

**Teaching Advanced Manding Skills to Children with Autism Spectrum Disorder  
Using Systematic Instruction, Speech-Generating Devices, and Skinner's  
Analysis of Verbal Behaviour**

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## THESIS HIGHLIGHTS

- Three children (across three studies utilizing single-case design) with autism spectrum disorder (ASD) who communicated using iPad-based speech-generating devices (SGD) were taught advanced manding skills (i.e., manding for actions, manding for “where” questions, and persistence of manding for “where” questions) using interrupted behaviour chain strategy (BCIS) and systematic teaching procedures.
- The use of BCIS was an effective way to capture the participant’s establishing operation (EO), which has two potential effects a) momentarily establishing an increase of the behaviour (i.e., target mand) and b) made the terminal reinforcer (i.e., completion of the behaviour chain) more effective as a reinforcer.
- Each participant showed acquisition of the advanced mand (i.e., manding for actions, manding for “where” questions, and persistence of “where” questions) and indicates the use of BCIS and systematic teaching was effective.
- Results of generalisation of skills were mixed, although when targeted with an additional teaching phase, the participants were able to show generalisation of the skill.

## ABSTRACT

Autism Spectrum Disorder (ASD) is characterized by marked impairments in social and communication skills, as well as restricted and/or repetitive patterns of behaviour or interests. Approximately 25-30% of children with ASD do not develop speech. As a result they may require augmentative and alternative communication (AAC) interventions. However, most interventions discussed in our present body of research focuses on basic communication skills like requesting. As such, it is important to investigate systematic teaching strategies for more complex requesting (i.e., manding) skills like requesting actions or requesting information. This research aims to extend previous manding literature by investigating effective methods for teaching advanced manding skills to children with ASD who communicate using an SGD.

Three empirical intervention studies that are presented in this thesis evaluated the use of behaviour chain interruption strategy (BCIS) and systematic teaching procedures based on the principals of applied behaviour analysis (ABA), to teach advanced manding skills (i.e., manding for actions, manding for “where” questions, and persistence of “where questions”) for individuals with ASD who use speech-generating devices (SGD).

Single-case research methodology was used via variations of the multiple baseline design (i.e., multiple probe multiple baseline design across participants and multiple probe multiple baseline across participants and behaviour chains) to evaluate the effectiveness of the interventions. A total of three participants (2 boys and 1 girl, ages 13, 10, and 5) participated in the interventions that were designed to teach the targeted mand. Results of each study yielded positive results, in that each participant acquired the targeted skill. Generalisation (i.e., across stimuli, over time, and across communication

partners) results were mixed, however with additional teaching with the use of systematic instruction they were also acquired. Although these results are preliminary, they indicated that advanced manding skills should be taught to children with ASD who communicate using SGDs and can be acquired with the use of systematic instruction.

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## **RESEAECH DECLARATION**

This current thesis is composed of the author's original work conducted for this PhD degree under supervision at Victoria University. No part of this work has been previously submitted for any other degree or diploma. Work by other authors has been duly referenced in text and contribution by others has been clearly stated.

Ethical approval for all three of the studies was gained through the Victoria University of Wellington Faculty of Education Ethics Committee. The ethical approval letter is included in Appendix A.

Input and feedback were received from the author's primary supervisor, Professor Jeff Sigafoos, and by other members of a cohort team, supervised by Professor Sigafoos. The studies presented in the current thesis were solely the independent work of the author, with assistance in conceptualization, data analysis, interpretation of results, and editing of chapters from Professor Sigafoos.

The author reports no conflicts of interests and takes sole responsibility for the content and writing of this thesis.



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## **CHAPTER 1**

### **INTRODUCTION**

#### **Developmental Disabilities**

The term developmental disability (DD) is a broad category used to describe severe disabilities that onset before the age of 22 and require individualized/specialized services across the individual's lifetime (Developmental Disabilities Assistance and Bill of Rights Amendment, 2000). Specific types of developmental disabilities include attention deficit/hyperactivity disorder, autism spectrum disorder, cerebral palsy, fetal alcohol spectrum disorder, fragile x syndrome, hearing loss, intellectual disability, kernicterus, muscular dystrophy, Tourette syndrome, and vision impairment (Center for Disease Control and Prevention, 2015). The Developmental Disabilities Assistance and Bill of Rights Act of 2000 specifies that developmental disabilities are attributed to mental impairment, physical impairment, or a combination of these, are present throughout the individual's life, and cause severe impairment of functional abilities in three or more areas, such as the self care, expressive or receptive language, learning, mobility, capacity for independent living, economic self-sufficiency, and/or self direction domains. The prevalence of all developmental disability was reported from 2006-2008 to be approximately 1 in 6 children in the United States (Boyle et al., 2011). The research presented in this thesis focused on teaching communication skills for children with autism spectrum disorder, thus the following section will provide specific information related to the characteristics of this specific type of developmental disability.

#### **Autism Spectrum Disorder**

Autism spectrum disorder (ASD) is a heterogeneous group of neurodevelopmental conditions that are collectively classified through a spectrum of disorders that can

cause significant social, communication and behavioural challenges (Lia, Lombardo, & Baron-Cohen, 2014; Center for Disease Control, 2015). ASD is identified by marked impairments with two primary diagnostic categories: social communication and stereotyped and restrictive patterns of behaviours (Center for Disease Control and Prevention, 2015). The term autism comes from the greek word “autos” which means “self” (Bleuler, 1950). Symptoms of ASD are typically observed before the age of 3 in most children (Center for Disease Control, 2015). ASD has been described as a heterogeneous condition, in that no two individuals with ASD have the exact same profile, but rather display similar features, which are classified within the core deficits of the diagnostic categories (Lord, Cook, Leventhal, & Amaral, 2000). There is often variation in levels of severity, presence of features, and comorbidity of other conditions, such as intellectual disability, hyperactive disorder, or language impairment (American Psychiatric Association, 2013; Matson & Goldin, 2013). Thus the new adoption of the Diagnostic Statistical Manual of Mental Disorders (DSM-5) evaluates each defining feature subdomains terms of the severity level (American Psychiatric Association, 2013).

### **Diagnostic Criteria**

The diagnostic criteria used to define ASD have their origins from the early 1900s when Bleuler coined the term *autism* (Bleuler, 1950). The defining features of ASD have continued to evolve after Kanner (1943) first described this condition in a report on 11 children. Autism (introduced as the term *early infantile autism*) was originally characterized by two defining features: (a) *autistic aloneness* (e.g., the inability to relate to others and maintain typical social relationships), and (b) insistence of sameness (e.g., obsessive desire of routines, repetitive and/or stereotyped behaviours; Kanner, 1943). Asperger (1944) separately identified children with

similar, yet less severe, symptoms, which came to be known as Asperger's syndrome. His observations were notably similar to the behavioural characteristics described by Kanner (1943) with the exception of language skills. That is, the children described by Asperger generally could be seen as having more sophisticated communication skills than the children described by (Kanner, 1943).

Today the most commonly used guideline for the diagnosis of ASD is based on the criteria presented in the DSM-5 (American Psychiatric Association, 2013). In 2013 the fifth edition of the DSM was adopted, which moved toward a physical medicine model (Matson & Williams, 2013). Several changes were made in from DSM-IV to DSM-5 with regards to the diagnostic framework. Specifically, DSM-5 has adopted the term *autism spectrum disorder* (ASD) to replace the terms autistic disorder, pervasive developmental disorder not otherwise specified (PDD-NOS), Asperger Syndrome, childhood disintegrative disorder, and Rett's disorder, which were listed in the DSM-IV. The new edition of DSM (i.e., DSM-5) also removed the clinical subtypes and restructured the sub-domains from three to two domains. Specifically, language delays are not included in the current diagnostic criteria for ASD because such delays are not specific to ASD. Instead, the language delay criterion has been replaced by a criterion that references impairment in the social communication domain (Bishop & Norbury, 2002; Lord & Jones, 2012). Additionally, the DSM-5 includes leveling system that includes three levels (i.e., level 3 – requiring very substantial support; level 2 – requiring substantial support; level 1 – requiring support).

Under the most current diagnostic criteria established in the DSM-5, two primary domains are used to evaluate symptoms of ASD. To meet the criteria for a diagnosis, an individual must show deficits in social communication and stereotyped

and restrictive patterns of behaviours. For the social communication domain, the individual must meet the criteria of each subdomain, either currently or previously. The subdomains are: a) social-emotional reciprocity, b) nonverbal social communication, and c) development or maintenance of relationships and adjusting to social contexts. For the restrictive patterns of behaviour domain, an individual must engage in at least two of the four subdomains currently or previously. These subdomains are: a) stereotyped or repetitive behaviour, b) excessive adherence to routines, rituals, or patterns of behaviour or resistance to, c) restricted or fixated interests of abnormal intensity, and d) hyper or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment. Additionally, the onset of these behaviours must occur during early development, cause clinically significant impairments, and are not more accurately explained by a diagnosis of intellectual disability or global developmental delay (American Psychiatric Association, 2013).

### **Social Communication Deficits**

The social communication deficits associated with ASD are classified into three sub-domains, (i.e., social-emotional reciprocity, nonvocal communicative behaviours used within social communication, and deficits in maintaining and developing relationships). Social emotional reciprocity includes behaviours ranging from engagement in social conversations to sharing interests with others and turn taking. Nonvocal communication includes behaviours such as eye contact, facial expression, body language, use of gestures, and dual use of language and nonvocal communication. For example, an individual with ASD might not engage in nonvocal communication, such as gesturing towards an object that is being referenced during a conversation. Deficits in relationships include adjusting one's behaviour to adapt to various social contexts, and difficulties in forming and/or maintaining relationships.

For example, an individual with ASD might find difficulty adapting across social contexts such as recess at school verses a birthday party due to the unstated social norms. Deficits in social communication can hinder children with ASD from engaging and developing relationships with peers (Haney, 2013).

### **Stereotyped and Restrictive Patterns of Behaviours**

The stereotyped and restrictive patterns of behaviour domain include behaviours that range from verbal and nonvocal behaviours such as rituals (e.g., lining up object or repetitive manipulation of objects), insistence on sameness (e.g., insisting on wearing a certain colour of shirt or insistence on a certain sequence of events) circumscribed or perseverative interests (e.g., perseverative with a particular makes and model of a car brand or perseveration of trains), and unusual reaction to sensory input (e.g., jumping up and down on tip-toes in the presence of a particular sound or repetitive hand flapping when a toy lights up and makes a sound (see Table 1, for a full description of domains and subdomains). Often this category of behaviours are described as automatic or automatically reinforced (Rapp & Vollmer, 2005), however, research also indicates that stereotypy can be maintained by consequences, such as gaining attention from others or being allowed to escape from task demands (Roantree & Kennedy, 2006).

**Table 1. DSM V Criteria for ASD** (American Psychiatric Association, 2000; 2013)*Diagnostic Criteria for Autism Spectrum Disorder 299.00 (F84.0)*

A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history.

1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.
2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
3. Deficits in developing, maintaining, and understand relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history.

1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypes, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).
3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
4. Hyper or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).

\*Severity is based on social communication impairments and restricted, repetitive patterns of behavior.

## **Prevalence of ASD**

The latest prevalence statistics from the United States (National Health Interview Survey) estimate that 1 in 45 children or 2.24% of children have a diagnosis of ASD (National Health Interview Survey, 2015). This is an increase from previous 2011-2013 estimates, which were estimated to be 1.25% (1 in every 68 children; Centers for Disease Control and Prevention, 2015; Zablotsky, Black, Maenner, Schieve, & Blumberg 2015). However, these estimates come from the United States of America and may not necessarily hold for countries with different diagnostic practices.

Indeed, prevalence estimates from other regions of the world (e.g., Asia and Europe) suggest an overall prevalence of 1 to 2.6% (Centers for Disease Control and Prevention, 2014; Kim et al., 2011). There have yet to be any statistically reported prevalence rates of ASD in New Zealand, however rates of ASD are thought to be about 1 in 100 (New Zealand Ministry of Health, 2015).

Increase in prevalence may be due a variety of factors, such as, the new broader definition, better diagnosis tools, early detection, greater social awareness, and utilizing different research methodologies to investigate prevalence (Elsabbagh et al., 2012; Kim et al., 2011; Matson & Kozlowski, 2011). Despite these factors, interventions (e.g., communication skills, adaptive skills, reduction of challenging behaviour) for children with ASD are still needed.

## **Etiology of ASD**

Although the etiology of ASD has not been identified in most cases, in up to 25% of cases, a genetic cause can be identified (Huguet, Ey, & Bourgeron, 2013). Research has found a strong genetic component by investigating recurrence within families. Rates of sibling recurrence of ASD are reported to occur between 2-18% of

families. In addition, it is estimated that 20% of non-ASD-affected siblings have a history of delays in language (Centers for Disease Control and Prevention, 2014; Constantino, Zhang, Frazier, Abbacchi, & Law, 2010; Ozonoff et al., 2011; Sumi, Tanai, Miyachi, & Tanemura, 2006). Research has also reported that identical twins are 36-95% more likely to have ASD if the other twin has ASD. In non-identical twins the rate is lower at 0-31% occurrence (Hallmayer et al., 2011; Rosenberg et al., 2009; Tanian, Nishiyama, Miyachi, Imaeda, & Sumi, 2008).

Several other risk factors have been identified. For example, some people with certain genetic or chromosomal conditions such as Angelman syndrome, Down syndrome, fragile X syndrome, or tuberous sclerosis may be at increased risk for also an ASD diagnosis (DiGuseppi et al., 2010; Cohen et al., 2015; Hall, Lightbody, & Reiss, 2008). Risks have been associated to children being born to older parents (Durkin, et al., 2008) and the use of assisted reproductive technology (ART), finding occurrences of ASD were about two times more likely compared to children conceived without using ART (Fountain et al., 2015).

### **Social Burden of ASD**

ASD is a major public health concern (Reed, Hirst, & Hyman 2012). Current statistics estimate that the annual direct and indirect per capita costs for children with ASD in the United States has reached between \$11.5 billion and \$60.9 billion per year (Center for Disease Control and Prevention, 2015). Further, it is estimated that on average a child with ASD incurs medical expenses 4.1 to 6.2 times greater than a child without ASD (Center for Disease Control and Prevention, 2015). Effective and proactive interventions that increase levels of functioning ability and independence should be a primary concern for stakeholders. For example, early intervention may be not only beneficial for children with ASD, but may also decrease the level of care



needed throughout the child's lifespan, thus decreasing costs for direct services (Chasson, Harris, & Neely, 2007; Jacobson, Mulick, & Green, 1998).

### **Comorbidity and Associated Characteristics**

Comorbidity has been defined in the literature as having two or more forms of psychopathology within a person (Matson & Nebel-Schwalm, 2007; Mannion, Leader, & Healy, 2013). Research has reported that more than 70% of individuals with ASD have comorbid medical, developmental, and/or psychiatric conditions (Lai et al., 2014). Evaluating comorbidity within an individual with ASD can often be challenging due to overlap and overshadowing within the defining features of the disability (Simonoff et al., 2008). Another noted challenge in determining comorbidity is that children with ASD may have difficulty in responding to questions related to their symptoms or express what symptoms are present (Matson & Nebel-Schwalm, 2007).

Comorbidity of at least one disorder has been reported to occur in 70% individuals with ASD, with another 41% having two or more (Simonoff et al., 2008). The presence of an intellectual disability has been discussed within research and estimated to occur in approximately 26 to 80% of individuals with ASD (Lord, Volkmar, & Lombroso, 2002). A comorbid diagnosis of Down Syndrome has been reported approximately 18% of individuals with ASD (DiGuseppi et al., 2010).

Comorbid mental health conditions rates appear to be relatively common among individuals with ASD (Matson & Williams, 2013; Tsai, 2014). Gjevik et al. (2011) reported that 72% of children and adolescents with ASD were diagnosed with at least one comorbid psychiatric disorder. The most prevalent being anxiety disorders (41%) followed by ADHD (31%). Another study estimated that between 11 and 84% of children with ASD experience some degree of debilitating anxiety symptoms

(White, Oswald, Ollendick, & Scahill, 2009). Further, comorbid rates of depression have been reported in 70% of young adults with ASD (Lugnegård, Hallerbäck, & Gillberg, 2011).

