □ ineffective □ Neutral □ effective □ Very effective □

8 Was the PECS training sessions involving home setting stressful to implement?

| Very stressful □ | Stressful □ | Neutral □ | Not stressful □ | Not at all stressful □ |
|---|---|---|---|---|

9 The major problem that prompted you to participate in this study is now:

| Considerably worse □ | Somewhat worse □ | No change □ | Improved □ | Completely improved □ |
|---|---|---|---|---|

10 To what extend has the PECS intervention helped with your child's functional communication skills including vocal and nonvocal?

| Considerably worse □ | Somewhat worse □ | No change □ | Improved □ | Completely improved □ |
|---|---|---|---|---|

11 Can you note any **commenting** examples outside of PECS training in which your child has effectively communicated with you or other families/sibling/peers using or not using PECS?
**Commenting** with/without PECS:

12 To what extend has the PECS intervention helped with other aspects of your child's behaviours, skills or problems?

| Considerably worse □ | Somewhat worse □ | No change □ | Improved □ | Completely improved □ |
|---|---|---|---|---|

13 Describe these changes or give example of Q 13 (e.g. eye-contact, inappropriate behaviours).

14 Do you view these changes as important and useful?

| | | | | |
|---|---|---|---|---|
| Very unimportant □ | Unimportant □ | Neutral □ | Important □ | Very Important □ |

15 Do you think the effort you put into the PECS intervention was worth the outcome?

| | | | | |
|---|---|---|---|---|
| Not worthwhile at all □ | Somewhat worthwhile □ | Neutral □ | Most worthwhile□ | Completely worthwhile □ |

16 Your overall feeling about the PECS intervention for your child is

| | | | | |
|---|---|---|---|---|
| Very negative □ | Negative □ | Neutral □ | Positive □ | Very Positive □ |

17 Do you think the PECS intervention benefited your child in general?

18 Do you have any other comment or suggestions that could help improve future research in this area?

## Appendix B SOCIAL VALIDITY QUESTIONNAIRE

**STUDY 2**

Child's name: Completed by:

Date: Relationship to child:

---

This questionnaire is part of our evaluation of the treatment programme that your child has received. Your feedback will help use to evaluate and develop our programme goals and procedures. Please answer the questions as honestly as possible. Your assistance is greatly appreciated

---

1 Was increasing your child (student)'s communication skills important and desirable?

Very unimportant □ Unimportant □ Neutral □ Important □ Very Important □

2 Was increasing your child (student)'s social interaction skills important and desirable

Very unimportant □ Unimportant □ Neutral □ Important □ Very Important □

3 Is the home or school environment a suitable place for PECS training?

Very unsuitable □ Unsuitable □ Neutral □ Suitable □ Very suitable□

4 Is it important to incorporate a parent or teacher into the implementation of PECS training?

| | | | | |
|---|---|---|---|---|
| Very unimportant □ | Unimportant □ | Neutral □ | Important □ | Very Important □ |

5 Was the time frame chosen for intervention reasonable?

| | | | | |
|---|---|---|---|---|
| Very unreasonable □ | Unreasonable □ | Neutral □ | Reasonable □ | Very reasonable □ |

6 Was PECS intervention by researcher, parent or teacher reasonably straightforward to implement?

| | | | | |
|---|---|---|---|---|
| Very complicated □ | Complicated □ | Neutral □ | Straightforward □ | Very straightforward□ |

7 Do you believe that the PECS intervention was an effective method to increase your child (student)'s communication skills?

| | | | | |
|---|---|---|---|---|
| Very ineffective □ | Ineffective □ | Neutral □ | Effective □ | Very effective □ |

8 Do you believe that the PECS intervention was an effective method to increase your child (student)'s social interaction skills?

| | | | | |
|---|---|---|---|---|
| Very ineffective □ | ineffective □ | Neutral □ | effective □ | Very effective □ |

9Was the PECS training sessions involving parents or teacher stressful to implement?

| | | | | |
|---|---|---|---|---|
| Very stressful □ | Stressful □ | Neutral □ | Not stressful □ | Not at all stressful □ |

10The major problem that prompted you to participate in this study is now:

| | | | | |
|---|---|---|---|---|
| Considerably worse □ | Somewhat worse □ | No change □ | Improved □ | Completely improved □ |

11To what extend has the PECS intervention helped with your child (student)'s functional communication skills including vocal and nonvocal?

| | | | | |
|---|---|---|---|---|
| Considerably worse □ | Somewhat worse □ | No change □ | Improved □ | Completely improved □ |

12Can you note any examples, outside of PECS training in which your child (student) has effectively communicated with you or other sibling/peers, using or not using PECS?

13To what extend has the PECS intervention helped with other aspects of your child (student)'s behaviour, skills or problems?

| | | | | |
|---|---|---|---|---|
| Considerably worse □ | Somewhat worse □ | No change □ | Improved □ | Completely improved □ |

14Describe these changes or give example of Q 13.

15 Do you view these changes as important and useful?

| | | | | |
|---|---|---|---|---|
| Very unimportant □ | Unimportant □ | Neutral □ | Important □ | Very Important □ |

16 Do you think the effort you put into the PECS intervention was worth the outcome?

| | | | | |
|---|---|---|---|---|
| Not worthwhile at all □ | Somewhat worthwhile □ | Neutral □ | Most worthwhile□ | Completely worthwhile □ |

17Your overall feeling about the PECS intervention for your child (student) is

| | | | | |
|---|---|---|---|---|
| Very negative □ | Negative □ | Neutral □ | Positive □ | Very Positive □ |

18Do you think the PECS intervention benefited your child (student) in general?

19Do you have any other comment or suggestions that could help improve future research in this area?

# Appendix B SOCIAL VALIDITY QUESTIONNAIRE

**STUDY 3**

Child's name: Completed by:

Date: Relationship to child:

---

This questionnaire is part of our evaluation of the treatment programme that your child has received. Your feedback will help use to evaluate and develop our programme goals and procedures. Please answer the questions as honestly as possible. Your assistance is greatly appreciated

---

1 Was increasing your child (student)'s communication skills important and desirable?

Very unimportant □ Unimportant □ Neutral □ Important □ Very Important □

2 Was increasing your child (student)'s social interaction skills important and desirable

Very unimportant □ Unimportant □ Neutral □ Important □ Very Important □

3 Is the home or school environment a suitable place for PECS training?

Very unsuitable □ Unsuitable □ Neutral □ Suitable □ Very suitable□

4 Is it important to incorporate a parent or teacher into the implementation of PECS training?

| | | | | |
|---|---|---|---|---|
| Very unimportant □ | Unimportant □ | Neutral □ | Important □ | Very Important □ |

5 Was the time frame chosen for intervention reasonable?

| | | | | |
|---|---|---|---|---|
| Very unreasonable □ | Unreasonable □ | Neutral □ | Reasonable □ | Very reasonable □ |

6 Was PECS intervention by researcher, parent or teacher reasonably straightforward to implement?

| | | | | |
|---|---|---|---|---|
| Very complicated □ | Complicated □ | Neutral □ | Straightforward □ | Very straightforward□ |

7 Do you believe that the PECS intervention was an effective method to increase your child (student)'s communication skills?

| | | | | |
|---|---|---|---|---|
| Very ineffective □ | Ineffective □ | Neutral □ | Effective □ | Very effective □ |

8 Do you believe that the PECS intervention was an effective method to increase your child (student)'s social interaction skills?

| | | | | |
|---|---|---|---|---|
| Very ineffective □ | ineffective □ | Neutral □ | effective □ | Very effective □ |

9 Was the PECS training sessions involving parents or teacher stressful to implement?

Very stressful □ Stressful □ Neutral □ Not stressful □ Not at all stressful □

10 The major problem that prompted you to participate in this study is now:

Considerably worse □ Somewhat worse □ No change □ Improved □ Completely improved □

11 To what extend has the PECS intervention helped with your child (student)'s functional communication skills including vocal and nonvocal?

Considerably worse □ Somewhat worse □ No change □ Improved □ Completely improved □

12 Can you note any examples, outside of PECS training in which your child (student) has effectively communicated with you or other sibling/peers, using or not using PECS?

13 To what extend has the PECS intervention helped with other aspects of your child (student)'s behaviour, skills or problems?