Other commonly occurring issues reported for individuals with ASD include epilepsy, feeding issues, sleep related issues, and challenging behaviour (Matson, Mahan, Hess, & Fodstad, 2010; William, Field, & Seiverling, 2010). The comorbidity of epilepsy has been estimated to occur between 11 and 39% of individuals with ASD (Bolton et al., 2010; Tuchman & Rapin, 2002). Feeding issues related to selectivity have been reported in approximately 76% of children with ASD (Matson, Fodstad, & Dempsey, 2009). Feeding issues have been cited in the research to correlate with restricted and repetitive patterns of behaviour (Kozlowski, Matson, Belva, & Rieske, 2012; Matson, Fodstad, & Dempsey, 2009). This may include restrictive patterns of food intake, food selectivity related to specific texture or type, which may resemble defining characteristics of ASD (i.e., restrictive and repetitive behaviours). Sleep related issues are prevalent in an estimated 40 to 80% of children with ASD (Souders et al., 2009). Sleep related issues can range from sleep onset delay (i.e., dyssomnias) shortened sleep cycles and early morning wakings to sleepwalking or night terrors (i.e., parasomnias; Giannotti, Cortesi, Cerquiglini, Vagnoni, & Valente, 2001; Goldman, et al., 2011; Goldman, Richdale, Clemons, & Malow, 2012; Paavonen et al., 2008; Tsai et al., 2012). In some cases, sleep problems appear to be exacerbated by the severity of ASD symptoms (Mayes & Calhoun, 2009) and correlated with challenging behaviour (Goldman, et al., 2011). Challenging behaviour has been reported in from 35 to over 90% of individuals with ASD (Holden & Gitlesen, 2006; Matson, Wilkins, & Macken, 2009). Further, research has investigated the correlation between challenging behaviour and communication impairments, finding that

children with more severe communication deficits have an increased likelihood of challenging behaviour (Didden et al., 2012; Lang, et al., 2013).

### **Communication Impairment**

Interestingly, the DSM-5 does not include communication impairment among the core criteria of ASD, due to high degree of variability of general delay in language and communication development (Charman, Drew, Baird, & Baird, 2003; Grzadzinski, Huerta, & Lord, 2013; Wetherby et al., 2004). Still, communication impairment is prevalent among children with ASD (American Psychiatric Association, 2013). Language and communication development in children with ASD appears to be influenced by general cognitive ability, severity of ASD symptoms, and overall level of adaptive behaviour functioning (Kjellmer, Hedvall, Fernell, Gillberg, & Norreigen, 2012). The severity of communication impairment in ASD can range from nonvocal (i.e., spoken language is not developed) to fully verbal (i.e., spoken language is fully developed with intact structural language abilities.). Even in the latter range, however, the child may still have deficits in social pragmatic use of language (Grzadziski, et al., 2013). For example, although an individual may have appropriate functional language, they may not have the conversational skills needed to make and maintain friendships.

At the more severe end of the autism spectrum, it is estimated that approximately 25 to 30% of individuals with ASD lack speech and language and are likely to remain nonvocal (Ganz, et al., 2012; Tager & Kasari, 2013; Wodka, Mathy, & Kalb, 2013). Further, it has also been suggested that up to 50% of individuals with ASD do not develop a sufficient amount of speech to meet their everyday communication needs (Rowland, 2009). These individuals could be described as having a severe communication impairment and would be viewed as candidates for

interventions that aim to establish the use of one or more augmentative or alternative communication systems (Beukelman & Mirenda, 2005; Ganz, et al., 2012).

### **Augmentative and Alternative Communication**

Augmentative and alternative communication (AAC) refers to the use of one or more nonspeech modes of communication to either supplement or replace limited or unintelligible speech. AAC systems can be classified as either unaided or aided systems (Beukelman & Mirenda, 2005). Given that severe communication impairment affects from 25 to 30% of children with ASD, it is clear that there will be many such children who would be candidates for participating in an AAC intervention that aims to establish functional use of an AAC system as an alternative mode of communication (Mirenda, 2003).

Unaided AAC systems have been defined as communication systems that do not involve the use of any external equipment or device, but rather uses the individual's own body as the mode of communication (Beukelman & Mirenda, 2005). Unaided AAC generally includes the use of manual signs, formal and informal gestures (e.g., pointing, head shake), and prelinguistic behaviours, such as pointing, gestures, head nodding, eye gaze, physical leading a communication partner to an object (Mirenda, 2001). Indeed, unaided AAC was the first type of AAC system studied for children with ASD and severe communication impairment (Carr, Binkoff, Kologinsky, & Eddy, 1978) and this mode continues to be used in intervention research (Carbone, Sweeney-Kerwin, Attanasio, & Kasper, 2010; Wendt, 2009).

Several rationales for teaching manual sign have been discussed in the literature (Gregory, DeLeon, & Richman, 2009; Wendt, 2009). For example, it has been suggested that manual signing may be an easier option for individuals who have difficulty imitating and producing spoken words, provided of course that the child is

able to imitate fine and gross motor movements (Sundberg & Partington, 1998; Wendt, 2009). It may also be easier to prompt motor movement than vocal speech sounds (Wendt, 2009). There is often a strong resemblance between the sign and the object/action it represents, which may help the learner acquire signs quickly (Wendt, 2009). Additionally, one particular advantage to using manual signs is that this communication system is unaided, thus does not require external equipment (Sundberg & Partington, 1998; Wendt, 2009). However, there are some potential disadvantages to the use of manual sign that warrant discussion and consideration when selecting an AAC modality. The most significant being that the communication partner must have an understanding of the signs used by the speaker (Mirenda & Erickson, 2000; Wendt, 2009). Thus, the number of communication partners may be limited and there may be a need for training potential communication partners (Mirenda, 2003; Wendt, 2009).

Over time AAC methods have evolved and research has investigated the use of total communication and its effectiveness for teaching communication skills to individuals with ASD. Total communication involves the use of pairing manual sign with speech and has been found to be more effective than sign alone (Barrera, Labato-Barrera, & Sulzer-Azaroff, 1980; Mirenda, 2003; Yoder & Layton, 1988). However, for some individuals manual sign may not be a viable communication mode. For example, individuals with motor imitation or motor planning deficits may have difficulty in learning a variety of manual signs and might benefit from a different AAC modality.

In contrast to unaided AAC modes, such as manual signing, aided AAC systems involve the use of some type of external equipment (Beukelman & Mirenda, 2005). Aided AAC systems can include high-tech devices, such as an electronic

speech-generating devices (e.g., an iPad® with speech synthesis software applications) or low-tech systems, such as a written communication, communication boards, or exchanging a picture card (Sigafoos, O'Reilly, Ganz, Lancioni, & Schlosser, 2007). The Picture Exchange Communication System (PECS), for example, is a manualized communication intervention system that involves the use of picture or symbol cards that are used via an exchange with a communication partner (Bondy & Frost, 1994; Bondy & Frost, 2001; Lancioni et al., 2007).

SGDs, previously referred to as voice output communication aids (VOCAs), are electronic devices that produce digitalized or synthesized speech output (Lancioni, et al., 2007; Thunberg, Sandberg, & Ahlsen, 2009.) Given technological advancements within the last decade, there has been a shift toward the use of portable electronic AAC devices such as tablet computers (e.g., Apple iPad®) and portable media players (e.g., Apple iPod®) rather than low-tech aided options (Shane et al., 2012; van der Meer & Rispoli, 2010). As a result of these advancements, several studies have been conducted that utilize such devices within communication-based interventions (Achmadi et al., 2012; Kagohara et al., 2012; van der Meer, Didden, et al., 2012; van der Meer et al., 2013). A review of this literature and intervention methodology will be discussed in the next chapter.

Arguably, aided AAC may have certain potential advantages. Because these systems often involve iconic graphic symbols, it is often presumed that learning to match a symbol to its real object equivalent will be relatively easy for children with ASD (Bondy & Frost 2002; Schlosser, Sigafoos, & Koul, 2009). In addition, fine motor deficits may create difficulty in acquiring manual sign for some individuals with ASD, thus an aided AAC option might provide a viable alternative (Mirenda, 2001). Additionally, many aided AAC systems create a concrete rather than

intangible modality, which may be beneficial for individuals with ASD since it allows the user a reference and perhaps signal to engage in communication when needed (Mirenda, 2001; Gantz et al., 2012). Some potential advantages for using aided AAC systems (e.g., SGDs) include the level of accessibility. For example, small electronic devices such as iPods and mobile devices are low in cost and easily portable, thus enabling use across various environments (Sennott & Bowker, 2009; Ganz, 2015). Such devices may also be appealing to stakeholders due to their common everyday use within society (Ganz, 2015). Further, devices are easily programmable to fit the expanding communication needs of the individual (Ganz, Hong, & Goodwyn, 2013; Shane et al., 2012). However, in light of these advantages it is important that stakeholders adopt efficacious methods (i.e., evidence based teaching procedures) for teaching communication skills, rather than unproven methods, such as facilitated communication, which can be potentially harmful (e.g., false acquisition of skills or knowledge, prompted messages, or false accusations; Ganz, 2015; Tostanoski, Lang, Raulston, Carnett, & Davis, 2013).

Today not only has there been an increase in mobile technology use within society at large, but also empirical research has continued to evaluate the use for individuals with ASD as an AAC modality (for a review of the literature see Ganz et al., 2012; van der Meer & Rispoli, 2010). The next chapter will systematically review the most recent literature investigating the use of aided AAC systems for individuals with ASD.

## CHAPTER 2

### Systematic Review of the Literature

#### Review of Typical Development

Typically developing children experience rapid acquisition of spoken language around the age of two and three years (Panico, Daniels, & Claflin, 2011; Raulston et al., 2013). At this time of language expansion, children acquire advanced mands (e.g., mands for actions and mands for information), which can be observed around 11 to 24 months (Hart & Risley, 1999; Sundberg, 2008). For example, a child might begin to develop two word utterances that give specificity to the mand (e.g., “Open door”, “Push me”, or “Pour juice”). As manding skills develop, they often become more sophisticated, such as mands for information. In particular mands for information often require the use of verbs, which contribute to the sequence of wh-question forms acquired (Bloom, Merkin, & Wootten, 1982; Brown, 1968). For example, *what*, *where*, and *who* questions seem to be acquired first, which might be attributed to the concrete nature of these question forms as well as the tendency of these question frames being paired with pro-verbs, such as *do* or *go* (Bloom et al., 1982; Tyack & Ingram, 1977). In contrast, *why*, *when*, and *how* questions may develop later, as they are less tangible ideas (Bloom et al., 1982; Brown, 1968).

#### Review of AAC Literature

Although language impairment is no longer a core feature in the criteria for the diagnosis of an ASD, it is an additional potential descriptor and many individuals diagnosed with ASD show comorbid language, and/or communication impairment (American Psychiatric Association, 2013). Thus, many individuals with ASD who have complex communication needs may require communication interventions and services depending on the severity of needs. Specifically, research has estimated that



approximately 25-30% of individuals with ASD do not fully develop a functional communication repertoire due to having little or no speech and language ability (Ganz, et al., 2012; Tager-Flusberg & Kasari, 2013; Wodka, et al., 2013). Such children are often considered to have severe communication impairments, complex communication needs, and/or can be classified as minimally verbal. Tager-Flusberg & Kasari (2013), for example, described children with autism who also have limited speech as being minimally verbal. Although they did not give a precise definition of this term, it appears to refer to children with very little expressive spoken language by the time they are of school age (Tager-Flusberg & Kasari, 2013). These authors do note however, that “this group is highly variable and therefore, no single explanation will account for all minimally verbal children” (p. 468-469). As such, the use of augmentative and alternative communication (AAC) systems may be beneficial for establishing a communication repertoire when spoken language has not developed or is underdeveloped. AAC systems commonly refer to the use of nonspeech modes of communication used to supplement or replace limited or unintelligible speech. AAC involves the use of aided and/or unaided systems (Schlosser & Sigafoos, 2006; Schlosser, Sigafoos, & Koul, 2009; Shane et al., 2012). Unaided AAC systems have been defined as communication systems that do not involve the use of any external equipment or device (Sigafoos & Drasgow, 2001). Examples of unaided AAC include pointing, gestures, head nodding, and use of manual signs (Mirenda, 2001). In contrast, aided AAC systems involve the use of equipment, devices, or other form of external aid to assist the individual (Bondy & Frost, 1994, 2001; Lancioni et al., 2007). Two examples of commonly used aided AAC systems are speech-generating devices (SGD) and the Picture Exchange Communication System (PECS; Shane et al., 2012; Sigafoos & Drasgow, 2001).

Previous research has evaluated procedures for the development of basic manding skills among individuals with ASD who use AAC systems (e.g., picture exchange, speech-generating devices, or manual sign). A number of studies have investigated teaching procedures for teaching nonvocal individuals with ASD to utilize an SGD (i.e., iPads® or iPods® loaded with speech generating applications) for manding for desired items (Achmadi et al., 2012; Banda, Copple, Koul, Sancibrian, & Bogschutz, 2010; Kagohara et al., 2010; Miriam, Wendt, Subramanian, & Hsu, 2013; van der Meer, Didden, et al., 2012; van der Meer, Kagohara, et al., 2012). In a systematic review of the literature, van der Meer and Rispoli (2010) analyzed 23 studies utilizing SGDs for individuals with ASD. Of the studies reviewed, 69.5% taught some form of requesting (i.e., manding) as the primary intervention target skill. In another review, Lorah et al. (2014) summarized 17 studies that evaluated the use of handheld computing devices or portable multimedia players as a SGD in the acquisition of communication skills. Of the studies included, the majority ( $n = 14$  of 17) used the Proloquo2Go® SGD application. In terms of verbal operants addressed, 94% ( $n = 16$ ) of the studies taught basic manding skills. Lastly, 93% of the participants in these studies acquired the targeted communication skill. However, there has been very little research investigating procedures for teaching advanced manding skills to individuals who communicate using SGDs.

To date, few studies (Choi, O'Reilly, Sigafos, & Lancioni, 2010; Shillingsburg, Powell, & Bowen, 2013; Yosick, Muskat, Bowen, Delfs, & Shillingsburg, 2015) have addressed teaching mands for actions to an individual who communicated using an SGD. For example, Sonnenmeier et al. examined communication across several verbal operants (e.g., mands, tacts, intraverbals) and engagement within the general education setting with a focus on the educational team

(i.e., using a structural model for educational team planning), rather than the participant. Although the study reported improvements in the communication skills of the participant, data and the teaching procedures were not reported, thus the increases in communication skills reported would be difficult to replicate and it is difficult to attribute the reported improvements to the intervention procedures and/or the targeting of mands for actions. Further, Choi et al. (2010) evaluated teaching two types of mands (i.e., requesting and rejecting items) using two types of BCIS (i.e., missing-item format and wrong item format). In this study four children with developmental disabilities, 3 children having autism, were taught using an SGD or PE in a trial based format, using systematic teaching (i.e., a progressive time delay and prompting). A multiple probe design across participants was used to evaluate the effects of the intervention. Results of this study were positive, in that the participants showed increases of the targeted responses, however only one participant was successfully taught a mand that could be classified as a mand for action (i.e., manding for a DVD to be played).

Some studies have evaluated procedures for teaching individuals with ASD to mand for information across various question types: *where*, *who*, *what*, and *how* (Betz Higbee, & Pollard, 2010; Koegel, Koegel, Green-Hopkins, & Barnes, 2010; Sundberg, Lobe, Hale, & Eigenheer, 2002; Williams, Perez-Gonzalez, & Vogt, 2003); however the participants in these studies often had a fair degree of existing speech and language skills. In a review of the literature Raulston and colleagues (2013) summarized 21 single case studies that targeted teaching mands for information to children with ASD who communicated using spoken language. Their findings concluded that the reviewed studies shared similar components, such as (a) the use of systematic instruction, (b) ensuring the participants motivation for the information by

arranging the environment (i.e., contriving the establishing operation), (c) using information and access to a preferred item/activity as the natural reinforcement for manding for information and (d) the use of systematic prompting and fading techniques. Further, the reviewed studies suggest that individuals with ASD can be taught to ask questions, thus extending communication repertoires. In a more recent review of the literature, Lechago and Low (2015) provided further review of the literature pertaining to manding for information by evaluating the importance of the motivating operations (MO), to help ensure establishing the mand for information. In particular, the authors provide analysis on MOs, which are often contrived to make information function as a reinforcer. Procedures that give attention to the learner's MO may provide a value altering affect for asking a question, since the information gained is related to accessing a preferred item or activity. Thus, attention to the MO may attribute to the successful outcomes reported in these studies. In light of this finding the current set of studies focused on evaluating procedures for creating effective MOs for teaching two different types of advanced mands.