Considerably worse □ Somewhat worse □ No change □ Improved □ Completely improved □

14 Describe these changes or give example of Q 13.
15 Do you view these changes as important and useful?

| | | | | |
|---|---|---|---|---|
| Very unimportant □ | Unimportant □ | Neutral □ | Important □ | Very Important □ |

16 Do you think the effort you put into the PECS intervention was worth the outcome?

| | | | | |
|---|---|---|---|---|
| Not worthwhile at all □ | Somewhat worthwhile □ | Neutral □ | Most worthwhile□ | Completely worthwhile □ |

17 Your overall feeling about the PECS intervention for your child (student) is

| | | | | |
|---|---|---|---|---|
| Very negative □ | Negative □ | Neutral □ | Positive □ | Very Positive □ |

18 Do you think the PECS intervention benefited your child (student) in general?

19 Do you have any other comment or suggestions that could help improve future research in this area?

# Appendix C  PECS training observation charts

**DAY:** Baseline/ PECS generalisation/ freeplay setting Child's name: Time: Age: Observer:
Setting: home/school V (yes) = occurred X (no) = not occurred

| **10-sec intervals** | **DVD time (..m:..s)** | **Unoccupied** | **Onlooker** | **Solitary play** | **Parallel play** | **Group play** | **Inapprop-riate** | **Stereotyp-ical** |
|---|---|---|---|---|---|---|---|---|
| 1 | (2m:40s) | | | | | | | |
| 2 | (2:50) | | | | | | | |
| 3 | (3) | | | | | | | |
| 4 | (3:10) | | | | | | | |
| 5 | (3:20) | | | | | | | |
| 6 (1min) | (3:30) | | | | | | | |
| 7 | (3:40) | | | | | | | |
| 8 | (3:50) | | | | | | | |
| 9 | (4) | | | | | | | |
| 10 | (4:10) | | | | | | | |
| 11 | (4:20) | | | | | | | |
| 12 (2min) | (4:30) | | | | | | | |
| 13 | (4:40) | | | | | | | |
| 14 | (4:50) | | | | | | | |
| 15 | (5) | | | | | | | |
| 16 | (5:10) | | | | | | | |
| 17 | (5:20) | | | | | | | |
| 18 (3min) | (5:30) | | | | | | | |
| 19 | (5:40) | | | | | | | |
| 20 | (5:50) | | | | | | | |
| 21 | (6) | | | | | | | |
| 22 | (6:10) | | | | | | | |
| 23 | (6:20) | | | | | | | |
| 24 (4min) | (6:30) | | | | | | | |
| 25 | (6:40) | | | | | | | |
| 26 | (6:50) | | | | | | | |
| 28 | (7) | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 29 | (7:10) | | | | | | | |
| 30 | (7:20) | | | | | | | |
| 31(5min) | (7:30) | | | | | | | |
| 32 | (7:40) | | | | | | | |
| 33 | (7:50) | | | | | | | |
| 34 | (8m) | | | | | | | |
| 35 | (8m:10s) | | | | | | | |
| 36 | (8:20) | | | | | | | |
| 37 (6min) | (8:30) | | | | | | | |
| 38 | (8:40) | | | | | | | |
| 39 | (8:50) | | | | | | | |
| 40 | (9) | | | | | | | |
| 41 | (9:10) | | | | | | | |
| 42 | (9:20) | | | | | | | |
| 43 (7min) | (9:30) | | | | | | | |
| 44 | (9:40) | | | | | | | |
| 45 | (9:50) | | | | | | | |
| 46 | (10) | | | | | | | |
| 47 | (10:10) | | | | | | | |
| 48 | (10:20) | | | | | | | |
| 49 (8min) | (10:30) | | | | | | | |
| 50 | (10:40) | | | | | | | |
| 51 | (10:50) | | | | | | | |
| 52 | (11) | | | | | | | |
| 53 | (11:10) | | | | | | | |
| 54 | (11:20) | | | | | | | |
| 55 (9min) | (11:30) | | | | | | | |
| 56 | (11:40) | | | | | | | |
| 57 | (11:50) | | | | | | | |
| 58 | (12) | | | | | | | |
| 59 | (12:10) | | | | | | | |
| 60 | (12:20) | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 61(10 min) | (12:30) | | | | | | | |
| 62 | (12:40) | | | | | | | |
| 63 | (12:50) | | | | | | | |
| 64 | (13) | | | | | | | |
| 65 | (13:10) | | | | | | | |
| 66 | (13:20) | | | | | | | |
| 67 (11min) | (13:30) | | | | | | | |
| 68 | (13:40) | | | | | | | |
| 69 | (13:50) | | | | | | | |
| 70 | (14) | | | | | | | |
| 71 | (14:10) | | | | | | | |
| 72 | (14:20) | | | | | | | |
| 73 (12min) | (14:30) | | | | | | | |
| 74 | (14:40) | | | | | | | |
| 75 | (14:50) | | | | | | | |
| 76 | (15) | | | | | | | |
| 77 | (15m:10s) | | | | | | | |
| 78 | (15:20) | | | | | | | |
| 79 (13min) | (15:30) | | | | | | | |
| 80 | (15:40) | | | | | | | |
| 81 | (15:50) | | | | | | | |
| 82 | (16) | | | | | | | |
| 83 | (16:10) | | | | | | | |
| 84 | (16:20) | | | | | | | |
| 85 (14min) | (16:30) | | | | | | | |
| 86 | (16:40) | | | | | | | |
| 87 | (16:50) | | | | | | | |
| 88 | (17) | | | | | | | |
| 89 | (17:10) | | | | | | | |
| 90 | (17:20) | | | | | | | |
| 91 (15min) | (17:30) | | | | | | | |
| **Totals % intervals** | | | | | | | | |

## Appendix C Percentage of independent PECS exchange trials for each PECS sessions

| Session ( **%** = independent exchange/total trials X 100) | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Mean (%)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phase 1** | | | | | | | | | | | | | | | | | | | | |
| **Phase 2** | | | | | | | | | | | | | | | | | | | | |
| **Phase 3A** | | | | | | | | | | | | | | | | | | | | |
| **Phase 3B** | | | | | | | | | | | | | | | | | | | | |
| **Phase 4** | | | | | | | | | | | | | | | | | | | | |
| **Phase 5** | | | | | | | | | | | | | | | | | | | | |
| **Phase 6** | | | | | | | | | | | | | | | | | | | | |

# Appendix C Cumulative new spoken words

| Sess-<br>ion | **Baseline** | **Phase 1** | **Phase 2** | **Phase 3A** | **Phase 3B** | **Phase 4** | **Phase 5** | **Phase 6** | **Maintenance** |
|---|---|---|---|---|---|---|---|---|---|
| **1** | | | | | | | | | |
| **2** | | | | | | | | | |
| **3** | | | | | | | | | |
| **4** | | | | | | | | | |
| **5** | | | | | | | | | |
| **6** | | | | | | | | | |
| **7** | | | | | | | | | |
| **8** | | | | | | | | | |
| **9** | | | | | | | | | |
| **10** | | | | | | | | | |
| **11** | | | | | | | | | |
| **12** | | | | | | | | | |
| **13** | | | | | | | | | |
| **14** | | | | | | | | | |

## Appendix C The number of mean length of utterance in home freeplay setting

| Sessions | MLU | Total number of morphemes | No of utterance | 2morpheme | 3 morpheme | 4 morpheme | 5 morpheme | 6 mo- | 7mo- | 8mo- |
|---|---|---|---|---|---|---|---|---|---|---|
| Baseline /Phase | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
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## Appendix C Home/school/kindergarten freeplay settings & Situational probe

| Phase | session | Prompted PECS mand (number of event) | Independent (non-prompted) PECS mand (number of event) | Vocal mand (number of event) | Other nonvocal mand (number of event) | Other vocal initiation | Other nonvocal initiation | Echolalic speech |
|---|---|---|---|---|---|---|---|---|
| Baseline | | | | | | | | |
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| **Phase 1** | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# Appendix C Intelligible vocalisation in PECS training

| **Sessions /Phase** | **Intelligible vocalisation** |
|---|---|
| Baseline 1 | |
| 2 | |
| 3 | |
| | |
| | |
| Phase 1 session 1 | |
| 2 | |
| 3 | |
| | |
| | |
| Phase 2 session 1 | |
| 2 | |
| 3 | |
| 4 | |
| | |
| Phase 3A | |
| | |
| Phase 3B | |
| | |
| Phase 4 | |
| | |
| Phase 5 | |
| | |
| Phase 6 | |
| | |
| Maintenance | |

# Appendix C Social interaction & play in home /school/kindergarten freeplay settings

| **Baseline/Phases**<br><br>No of min/Total number of min x 100= % | **Unoccupied** | **Onlooker** | **Solitary**<br><br>**play** | **Parallel**<br><br>**play** | **Group**<br><br>**play** | **Inappropriate behaviour** | **Stereotypical behaviour** |
|---|---|---|---|---|---|---|---|
| Baseline /phase | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
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| Phase1 | | | | | | | |
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## Appendix C EVENT SAMPLING