Still, research that investigates teaching mands for information to children who communicate using an AAC mode (i.e., speech-generating device or picture exchange) is relatively limited. Indeed, there appears to be only one study (Ostryn & Wolfe, 2011) that has used assistive technology (e.g., picture exchange) with a participant with limited spoken language. This study was not able to fully capture the results of the participant manding for information using an AAC system because within the study the participant began using spoken language rather than the AAC mode. Given that AAC systems have been successful in teaching communication interventions for individuals with ASD (Ganz et al, 2012; van der Meer & Rispoli, 2010), it is likely to be beneficial and worthwhile to investigate effective teaching

procedures for nonvocal individuals with ASD using an AAC system (Raulston et al., 2013). Further, researchers have recently suggested that teaching advanced mands to children with ASD who communicate using a AAC system is an area of research that should be investigated (Ganz, 2015; Lechago & Low, 2015; Raulston et al., 2013).

### **Development of Advanced Mands**

As mentioned at the start of this chapter, typically developing children experience rapid acquisition of spoken language around the age of two and three years of age (Panico et al., 2011; Raulston et al., 2013). It is at this time of language expansion that many children acquire what could be referred to as advanced manding skills (e.g., mands for actions and mands for information). Such advanced mands seem to emerge around 11 to 24 months (Hart & Risley, 1999; Sundberg, 2008). For example, a 2-year-old child has often developed two word utterances that give specificity to the mand (e.g., “Open door”, “Push me”, or “Pour juice”). Mands for information also often emerge around this age range (Bloom, et al., 1982; Brown, 1968). For example, *what*, *where*, and *who* questions are acquired and later, *why*, *when*, and *how* questions (Bloom et al., 1982; Brown, 1968).

### **Conceptual Framework: Skinner’s Analysis of Verbal Behaviour**

For the past few decades several researchers have applied Skinner’s (1957) analysis of verbal behaviour as a conceptual framework for teaching communication skills to children with ASD and other developmental disabilities (Sautter & LeBlanc, 2006; Sundberg & Michelle, 2001). The application of Skinner’s analysis of verbal behaviour can also be classified as an emerging conceptual framework for AAC intervention for children with ASD and other developmental disabilities (Bondy, Tincani, & Frost, 2004; Lovaas, 2003; Sigafos & Reichle, 1993; Sundberg & Michael, 2001). Traditionally, linguists define language in terms of the meaning and

structure of words (Bloom, 1993). However, many scholars ascribe to the idea that language is acquired as a product of general learning processes, similar to the way a child may learn to tie their shoes or ride a bike (Bloom, 1993). Skinner (1957) also ascribed to the notion that language (i.e., verbal behaviour) is acquired similarly to other operant behaviours (i.e., “Behaviour that is selected, maintained, and brought under stimulus control as a function of its consequences.” [Cooper, Heron, & Heward, 2007, p. 700]). In particular, Skinner analyzed language by evaluating the relevant contingencies that maintain the verbal behaviour (Skinner, 1957, 1974). Although Skinner evaluates function of behaviour rather than the topography, humans are arguably unique in being the only organisms that have developed vocal musculature that has come under operant control (Skinner, 1974). Thus, the term verbal behaviour was used by Skinner to explain behaviour related to communication. Specifically, Skinner defines verbal behaviour as any behaviour that is reinforced through the mediation of another person’s (i.e., the listener’s) behaviour. With regard to the topography, he specified that verbal behaviour could be vocal behaviour (e.g., saying “I want coffee”) or nonvocal behaviour (e.g., gesturing towards cup of coffee) as both are effective only through the mediation of another person (Skinner, 1957).

### **Verbal Operants**

Skinner further breaks down his analysis of verbal behaviour into six function units called verbal operants. These verbal operants are the mand, tact, echoic, intraverbal, textual, and transcription (Skinner, 1957). Although these verbal operants are clarified and defined separately by Skinner, to understand the function of these units, essentially the combination of operants are what comprise conversations exchanges (Cruvinel & Hubner, 2013). Early behavioural communication

interventions often focus on teaching echoics, mands, tacts, and intraverbal skills (Sundberg & Michael, 2001).

Teaching manding skills is often the focus in the beginning verbal behaviour interventions, as developmentally it is the first operant that a child learns (Sundberg & Michael, 2001; Hart & Risley, 1999). The word mand derives from its root, *command*, *demand*, or *countermand* (Skinner, 1957). Skinner defines the mand as an elementary verbal operant “in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation” (p. 35-36). More concisely stated, the mand is a request for a desired event or stimulus or the termination of an undesirable event or stimulus. For example, if a speaker tells a listener “I want a coffee” and the listener responds to the speaker by giving him/her a coffee, then the behaviour in which the speaker engaged, asking for coffee, can be considered a mand. The future occurrence of this mand under similar conditions would strengthen the response “I want coffee”, but the control over the response would be related to the state of deprivation or satiation (i.e., motivating operations). Other types of mands are rejecting nonpreferred stimuli and manding (e.g., requesting) information. One type of mand for information is question-asking provided of course that the question-asking is controlled by deprivation or aversive stimulation (such as lack of information) and reinforced (that is maintained by) a characteristic consequence, such as being told the correct information by the listener.

The tact is another kind of verbal operant that is commonly addressed in language interventions for individuals with ASD. The word tact comes from its root, *contact*, meaning that the individual is coming into contact with the environment (Skinner, 1957). If a speaker is outside and notices a new café and says, “Look there’s

a new café!” the listener might respond by saying, “Yeah, it is.” A tact is generally reinforced by some form of generalised conditioned reinforcement, such as social attention (i.e., the remarks of the listener; Skinner, 1957).

An echoic is a type of verbal operant in which the behaviour is under the control of a verbal stimulus and has point-to-point correspondence with that stimulus (Skinner 1957). Simply stated, the listener hears someone say a word, then repeats or echoes what was heard. For example, if a teacher says, “Say, toy”, and the listener repeats the word “toy”, the listener’s verbal behaviour can be classified as an echoic because he or she echoed the word. Much everyday conversation appears to be hugely echoic as when a person says “hello” and his or her communication partner says Hello in return or when a speaker initiates a conversation by saying “Looks like rain.”, and the listener echoes part of that statement (e.g., “Yes, it certainly does look like rain.”). The reinforcement of echoic behaviour is provided in the form of generalised conditioned reinforcement, such as an affirming comment from the listener. Echoic skills are often addressed during language interventions for children with ASD (Lovaas, 2003).

Intraverbals are also frequently addressed during early communication interventions. An intraverbal is a type of verbal behaviour that does not have point-to-point correspondence with the preceding verbal stimulus. Intraverbal responses can be formulaic or trivial and often are seen in the form of small talk (Skinner, 1957). For example, a speaker may respond to a listener’s greeting (“Hello, how are you?” by saying, “I’m fine!”) Often, intraverbal behaviour is seen in a chain of verbal responses within several communication exchanges. Similar to the tact, intraverbals are reinforced by generalised conditioned reinforcement, such as the verbal acknowledgement/response of the listener.



Skinner (1957) further defines a secondary level of verbal operant, which involves the speaker manipulating his or her own verbal behaviour. One such manipulation involves what is referred to as various types of autoclitic relations. In the autoclitic relation, the speaker modifies his or her verbal behavior produce a more specific action on a listener, such as trying to increase the probability that the listener will reinforce his or her mand, for example. The autoclitic, is further defined as a relation with a primary operant (e.g., mand, tact, intraverbal). Within the context of an autoclitic relation, the speaker discriminates the controlling variables of his or her own behaviour and describes them to the listener, who discriminates whether or not to serve as a mediator of reinforcement. The speaker in this situation would become both listener and observer of his or her own verbal behaviour and its controlling variables, and in turn become a speaker again (i.e., verbal behaviour about verbal behaviour). For example, a child might have learned that simply asking the after-school babysitter for a cookie will not be reinforced, and so the child modifies his or her mand by using a autoclitic, such as “My mom always let’s me have cookies after school.” It should be noted that Skinner specified that the autoclitic relation does not develop until the primary operants are “established in strength” (p. 330) within the repertoire. This is perhaps one reason why researchers have recommended that autoclitics should not be targeted in the early stages of language intervention (Sundberg, 2007).

There are at least two reasons why Skinner’s analysis of verbal behaviour might be useful as a framework for language interventions for individuals with ASD. First, Skinner (1957) identified separate sources of antecedent control for the verbal operants. A *mand* is useful to the person when it is under the control of an individual’s motivation (e.g., the condition of hunger would elicit a *mand* for food). A *tact*, in contrast, is under the antecedent control of a visual discriminative stimulus

(e.g., a child sees a plane in the sky and says “plane”). An *intraverbal* is under the control of a verbal discriminative stimulus (e.g., someone says “hello” and you respond by saying “hey”). Identifying the effective sources of control allow for practitioners to arrange/manipulate these conditions, which is often useful when setting out to teach the skills. For example, if you know the conditions under which a response should occur then it would seem easier to teach that response to occur under those conditions. Second, Skinner’s analysis of language may be of some advantage because it emphasizes the crucial and reciprocal role of both speaker and listener behaviour (Cruvinel & Hubner, 2013; Sundberg & Michael, 2001).

Communication interventions for individuals with ASD often focus initially on teaching mands (Albert, Carbone, Murray, Hagerty, & Sweeney-Kerwin, 2012; Shafer, 1994; Sidener, Shabani, Carr, & Rolland, 2006). Several reasons have been given for this, including (a) teaching mands can lead to a child’s wants and needs being met, (b) the benefits for training often correspond with decreases in challenging behaviour, (c) can cause increases in social communication, and (d) can lead to more spontaneous communication (Albert et al., 2012; Shafer, 1994; Sundberg & Parington, 1998). In addition to these reasons beginning a language intervention with mand training is potentially of benefit for children with ASD because it may help them to access the reinforcing consequence (i.e., obtaining a requested item), thus possibly increasing the extent to which the child is willing to communicate and participate in communication intervention (Sundberg & Michael, 2001).

### **The Importance of the Mand**

The mand is considered to be unique in Skinner’s (1957) analysis because it is the only one of his verbal operants that is defined by the fact that it is controlled primarily by a MO (i.e., deprivation or aversive stimulation) rather than a verbal or

nonverbal discriminative stimulus. For example, Sundberg and Michael (2001) noted that mands are of direct benefit to the speaker by enabling him or her to access reinforcement (e.g., requesting coffee causes the consequence/reinforcement of getting coffee) and is a critical aspect of language development. Often individuals with communication impairments, such as individuals with ASD or other developmental disabilities, have defective manding repertoires, and this deficit may be associated with occurrences of challenging behaviour, such as aggression and self-injury (Carr & Durand, 1985). Consequently, utilizing mand training for individuals with ASD has been shown to have positive results due to the specific reinforcement that is gained (Sundberg & Michael, 2001). Additionally, decreases in challenging behaviour have also been attributed to the result of an efficient manding repertoire (Durand, 1999; Franco et al., 2009; Olive, Lang, & Davis, 2008).

Another important feature of the mand, that requires specific attention and monitoring when teaching a learner, is the motivational conditions of the learner. Michael (1988) provided further clarification on the topic of motivation regarding the mand by describing what is known as an establishing operation (EO), and has since been further defined as an MO (Laraway, Snyckerski, Michael, & Poling, 2003; Michael, 1988, 1993, 2000). An MO is defined as any stimulus condition or environmental event that (a) alters the reinforcing or punishing effectiveness of some stimulus, object, or event; and (b) alters the frequency of all behaviour that has been reinforced or punished by that stimulus, object, or event (Michael, 2001). The mand is unique in that it is the only verbal operant that is controlled by a motivational variable (i.e., MOs) rather than a stimulus (Shafer, 1994; Sundberg & Michael, 2001). Thus, when teaching communication skills to individuals with ASD, it would seem useful to begin by teaching them to mand because teaching the mand first allows the learner to

come into immediate contact with reinforcement, which helps create a history of reinforcement for communication acts. However, for the mand to be optimal for the learner, it may need to occur in the absence of the physical object or condition that is reinforcing the mand (i.e., a pure mand), and be under the control of the MO (Sigafoos & Reichle, 1993; Sundberg & Michael, 2001). Therefore, the individual should be able to mand for an item that is absent from the environment and thus the mand is more likely to be related to the prevailing MO.

Previous research on manding has outlined various ways to alter the learning environment in such a way that the learner's MO is affected, in order to create opportunities in which manding is more likely to occur. One way to contrive a learner's MO involves environmental manipulation that utilizes the natural schedules of deprivation and satiation to create opportunities for manding. For example, Sigafoos and colleagues (1989) taught learners to reject food after becoming satiated. Gobbi and colleagues (1986) utilized naturally occurring deprivation of food to teach individuals to mand for food and drinks during mealtimes. A second way to contrive an MO, as discussed in previous research, involves withholding missing objects or actions needed to complete a task. This method is often utilized when teaching advanced manding skills. For example, Hart and Risley (1974) taught participants to mand for materials placed out of reach. Sundberg and colleagues (2002) taught participants to ask *where* a missing item was located. An additional way to contrive the MO is the use of an interrupted behaviour chain. A behaviour chain can be used to teach a learner a series of steps needed to complete a task (e.g., the steps used to make an ice-cream sundae). Hall and Sundberg (1987) taught participants to request a needed item within the steps of a behaviour chain. Interrupted behaviour chains have also been used to teach advanced manding skills, such as manding for information.

For example, Lechago and colleagues (2010) taught participants to mand for information teaching *where* and *who* questions by interrupting the steps of a task (e.g., making a model volcano erupt).

### **Types of Mands**

Skinner (1957) further defines the mand in terms of the participant's involvement with different parts of speech. Thus for the development of complex language skills, it is necessary for language interventions to extend past basic mand training and address more sophisticated manding such as those with verbs, adjectives, prepositions, and adverbs. It is also important to note that advanced mands also require the functional source of the controlling MO (Sundberg, & Michael, 2001).

Advanced manding (e.g. manding for multiple items, manding for actions, manding for information) is an important skill for any learner because it allows the speaker to engage more precisely with the environment and may promote the acquisition of other language skills (Raulston, et al., 2013; Sundberg & Michael, 2001; Sundberg & Parington, 1998). Examples of advanced manding include: manding for an action (e.g., "Please pour my juice."), manding for multiple items (e.g. "I want Buzz Lightyear and Woody."), and manding for information (e.g. "Where are my car keys?").

Skinner (1957) defined mands for information as a mand in the form of a question, which specifies verbal action. A mand for information is simply asking a question to a listener that provides the speaker with requested information. Aside from the obvious value of asking questions (i.e., retrieving information), mands for information are essential for social conversations, fulfilling wants and needs, and create a greater opportunity to have various interactions across different people and environments (Koegel, et al., 2010; Raulston et al., 2013; Sundberg & Michael, 2001).

Asking questions is an important skill for verbal development; however, it can be difficult for individuals with ASD because they are generally not reinforced by the information they retrieve (Lechago & Low, 2015; Raulston et al., 2013; Sundberg & Michael, 2001). Therefore, interventions used with individuals with ASD should pay close attention to the learner's MO (Lechago & Low, 2015; Raulston et al., 2013; Sundberg, et al., 2002).

### **Methods for Teaching Advanced Manding Skills to Individuals with ASD**

Various approaches to communication interventions have been reported in the literature. Empirical research suggests two primary instructional categories, *didactic* and *naturalistic*, for teaching communication interventions to children with ASD (Allen & Cowan, 2008; Tarbox & Najdowski, 2008; Volkmar, Paul, Klin, & Cohen, 2005).

Didactic methods generally apply the principles behaviour and may be similar to operant conditioning procedures where a trial-based format (i.e., discrete-trial training) is used. Didactic teaching is adult-led instruction, with clear contingencies (i.e., clearly delivered discriminative stimulus and consequence). Discrete-trial training (DTT) can be classified as a didactic method. DDT involves breaking down skills into small units of instruction called a trial (Smith, 2001; Tarbox & Najdowski, 2008). This method is used to teach a variety of skills, including communication, which may then be generalised to the natural context (Smith, 2001). One of the first uses of DTT with children involved teaching a young boy with autism to engage in spoken communication (i.e., Wolf, Risley, & Mees, 1964), and has continued to be selected as a teaching method (Sundberg & Parington, 1999). One of the primary advantages of using this method is the high number of teaching trials that can be

provided in a teaching session (Sundberg & Partington, 1999; Tarbox & Najdowski, 2008).

In contrast, naturalistic interventions often involve the use of environmental arrangement and naturally occurring reinforcement contingencies (Allen & Cowan, 2008). Naturalistic teaching approaches include milieu teaching, incidental teaching, pivotal response training, and behaviour chain interruption strategy (BCIS) (Cater & Grunsell, 2001; Shafer, 1994). Research has outlined several benefits for using naturalistic interventions during mand training. In particular, naturalistic interventions tend to capitalize on the MO of the learner, which is essential for training more complex manding repertoires (Hall & Sundberg, 1987; Michael, 2001; Sundberg & Partington, 1998).