**Baseline / PECS / Generalisation setting / Maintenance**

**EVENT SAMPLING**

| | |
|---|---|
| **Child's name:** | **Age:** |
| **Date:** | **Observer:** |
| **Setting** | **Time** |

**BEHAVIOUR:**

| **Time** | **Antecedent Event** | **Behaviour** | **Consequent Event** |
|---|---|---|---|

**Field Note:**

**Trainer:**

**Communicative partner:**

**Physical prompter:**

**Any events:** **Any new words:**

**Comments:**

**Appendix D** The Ethics, Permission letter, Explanatory statement, & Consent form

MONASH University

**Standing Committee on Ethics in Research Involving Humans (SCERH)**
Research Office

Postal – Monash University, Vic 3800, Australia
Building 3E, Room 111, Clayton Campus, Wellington Road, Clayton
Telephone +61 3 9905 5490 Facsimile +61 3 9905 1420
Email scerh@adm.monash.edu.au www.monash.edu/research/ethics/human/index/html
ABN 12 377 614 012 CRICOS Provider #00008C
**Standing Committee on Ethics in Research Involving Humans (SCERH)**
Research Office

## Human Ethics Certificate of Approval

**Date 6 June 2008**
**Project Number CF08/0997 - 2008000494**
**Project Title Peer mediated picture exchange communication system (PECS) training for a child with autism**
**Chief Investigator Prof Dennis Moore**
**Approved From: 6 June 2008 To: 6 June 2013**

**Terms of approval**

1. The Chief investigator is responsible for ensuring that permission letters are obtained and a copy forwarded to SCERH before any data collection can occur at the specified organisation. **Failure to provide permission letters to SCERH 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 SCERH.
4. You should notify SCERH 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:** Requires the submission of a Request for Amendment form to SCERH and must not begin without written approval from SCERH. 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. SCERH 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 SCERH 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 CannyChair, SCERH Cc: Dr Angelika Anderson; Ms Jung-ae Yoon

Postal – Monash University, Vic 3800, Australia
Building 3E, Room 111, Clayton Campus, Wellington Road, ClaytonTelephone +61 3 9905 5490 Facsimile +61 3 9905 142Email scerh@adm.monash.edu.au www.monash.edu/research/ethics/human/index/html ABN 12 377 614 012 CRICOS Provider #00008C

# Department of Education and Early Childhood Development

50 Lonsdale Street GPO Box 4057 Melbourne Victoria 3001 DX210081 www.dhs.vic.gov.au Telephone: (03) 9616 7777
Facsimile: (03) 9616 8329 8 August 2008

Ms Annie Yoon
Faculty of Education

Building 5

Monash University,

Clayton Campus

Clayton, VIC 3800

Dear Ms Yoon,

**RE: Application to undertake research involving the Office for Children, Department of Human Services**

I write to you concerning your application to the Early Childhood Research Committee (ECRC) to undertake research entitled *"Peer mediated PECS (Picture Exchange Communication System) training for children with autism"*

I am pleased to inform you that the Office for Children RCC will support the research subject to the following conditions:

- The research is conducted in accordance with the documentation you provided to the RCC;

- The provision of a copy of the University of Monash University Standing Committee on Ethics in Research involving Humans approval letter;

- The provision of a final report to the RCC at the completion of the research;

- The provision of a one page summary of the outcomes of the research and how this relates to the Office for Children;

• The provision of a seminar/presentation to Office for Children staff on the outcomes of the research – with details to be arranged with the RCC Secretariat;

• That you provide the RCC with the opportunity to review and provide comment on any materials generated from the research prior to formal publication. It is expected that if there any differences of opinion between the RCC and yourself related to the research outcomes, that these differences would be acknowledged in any publications, presentations and public forums;

• That you acknowledge the support of the Office for Children Research Coordinating Committee in any publications arising from the research; and

• The project is commenced within 12 months of this approval letter, after this time the approval lapses and extensions will need to be considered by the RCC.

Our Ref: **2008/205** If you have any further enquiries, please don't hesitate to contact the RCC Secretariat on [redacted] or via emai[redacted] The RCC wishes you the best in your research and we look forward to seeing the results in due course.

If you have any further enquiries, please don’t hesitate to contact the RCC Secretariat on [redacted] or via email [redacted] The RCC wishes you the best in your research and we look forward to seeing the results in due course.

Yours sincerely

[redacted]

Joyce Cleary
Chair, Early Childhood Research Committee

# PARENTS

## Permission Letter for “PECS training for a child with autism”

25 June 2008

Principal researcher: Professor Dennis Moore & Dr Angelika Anderson

Co-researcher: Jung-ae (Annie) Yoon

Building 5, Clayton Campus,

Faculty of Education

MONASH UNIVERSITY VIC 3800

Dear **Jung-ae (Annie) Yoon**

Thank you for your request to invite my child for the above-named research.

I have read and understood the Explanatory Statement regarding the research < PECS training for children with autism> and hereby give permission for this research to be conducted.

Yours Sincerely,

__________________________

Parent’s name:

# PARTICIPANTS

## Permission Letter for “PECS training for a child with autism”

25 June 2008

Principal researcher: Professor Dennis Moore & Dr Angelika Anderson

Co-researcher: Jung-ae (Annie) Yoon

Building 5, Clayton Campus,

Faculty of Education

MONASH UNIVERSITY VIC 3800

Dear **Jung-ae (Annie) Yoon**

Thank you for your request to invite myself for the above-named research.

I have read and understood the Explanatory Statement regarding the research < PECS training for children with autism> and hereby give permission for this research to be conducted.

Yours Sincerely,

Participant’s name:

# Elwyn Morey Centre

# Early Childhood Intervention Program

## Permission Letter for “PECS training for a child with autism

25 June 2008

Principal researchers: Professor Dennis Moore & Dr Angelika Anderson

Co-researcher: Jung-ae (Annie) Yoon

Building 5, Clayton Campus,

Faculty of Education

MONASH UNIVERSITY VIC  3800

Dear **Jung-ae (Annie) Yoon**

Thank you for your request to recruit participants from the Elwyn Morey Centre for the above-named research.

I have read and understood the Explanatory Statement regarding the research <PECS training for children with autism> and hereby give permission for this research to be conducted.

Yours Sincerely,__________________________

Di Chandler

Manager Elwyn Morey Centre

# Permission Letter for “PECS training for a child with autism

4 April 2008

Principal researcher: Professor Dennis Moore & Dr Angelika Anderson

Co-researcher: Jung-ae (Annie) Yoon

Building 5, Clayton Campus,

Faculty of Education

MONASH UNIVERSITY VIC 3800

Dear **Jung-ae (Annie) Yoon**

Thank you for your request to recruit participants from this preschool for the above-named research.

I have read and understood the Explanatory Statement regarding the research <PECS training for children with autism> and hereby give permission for this research to be conducted.

Yours Sincerely,

__________________________

Name:

Director:

25 June 2008

**Explanatory Statement –** Elwyn Morey Centre

Title: PECS training for a child with autism

This information sheet is for you to keep.

My name is Jung-ae (Annie) Yoon and I am conducting a research project with Professor Dennis Moore and Dr Angelika Anderson in the Department of Education towards a PhD at Monash University. This means that I will be writing a thesis which is the equivalent of up to 800 pages.

I seek the participation of a child between the ages of three and five years for this study. The child will have been diagnosed with a moderate to severe level of Autism Spectrum Disorder and have limited functional language. Finally, the child must attend a preschool environment such as kindergarten.

This study uses the picture exchange communication system (PECS) to develop functional communication for children with autism. The aim of the study is to provide an empirical demonstration of the effectiveness of peer mediated intervention using PECS in increasing spontaneous language and communication skills of a preschool child with autism.

PECS involves the use of small cards with pictures on them of things the child likes. As the child progresses through PECS training, the child will develop the ability to communicate using the picture cards to request these items in a variety of situations.

PECS provides a practical and functional communication system for non-verbal children with autism. The literature suggests that a large number of children with autism who learn PECS show development of spoken language, social interaction and a reduction in problem behaviours. Peer involvement is advocated as a useful approach for facilitating the participation of children with autism in the general education classroom. The literature indicates that peer involvement is effective in improving social interaction and communication for children with autism and that typically developing children also increase interaction towards to children with autism.

This study seeks to provide PECS intervention involving typically developing children to increase functional communication and social interaction for children with autism. Learning to use peer-mediated intervention strategies in more than one context might increase generalisation across settings and provide more opportunities for a child with autism to adapt strategies to different situations.

The study will involve teaching the children with autism through the support of typical peers in the use of PECS. There will be PECS training sessions, observation sessions and PECS training with peer involvement sessions for the child with autism. Sessions will be conducted and video taped at the child's home and at preschool for up to 20 minutes. In addition, typically developing children will be involved in PECS training sessions and observation sessions at the classroom three times a week for up to 4 months. All sessions will be conducted at mutually convenient times at home and at preschool.

To minimise outside intrusion, the researcher will choose mutually convenient time for parents, teachers and participants. If necessary, participation on a particular day can be postponed to a later time in the day or a following day. To deal with participants' potential distress during data collection, the researcher will, if required, stop a session and obtain further advice and assistance from preschool staff, the counsellor, or psychologist.

No negative effects are anticipated from this research. However, it is possibly that this study may not be successful in improving the child's communication skills. We endeavour to conduct this research in an entirely professional and ethical manner, in accordance with Monash University's ethical guidelines and University regulations.

There is no cost to you to participate in the research. It is expected that the child will benefit from the training involved by acquiring functional communication skills and potential improvements in other developmental areas. Such benefits may also extend to improve behaviour in class and improved socialisation with other children.

Participation in this research is entirely voluntary and if you have any concerns please contact me by email or telephone or my supervisor Professor Dennis Moore or Dr Angelika Anderson by post, email or telephone.

I will endeavour to protect the confidentiality of the child's results and the school involved by the use of a pseudonym in all reporting and no names will be recorded on any observation sheets. It is hoped that beyond assessment requirements, the study will be reported in psychological journals or conference presentations. Storage of the data collected will adhere to the University regulations and these will be kept on University premises in a locked cupboard/filing cabinet for 5 years. Only the study investigators, including my supervisors Professor Dennis Moore and Dr Angelika Anderson, and myself will have access to the data.

If you would like to be informed of the research finding, please contact Jung-ae(Annie) Yoon [redacted] or [redacted] or you may contact my professor Dennis Moore on [redacted] or [redacted] or post: Building 5, Monash University, Clayton Campus, Wellington Rd, Clayton, 3800.

Thank you. Jung-ae (Annie) Yoon_________________

25 June 2008

**Explanatory Statement -** Parents of a child with autism

Title: PECS training for a child with autism

This information sheet is for you to keep.

Dear Parent/Guardian

My name is **Jung-ae (Annie) Yoon** and I am conducting a research project with Professor Dennis Moore and Dr Angelika Anderson in the Department of Education towards a PhD at Monash University. This means that I will be writing a thesis which is the equivalent of up to 800 pages.

This project is being conducted with the Elwyn Morey Centre at Monash University where your child attends an early learning program. Your child has been recommended by staff as being an ideal participant for this study. The reason your child is ideal for this study is that the research requires a child aged 3 to 5 years, who has been diagnosed with autism and demonstrates associated speech and communicative delays. In addition, the child must be enrolled full time in preschool and have a parent who will be prepared to participate.

This study uses the picture exchange communication system (PECS) to develop functional communication for children with autism. The aim of this study is to demonstrate the effectiveness of PECS when conducted with support from your child's peers in the pre-school.

PECS provides a practical and functional communication system for non-verbal children with autism. The literature suggests that a large number of children with autism who learn PECS show development of spoken language, social interaction and a reduction in problem behaviours. Peer involvement is advocated as a useful approach for facilitating the participation of children with autism in the general education classroom. The literature indicates that peer involvement is effective in improving social interaction and communication for children with autism and that typically developing children also increase interaction towards children with autism.

This study seeks to provide PECS intervention with involvement of typically developing children to increase functional communication and social interaction for a child with autism. Learning to use peer-mediated intervention strategies in more than one context might increase generalisation across settings and provide more opportunities for a child with autism to adapt strategies to different situations.

PECS involves the use of small cards with pictures on them of things your child likes. As your child progresses through the PECS training, they will develop the ability to communicate using the picture cards to request these items in a variety of situations.

The study will involve teaching your child to use PECS. All session will take up to 20 minutes. There will be training sessions, observation sessions and peer mediation sessions. All session will be conducted and video taped in your home and at preschool. Trainings sessions and observation sessions would be conducted in your home three times a week for up to 4 months. Observation sessions and peer mediation sessions would be conducted in the preschool three times a week for up to 6 months. To minimise outside intrusion, the researcher will choose mutually convenient time for parents, teachers and participants. If necessary, participation on a particular day can be postponed to a later time in the day or a following day.

No negative effects are anticipated from this research. However, it is possibly 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, in accordance with Monash University's ethical guidelines and University regulations.

There is no cost to you to participate in the research. It is expected that your child will benefit from the training involved by acquiring functional communication skills and potential improvements in other areas of behaviours. Such benefits may also extend to improve behaviour in class and improved socialisation with other children.

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. To deal with participants' potential distress during data collection, the researcher will, if required, stop a session and obtain further advice and assistance from preschool staff, the counsellor, or psychologist. Should you wish to withdraw or if you have any concerns please contact me by email or telephone or my supervisor Professor Dennis Moore or Dr Angelika Anderson by post, email or telephone.

I will endeavour to protect the confidentiality of the child's results and the school involved by the use of a pseudonym in all reporting and no names will be recorded on any observation sheets. It is hoped that beyond assessment requirements, the study will be reported in psychological journals or conference presentations. Storage of the data collected will adhere to the University regulations and will be kept on University premises in a locked cupboard/filing cabinet for 5 years. Only the study investigators, including my supervisors Professor Dennis Moore and Dr Angelika Anderson, and myself will have access to the data. Your child's results and a copy of the final report can be made available to you at no cost by contacting me.

If you would like to be informed of the research finding, please contact Jung-ae(Annie) Yoon [redacted] or [redacted] or you may contact my professor Dennis Moore on [redacted] or [redacted] or post: Building 5, Monash University, Clayton Campus Wellington Rd, Clayton, 3800.Thank you. Jung-ae (Annie) Yoon_________________

25 June 2008

**Explanatory Statement –** Parents of children who do not have autism

Title: PECS training for a child with autism

This information sheet is for you to keep.

Dear Parent/Guardian

My name is **Jung-ae (Annie) Yoon** and I am conducting a research project with Professor Dennis Moore and Dr Angelika Anderson in the Department of Education towards a PhD at Monash University. This means that I will be writing a thesis which is the equivalent of up to 800 pages.

This project is being conducted in the preschool where your child attends. Your child has been recommended by staff as being an ideal participant for this study. The study requires two children who are aged between three to five years old with full time enrolment. In addition, your child has demonstrated an interest in communicating and engaging with a child with autism (the subject of the study) in your child's pre-school.

This study uses the picture exchange communication system (PECS) to develop functional communication for children with autism. The aim of this study is to demonstrate the effectiveness of PECS for a child with autism when conducted with support from your child in the pre-school.

PECS involves the use of small picture cards to exchange with preferred items or foods which a child with autism can use to communicate with others. As your child progresses with the target child through PECS intervention, the study will assess the value of positive social outcomes between your child and the target child with autism.

PECS provides a practical and functional communication system for non-verbal children with autism. The literature suggests that a large number of children with autism who learn PECS show development of spoken language, social interaction and a reduction in problem behaviours. Peer involvement is advocated as a useful approach for facilitating autistic children's participation in the general education classroom. The literature indicates that intervention with peer involvement is effective in improving social interaction and communication for children with autism and that typically developing children also increase positive interaction towards children with autism.

This study seeks to provide PECS intervention involving typically developing children to increase functional communication for a child with autism. Learning to use peer-mediated intervention strategies in more than one context might increase generalisation across settings and provide more opportunities for a child with autism to adapt strategies to different situations.

The study will involve teaching your child to use PECS with the child with autism. All sessions will take up to 20 minutes and will be video taped. There will be peer training sessions and observation sessions. Trainings sessions and observation sessions will be conducted in the preschool setting three times a week for up to 4 months. To minimise outside intrusion, the researcher will select a mutually convenient time for you and your child. If necessary, participation on a particular day can be postponed to a later time in the day or a following day. No negative effects are anticipated from this research. We endeavour to conduct this research in an entirely professional and ethical manner, in accordance with Monash University's ethical guidelines and University regulation.

There is no cost to you to participate in the research. 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. To deal with participants' potential distress during data collection, the researcher will, if required, stop a session and obtain further advice and assistance from preschool staff, the counsellor, or psychologist. Should you wish to withdraw or if you have any concerns please contact me by email or telephone or my supervisor Professor Dennis Moore or Dr Angelika Anderson by post, email or telephone.

I will endeavour to protect the confidentiality of your child and the school involved by the use of a pseudonym in all reporting and no names will be recorded on any observation sheets. It is hoped that in addition to reporting in a thesis, the study will be reported in psychological journals or conference presentations. Storage of the data collected will adhere to the University regulations and these will be kept on University premises in a locked cupboard/filing cabinet for 5 years. Only the study investigators, including my supervisors Professor Dennis Moore and Dr Angelika Anderson, and myself will have access to the data.