### **Systematic Review of Behaviour Chain Interruption Strategies**

Various approaches have been used to ensure the proper MO is in effect during manding interventions. First, it is often considered essential to utilize natural reinforcement contingencies, that is to reinforce a mand for a specific item (e.g., “Can I have a cookie?”) with the item requested (provision of a cookie). Second, many intervention packages also suggest that steps be taken to ensure that the requested item has sufficient reinforcement power so as to enable more efficient skill acquisition (i.e., ensuring the presence of the MO). More simply, the target mand will likely be acquired faster if the natural consequence has more reinforcing power. For example, providing a cookie before lunch may lead to faster acquisition of the mand for a cookie than providing a cookie contingent on a mand after lunch when the child may be less hungry. A number of tactics have been developed to in an effort to occasion specific MOs during the teaching mands to individuals with ASD. One such

class of tactics includes behaviour chain interruption strategies (BCIS; Carter & Grunsell, 2001; Shafer, 1994).

The BCIS was originally developed as a method to teach individuals with developmental disabilities functional communication within the natural environment (Hunt & Goetz, 1988). These initial results were then replicated within the context of manding (Alwell, Hunt, Goetz, & Sailor, 1989; Goetz, Gee, & Sailor, 1985; Gee, Graham, Goetz, Oshima, & Yoshioka, 1991; Hunt, Goetz, Alwell, & Sailor, 1986; Sigafos, Reichle, Doss, Hall, & Pettitt, 1990). The BCIS can be conceptualized as a class of naturalistic intervention strategies that involve contriving MOs in various ways so as to facilitate the teaching of mands (Carter & Grunsell, 2001; Hunt & Goetz, 1988). Implementing a BCIS typically involves identifying a familiar behaviour chain that can be interrupted at a predetermined step (generally the middle of an ongoing chain) in order to establish the natural consequences of a specific mand (i.e., provision of the request) as a reinforcer (Carter & Grunsell, 2001; Goetz, et al., 1985; Hunt & Goetz, 1988). For example, a behaviour chain, such as getting ready to go play outside, could be used as a context for teaching a child to request help in finding his or her jacket. Specifically, the behaviour chain might include (a) finding shoes, (b) putting shoes on, (c) finding one's jacket, (d) putting on the jacket, (e) exiting the door, and (f) playing on the playground equipment. To interrupt such a chain, and thus create an MO for a mand such as *Where is my jacket*, a therapist might hide the jacket prior to the start of the chain. To teach this mand, the therapist would wait for the child to come to that step in the chain and might then model the correct response, wait for an approximation from the child, and then provide the information regarding the location of the missing jacket (e.g., Albert, et al., 2012; Betz, et al., 2010; Sundberg, et al., 2002).



Researchers have described a number of such interruption scenarios and used these as the context for teaching mands to individuals with ASD. The missing-item format, for example, involves removing an item that would be needed to complete a step in the behaviour chain (Lechago, et al., 2010; Sundberg et al., 2002). Another scenario involves temporarily withholding or blocking access to a reinforcer (Roberts-Pennell & Sigafoos, 1999; Sigafoos & Littlewood, 1999). For example, a therapist could stand in front of the cabinet where bread is kept to interrupt a sandwich-making chain.

The purpose of the following systematic review was conducted during the literature review stage of my proposal development to evaluate applied research that has evaluated the effects of using different BCIS scenarios for teaching mands to individuals with ASD. A review of this type was considered necessary to inform the design of my thesis research. The publication of this review was also viewed as being of some potential value to practitioners in guiding the use of BCIS to develop manding skills in persons with ASD.

## **Method**

### **Search Procedures**

Systematic searches were conducted in several electronic databases, specifically (a) Education Resources Information Center (ERIC), (b) Medline, (c) Psychology and Behavioral Sciences Collection, and (d) PsycINFO. Searches in each database were limited to English language articles appearing in peer-reviewed journals. Each database was searched using three combinations of terms (List 1, 2 and 3), which were inserted into the keyword field. List 1 included terms related to BCIS (i.e., “behaviour chain\*”, “chaining procedure”, “chain\*”, and “interrupted behaviour chain”). List 2 included terms related to the target skill of the intervention (i.e.,

“mand\*”, “request\*”, “ask\*”, “communication”, and “functional communication”). List 3 included terms related to an ASD diagnosis (i.e., “auti\*”, “ASD”, “Asperger\*”, “PDD-NOS”, and “developmental disability”). Two of the authors independently screened the full-text of the returned articles to determine whether or not the study was relevant to the present review. The references of each article identified for inclusion were then reviewed to identify possible additional studies. Lastly, hand searches, covering the period from January 2014 to January 2015 inclusive, were conducted for each journal containing the included studies. A total of 57 studies were considered for possible inclusion from these searches.

### **Screening and Inclusion Criteria**

Each of these 57 studies was then screened to determine if the study met the following inclusion criteria: (a) included at least one participant with a diagnosis of ASD, Asperger Syndrome, or Pervasive Developmental Disorder-not otherwise specified (PDD-NOS), and (b) evaluated the use of one or more BCIS scenarios to teach manding behaviour. Application of these inclusion criteria resulted in 15 studies being included in this review (see Table 2). Two authors independently applied the inclusion criteria to the 15 studies yielded in the searches. Agreement on whether each article should be included or excluded was obtained for 14 out of the 15 studies (93%). A third author then reviewed the study in which there was disagreement and decided it should be included.

### **Data Extraction**

The 15 included studies were summarized in terms of the following variables: (a) participant characteristics, (b) dependent variables, (c) type of BCIS scenario, (d) prompting procedures used as part of the BCIS, (e) the communication mode taught to the participants (e.g., manual signing, picture exchange, use of speech-generating

devices); (f) the research design used the study, (g) summary of the results, and (h) an assessment of the certainty of evidence from the study.

BCIS scenarios were classified by the types of interruptions, (i.e., missing-item format, delay presentation, item out of reach, blocking/withholding access, or incomplete/limited access) as outlined in Carter and Grunsell (2001). Study results were classified as positive, mixed, or negative based on visual analysis of graphed results (Gast & Ledford, 2009) and using the definitions developed by Lang et al. (2012) and Davis et al. (2011). Briefly, a positive result meant that all of the participants showed improvement in learning the targeted mand skill(s). A mixed result meant that some, but not all participants showed improvement in learning the targeted mand skill(s). A negative result meant that none of the participants showed improvement in learning the targeted mand skill(s). Furthermore, studies were also classified in terms of methodological quality by ranking the level of certainty as “insufficient”, “preponderant”, or “conclusive” using descriptors provided by Mulloy et al. (2010), Simeonsson & Bailey (1991), and Smith, 1981). The classification at the insufficient level of certainty indicated the study did not utilize an experimental design (e.g., case studies, group designs with out a control group, or AB designs). Studies were classified at the preponderance level of certainty if they demonstrated experimental control (i.e., a single case research design or an experimental group design with a control group), reported adequate inter-observer agreement (i.e., at least 20% or more sessions collected with a mean of 80% or higher), operationally defined dependent variables, and provided enough detail to enable replication. Further, studies were also classified at the preponderance of evidence level if they contain limitations with regards to alternative explanations for results (e.g., multi-component interventions). Lastly, the conclusive level of evidence was used to classify studies

that met the components of the preponderance level of certainty, but also attempted to control for confounding variables (e.g., placebo controlled or double-blind studies).

### **Checking for Accuracy**

After data was extracted from each study, a summary was developed by the first author. This summary was checked for accuracy by a second author acting independently. For this task, a checklist was developed that included the following seven questions: (a) Are the participants described accurately? (b) Are the dependent variables accurately described? (c) Is (are) the type(s) of BCIS accurately described? (d) Are the prompting procedures accurately described? (e) Is the communication mode accurately described? (f) Are the research designs accurately described? (g) Are the results accurately summarized?, and (h) Is the certainty of evidence accurately classified? In the case of a no response to any of these questions, the two authors then edited the summary until agreement on the accuracy of the coding and summary was reached.

### **Participants**

The 15 studies provided intervention to a total of 37 participants with ASD. Thirty-four participants (92%) were male and three were female (8%). Thirty of those participants (81.1%) had a diagnosis of autism, one (2.7%) had an additional diagnosis of a seizure disorder, five (13.5%) had an additional diagnosis of a cognitive delay or intellectual disability (three participants with severe intellectual disability and two with moderate intellectual disability), and 1 (2.7%) participant was described as having PDD-NOS. Participant ages ranged from 3 to 14 years ( $M = 5$  years, 8 month old), but not all studies reported ages.

### **Settings**

The studies reviewed conducted interventions in two settings. School settings

were used in 10 studies (66.7%) (Alwell, et al., 1989; Betz et al., 2010; Duker, Kraaykamp, & Visser, 1994; Grunsell & Carter, 2002; Lechago et al., 2010; Roberts-Pennell & Sigafoos, 1999; Sidener et al., 2010; Sigafoos & Littlewood, 1999; Sigafoos, Kerr, Roberts, & Couzens, 1994; Sundberg et al., 2002). The remaining five studies (33.3%) took place in clinics (Albert et al., 2012; Endicott & Higbee, 2007; Lechago, Howell, Caccavale & Peterson, 2013; Sigafoos et al., 2013; Tada & Kato, 2005).

### **Dependent Variables**

Mands related to requesting preferred items were taught in nine (60%) studies (Albert et al., 2012; Alwell et al., 1989; Duker, et al., 1994; Grunsell & Carter, 2002; Roberts-Pennell & Sigafoos, 1999; Sigafoos & Littlewood, 1999; Sigafoos et al., 1994; Sigafoos et al., 2013; Tada & Kato, 2005). Mands for information were taught in five (33.3%) studies (Betz et al., 2010; Endicott & Higbee, 2007; Lechago et al., 2010; Lechago et al., 2013; Sundberg et al., 2002). Mands for information included teaching where, who, and how question types. The Sidener et al. (2010) study focused on teaching mands and tacts.

### **Intervention Procedures**

Verbal cues (e.g., *Let's play the game. Get [item name]*) were used to set the occasion for a manding opportunity in 10 (67%) of the studies (Albert et al., 2012; Betz et al., 2010; Endicott & Higbee, 2007; Lechago et al., 2010; Lechago et al., 2013; Roberts-Pennell & Sigafoos, 1999; Sidener et al., 2010; Sigafoos et al., 2013; Sundberg et al., 2002; Tada & Kato, 2005). For example, Lechago et al. (2013) used the instruction *Make a volcano* to signal the start of the behaviour chain and to set the occasion for a mand for information (i.e., *How do I?*). After the participant emitted the correct mand for information, the experimenter provided directions on how to

make the volcano erupt so that the volcano activity could continue. Twelve studies (80%) used modeling procedures to prompt correct mands (Albert et al., 2012; Alwell et al., 1989; Betz et al., 2010; Edicott & Higbee, 2007; Lechago et al., 2010; Lechago et al., 2013; Roberts-Pennell & Sigafoos, 1999; Sidener et al., 2010; Sigafoos & Littlewood, 1999; Sigafoos et al., 1994; Sundberg et al., 2002; Tada & Kato, 2005). Modeling included the use of verbal models, such as saying the mand that the participant was supposed to produce. Four studies (27%) used physical and/or partial physical prompting procedures (Alwell et al., 1989; Grunsell & Carter, 2002; Roberts-Pennell & Sigafoos, 1999; Sigafoos et al., 1994). Other types of prompting procedures included the use of graduated guidance (e.g., Albert et al., 2012) and errorless prompting, which consisted of a progressive time delay and verbal and/or physical model prompts (Roberts-Pennell, & Sigafoos, 1999). Clearly, most studies used a combination of prompting strategies as part of the intervention procedures.

Varying forms of reinforcement were also used across these 15 studies. All of the included studies involved listener delivered consequences that were hypothesized to function as a type of natural reinforcement. Generally, this involved enabling the participant to continue the behaviour chain and, thus, obtain the natural or terminal reinforcer associated with continuing or completing that chain. However, in addition to arranging this type of [natural] reinforcement some studies (e.g., Alwell et al., 1989) included providing praise for correct mands.

### **Types of BCIS Scenarios**

Seven studies (47%) employed the missing-item format (Albert et al., 2012; Betz et al., 2010; Endicott & Higbee, 2007; Lechago et al., 2010; Sidner et al., 2010; Sundberg et al., 2002; Tada & Kato, 2005). For example, Albert et al. (2012) used the missing-item format to target a mand for glitter, which was needed to complete an art

project. Withholding an item, or limiting or blocking access to an item, was used in four (26.7%) of the studies (Lechago et al., 2013; Roberts-Pennell & Sigafoos, 1999; Sigafoos & Littlewood, 1999; Sigafoos et al., 2013). For example, Sigafoos et al. (2013) interrupted engagement with preferred toys to create opportunities for the participants to request more toy play. Another interruption strategy involved placing needed items out of reach (Grunsell & Carter, 2002). Finally, three (20%) of the studies employed a combination of BCIS scenarios, such as delaying the presentation of an item, blocking the use of items, blocking access to items, positioning items out of reach, or delaying the provision of needed assistance (Alwell et al., 1989; Duker et al., 1994; Sigafoos et al., 1994).

### **Research Designs, Interobserver Agreement, and Procedural Integrity**

Although group designs were not excluded, all of the studies meeting the inclusion criteria used single-case research designs (Gast & Ledford, 2009). Multiple baseline designs were used in 12 (80%) of the studies (Albert et al., 2012; Alwell et al., 1989; Betz et al., 2010; Endicott & Higbee, 2007; Grunsell & Carter, 2002; Lechago et al., 2010; Lechago et al., 2013; Roberts-Pennell & Sigafoos, 1999; Sigafoos et al., 1994; Sigafoos et al., 2013; Sundberg et al., 2002; Tada & Kato, 2005). Specifically, four of the included studies (27%) used a multiple baseline across participants (Betz et al., 2010; Endicott & Higbee, 2007; Grunsell & Carter, 2002; Sigafoos et al., 2013). Multiple baseline across activities were conducted in 2 (13%) of the studies (Albert et al., 2012; Tada & Kato, 2005). Some of these studies included variations of the multiple baseline design. For example, three of the studies (20%) used a multiple probe design (Alwell et al., 1989; Lechago et al., 2013; Sigafoos et al., 1994).

Varying amounts of interobserver agreement (IOA) were collected in all

studies. Across studies the mean IOA was greater than 97% (range 94% to 100%). Procedural integrity or treatment fidelity checks were reported in six (40%) of the studies with a mean of 99% (range 97 to 100%) (Betz et al., 2010; Grunsell & Carter, 2002; Lechago et al., 2010; Lechago et al., 2013; Sigafoos et al., 2013; Sidener et al., 2010).

## **Results**

All of the reviewed studies reported positive results with regards to acquisition of the targeted mand. In addition, at least one type of generalisation assessment was conducted in 13 of the studies (87%). Specifically, generalisation was assessed either across (a) environments, (b) stimuli (e.g., novel toy, novel activity, or, novel chain), (c) communication partners, and/or (d) time (i.e., maintenance). Positive results for these generalisation assessments were reported for nine (60%) of the studies (Albert et al., 2012; Alwell et al., 1989; Endicott & Higbee, 2007; Grunsell & Carter, 2002; Sigafoos & Littlewood, 1999; Sigafoos et al., 1994; Sigafoos et al., 2013; Sundberg et al., 2002; Tada & Kato, 2005). Mixed results from the generalisation assessments were reported in four (27%) of the studies (Betz et al., 2010; Lechago et al., 2010; Lechago et al., 2013; Roberts-Pennell & Sigafoos, 1999).

The most commonly assessed form of generalisation was generalisation across stimuli (toys, activities, or contexts), which was undertaken in 11 (73%) of the 15 studies (Albert et al., 2012; Alwell et al., 1989; Betz et al., 2010; Grunsell & Carter, 2002; Lechago et al., 2010; Lechago et al., 2013; Roberts-Pennell, & Sigafoos, 1999; Sigafoos et al., 1994; Sigafoos et al., 2013; Sundberg et al., 2002; Tada & Kato, 2005). Other studies assessed generalisation across environments ( $n = 5$  or 33% of the studies; Albert et al., 2012; Alwell et al., 1989; Betz et al., 2010; Edicott & Higbee, 2007; Grunsell & Carter, 2002). Generalisation across people was measured in three



(20%) of the studies (Albert et al., 2012; Endicott & Higbee, 2007; Sigafoos & Littlewood, 1999). Six studies (40%) included assessment for multiple types of generalisation (Albert et al., 2012; Alwell et al., 1989; Edicott & Higbee, 2007; Grunsell & Carter, 2002; Lechago et al., 2013; Sundberg et al., 2002). Finally, generalisation across time (i.e., maintenance) was assessed in four (27%) studies (Alwell et al., 1989; Grunsell & Carter, 2002; Lechago et al., 2013; Sundberg et al., 2002) with such assessments occurring from 2 to 24 weeks after intervention ( $M = 15$ ).