If you would like to be informed of the aggregate research finding, please contact Jung-ae(Annie) Yoon [redacted] or [redacted] or you may contact my professor Dennis Moore on [redacted] or [redacted] or post: Building 5, Monash University, Clayton Campus, Wellington rd, Clayton 3800.

Thank you.

Jung-ae (Annie) Yoon

25 June2008

**Explanatory Statement –** Preschool principles/teacher

Title:  PECS training for a child with autism

This information sheet is for you to keep.

Dear teacher

My name is Jung-ae (Annie) Yoon and I am conducting a research project with Professor Dennis Moore and Dr Angelika Anderson in the Department of Education towards a PhD at Monash University.  This means that I will be writing a thesis which is the equivalent of up to 800 pages.

This project is being conducted with your preschool where your students attend an early learning program. Your student has been recommended by staff at the Elwyn Morey Centre at Monash University as being an ideal participant for this study.  The reason your student is ideal for this study is that the research requires a child aged 3 to 5 years, who has been diagnosed with autism and demonstrates the associated speech and communicative delays.  In addition, the child must be enrolled full time in preschool and has a parent who will be prepared to participate.  Two typical peers who are enrolled in the same class as the child with autism will also be required to participate in the study. The parents of a child with autism have given their consent for their child to participate in the study.  I am seeking your permission to conduct observation and picture exchange communication system (PECS) training for a child with autism at your school.

This study involves the use of PECS to develop functional communication skill for children with autism. PECS program consists of six phases in which a child learns to exchange pictures with preferred items or foods to communicate with others. The aim of this study is to demonstrate the effectiveness of PECS when conducted with support from the children’s peers in the pre-school.

PECS is widely used in teaching communication skills to children with autism and is recognised as a being highly effective communication system.  Furthermore, PECS is unique in that it teaches children to self-initiate communication rather than just respond to prompts. Recent studies suggests that a large number of children with autism who learn PECS show development of spoken language, social interaction and a reduction in problem behaviours.  Peer involvement is advocated as a useful approach for facilitating the participation of children with autism in the general education classroom. The literature indicates that peer involvement is effective in improving social interaction and communication for children with autism and that typically developing children also increase interaction towards children with autism.

This study seeks to provide PECS intervention involving typically developing children to increase functional communication and social interaction for a child with autism.  Learning to use peer-mediated intervention strategies in more than one context might increase generalisation across settings and provide more opportunities for a child with autism to adapt strategies to different situations.

The study will involve teaching the child with autism through the support of typical peers in the use of PECS. There will be PECS training sessions, observation sessions and PECS training with peer involvement sessions for the child with autism. Sessions will be conducted and video taped at the child's home and at preschool for up to 20 minutes. In addition, typically developing children will be

involved in PECS training sessions and observation sessions at the classroom three times a week for up to 4 months. All sessions will be conducted at mutually convenient times at home and at preschool. To minimise outside intrusion, the researcher will choose mutually convenient time for you and participants. If necessary, participation on a particular day can be postponed to a later time in the day or a following day. To deal with participants' distress during data collection, the researcher will stop the sessions and will obtain advices and help from to the preschool staff, counsellor, or psychologist.

Participation in this research is entirely voluntary and no negative effects are anticipated from this research. However, it is possibly that this study may not be successful in improving the child's communication skills. We endeavour to conduct this research in an entirely professional and ethical manner, in accordance with Monash University's ethical guidelines and University regulations.

There is no cost to you to participate in the research. It is expected that the child will benefit from the training involved by acquiring functional communication skills and potential improvements in other developmental areas. Such benefits may also extend to improve behaviour in class and improved socialisation with other children. If you have any concerns please contact me by email or telephone or my supervisor Professor Dennis Moore or Dr Angelika Anderson by post, email or telephone.

I will endeavour to protect the confidentiality of the child's results and the school involved by the use of a pseudonym in all reporting and no names will be recorded on any observation sheets. It is hoped that beyond assessment requirements, the study will be reported in psychological journals or conference presentations. Storage of the data collected will adhere to the University regulations and these will be kept on University premises in a locked cupboard/filing cabinet for 5 years.

If you would like to be informed of the research finding, please contact Jung-ae(Annie) Yoon [redacted] or [redacted] or you may contact my professor Dennis Moore on [redacted] or [redacted] or post: Building 5, Monash University, Clayton Campus, Wellington rd, Clayton 3800.

Thank you. Jung-ae (Annie) Yoon __________________

**Consent Form –** Parents of a child with autism

Title: PECS training for a child with autism

*I agree that ____________ (full name of participant) may take part in the above Monash University research project. The project has been explained to ___________ (full name of participant) and to me, and I have read the Explanatory Statement, which I keep for my records.*

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. Should such a request be made, I will in acting on behalf of my child, notify the researcher and the research shall immediately cease or rest for the period specified. 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.

I understand my child will be trained to use picture exchange communication system at home and at the preschool. I understand the aim of this study is to demonstrate the effectiveness of PECS when conducted with support from typically developing children in the pre-school.

I understand the study will involve:

- pre-intervention interview, PECS training sessions, observation sessions and PECS training with peer involvement for my child for sessions of up to 20 minutes that will be video taped
- conducting at home and at preschool sessions at mutually convenient times
- the occurrence of sessions in my home and preschool over a 4 month period during which time there will be three training sessions and three observation sessions per week.

I understand that data from the study will be kept in secure storage and accessible only to the research team. I understand that the data will be destroyed after a 5 year period. I also understand only the study investigators, including supervisors Professor Dennis Moore and Dr Angelika Anderson, and Annie Yoon will have access to the data.

**Participant's name: ________________**

**Participant's Age: _________________**

**Parent's / Guardian's Name: __________________**

**Parent's / Guardian's relationship to participant: ________________________**

**Parent's / Guardian's Signature: __________________________**

**Date: ______________________**

**Consent Form –** Preschool principles/teacher

Title: PECS training for a child with autism

I agree that ____________ (full name of teacher) may take part in the above Monash University research project. The project has been explained to ___________ (full name of participant) and to me, and I have read the Explanatory Statement, which I keep for my records.

I understand that I agree to permit the research activity to occur in preschool settings. I further understand that any information provided by myself or the participants is strictly confidential, and that any reports from the study will not, under any circumstances, contain any personally identifiable information.

I understand the aim of this study is to demonstrate the effectiveness of PECS when conducted with support from typically developing children in the pre-school.
I understand the study will involve:

- teaching the child with autism through the support of typical peers in using PECS program
- PECS training sessions, observation session and PECS training with peer involvement sessions for the child with autism
- sessions up to 20 minutes that will be video taped at the child's home and preschool
- training typically developing children to use PECS program at the preschool over up to 4 months during which time there will be three training sessions and three observation sessions per week
- mutually convenient session times at the preschool for you and the participants.

I understand that data from the study will be kept in secure storage and accessible only to the research team. I understand that the data will be destroyed after a 5 year period. I also understand only the study investigators, including supervisors Professor Dennis Moore and Dr Angelika Anderson, and Annie Yoon will have access to the data.

**Participant's name: ________________**

**Participant's Age: _________________**

**Parent's / Guardian's Name: __________________**

**Parent's / Guardian's relationship to participant: ________________________**

**Parent's / Guardian's Signature: __________________________**

**Date: ______________________**

**Consent Form –** Parent of children who do not have autism

Title: PECS training for a child with autism

I agree that ____________ (full name of participant) may take part in the above Monash University research project. The project has been explained to me, and I have read the Explanatory Statement, which I keep for my records.

I understand that my child 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. Should such a request be made, I will in acting on behalf of my child, notify the researcher and the research shall immediately cease or rest for the period specified. 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. In addition, I understand that the information of the target child will be kept confidential.

I understand the aim of this study is to demonstrate the effectiveness of PECS when conducted with support from typically developing children in the pre-school.

I understand the study will involve:

- teaching my child to use PECS to support a peer with autism at my child's pre-school
- observation sessions and PECS training with peers at preschool
- video taping of all sessions of up to 20 minutes at preschool
- training and observation session three times a week for up to 4 months
- mutually convenient session times at preschool for your child.

I understand that data from the study will be kept in secure storage and accessible only to the research team. I understand that the data will be destroyed after a 5 year period. I also understand only the study investigators, including supervisors Professor Dennis Moore and Dr Angelika Anderson, and Annie Yoon will have access to the data.