### **Certainty of Evidence**

The majority of studies met the criteria for providing preponderant evidence (80%;  $n = 12$  studies). These studies (a) used an experimental design, (b) had adequate interobserver agreement, (c) had operationally defined dependent variables, and (d) included sufficient procedural details to enable replication (Albert et al., 2012; Alwell et al., 1989; Betz et al., 2010; Duker et al., 1994; Endicott & Higbee, 2007; Grunsell & Carter, 2002; Lechago et al., 2010; Lechago et al., 2013; Sigafoos et al., 1994; Sigafoos et al., 2013; Sidener et al., 2010; Tada & Kato, 2005). The remaining three studies (Robert-Pennell & Sigafoos, 1999; Sigafoos & Littlewood, 1999; Sundberg et al., 2002) were classified as insufficient, providing less certain evidence, but in two of these studies (Robert-Pennell & Sigafoos, 1999; Sundberg et al., 2002) the only concern was fewer percentage of sessions (15 to 19% of sessions) had been checked for interobserver agreement. While this is less than the generally accepted cut-off of 20%, the overall level of agreement reported in these studies was above the generally accepted standard of 80%. The other study (Sigafoos & Littlewood, 1999) was rated as providing an insufficient certainty of evidence owing to the use of a pre-experimental (A-B) design.

**Table 2.** *Summary of research using interrupted behaviour chain procedures*

Citation	Participant Characteristics	Dependent Variable	BCIS Scenarios	Communication Mode	Research Design	Results	Certainty of Evidence
Albert et al. (2012)	2 males, 5 & 8 years old with diagnosis of autism (one also with seizure disorder) 1 female, 5 years old with diagnosis of PDD/ASD	Type of mand response produced by the participant (i.e., unprompted or prompted).	Missing-item format: Three behaviour chains were identified for each child (e.g., art activity, making toast, listening to music) and interrupted by hiding a needed item (e.g., glitter, toaster, CD player) so that he or she could not continue the activity.	Speech communication	Multiple baseline across activities	Positive: All participants learned to independently mand for missing items after mand training was conducted.	Preponderant: Clear experimental design, adequate interobserver agreement (25% of sessions; 95% average IOA), operationally-defined dependent variables, sufficient detail to replicate the study. Although exact percentage of measures were not reported for treatment fidelity, the authors stated the instructor followed designated procedures and specified criteria.
Alwell et al. (1989)	1 male, 7 years old with autism and cognitive delay 2 females, 6 & 7 years old with developmental and cognitive delay	Cumulative correct requests	Withholding needed item; Blocking access to needed item; Response blocking: Three behaviour chains were identified for each child (e.g., going outside, getting a drink, playing with toys) and interruptions occurred by withholding a needed item, blocking the child from accessing the needed item, or by restraining the child's movements so that he or she could not continue the activity.	Gestures and manual sign; picture communication system; speech or manual sign	Multiple probe across responses	Positive: All participants learned the targeted requesting responses and generalised to out-of-routine contexts.	Preponderant: Clear experimental design, adequate interobserver agreement (average of 24% of sessions; 95.2% IOA), operationally-defined dependent variables, sufficient detail to replicate the study. Although exact percentage of measures were not reported for treatment fidelity, the authors stated measurement was taken for 42 sessions and the instructor followed designated procedures and specified criteria with two exceptions.
Betz et al. (2010)	2 males, aged 5 and 3.5 years with autism. 1 female, aged 4.5 years, with autism.	Percentage of correct independent mands for information using where + item name	Missing-item format: The child was able to select and play with one of five preferred toys for 30s. The child was then instructed to put the toy on the table and was distracted while the toy was hidden.	Speech communication	Multiple baseline across participants.	Positive: Participants acquired the targeted skill (Where + item?), and generalised to novel items in the training setting, and to novel items in novel settings. Generalisation to the natural context of a behaviour chain did not occur until training using an interrupted behaviour chain procedure.	Preponderant: Clear experimental design, adequate interobserver agreement (35% of sessions; 100% IOA), operationally-defined dependent variables, sufficient detail to replicate the study, and measures of treatment fidelity (30% of sessions; 99% for participants) were reported.

Duker et al. (1994)	Manual sign group consisted of 3 females, aged 12, 15, and 15 years with varying disabilities. Speech communication group consisted of 3 males, aged 24, 11, and 14 years, with varying disabilities (one participant with autism).	Frequency of spontaneous gesture requests (for manual sign group) and frequency of spontaneous requests using speech for the speech communication group.	Incomplete item or limited access to item: When the child requested a toy (e.g., puzzle, clay, music), the teacher provided one quarter or half of the item or 1 or 2 min of access depending on the treatment phase, then withdrew the item or activity.	Manual sign and speech communication	Reversal	Mixed: Five out of six participants had reported increases in frequency of spontaneous requests. Specifically, the participant with a diagnosis of autism did not show increases in spontaneous requesting during treatment.	Preponderant: Clear experimental design, adequate interobserver agreement (23% manual sign group sessions and 39% speech group sessions; 98% IOA for manual sign group and 99% IOA for speech group), operationally-defined dependent variables, sufficient detail to replicate the study. Although exact percentage of measures were not reported for treatment fidelity.
Endicott & Higbee (2007)	4 males, aged 3, 4, 4, and 5 years with autism.	Experiment 1: percentage of correct mands for “Where?” Experiment 2: percentage of correct mands for “Who?”	Missing-item format: The child was given 30 s access to a preferred item, then was taken away from the learning area while the item was hidden.	Speech communication	Multiple baseline across participants with generalisation phase and an embedded multi-element design to evaluate the intervention using high-preferred and less-preferred items.	Positive: Experiment 1: All participants acquired the mand for information using “Where [item]?” for the highly preferred items and 2 of the 3 participants acquired this mand with low-preferred items. Two participants generalised <i>where</i> mands from clinic to home. Positive: Experiment 2: All 3 participants acquired mands for information using “Who has [item]?” for high and low-preferred items.	Preponderant: Clear experimental design, adequate interobserver agreement (average of 87% of sessions; 100% average IOA), operationally-defined dependent variables, and sufficient detail to replicate the study, although treatment fidelity was not reported.

Grunsell & Carter (2002)	2 males, aged 7:2 and 8:5 years with intellectual disability, autistic behaviours, communication disorder, and ADHD (one participant). 2 females, aged 8:7 and 8:6 years with intellectual disability, communication disorder, and autistic behaviour (one participant).	Percentage of opportunities with a correct request (e.g., touching picture cards or symbol cards).	Item out of reach: needed items (e.g., musical instruments) placed on a shelf out of reach but visible during routine.	Use of Pictorial Communication Symbols (PCS)	Multiple baseline across participants.	Positive: All participants showed an increase in targeted requests, which also generalised to untaught routines and untaught symbols, as well as out of context.	Preponderant: Clear experimental design, adequate interobserver agreement (100% of sessions; 100% IOA), operationally-defined dependent variables, sufficient detail to replicate the study, and measures of treatment fidelity (39% of sessions; 100% fidelity) were reported.
Lechago et al. (2010)	3 males, aged 4:6, 4:6, and 7 years with autism.	Cumulative number of targeted mands ( <i>Where + item</i> and <i>Who has + item</i> ).	Missing-item format: Three behaviour chains were identified for each child (e.g., volcano, ice cream, doll) and were interrupted by hiding the need item (i.e., spoon) so that he or she could not continue the activity.	Speech communication	Nonconcurrent multiple baseline across participants.	Positive: All participants acquired the targeted mands and generalised the mands across activities. Participant 2 also generalised mands for information to an untaught noun (i.e., truck).	Preponderant: Clear experimental design, adequate interobserver agreement (96% average of sessions; 100% average IOA), operationally-defined dependent variables, sufficient detail to replicate the study, and measures of treatment fidelity (average of 94% of trials; 97% average fidelity) were reported.
Lechago et al. (2013)	3 males, aged 7:7, 7:7, and 5:9 years with autism.	Cumulative number of correct mands ( <i>How do I? and How many?</i> ).	Withholding access: Four behaviour chains were identified for each child (e.g., making a tornado, making a volcano, making chocolate milk) and were interrupted by withholding access to the information needed to complete the activity.	Speech communication	Concurrent multiple probe across behaviour chains.	Positive: All participants acquired the targeted mands for information and generalised across MOs and response topographies.	Preponderant: Clear experimental design, adequate interobserver agreement (71% average of sessions; 94.3% average IOA), operationally-defined dependent variables, sufficient detail to replicate the study, and measures of treatment fidelity (92.3% average fidelity) were reported. Additionally, IOA was collected on procedural fidelity (on an average of 34.6% of sessions) with an average agreement of 98%.

Roberts-Pennell & Sigafoos (1999)	2 males, aged 3 years, one with Ventricular Leukomalacia; the other with autism and intellectual disability. 1 female, age 3 years, with Lennox-Gastaut syndrome and intellectual disabilities.	Percentage of correct requests (speech, sign, or symbol) and generalisation to untaught routines and beginning of routine.	Withholding access: Two behaviour chains were identified for each child (e.g., playing on the playground, listening to music, playing with toys) and were interrupted within on-going play by passively blocking access or turning off the control switch of the toy. At the point of interruption the trainer asked, 'Do you want more?'.	Speech communication, manual sign, or use of picture symbols.	Multiple baseline across participants.	Positive: All participants had an increase in independent requests, however the participant with autism had lower levels of progress. Two of the participants did not transfer the request taught when interruption to the initiation of the task.	Insufficient: Although IOA was reported at 100%, it was collected on less than 20% of all sessions (IOA was collected during 15.8%, 16.7%, and 20% of sessions across participants). Treatment fidelity was not reported. It should be noted that this study demonstrated experimental control, operationally defined dependent variables, and provided adequate details for replication.
Sidener et al. (2010)	Experiment 3: 1 male, aged 4 years with autism.	Sessions to criterion for the for acquisition of tacts versus tacts and mands	Missing-item format: The experimenter asked the participant to engage in a preferred activity (e.g., cubes, puzzle, felt). The last piece required to complete the chain was hidden by the experimenter.	Speech communication	Modified Alternating Treatment Design	Positive: The participant acquired the targeted mands, but had varying acquisition rates across word sets for both mands and tacts, suggesting that the mixed verbal operant training did not result in faster acquisition than single operant training.	Preponderant: Clear experimental design, adequate interobserver agreement (100% of sessions; 99% IOA), operationally-defined dependent variables, sufficient detail to replicate the study, and measures of treatment fidelity (48% of sessions; 98% fidelity) were reported.
Sigafoos & Littlewood (1999)	1 male, aged 4:8 years with autism.	Independently saying <i>Play</i> when play was interrupted.	Response blocking: When the child was on the playground, his play was interrupted 1 to 3 times at each of four interruption points (e.g., when he attempted to cross a wooden bridge, when he started walking across a balance beam, when he stepped on to the obstacle course, and when he reached for the rope to climb the rope ladder). Interruption involved gently holding him from behind so that he could not continue the action.	Speech communication (i.e., saying the word <i>Play</i> when his play was interrupted)	A-B design.	Positive: The participant acquired the target mand and generalised its use to an earlier point of interruption as well as to a new teacher.	Insufficient: The research design was pre-experimental. However, there were adequate interobserver agreement was reported (average of 29% of sessions; 95% IOA), operationally defined dependent variables, and there were sufficient detail to replicate. Treatment fidelity was not reported.

Sigafoos et al. (1994)	26 children, aged 3 to 15 years with moderate to severe disabilities in several classrooms Classroom 1: 5 boys, aged 6 to 8 years old, with autism; classroom 6: 1 with autism)	Number of opportunities provided per minute (by teacher). Cumulative number of requests made by the students.	Missing-item; Blocking access; Delayed-assistance: Regularly scheduled activities (e.g., painting, playing with toys, pre-academic task) within the classroom were selected as behaviour chains. Consultation was provided to the teacher on the three types of interruptions and how he or she might incorporate them into the classroom activities. Five minutes before each session the teacher reviewed the written description of the interruption types. After the session feedback was provided	Speech communication and manual sign	Multiple probe across classrooms	Positive: An increase in number of opportunities for requesting behaviour was reported as well as an increase in correct student responses. Opportunities and student responses continued to be observed in generalisation and follow-up sessions.	Preponderant: There was a clear experimental design, adequate interobserver agreement (average of 40% of sessions; 96% IOA), operationally-defined dependent variables, and sufficient detail to replicate the study. Treatment fidelity was not reported.
Sigafoos et. al. (2013)	2 males (brothers), aged 5 and 4 years old with autism.	Cumulative number of independent activations of a speech-generating device (SGD) to request continuation of toy play Cumulative number of reaching behaviours. Cumulative number of challenging behaviours (i.e., hitting).	Withholding access: The participant was given 30 s of access to a preferred toy (e.g., ball, puzzle, book). The trainer then gently removed the toy from the child and said, 'My turn now. Let me know if you want to play with the toy'.	Use of a speech-generating device	Multiple baseline across participants.	Positive: Each participant acquired independent requesting (i.e., use of the SGD), and a decrease in reaching. The one child with challenging behaviour also showed a decrease in this behaviour. Requesting skills were maintained over time and generalised to novel items.	Preponderant: Clear experimental design, adequate interobserver agreement (62% of interruptions; 100% IOA), operationally-defined dependent variables, sufficient detail to replicate the study, and measures of treatment fidelity (62% of interruptions; 100% fidelity) were reported.

Sundberg et al. (2002)	Experiment 1: 2 males, age 5 and 6 years with autism. Experiment 2: 2 males, aged 5 and 8 years, with autism	Experiment 1: Percentage of correct use of Where?" Experiment 2: Correct and incorrect use of Where?" and Who?.	Missing-item format: For each child two items were used (i.e., 1 reinforcer and 1 neutral stimuli). Brief access to the toy was given to the child prior to the interruption. The child was distracted while the item was hidden inside one of the three containers.	Speech communication	Multiple baseline across questions and a multi-element design.	Positive: Experiment 1: Both participants increased the use of Where? mands. Participant 1 did not generalise to untrained neutral items. Positive: Experiment 2: Both participants acquired the mand "who has it?". Both participants showed slower latency between verbal stimulus, "I gave it to the teacher" and the question "who has it?" for preferred items than for neutral items. Maintenance was probed for 1 participant and skills were maintained at 6 months.	Insufficient: IOA was not collected on at least 20% of sessions (IOA was collected on 19% of Experiment 1 sessions and 18% of Experiment 2 sessions) The percentage of IOA were high in both experiments (98 and 95% respectively). However, the study demonstrated experimental control, operationally defined dependent variables, and provided adequate details for replication. Treatment fidelity was not reported.
Tada & Kato (2005)	1 male, aged 4:10 years with autism.	Percentages of occurrences of mand topographies per session and percentage of on-task behaviour.	Missing-item format: During a preferred (i.e. drawing) and non-preferred (i.e. stickers) task needed items were missing from the materials provided (e.g, a pen case not containing certain colors).	Speech communication	Multiple baseline across activities	Positive: The participant acquired independent mands and maintained and generalised to novel materials. On-task behaviour was higher during the drawing activity, which suggested a higher preference for this activity.	Preponderant: There was a clear experimental design, adequate interobserver agreement (45% of sessions 95% IOA), operationally-defined dependent variables, and sufficient detail to replicate the study. Treatment fidelity was not reported.

## Discussion

We identified and summarized 15 studies that used the BCIS to teach manding skills to individuals with ASD. Various BCIS scenarios were used, but the most commonly used was the missing-item format. In addition to using one or more BCIS, the studies also shared a number of intervention components using similar types of response prompting procedures. Overall, the studies reported positive results and could be seen as providing a high certainty of evidence owing to the use of single-case experimental designs to evaluate the effects of intervention on the acquisition and generalisation of the targeted manding skills. The results of this review thus suggest that the BCIS is an effective approach for teaching manding skills to individuals with ASD. This conclusion is consistent with an earlier review into the use and validation of the BCIS for teaching manding skills to individuals with developmental disabilities (Carter & Grunsell, 2001). Further, many well-established researched-based interventions packages for individuals with autism include BCIS strategies. For example, Pivotal Response Training, Enhanced Milieu Teaching, and Prelinguistic Milieu Teaching all include BCIS strategies as part of their intervention packages (Hancock, & Kaiser, 2002; Yoder, & Stone, 2006; Verschuur, Didden, Lang, Sigafoos, & Huskens, 2014). This review provides additional support for the unique contribution of the BCIS component within those packages.

Attention to MOs seems to be an important variable for effective use of the BCIS (Albert et al., 2010; Hall & Sundberg, 1987; Sundberg & Partington, 1998; Sundberg et al., 2002). Effective use of MOs, would in turn seem to depend to some extent on identifying and making use of preferred behaviour chains or behaviour chains that lead to highly preferred terminal reinforcers. At a conceptual level, some of the studies appeared



to make use of what can be defined as a Transitive Conditioned MO (CMO-T; Michael, 1993; Shafer, 1994; Albert et al., 2012). The idea of a CMO-T is that an item within a chain, which might initially have been a neutral stimulus (e.g., a knife), could become momentarily valuable because of the relation with another reinforcing item within a chain (e.g., spreading a highly preferred jam on the toast). Thus, the individual is likely to be motivated to mand for a knife when reaching that step of the task and so making sure ensuring the knife is missing is one way to establish the knife as a reinforcer and thus strengthen mands that will lead to a knife being delivered by the listener. In other scenarios a different type of CMO, specifically, a Reflexive Conditioned MO (CMO-R), seems to have been in effect. The idea of a CMO-R is that one can create the need for a mand by blocking access to the terminal reinforcer within a behaviour chain. At a practical level, both the CMO-T and the CMO-R operations seem to require that there is a powerful reinforcer that the person wants to access at some point in the chain and that this reinforcer will be obtained by producing the targeted mand.

Along these lines, most of these 15 studies used some type of familiar activity (e.g., music activity) or pre-trained participants in completing the chain to ensure that they knew what was needed to complete the chain. Success in using a BCIS would seem to depend on the extent to which the participant is familiar with the chain. For example, it would seem that knowing that a knife is required to spread butter on toast is a prerequisite for teaching the individual to mand for a knife when one is not present during a toast making activity. However, it is also possible that with continued exposure to a chain, the reinforcing properties of the terminal reinforcer might be transferred to previous steps of the behaviour chain and this could then help to establish neutral stimuli as reinforcers,

and thus lead to more opportunities to teach additional mands (Albert et al., 2012). For example, in the context of making toast, several items that might have been neutral stimuli initially (e.g., the toaster, the knife), might become the reinforcers for mand training (i.e., teaching the person to request the toaster and knife, so that he or she can eventually access the highly preferred terminal reinforcer of buttered toast). Creating such opportunities to teach additional mands within a single behaviour chain could be seen as particularly important when working with individuals who have a limited number of reinforcing items for which they are motivated to mand.

Based on the ways in which the BCIS was implemented in these studies, there are a few suggestions that could be made with respect to selecting the type of interruption strategy to use within a BCIS-based intervention. First, some individuals might find an interruption aversive, which might provoke problematic mand forms, such as tantrums, aggression, or self-injury. To prevent this, it would seem useful to select interruption points that create an MO for manding, but which are not overly aversive as described by Goetz et al. (1985). Additionally, when using a BCIS that may signal a worsening condition (i.e., CMO-R), the listener might become a signal that reinforcement is not available, which could prevent the individual from emitting in the targeted mand. Use of the missing-item format might be indicated in this situation because this type of interruption might be seen as less aversive than blocking access (Shafer, 1994). Another way to make interruptions less aversive might be to include some uninterrupted behaviour chains on a regular schedule (Lechago et al., 2010).

The results of this review point to several area for possible future research. First, it would seem useful to consider future studies to investigate the use of BCIS in regards

to transfer of stimulus control, manipulation of MOs, and across various types of learners. Additionally, research should investigate generalisation across various items within an existing behaviour chain. Specifically, generalisation within a behaviour chain to novel stimuli (i.e., other items present in the behaviour chain) may be a valuable and potentially time efficient approach to increasing the number of mand forms in the person's repertoire. For example, using one behaviour chain to extend the mand forms in a person's repertoire to several stimuli related to the behaviour chain could save practitioners time as well as resources, because they could avoid having to plan for several teaching situations, and could simply capitalize on the already existing behaviour chain. For example, within the context of an arts and crafts activity, a teacher could hide several different items (e.g., paint brush, paint, or paper) to create the opportunity for a variety of mands. Finally, using BCIS may be an approach to teaching other verbal operants in the context of manding (e.g., transfer of mands to tacts) in a naturalistic context.

One advantage of BCIS seems to be that is easy for practitioners to use. For example, BCIS can be added to already existing routines in the natural environment (Sigafos et al., 1994), such as by hiding an item to create an opportunity for a mand. Because BCIS uses naturally occurring reinforcement contingencies (i.e., the terminal reinforcer of the behaviour chain) rather than contrived reinforcement, this may also be an added benefit for both practitioners and the participant, because it can be added into existing preferred activities. Contrived reinforcement (i.e., reinforcement contingency not typically available in the natural environment or as a product of the behaviour outside of intervention sessions) in settings like schools may be a point of disagreement for

stakeholders, especially if they cause disruption to the environment. Thus, capitalizing on the learners MO and the naturally occurring reinforcement contingences avoids this potential problem. Further, teaching children to contact the environment through naturally occurring reinforcement is useful when programming for generalisation, and may lead to an increase in attending to a greater variety of discriminative stimuli (Stokes & Baer, 1977).

### **Summary and Rational for Research**

Based on the findings of the current body of research, it is clear that future research efforts should build upon Skinner's analysis of verbal behaviour by teaching nonvocal individuals with ASD to develop advanced manding skills using an SGD. This proposal aims to improve and expand the current body of research on advanced manding skills for individuals with ASD. Specifically, this project will consist of three studies, which will utilize Skinner's analysis of verbal behaviour to determine effective and systematic methods to teach nonvocal individuals with ASD to learn advanced manding skills by utilizing an SGD.

### **Research Question**

The studies presented in this thesis aim to determine effective instructional procedures for teaching nonvocal individuals with ASD to use advanced manding skills (e.g., manding for actions and manding for information) using AAC devices. Since communication is a pivotal skill research is needed to further determine the best types of teaching procedures to use with individuals who have severe deficits in this area. The proposed research will help identify what instructional procedures yield effective results for teaching complex language skills using an AAC device, which are essential skills for individuals to engage

with people and within their environment. Theoretically, this research aims to investigate communication using behaviour-analytic technology that focuses on an individual's motivation, which is essential for teaching causality and meaning of language interactions. The following research questions will be evaluated via the studies presented in this thesis.

1. Can children with ASD learn to use SGD's for advanced manding skills (e.g., manding for actions and manding for information using "Where" questions)?
2. What prerequisites skills are needed for success with this type of advanced mand training?
3. Does the use of interrupted behaviour chains yield positive results for learning advanced manding?
4. Does teaching advanced manding lead to better communication outcomes?
5. Do advanced manding skills generalise across novel items?

### Definition of Terms

*Augmentative and alternative communication (AAC)* - AAC refers to the use of nonspeech modes of communication to supplement or replace limited or unintelligible speech. AAC involves the use of aided (e.g., speech-generating devices (SGD) and Picture Exchange) and/or unaided (e.g., pointing, gestures, head nodding, and use of manual signs) systems. (Bondy & Frost, 2001; Mirenda, 2001; Schlosser & Sigafoos, 2006; Shane et al., 2012).

*Discriminative Stimulus ( $S^D$ )* – A stimulus in the presence of which responses have been reinforced and in the absence of which the same type of responses have occurred and not been reinforced (Cooper, et al, 2007).

*Consequence* – A stimulus change that follows a behaviour of interest. Some consequences, especially those that are immediate and relevant to the current motivational state, have significant influence on future behaviour. Consequences can either increase behaviour (i.e., reinforce) or decrease behaviour (i.e., punish) (Cooper, et al., 2007).

*Contingency* – The dependent and/or temporal relations between operant behaviour and its controlling variables (Cooper, et al., 2007).

*Mands* – An elementary verbal operant that is evoked by an MO and followed by a specified reinforcer (e.g., requesting or rejecting). Example of different types of mands:

- 1.) *Mands for actions* – A type of mand that uses a verb (i.e., action) and increase the precision of the mand (e.g., asking for a door to be opened).
- 2.) *Mands for information* – A question which specifies a verbal action and the behaviour of the listener. Mands for information are reinforced by access to information (i.e., answer to the question) (Cooper, et al., 2007; Skinner, 1957).

*Motivating operations (MO)* - An environmental event, or stimulus condition that: (a) alters the power of a specific stimulus change to function as a reinforcer, and (b) influences the frequency of behaviours maintained by that specific reinforcer (Cooper, et al., 2007; Michael, 1993).

*Speech-generating devices (SGD)* - Electronic devices that produce digitalized or synthesized speech output (Lancioni, et al., 2007; Thunberg, et al., 2013.)

*Verbal behaviour* – Behaviour whose reinforcement is mediated by a listener and can included both vocal and nonvocal behaviour (Cooper, et al., 2007; Skinner, 1957).

## CHAPTER 3

### STUDY 1: Teaching Mands for Actions

#### Introduction

Verbal behaviour is a ubiquitous feature of human interaction (Skinner, 1957). Simply stated, people often communicate with each other. Communication might be an end in its own right, but a well-established verbal behaviour repertoire often enables the individual to more precisely contact and engage with others and their environments (Ostry, Wolfe, & Rusch, 2008; Skinner, 1957; Sundberg & Michael, 2001). Perhaps due to what appears to be a core deficit, the verbal behaviour repertoires of individuals with ASD often do not develop or are underdeveloped. It is estimated that about 25 to 30% of individuals with ASD do not fully develop spoken language and may therefore benefit from the use of augmentative or alternative communication systems (AAC; Ganz, et al., 2012; Tager-Flusberg & Kasari, 2013; Wodka, et al., 2013). Several studies have evaluated the development of a basic manding repertoire for individuals with ASD who use AAC systems (e.g., picture exchange, speech-generating devices, or manual sign).

In a review of the literature of interventions involving speech-generating devices (SGDs) for children with ASD, van der Meer and Rispoli (2010) found that 69.5% of the participants in these studies were taught to use the SGD to achieve what might be referred to as basic manding skills (i.e., activating a single icon from the screen to request access to a preferred object or activity). The results of these studies suggested that systematic instructional procedures can be effective in teaching children with ASD to use SGDs to accomplish basic manding functions. Specifically,



87% of the 23 included studies reported that the participants had successfully acquired the targeted mand(s).

After a child learns use to use a SGD to perform basic mands, a logical next step would be to teach more advanced manding skills, such as manding for multiple items, manding for actions, and/or manding for information (Betz, et al., 2010; Lechago, et al., 2013; Raulston et al., 2013). When looking at communication from a Skinnerian framework (Skinner, 1957), the form of the mand may be considered less important than its function. For example, in some cases a mand for action, when compared to a basic mand, may be more precise and thus more likely to lead to a reinforcing outcome for the speaker. To illustrate, if a speaker produced the mand *Door*, the function of that mand may be unclear to the listener. When such a mand was in fact used in an attempt to get the listener to open the door, it might be misinterpreted by the listener as a tact (*Yes, that is a door.*) or as a mand for information (e.g., as if the speaker were asking *Where is the nearest door?*). However, such misinterpretation is perhaps less likely when the speaker produces more precise (or advanced) mands for specific actions, such as by producing the mand, *Please, open that door for me*. To reduce the probability of any such misinterpretations and to enable the listener to provide the corresponding reinforcement for the speaker's mands, there would seem to be some benefit to teaching these types of seemingly more precise and advanced mands (e.g., mands for action).

Various procedures have been evaluated for teaching these types of more precise or advanced manding skills. One such procedure makes use of the behaviour chain interruption strategy (BCIS). The BCIS could be viewed as a naturalistic

approach for creating opportunities for teaching communication skills. Generally, this procedure involves creating opportunities to mand by interrupting a chain (or sequence) of behaviour (Carter & Grunsell, 2001; Goetz, et al., 1985; Hunt & Goetz, 1988). BCIS appears to be a potentially useful approach in part because it seems to be an effective way of creating the need or motivation for communication. More technically, the need to mand is created by contriving a motivation operation (MO) through the interruption of a behaviour chain that eventually leads to reinforcement. The MO is contrived by interrupting the chain and requiring a mand before the chain can be continued to its terminal reinforcement. The mand is reinforced by a listener response, such as providing some needed materials, providing some needed information or assistance, and/or performing a necessary action. Once the mand has been reinforced by the listener taking the appropriate action, the speaker will have the necessary materials, information, and/or assistance that will enable him or her to continue the chain and ultimately access the terminal reinforcer (Albert, et al., 2012; Carter & Grunsell, 2001; Hunt & Goetz, 1988).

Research has evaluated the use of the BCIS to teach advanced manding skills, such as manding for information (Betz et al., 2010; Lechago et al., 2013; Raulston et al., 2013). Betz et al. (2010), for example, used the BCIS to teach three children, ages 3.5 to 5, with autism to mand for information. The verbal children were taught to ask *where* questions when a preferred toy had been hidden (e.g., *Where is the ball?*) and evaluated the context of a multiple baseline design across participants. The intervention phase consisted of a 5 s time delay and given a verbal prompt(s) (i.e., “Where [item]?”) with differential reinforcement in the form of verbal praise and the location of the item was given. Each participant acquired the targeted mand(s) for

information. After acquisition, additional training was provided to promote generalisation to new behaviour chains (e.g., bowling, colouring, and playing with trains).

Lechago et al. (2013) also used a BCIS to teach two different question frames, *How do I?* and *How many?* to three verbal children, ages 5.9 and 7.7, with ASD. The intervention consisted of a 10 s time delay and a relevant verbal prompt (e.g., “Say, ‘How do I make a tornado?’”) and was evaluated using a concurrent multiple probe design across behaviour chains. Independent mands for *How do I?* or prompted mands (i.e., the participant imitated the prompt within 2 s) were given the information on how to complete the chain. As a result of the intervention each participant acquired the targeted mands, however the newly acquired mands did not show response generalisation (i.e., after learning *How do I?*, the participants did not spontaneously emit *How many?*). This suggests that the two mands (i.e., *How do I?* and *How many?*) were functionally independent and that teaching one form was unlikely to enable participants to produce the other form. This is not surprising given that the conditions under which the two forms would be indicated were different. That is, manding *How do I?* would be useful under conditions very different from when the mand *How many?* would be needed.

In a review of the literature on teaching mands for information, Raulston et al. (2013) noted that 10% of the 21 studies included in the review used the BCIS. Raulston et al. argued that successful intervention appeared to depend to some extent on creating an effective MO to ensure the need for question-asking behaviour. However, to date research has not yet evaluated the use of the BCIS for teaching

mands for actions. Thus a useful direction for future research would be to evaluate the effectiveness of using the BCIS to teach mands for actions.

To this end, few studies that have investigated procedures for teaching children with ASD to mand for actions (Choi, et al., 2010; Shillingsburg, Powell, & Bowen, 2013; Yosick, et al., 2015). For example, Choi et al. (2010) evaluated teaching two types of mands (i.e., requesting and rejecting items) in the context of the missing-item format and wrong item format, which are types of BCIS. In this study four children with developmental disabilities (3 children having diagnosis of autism), ages 6.5 to 9.5, were taught using an SGD or PE (based on their previous use) to in a trial based format that included a progressive time delay and prompting. The effects of the intervention were evaluated via a multiple probe design across participants. Overall results of the study suggested the procedures were effective in producing an increase of the targeted responses. In particular, the data suggested that one participant in this study was successfully taught to mand for a DVD to be played, which might classified as a type of mand for action. Shillingsburg et al. (2013) taught five children, ages 3 to 8 with ASD to vocally mand for the removal of stimuli that were blocking access to a preferred activity (e.g., when watching TV, someone obstructing the view). Intervention consisted of a constant time delay and prompted the mand for removal (e.g., “Move please”). The effectiveness of the intervention was evaluated using an adapted alternating treatments design and a nonconcurrent multiple baseline design across participants. Each participant acquired the mand for removal. Interestingly, two participants in this study were taught the mand *Move please*, which could be classified as a mand for action. Yosick et al. (2015) focused on teaching multiword mands, which included mands for actions (e.g., *Give me juice*,

*Stack Lego, Press play, Open book, etc.*). This study included 30 children (23 with a diagnosis of autism, 56.7% under the age of 4 and 43.3% five years and older), the remainder having a developmental delay. Intervention consisted of prompting and differential reinforcement related to increases in the length of the request. The effects of the intervention were measured using a nonconcurrent multiple baseline design across participants, however due to the number of participants nonoverlap of all pairs (NAP) was used to measure the effect size. Interventions were shown to be effective in that there were increases for the participants, with 70% of participants showing a strong effect.