Participant's name: ________________

Participant's Age: _________________

Parent's / Guardian's Name: __________________

Parent's / Guardian's relationship to participant: ________________________

Parent's / Guardian's Signature: __________________________

Date: ____________________

## Appendix E PRE-INTERVENTION QUESTIONNAIRE

**Child's name:** **D.O.B:**

**Family information:**

**Cultural background:**

**Language spoken at home:**

**Religion:**

**Any known allergies:**

**Date of Interview:**

1. What is your child's gender?

2. How old is your child?

3. What has your child been diagnosed with?

4. What age was your child first diagnosed?

5. Who diagnosed your child?

6. What formal assessments has your child undertaken? What were the results for each assessment?

7. Does your child have siblings? If yes, how old are the

8. At what age did your child first receive treatment?

9. At what age did your child start at the Elwyn Morey Centre (or other current intervention centre)?

10. What intervention services does your child currently receive? If any, how long have these services been used?

11. Has your child showed any improvements of social or communicative behaviours with the use of these services?

12. If any, what problem behaviours does your child exhibit that are of a concern to you?

13. Does your child have any particular habits, hobbies or activities that he or she is particularly interested in or spend more time doing?
14. What types of toys, foods or other items does your child like or enjoy? Can you indicate which of these you think he or she would find particularly motivating?

**Toys**:

**Foods**:

15. What kinds or types of toys, foods or other items does your child dislike? Can you indicate which of these you think he or she would particularly find less motivating?

**Toys**:

**Foods**:

16. Do you have any concerns, queries or questions regarding the intended intervention and purpose of the present research?

17. Who are your child's best friends at preschool and in other places?

18. How does your child behave or respond to new situations eg. new toy or friend's house?

19. Which indoor and outdoor places or areas does your child like the most? Which ones does he or she dislike the most?
20. What are your expectations and concerns about your child (e.g. social interaction, communication)?

**Concerns**:

**Expectation:**

## Appendix E  Vocabulary selection worksheet

**Child:** **Person completing form:**

**Date:**

**Instructions:** List up to 5-10 items for each category. Include only those items that your student or child currently enjoys (or dislikes for final category).

| | |
|---|---|
| Things your student/child likes to eat | |
| Things your student/child likes to drink | |
| Activities your student/ child likes (watching television, spinning, sitting in a special chair, squeezes) | |
| Social games your student/child likes (peek-a-boo, chase, tickles, etc.) | |
| Places your student /child likes to visit | |
| What your student /child chooses to do during free time | |
| People your student/child recognises and enjoys being with | |
| Items, activities your student/child DOES NOT like | |

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# Appendix F The assessment of basic language and learning skill-revised (ABLLS-R) results for Study 1

## Basic Learner Skills Section

A. Cooperation and Reinforcer Effectiveness

Angel is unable to respond quickly when instructions are given with reinforcement (A11 & A14=0). However, Angel is able to look at non-reinforcing items, take an item, respond to multiple instructors, wait before touching stimuli and look to an instructor for instructions. In addition, she is able to scan items in array before responding, uses various reinforcements, work for intermittent reinforcement, look for an instructor's facial expression, respond to social reinforcers, wait appropriately for reinforcer delivery, and seek approval for task completion (A3-4, A7-10, A12-13, A15-19=1). Angel will also usually take preferred items when offered and will preferentially take a reinforcer when offered two items, where an item is not a reinforcer (A1 & A2=2).

B. Visual performance

Angel is generally unable to match either identical objects or identical pictures (B3-10, B12-13, B12-27=0). However, she is able to complete a square-edged framed puzzle (B11=1). In addition, she is able to do a single puzzle set and put pieces in a box (B1-2=2).

C. Receptive language

Angel is mostly unable to give objects following instructions to provide selected, named items by an instructor. This includes an inability to respond to instructions to match objects to picture cards whether by hand signals, fluent discriminations or through selection of items by another's gaze. Furthermore, Angel cannot select items based on their function, class and features (C8, C12-14, C17-20, C23-26, C28-29, C31-57=0). However, Angel will sometimes look at a person when her name is called and follow simple instructions in certain situations (C1-3, C5, C7,C9-10, C16, C21-22, & C30=1). She is able to follow instructions to touch a common item and select one reinforcer from an array of objects (C4, 11 &15 =2). Finally, Angel does demonstrate the ability to follow instructions to do her favorite activities, even though that activity is not occurring at that time (C6=3).

D. Motor imitation

Angel is generally able to imitate others' simple actions including gross and fine motors (D 3-4, 8-9, 11-12, 14, 17, 20 23, 25 & 26=1). However, she is unable to imitate discriminating motor movement, varied imitation instructions with multiple objects and delayed imitation (D1-2, 5-7, 10, 15-16, 18-19, 21-22, 24 & 27=0).

E. Vocal imitation

Angel is not able to imitate sequences of single words and multiple sound combinations (E 2, 5-6, 10-11, 15-18=0). However, she is able to imitate sounds in a consistent pattern (eg. a consonant vowel formation such as "bye-bye"), and to provide imitations of simple words or numbers or phrases (E1, 3-4, 7-9, 12-14, 19-20=1).

F. Requests

Angel is unable to request attention through most of the categories tested, including requests that involve the use of adjectives, pronouns, adverbs and information using what, where, who, which, when and how (F10-11, F13-29=0). However, Angel is able to request items with simple one or two word constructions, while also requesting missing items needed for a task, as well as seeking help when she needs it. (F7-9, F12=1). Angel is able to ask for what she wants when the reinforcer is present (F2=2) and is able to use signs or words for requests (F3=3). In addition, Angel is able spontaneously ask for items that are present or not present (F4-6=4) using vocal or nonvocal communication.

G. Labeling

Angel is generally not able to label objects, items, body parts, actions (G2-20, 22-42, 44-47=0). However she is able to label a few reinforcers, words and can express her emotions (G1, G21 & G43=1).

H. Intraverbals

Angel lacks intraverbal skills (H3-49=0) but is able to provide words for songs ie. when the song is being sung with others (H1-2=1).

I. Spontaneous vocalizations

Angel is able to vocalise identifiable speech sounds, words and can sing songs with models (I 1-2 & 15-18=1). In addition, she is good at singing songs while others are singing or while listening to other sources such as CDs or videos (I 4=3). However, she is not able to add spontaneous comments during a conversation (I 9=0).

J. Syntax and grammar

Angel is generally not able to use syntax and grammar (J 1-4, J6-20=0). However, she is able to use regular plurals (e.g. socks) occasionally.

K. Play and leisure

Angel is generally not able to interact with other children or play simple games with peers (K 7 & K9-15=0). However, she is able to explore a variety of toys and accepts toys from other children (K1-2 & K8=1). In addition, she is able to play independently with toys indoors and outdoors (K3-6=2).

L. Social interaction

Angel is not able to follow directions from peers to adjust her behaviours, deliver a message or talk with others. Nor she is able to ask and maintain the attention of others (L11-12, L18-19, L24-34=0). However, she is able to engage in physical interaction near other children, take offered items, show interest in others' behaviour and physically approache other children (L1-2, L4-10, L13-17, L20-23=1). Furthermore, she is able to respond appropriately to positive physical interaction by other children (L3=2).

M. Group instruction

Angel generally does not follow group instructions with discrimination or raise her hand to get the teacher's attention, or to answer questions (M2, M4, M6-10=0). However, she is able to sit appropriately in a small group and follow group instructions from the teacher (M1, 3, 5, M11-12=1).

N. Classroom routines

Angel is generally able to follow a daily routine, work independently on activities for a short time, get in line on request, get materials and, put away materials with prompts (N1-2, N4, N6-10=1). In addition, she is able to sit and wait during routine transitions (N3 & N5=2).

O. Generalised responding

Angel is usually not able to use skills acquired in one situation to other situations (P2-6=0). However, she is able to recognise an item's general category in relation to similar items within ten trials (P1=1) e.g. that a brown cup and a striped cup are both cups.

Q. Reading

Angel is not able to identify words and letters (all Q=0).

R. Math

Angel cannot count or recognise numbers (all R=0).

S. Writing

Angel is unable to copy letters (S2-10=0). However, she is able to make marks on paper (S1=2).

T. Spelling

Angel is not able to match letters, copy words and spell (T1-7=0).

U. Dressing

Angel cannot put on or put off items of clothes such as shirts, or button or unbutton clothes or use zippers (U 3-4, U8-15=0). However, she can put on and take off pants, shoes, socks and a coat (U1-2, U5-7=1).

V. Eating

Angel can feed herself using fingers, forks and spoons and can drink using a cup, and also a straw (V1-4, V6, 8 10=2). She can clean up the table with verbal prompts (V9=1), however she cannot use a hand knife (V5 & 7=0).

W. Grooming

Angel is able to wash her hands, dry her face, brush her hair and teeth and blow her nose, but only through prompts (W1-7=1).

X. Toileting

Angel has no toileting skills (all X=0).

Y. Gross motor

Angel is not able to get into and out of a kneeling position, run smoothly, walk backwards, hop on two feet or control a ball (Y2-3, Y7-12, Y15-18, Y20-29). However, she is able to walk, jump, roll sideways, balance on one foot, and skip (Y1, 4-6, 13-14, 19=1).

Z. Fine motor

Angel can do a variety of fine motor skills such as grasping a crayon, inserting puzzle pieces, placing pegs, and turning pages (Z1-3, Z6-8, Z13-15, Z17, Z19, Z23, Z25=1). However, she is not able to use advanced fine motor skills such as putting in multiple puzzle pieces or blocks, colour within boundaries, or squeeze glue and copy shapes (Z4-5, Z9-12, Z16, Z18, Z20-22, Z24, Z26-28=0).

# Appendix G The assessment of basic language and learning skill-revised (ABLLS-R) results for Study 2

**Basic Learner Skills Section**

A. Cooperation and Reinforcer Effectiveness

Bee is unable to generalize learned skills with other instructors and has difficulty to uses a variety of items and complete tasks with interaction with instructor (A7, 8, 12, 14, 15, 18 & A19=0). However, Bee is able to look and responds to instructor with controlled items and respond to social reinforcers with prompts and waits with simple prompts. (A1-4, A6, A9-11, A16-17=1). Bee will also usually approaches to a simple task when a response is required for reinforcement (A5 =2).

B. Visual performance

Bee is generally unable to match multiple puzzles, jisaw puzzle, matching associated pictures, 3-dimential objects, arranging items with a order and drawing lines of mazes (B14-16, B19, 20, 23, 25 & B27=0). However, she is able to match a single item, puzzles with insert frame and can sort different items(B6, 8, 10, 12, 13, 17,18, 21, 22 & B26=1). In addition, she is able to match two objects to an identical objects or pictures in an array of items and can match puzzle with square edged frame (B3, 4, 7 & B11=2) and she is able to do four block design on picture cards (B9=3). Bee is able to do a single puzzle, form box (B1, 2 & B4= 4).

C. Receptive language

Bee is unable to follow instructions which require her to give a named item and unable to follow instructions to touch item vs a distracter. She is not able to follow instruction by touching or pointing her own body part and select a specific item when presented in an six array. Also she is not able to follow another's eye gaze, giving items, going to other person, pretending action, selecting associating pictures, selecting by feature, function, class and locating objects within pictures, selecting pictures of "same" and "different", pictures of social interactions and representing emotions (C6, C8, 10, 15, 16, 18, 21-23, 25, 27-29, 32, 34-39, 42-47, 51-57=0). However, Bee will rarely respond to her name, looking and touching a item when prompted, and follow simple instructions in certain situations. Also she is able to select and discriminate one of two pictures as well as following simple hand signals (C1, 3, 5, 7, 11-14, 17, 19, 20, 24, 26, 30, 31, 33, 40, 41& 48-50 =1). She is able to follow instructions to touch a common item (C4=2). Finally, Bee is able to follow an enjoyable action when the activity occurs (C2=3).

D. Motor imitation

Bee is generally unable to imitate independently others' simple actions including gross and fine motors (D 1, 9-11, 13, 14, 17, 19, 22, 23, 25 & 27=0). However, she is able to imitate motors with verbal prompts, can imitate known actions or imitating following a model(D3-8, 12, 15, 16, 18, 20, 21 & 24=1).

E. Vocal imitation

Bee is not able to imitate sounds, sequences of single words, phrases and multiple sound combinations (E 1-18=0).

F. Requests

Bee is unable to request what she wants spontaneously without prompting. She is not able to request using sentences, help, new items and requesting informations such as what, where, which, when, how and why spontaneously. (F3-6, 8-11, 13, 15-17, F19-29=0). However, Bee is able to request items by indicating pulling or sign and request help or attention only a few situations (F1, 2, 7, 12, 14, F18=1).

G. Labeling

Bee is totally not able to label objects, items, body parts, actions (G1-47=0).

H. Intraverbals

Bee is not able to use intraverbal skills (H1-49=0).

I. Spontaneous vocalizations

Bee is not able to vocalise identifiable speech sounds, words as she does not have words (I 1-9=0).

J. Syntax and grammar

Bee is not able to use syntax and grammar (J 1-4, J6-20=0).

K. Play and leisure

Bee is generally not able to interact with other children and talk with other children (K2, K6-15=0). However, she is able to explore a variety of toys (K1& K5=2) and she is able to play independently with toys indoors and outdoors (K3 & K4)

L. Social interaction

Bee is not able to interact socially with other children and a message or talk with others. Nor she is able to ask and maintain the attention of others (L1-28, L30-34=0). However, she is able to shows interest in other's activity to respond (L29=1).

M. Group instruction

Bee is not able to attends to her teacher in a group situation and is not able to follow group instructions e.g. not able to discriminate raising her hand to get obtain the teacher's attention, or to answer questions (M3-10=0). However, she is able to sit appropriately in small and large group (M1, 2=1).

N. Classroom routines

Bee is generally able to follow a daily routine, wait her turn, gets own materials and work independently, get in line on request, get materials and, put away materials with prompts (N1-2, N5-10=0). In addition, she is able to sit and physically transition to the next area or activity (N3 & N4=1).

O. Generalised responding

Bee is not able to use skills acquired in one situation to other situations (P1-6=0).

Q. Reading

Bee is not able to identify words and letters (all Q=0).

R. Math

Bee cannot count or recognise numbers (all R=0).

S. Writing

Bee is unable to copy letters (S1-10=0).

T. Spelling

Bee is not able to match letters, copy words and spell (T1-7=0).

U. Dressing

Bee is not able to dress herself. She cannot put on or put off clothes (U 1-15=0).

V. Eating

Bee is not able to feed self with a spoon, fork, knife (V4-7 & V9 =0). She can drink from a straw and a cup (V2, 3, 8, V10=1), however she can use fingers to eat foods (V1=2).

W. Grooming

Bee is not able to wash her hands, dry her face, brush her hair and teeth and blow nose, (W1-5 & W7=0). She is able to brush teeth when prompted (W6=1).

X. Toileting

Bee has no toileting skills (all X=0).

Y. Gross motor

Bee is not able to hop on two feet, throw ball from chest, walk across a beam, catch a ball, balance with one foot, kick a ball, skipping, jumping jacks, riding a bicycle (Y1, Y8-9, Y14-20, Y22-30=0). However, she is able to do simple gross motor such as walk forward, kneel, run smoothly, jumping forward and backward, climbing a ladder and rolling a ball (Y1-7, 10-13, 21=1).

Z. Fine motor

Bee is not able to use advanced fine motor skills such as putting spring-type clothespins on a line, color within boundaries, cuts paper with shapes, remove wrappers from foods, squeezes a glue and copy shapes (Z 9-22, Z 24-28=0). However Bee can do simple fine motor skills such as strings beads, stacks blocks, turning pages, grasping a crayon, inserting puzzle pieces and placing pegs on a board (Z1-8 & Z23 =1).

# Appendix H The assessment of basic language and learning skill-revised (ABLLS-R) results for Study 3

## Basic Learner Skills Section

A. Cooperation and Reinforcer effectiveness

Charlie is generally able to look at a non-reinforcing item, take and approach a reinforcer when offered, and is able to respond when an adult uses reinforcement. On occasions he is able to speak a few words during delivered reinforcement; he also prefers reinforcements that involve fun. He waits appropriately if a reinforcer delivery is delayed (A3-6, A13- 14, A17=1). He will also usually take preferred items when offered and will preferentially take a reinforcer when offered two items, where one item is not a reinforcer. He responds to multiple instructors and he looks for an instructor's facial changes and seeks recognition for task completion; he also works independently to complete a task with an effective reinforcer (A1-2, A7, A 15, A18-19=2). He responds to social reinforcers (A16=4).

B. Visual performance

Charlie is mostly unable to arrange items in a logical order and is also unable to draw a line from the start to end of simple mazes (B25, A27=0). However, he is able to complete matching simple items and can match the patterns with items such as matching puzzles without a frame. In addition, he can replicate simple three-dimensional objects and can match objects after observing others matching these objects beforehand. He is also able to arrange a set of pictures in a sequence (B7, B13-14, B23-24, B26=1). He can also match pictures to objects and put pieces in a box; (B2, B6, B12=2). Charlie has other visual performance skills, including: sorting non-identical items when given non-identical objects; performing block designs on a picture card as well as doing puzzles with multiple connecting pieces. Charlie has the ability to complete jigsaw puzzles, match associated pictures and find the initial item when items are re-shown (B3, B5, B8-10, B15-22=3). Charlie successfully completes puzzles with a single-piece type of inset and puzzles with square-edged border frame (B1, B11=4).