While each of these three studies reported successful acquisition of mands for actions by some of the participants, there would seem to be need for extending this work to focus more explicitly on using the BCIS to teach mands for actions to additional children and specifically to children using SGDs because the evidence-base on teaching actions mands is limited. Primarily, there have only been a few participants in these studies that have been taught to use a SGD to produce actions mands. Given that SGDs are increasingly being used and recommended as an AAC mode for children with ASD (Ganz, 2015; Ganz, Rispoli, Mason, & Hong, 2014; Schlosser & Wendt, 2008), it would seem useful to evaluate whether children can be taught to use SGDs for more advanced manding skills.

When evaluating the complexity of a mand for an individual who communicates using an SGD, evaluation of the number of responses needed to complete the mand should be considered. The majority of research related to mand training with SGDs the participants were only required to make one response (i.e., select one icon for the display of the SGD, which then lead to the relevant synthetic

speech output). However research has begun to extend towards evaluation of more complex mands by increasing the number of responses to compose a mand on an SGD. In one relevant study, Achmadi et al. (2012) targeted advanced operations on an iPod-based SGD, which included two intervention phases. Two children (ages 13 and 17) with autism were taught to use an Apple iPod®-based SGD with Proloquo2Go® application (Sennott & Bowker, 2009) to navigate and produce a multiple step mand and turn on and unlock their device. The effectiveness of the interventions were assessed using a multiprobe multiple baseline across participants design, which included two intervention phases. The first intervention phase targeted navigation of screens (i.e., navigation across two screens and back to the home screen) within the context of a manding sequence. The second intervention phase targeted turning on the device and unlocking it in the context of manding. Intervention procedures for the first intervention phase included the use of a verbal cue (e.g., “Let me know if you want something” or “What do you want to eat” 10 s time delay with graduated guidance prompting procedure for both screens within the mand sequence. Both prompted and independent mand sequences were reinforced with the corresponding item. The second intervention phase began with the same verbal cue, followed by a 30 s time delay, then a combined verbal and gesture prompt (e.g., telling the participant to turn it on while pointing to the home button). Both participants in this study acquired each targeted skill and were able to maintain the skills over time. However, the actual manding skills taught did not move beyond making a single-response request for a preferred object.

In another related study, Waddington et al. (2014) evaluated teaching a multi-function manding sequence using an iPad-based SGD with Proloquo2Go®

application for three boys (ages 7, 8, and 10) with autism. Effects of the intervention were measured using a multiple baseline design across participants. Specifically, participants were taught using systematic instruction (i.e., least-to-most prompting and contingent reinforcement) to make a general mand for a toy, then a specific mand for a particular type of preferred toy, and then finally engage in a social response (e.g., “*Thank you.*”) using a static screen display (i.e., four icons displayed on the screen that required the participants to discriminate between the icons). Results were mixed in that two of the three participants showed increases in performance of the three-step communication sequence using the static display, however, the third participant required a procedural modification to acquire the targeted mand sequence. The procedural modification used involved changing the display type to a progressive screen, meaning that selecting the first correct icon progressed to a new screen with relevant icons needed to complete the mand sequence. With the procedural modification, this participant showed greater accuracy (up to 100% of the correct sequence) of correcting emitting the three-step manding sequence than with the static display option (up to 10% of the correct sequence). While targeting a three-step sequence could be viewed as more advanced than teaching a single response mand, it is still the case that in this study the general and specific mands taught could be viewed as involving only a single component mand response (i.e., selecting a single icon from the screen of the SGD to request a single preferred object), rather than the arguably more advanced manding skill of manding for actions using multiple icons.

In light of the limited number of studies targeting advanced manding skills for individuals with ASD who communicate using SGDs, the present study was designed to investigate the effects of implementing systematic instruction within a BCIS to

teach manding for actions to three children with ASD who did not have functional speech and were thus being taught to use a SGD. Further, this study also designed to evaluate generalisation of the action mand to a novel stimulus within the behaviour chain and assess the maintenance of the newly acquired mand over time.

## **Method**

### **Participants**

Three children were selected to participate in this study from a pool of children who had been attending a university-based clinical programme for children with developmental disabilities. The children were selected because they had been diagnosed with of autism, one with a dual diagnosis of Down syndrome (i.e., Franny), and were assessed as having severe symptoms of autism, little or no functional speech, and limited augmentative communication skills related to manding for action, as determined by a number of standardized assessments that were conducted prior to the baseline phase of the study.

Parents, teachers, and school administrators provided their informed consent for the children to participate in this thesis research, which was approved by the relevant university ethics committee. Through informal conversations, parents and teachers expressed agreement that the mands being targeted in these studies would be beneficial to for the children to learn. In addition, the parents and teachers agreed that the mands being taught would enable the children to ultimately gain access to important sources of reinforcement (i.e., reflected the children's preferences). Their provision of informed consent also suggests that they found the proposed teaching methods acceptable. As such, the research appeared to have social validity.



### **Standardized Assessments**

Three standardized assessments were conducted prior to the baseline phase of the present study. These were (a) the Childhood Autism Rating Scale (CARS; Schopler, Reichler, Devellis, & Daly, 1980), (b) the second edition of the Vineland Adaptive Behavior Scales (Vineland-II; Sparrow, Cicchetti, & Balla, 2005), and (c) the Verbal Behavior Milestone Assessment and Placement Program (VB-MAPP; Sundberg, 2008). With regards to the Vineland and the CARS, these assessment tools were conducted in an interview format with the parent or teacher. The VB-MAPP was conducted via parent and teacher interviews and structured observations. During structured observations, a contrived play/activity scenario was used and reinforcing items were available to be requested by the participant.

The CARS is an empirically validated 15 item rating scale that is used to assess the severity of autism symptoms. The assessment covers early development and includes categories such as social, emotional, and communication skills, and restrictive and/or repetitive patterns of behaviour, play, and routines (Schopler, et al., 1980). For the purpose of this study, it was used in an attempt verify the existing diagnosis of autism for each participant and provide information related to the severity of each child's autism symptoms.

The Vineland-II is a widely used assessment tool that evaluates adaptive behaviour functioning. This assessment includes the following domains: communication, daily living, socialization, and motor skills. Further it identifies both strengths and weaknesses within and across domains (Sparrow, et al., 2005). For the purpose this study, it was selected to provide information regarding the level of communication skills. In particular we were able to identify that each participant in

this study had severe communication impairments as evidenced by scoring within the severe functioning range on this assessment.

Lastly, the VB-MAPP was used to further assess the communication repertoires of each participant. The VB-MAPP is based on Skinner's (1957) analysis of verbal behaviour. It assesses development language across the typical developmental sequence and across the main classes of verbal operants defined by Skinner (i.e., mand, tact, intraverbal, echoic). It includes 170 milestones across three different learning levels and assesses 16 different skill categories. This assessment was selected to provide further details regarding the communication repertoire of each participant. In particular, this assessment provided specific information related to the inclusion criteria for each study. Thus, for the purpose of this research, only the following categories within the assessment were conducted: manding, tacting, and listener responding (Sundberg, 2008; see Table 3.1 for a detailed description of each participant's assessment results).

### **Participants and Assessment Results**

Ryan was 10 years old. He scored a 42.5 on the CARS, which indicated severe autistic symptoms. On the Vineland-II, he scored at the 1:11 (year:month) age equivalency level on the receptive domain and 2:1 on the expressive domain, which indicated low adaptive functioning. For written communication, he scored at the 7:1 age equivalency level, which indicated a moderately low adaptive functioning. On the VB-MAPP, he was rated at an emerging level two, which meant that he was functioning at an age equivalency of about 18 months in terms of his expressive language development. Specifically, the VB-MAPP indicated that he was able to make specific requests for items that were not visually present by naming the item or

using its features (e.g., colour, size, quantity). He could also mand for approximately 15 missing, but needed, items and would spontaneously mand for at least 50 different items (see Table 3.1) His topography of communication consisted of written text (i.e., would write or type out a response). He had been using the typing feature of his SGD for approximately 2 years prior to this study.

Franny was 13 years old. She scored a 46 on the CARS, which indicated severe autistic symptoms. On the Vineland-II, she scored at the 1:4 age equivalency level on the receptive domain and at the 1:3 age equivalency level on the expressive domain, which indicated low adaptive functioning. For written communication, she scored a 3:10 age equivalence, which indicated low adaptive functioning. On the VB-MAPP, she was at the beginning stages of level two, which meant that she was functioning at an age equivalency of about 18 months. In particular, she was able to mand for items not visually present, and mand for at least 15 different items, but had not yet acquired mands for actions (see Table 3.1). Franny's communication topography consisted of symbolic icons on her SGD. She had been using an SGD prior to the study for approximately one year. She was able to visually discriminate between icons, navigate within the SGD application, and activate the sentence strip feature to produce the digitized speech.

Seth was 5 years old. He scored a 43.5 on the CARS, which indicated severe autistic symptoms. On the Vineland-II, he scored at the 1:1 age equivalency level for the receptive domain and 0:8 for the expressive domain, which indicated low adaptive functioning. For written communication, he scored a 3:5 age equivalency, which indicated a moderately low adaptive functioning. On the VB-MAPP, he was at an emerging level two for his manding repertoire, which meant that he was functioning

at an age equivalency of about 18 months. Specifically, he was able to mand for at least five needed, but missing items (related to preferred toys and activities) and mand for at least 15 different items. Prior to the start of the study he had one request for actions related to items (i.e., open) and used it spontaneously and across a variety of items he needed to be opened (see Table 3.1). Seth's communication topography consisted of symbolic icons on his SGD. He had been using an SGD for approximately 1.5 years prior to the start of this study. He was able to visually discriminate between icons, navigate within the SGD application, and activate the sentence strip feature to produce the digitized speech.

**Table 3.1.** *Assessment results for each participant**Summary of the Childhood Autism Rating Scale for each participant*

Participant	Total Score	Intensity Rating
Ryan	42.5	Severe
Franny	46	Severe
Seth	43.5	Severe

*Summary of the Vineland Assessment (age equivalence) for each participant*

Domains/ Subdomains	Participants		
	Ryan	Franny	Seth
Communication	Low adaptive level	Low adaptive level	Low adaptive level
Receptive	1:11	1:4	1:1
Expressive	2:1	1:3	0:8
Written	7:1	3:10	3:5
Daily Living Skills	Low adaptive level	Low adaptive level	Low adaptive level
Personal	5:2	1:7	2:7
Domestic	3:11	2:6	2:11
Community	5:4	2:10	1:10
Socialization	Low adaptive level	Low adaptive level	Low adaptive level
Interpersonal Relationships	0:9	0:7	1:4
Play and Leisure Time	0:9	0:9	0:8
Coping Skills	2:6	1:11	1:6
Motor Skills	Moderately low adaptive levels	Low adaptive level	Low adaptive level
Gross	4:11	2:4	2:1
Fine	4:11	1:7	2:4

## **Setting and Sessions**

Sessions for Ryan and Franny were conducted in a small conference room at their school. The room had a table and chairs, with cabinets and shelves. Sessions for Seth were held in a university-based clinic room, which contained child-sized chairs, a cabinet, and a two-way mirror. Each session consisted of one behaviour chain (i.e., one activity), which required approximately 5 min. During each session, participants sat across from the experimenter at the table and a second experimenter typically sat a few feet away from the participant on one side of the room (to assess the reliability of data collection and fidelity of procedural implementation). Two or three sessions (two or three behaviour chains/activities) were conducted per day and sessions were conducted 2 to 3 days per week.

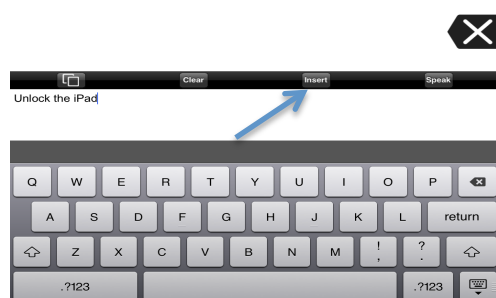
## **Speech-generating Devices**

Each participant was taught to use an Apple iPad® mini equipped with the speech synthesizing application Proloquo2Go® (McNaughton & Light, 2013; Sennott & Bowker, 2009). Ryan used the keyboard feature of Proloquo2Go® to type out his targeted action mand (i.e., typing the targeted mand form, inserting the composed mand form into the sentence strip, then activating the sentence strip so as to produce the corresponding synthesized speech output). Franny and Seth used symbolic icons, selection for the set of icons within the Proloquo2Go® programme to produce the targeted mands. Franny and Seth were required to (a) navigate across screens of the SGD, (b) select the correct icons from the screen pages, which moved the icon to the sentence strip, and then (c) activate the sentence strip so as to produce the corresponding synthesized speech output. In some cases, icons were added to the Proloquo2Go® library by taking photographs of the corresponding items or actions

that needed to be communicated (i.e., computer, iPad, unlock) for the targeted mand.

Figure 3.1 shows the device display type and response chain for each participant.

### Typing display

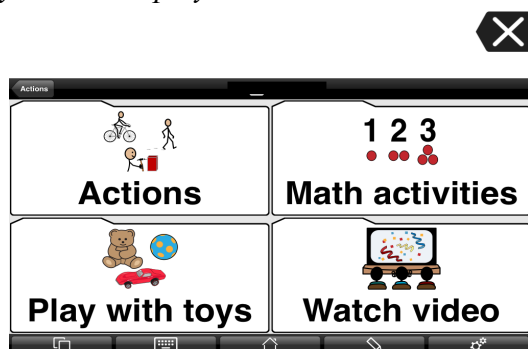


Typed message is inserted into the sentence strip.

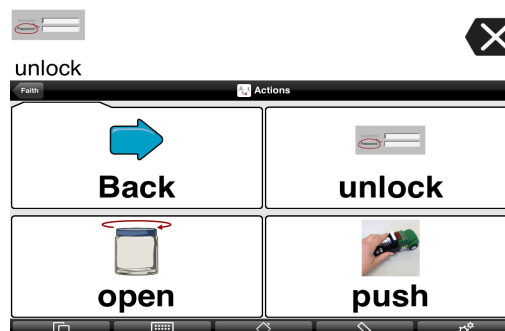


Sentence strip message is activated to produce digitized speech production.

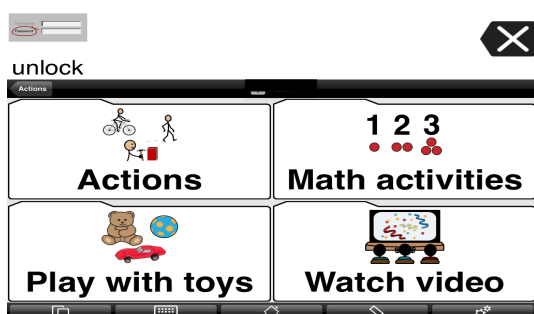
### Symbolic Display



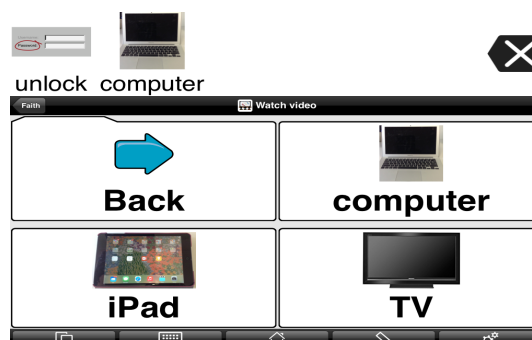
Main Screen: Action folder is selected which Progresses to the action icons.



Action Folder: Participant selects the corresponding action for the target mand, then navigates "back" to the main screen.



Main Screen: From the main screen, the participant selects the corresponding activity, "watch video".



Watch Video Folder: The participant select the corresponding icon for the action mand, then uses the sentence strip to activated and produce digitized speech.