C. Receptive language

Charlie is able to follow simple motor actions, acquire new skills without intensive training and is able to point to items from an array of items (C9, C18-19, =1). He responds to his own name, follows instructions, looks at and touches in various positions. In addition, he can follow instructions to touch an item and select the item from two objects. His skills include: touching his own pieces of clothing, following directions to go a person; playing and pretending to be another person, animal or object; and selecting items according to an instructor's question. He is also able to select two items from a larger set and in sequence. He can locate objects in a larger picture and select pictures of specific locations and activities and can select "same" and "different" when three objects are placed before him (C1, C3-5, C10-12, C20, C22, C27, C32, C34, C36,C40-41,C43-44,C50,C53,C55 =2). Charlie also follows instructions to do his favourite activities and for routine situations. He is able to follow directions to touch items, select one of three pictures representing actions and select objects by class and feature. He also can select single items with two characteristics (e.g. the big red ball" and " the hot breakfast cereal") and can follow instructions which require selections involving pronouns. He is able to select non-examples of items (e.g. not food, not yellow) and pictures of social interactions (C2, C6-7, C17, C23, C35, C, 37-39, C47,C52, C56-57=3). Finally, Charlie's capabilities also include: following instructions to select one of two common objects; touching or pointing to his own body parts; selecting one of six or more objects on a table; following an instruction to walk; giving an item; and getting a named item. He also can select pictures of common community helpers in his environment (e.g. sounds and emotion) and he can select a set of items with two specific characteristics such as function and class (C13-16, C21, C24, C28-31, C33,C42, C45-46, C48-49,C51,C54=4)

D. Motor imitation

Charlie is generally able to touch objects in sequence following an instructor's demonstration. He can imitate a sequence of motor activities including repetition motors, movement, vocalisation and using multiple objects (D13, D18-20, D22-24=1). He is also able to imitate using objects, gross motor movements including hand, leg, head and mouth. He can imitate ongoing actions with speed and difficult motor movements (D2-7, D9-10, D14-17,D 21=2). He is also able to imitate gross motor actions modelled in a mirror including facial/oral and fine motor action. Charlie is able to imitate motor movements spontaneously without an adult's verbal prompt (D8, D11-12, D25-26=3). He can imitate motor actions using objects as well as delay imitations (D1, D27=4).

E. Vocal imitation

Charlie is not able to imitate number sequences on request or words said too quickly (E7-8, E11, E14-15=0). However, he is able to imitate single sounds such as "mama, baba" and can provide imitations of simple words or short messages and spontaneously imitate a few simple phrases (E2, E4-5, E10, E13, E17-18, E20=1). He is able to imitate initial words, numbers and consonant-vowels including soft loud vs. soft sound words (E3, E6, E9, E16, E19=2). He is able to imitate some words on request (E1, E12=3).

F. Requests

Charlie is unable to request using adjectives, pronouns and adverbs, including the seven key question markers in English: what, where, who, which, why, when and how (F16, F20-22, F24-28=0). However, Charlie is able to request items through eye-contact (F7, F11, F13, F15, F17, F19, F23=1). Charlie is able to ask for what he wants by indicating specific items using head movement or saying yes/no and he can request spontaneously (F1, F10, F12, F18, F29=2). In addition, Charlie is able to request others to perform an action and to find him missing items needed for a task (F8-9, F14=4).

G. Labeling

Charlie cannot label complex phrases. He is also unable to label the class of individual items including describing items or events, spontaneous labelling social interaction behaviours and multiple phrases (G11, G19-21,G25,G38-39,G41, G44-47 =0). Charlie can label with known items, parts of features of objects, two-components of labels including noun and adjective. He is able to identify obvious problems and label propositions of items (G9-10, G12, G18, G22, G30,G35, G36=1). He is able to label pieces of clothing, common ongoing actions, indicating yes/no and items at a distance (G6-8, G23, G26, G28, G32, G34, G37, G40=2). He is able to label body part, adjective, items with function, feature, class (G5, G13-17, G27, G29, G31=3). He is able to labels common objects used as reinforcers, including pictures, people, simple emotions and internal events (G1-4, G24,G33, G42-43=4).

H. Intraverbals

Charlie lacks intraverbal skills including answering questions based on who/whose/when/what and other intraverbal associations (H2-3, H22-24, H28-29, H33, H40, H43-45, H47-48=0) but he is able to fill in words from songs and name the item in a phrases and will be able to answer simple what/where regarding items found in the home or classroom (H1, H5, H7-8, H10-18, H25, H34-36, H39, H41-42, H46=1). He is able to fill in the remaining words in phrases, naming the function of an item, and provide yes/no answers with head movements (H9, h37-38, H49=2). He is able to provide answers to questions regarding personal information and provide names for animal sounds (H4, H6=3). He is able to name items, people, activities previously observed and can answer simple questions based around "which" or "how" (H19-21, H26, H31-32=4).

I. Spontaneous vocalizations

Charlie can only sing songs with models (I 4=1). He is able to make vocal imitations spontaneously including requesting, labelling and conversation (I 3, I6-9=2). He can also make a variety of spontaneous speech sounds (I1=4).

J. Syntax and grammar

Charlie is generally not able to use syntax and grammar (J 1-20=0).

K. Play and leisure

Charlie is able to explore a variety of toys and allows others to touch toys (K1-2, K8, K14=1). In addition, he is able to actively play with toys including board games (K5, K15 =2). He is capable of pretend play and will play with others K10-11=3). He plays simple ball games, allows peers to play with him and plays independently in indoor and outdoor (K3-4, K6-7, K9, K12-13=4)

L. Social interaction

Charlie is able to take offered items, follow simple directions, imitate peers, and allow peers to give him instructions (L2, L8-9, L13-14, L23-28, 30-31=1). He is able to engage appropriately when peers are around him, he shows interest in what others are doing, looks at others, and physically engages with other children (L1, L3-7, L10-L12, L15, L17-19, L21-22, L29, L33=2). Furthermore, he physically prompts others to do activities and share items (L11, L20, L32=3). He is able to label simple items for others and gain the attention of others (L16, L34=4).

M. Group instruction

Charlie does not sit still in a large group for very long (M2=0). However, he is able to sit appropriately in small group and follow group instructions from the teacher (M1, M3-4, M8-11=1). He also follow instructions presented to a group situation and he is able to raise his hand to answer simple question (M5, M7,9-11, M12=2). He is also able to follow a discrimination question eg. request from a teacher asking students wearing red pants to line up (M6=4).

N. Classroom routines

Charlie is generally able to sit and wait, get in line, work independently and return materials and complete tasks (N3-10=1). In addition, he is able to follow daily routines in the classroom (N1=2) and he is able to work independently during activities (N2=3).

O.  Generalised responding

Charlie is able to use other appropriate responses after learning a response to a given situations (P5=1). He is also able to generalise across stimulus and instructors; use skills in a group; and generalise language skills to other situations (P1-4, P6=2).

Q. Reading

Charlie is not able to identify words and letters (all Q=0).

R. Math

Charlie generally cannot name numbers or add numbers (R2, R5-14, R17-18, R19-29=0). However, he is able to count very simple numbers with prompts and can recognise the words that are the same or different (R1, R3-4, R15-16, =1).

S. Writing

Charlie is unable to copy letters (S2-10=0). However, he is able to make marks on paper (S1=2).

T. Spelling

Charlie is not able to match letters, copy words or spell (T1-7=0).

U. Dressing

Charlie cannot button or unbutton clothes, fasten buttons or tie shoes (U4, U11, U13, U15=0). However, he can put on and take off socks and use snaps (U6, U8-10, U12=1). He also pull his pants up and down, take shoes off and on and adjust clothing when needed (U1-3, U5, U7,U14=2).

V. Eating

Charlie can feed himself using his fingers and general cutlery and drink using a cup (with or without a straw) (V1-10=2).

W. Grooming

Charlie is able to wash his hands, dry his face, brush his hair, clean his teeth and blow his nose without assistance (W1-7=2).

X. Toileting

Charlie has no toileting skills (all X=0).

Y. Gross motor

Charlie is not able to hop, ride a tricycle or bicycle, kick a ball at a target, or play jumping jacks (Y8, Y16, Y20, Y26, Y29-30=0). However, he is able to walk sideways, jump, roll sideways, balance on one foot, and skip (Y1-7, Y9-15, Y17-19, Y21-25, Y27-28=1).

Z. Fine motor

Charlie is not able to use advanced fine motor skills. For example, he cannot even roughly copy simple shapes or patterns, or cut out shapes (Z20, Z27-28=0). However, Charlie can do a variety of fine motor skills including grasping pens and crayons, inserting puzzle pieces, placing pegs, turning book pages and removing wrappers (Z1-19, Z21-26=1).