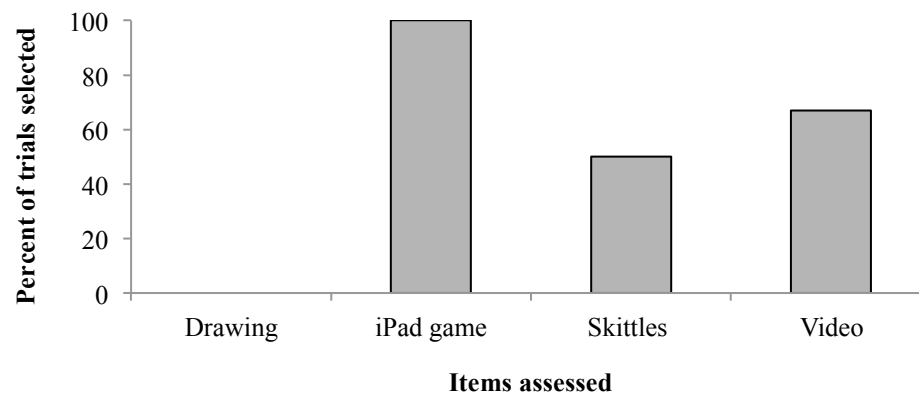
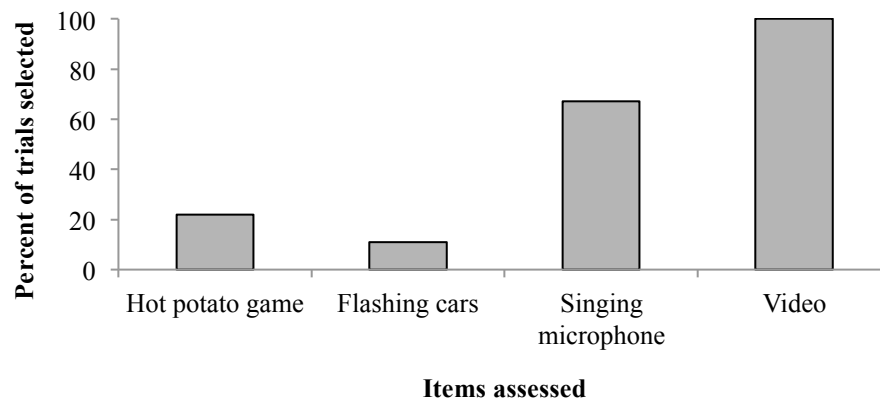
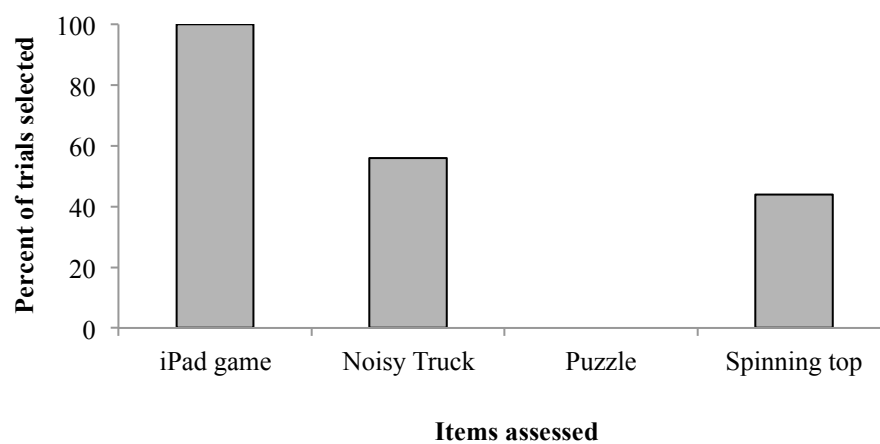
Figure 3.1. Display type and response chain



## Identifying Preferred Activities

Preferred activities were identified for each participant through a two-part preference assessment (Kang et al., 2013). First, the child's parent and/or teacher were interviewed using an adaptation of the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher, Piazza, Bowman, & Amari, 1996). This interview protocol is designed to provide information on various types of preferred items (e.g., food, drink, activities, toys, etc.) and consists of 10 open-ended questions (see Appendix A). The resulting responses from informants is intended to assist in identifying potential reinforcers from several classes of objects/activities, such as foods, drinks, toys, and activities. This indirect preference assessment interview was followed by a direct preference assessment. For the direct preference assessment, a pairwise preference assessment was conducted (Fisher et al., 1992) using four items/activities that were nominated as most preferred by the child from the parent/teacher interviews. The extent to which the children selected and used/engaged in these items/activities was systemically tested by offering a choice between two items (game v. puzzle, puzzle v. toys, etc.). Pairs were formed to ensure all possible combinations of items/activities were assessed in the choices format. Choice opportunities were configured in a discrete-trial format. For each trial, the experimenter presented two items while saying, *Which one do you want?* A wait time of approximately 10 s was given for the participant to indicate a choice (i.e., reaching for and taking one of the items or engaging in one of the activities). If the participant made a choice for an item or started to engage in an activity within 10 s, the researcher gave them the corresponding item or allowed access to the activity for approximately 30 s. After brief access, the experiment retrieved the item back from

the participant (i.e., saying “My turn” while extending their hand towards the participant) and a 5 s inter-trial time was given. If no selection was made, a 5 s inter-trial time was given, followed by the next trial. For each offer, the item/activity the participant selected was recorded to identify a hierarchy of preference. Three sessions, each of which consisted of six trials (i.e., covering all possible pairings of the four items) were conducted to gain a hierarchy for each participant. Results of the pairwise preferences assessment are shown in Figure 3.2. For Ryan and Seth, their highest scored item was playing a video game on an iPad mini®. Franny most often choose to watch a music video.

*Ryan's Results**Franny's Results**Seth's Results***Figure 3.2.** *Study 1 Preference Assessment Results*

## **Behaviour Chains**

Based on the results of the preference assessment (Table 3.2) and feedback given from the parents and teachers related to the action mand selected, a task analysis of a corresponding behaviour chain was developed for each participant. The behaviour chain was developed by the author so as to represent the steps/responses/behaviours required to initiate and complete the activity and thus obtain the terminal reinforcer for the chain. Within each behaviour chain, the author also identified where in the chain an interruption would occur so as to create the need for an action mand.

Each behaviour chain involved the participant retrieving the needed device (i.e., an iPad mini®, iPod®, or a laptop computer) from a specific location, opening the case that the device was in, and turning the device on in order to access/activate the video game (Ryan and Seth) or watch the music video (Franny). Table 3.2 delineated the steps of each behaviour chain identified for each participant. It is important to note that the devices the children used to play video games or watch music videos was not the same device that they used as a SGD to mand for action. The former devices were instead designated for use only for playing the video games and watching music videos. These devices were therefore installed with various games and music videos (e.g., Toca Boca®, Lego® games, music videos).

**Table 3.2.** *Description of Targeted Behaviour Chains*

<i>Participant</i>	<i>Behaviour Chain</i>	<i>Description</i>	<i>Terminal Reinforcer</i>
Ryan	iPad game	Remove lid from bin Get out iPad Open the cover *Turn on Select game	Play game
Seth	iPad game	Remove lid from bin Get out iPad Open the cover *Turn on Select game	Play game
Franny	Music video	Gets laptop Opens case Gets laptop from case *Turn on laptop Selects video	Watches video

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\* Denotes point of interruption

### **Receptive Identification and Tact Probes**

After the preference assessments, but prior to a prerequisite training phase related to the behaviour chains and prior to the baseline phase, each participant was assessed to determine if he or she could correctly identify (receptive identification) the device that was to be used in his or her respective behaviour chain (i.e., iPad® mini, laptop, or iPod®). Additionally, Ryan was tested to determine if he could correctly spell out the names (i.e., tacts) for the materials that were required for preferred activity. Three probe trials were given to each participant. For each of these three receptive probes, trials consisted of the experimenter placing an array of three picture cards in front of the child. The left-right placement of the cards was varied in a random order. The experimenter then said *Give me [item name.]*. Each participant was given 10 s to respond. Correct responses were defined as the participant picking up the corresponding picture and handing it to the experimenter. Correct and independent responses were followed by descriptive social praise (e.g., *Good job, that is an iPad.*). Had incorrect responses occurred, they would have been ignored and then followed by a 5 s inter-trial interval. Each participant scored 100% accuracy on these receptive probes. For Ryan, tact trials consisted of the experimenter holding up a picture card and asking *What's this?*. Correct responses were followed descriptive social praise (e.g., *Good job, that is an iPad.*) and incorrect responses were ignored. Ryan scored 100% accuracy on the tact probes.

### **Prerequisite Training**

After determining preference for each participant and developing the task analyses for the behaviour chains, each participant was taught to complete their respective behaviour chain, except they were not taught to produce the targeted mand

for action (i.e., they were taught to retrieve the device, open the case, and turn on the device). Each participant received training on these steps using least-to-most prompting procedure and received verbal praise for completing each step. Two or three training sessions per day were given about 2 or 3 times a week. Each session consisted of one full behaviour chain with access to the terminal reinforcer (i.e., playing a video game or watching a music video) to ensure each participant had a history of contacting the terminal reinforcer without an interruption within the behaviour chain. The start of each session was initiated by the experimenter saying *Let's play a game on the iPad*, or a relevant instruction to the corresponding behaviour chain, to initiate the start of the behaviour chain. Since each participant had previous exposure to the activity selected, least-to-most prompting was selected to train the behaviour chains. This hierarchy included the following prompts: (a) gesture, (b) vocal, (c) partial, and (d) full, with a 5 s delay used before moving through the prompting levels. Differential reinforcement (i.e., enthusiastic praise for independent completed steps and unenthusiastic praise for prompted steps) was given to prompt independent completion of each step of the behaviour chain. Since each participant had previous experience with the selected activities each participant was able to independently complete each step of his or her respective behaviour chain after no more than 12 training sessions.

### **Response Definition and Data Collection**

The dependent variable was the mand for action. During each session, the experimenter recorded whether the participant had independently emitted the mand for the action that was needed to continue the behaviour chain, or the level of prompting that was used to evoke the required mand for action. An independent

response was defined as the participant emitting the targeted mand for action (e.g., “*Unlock iPad*”, “*Unlock computer*”) within 5 s of when that mand was required. Independent mands were coded as having occurred at the MO level, to indicate that the mand for action was probably under control of the MO. If an independent response did not occur within 5 s or if an incorrect response occurred during the 5 s interval, then the experimenter used a least-to-most prompting procedure to ensure that the correct mand for action occurred. Prompted responses were recorded as F when a full prompt was required (i.e., the use of physical guidance with verbal prompt), a P when a partial prompt was required (i.e., partial physical guidance to activate the correct symbols), as V when a vocal prompt was required (i.e., *Press [symbol name]* or *Say, Unlock the iPad*), or as G when a gesture prompt was required (i.e., gesturing towards the device or appropriate symbol). The order of prompting was as follows: (a) gesture, (b) vocal, (c) partial, and (d) full, with a 5 s delay used before moving from the least to the most level of prompt. In baseline, when the least-to-most prompting procedure was not used, opportunities that ended without the participant making a response, or making an incorrect response (i.e., activating an irrelevant symbol) were both coded as IR for incorrect response.

### **Experimental Design**

A concurrent probe multiple baseline design across participants (Gast & Ledford, 2009) was used to assess the effectiveness of the intervention on the acquisition of the targeted mands for actions. This design involved the following sequence of phases: (a) baseline, (b) intervention, (c) procedural modification (Franny and Seth), (d) follow-up, and (e) re-training (Franny only). This design was selected to evaluate whether mands for actions were acquired (i.e., occurred at the MO level)



during the course of the intervention. All of the participants were introduced simultaneously to the baseline phase and after a stable trend (i.e., at least three consecutive data points with no occurrences of the target mand) was established for each participant, probes were under-taken intermittently to demonstrate continued non-occurrence of actions mands prior to the intervention. When the first participant had acquired the targeted action mand (i.e., responding at the MO level over three intervention sessions), the intervention phase was introduced to the second participant (i.e., Franny). When she showed improved performance with intervention, then the intervention was extended to the last participant (i.e., Seth).

### **Procedures**

Within all sessions the following variables were held constant: (a) time of day (i.e., sessions were conducted at roughly the same time each day and on the same days each week), (b) materials with the behaviour chain, and (c) presence, location, and display settings on the SGD.

**Baseline.** During baseline, each session was initiated by the experimenter saying *Let's play a game on the iPad*, or a relevant instruction to the corresponding behaviour chain, to initiate the start of the behaviour chain. Verbal praise was delivered when the participant completed each step of the behaviour chain prior to the interruption (e.g., *Nice job opening the iPad case*). When the interruption occurred (i.e., a locked screen), the instructor waited 10 s to determine if the participant would independently produce the action mand (i.e., “*Unlock the iPad.*” or “*Unlock computer.*”). The participant was not prompted to produce the action mand, but an independent response would have resulted in the experimenter immediately unlocking the iPad or computer to enable continuation of behaviour chain. When the participant

did not independently produce the action mand within 10 s, or if he/she produced an incorrect mand during the 10 s interval, then this response was ignored. After the 10 s wait interval, the experimenter took the necessary steps to end the interrupt so that the behaviour chain could continue. This fixed-time or non-contingent continuation was implemented to maintain the child's participation in the activity and prevent extinction-induced challenging behaviour (e.g., tantrums).

**Intervention.** Intervention sessions were similar to baseline except that when the behaviour chain was interrupted, the participant was given 5 s to respond with the correct action mand. This shorted response time (i.e., a 10 s delay was used in baseline) was used in an effort to prevent error patterns from emerging. If an independent (MO) response occurred within this 5 s interval, then the experimenter performed the requested action so that the behaviour chain could continue. If the required action mand did not occur within 5 s, then the experimenter followed the least-to-most prompting procedure until the participant made the required action mand. The prompting sequence followed by the experimenter involved first giving a gesture prompt (e.g., pointing towards the device, correct navigational button, or the correct symbol). If a correct action mand did not occur within 5 s of the gesture prompt, then the experimenter gave a vocal prompt (e.g., *Say, Unlock the iPad* or *Press the unlock symbol*). If a correct action mand did not occur within 5 s of the vocal prompt, then the experimenter gave a partial physical prompt, which involved using the a small amount of physical guidance. If a correct action mand did not occur within 5 s of the partial physical prompt, then the experimenter gave a full physical prompt, which involved using hand-over-hand guidance to ensure that the child selected the correct letters/icons and activated the speech output on the SGD. This

sequence was based on a prior evaluation of participants' reactions to gesture, vocal, and physical prompts during the standardized assessments (i.e., VB-MAPP). These observations suggested that the gesture prompt could be considered the least intrusive prompt for the children, followed by the vocal and then the partial and full physical prompting. When implementing the prompting sequence during intervention, the experimenter also arranged for different consequences to occur for each level of prompting. This was done in an effort to promote prompt fading and reduce/prevent prompt dependency. Specifically, prompted responses resulted in performing the necessary action and providing neutral verbal praise (e.g., *Sure, I'll unlock the iPad.*), whereas independent mands (i.e., a correct action mand occurring at the MO level) responses resulted in performing the necessary action and providing enthusiastic verbal praise (e.g., *Nice asking all by yourself!*).

**Procedural modifications.** For Franny and Seth, additional learning opportunities were provided to in an effort to promote more rapid acquisition because they showed highly variable responding during the initial intervention sessions. The modification involved providing five errorless learning trials prior to the start of each intervention session. These practice trials were introduced in an effort to give the participants more practice in performing the correct action mand when an interruption (i.e., a locked screen) occurred. Verbal praise was given after each correct response during the practice trials. Differential levels of verbal praise (i.e., neutral tone verses enthusiastic tone) were used for prompted (G, C, P, or F) verses independent (MO) level action mands promote prompt fading. After five trials, the participant was given brief access (i.e., approximately 30 s) to what was presumed to be the terminal reinforcer associated with the final step of the behaviour chain (e.g., playing a video

game or watching a music video). Practice trials were discontinued after the participant had three successive sessions with action mands occurring at the MO level.

**Follow-up.** Three follow-up sessions were conducted for each participant. These occurred one month after the final intervention session for Ryan and Seth and eight weeks later for Franny. Procedures were the same as in baseline in that no prompts were used, incorrect responses were ignored, and after a 10 s wait interval, the experimenter took the necessary steps to end the interrupt so that the behaviour chain could continue. Correct responses resulted in the experimenter performing the necessary action to continue the behaviour chain and providing enthusiastic verbal praise (e.g., *Nice asking all by yourself!*).

**Extra teaching phase.** Franny received an extra teaching phase after her follow-up sessions. The procedures used were identical to her procedural modification phase.

**Generalisation probes.** During each phase of the study, generalisation probes were conducted to assess for generalisation to a different locked device. Specifically, for Ryan and Seth generalisation was assessed within the video game behaviour chain using an iPod rather than the original iPad. For Franny generalisation was assessed within the watching a music video behaviour chain using an iPad, rather than the original laptop. Generalisation sessions were conducted following the same procedures as baseline sessions.

### **Interobserver Agreement**

A second observer independently collected data on the participant's responses and level of prompting used during each phase of the study (including generalisation

probes). Mand responses were coded in terms of occurrence and the level of prompting required (i.e., MO, G, V, P or F or IR). An agreement was scored if the experimenter and independent observer had recorded the same data for each session, whereas any discrepancy was counted as a disagreement. Inter-observer agreement (IOA) was calculated by using the formula:  $\text{Agreements} / [\text{Agreements} + \text{Disagreements}] \times 100\%$  to determine the percentage of agreement for each session. IOA was collected on 41 to 95% of the sessions conducted for each participant and each phase of the study. For Ryan, the independent observer collected data on 95% of sessions with a mean agreement of 99% (range 80 to 100%). For Franny, the independent observer collected data on 87% of the sessions with a mean agreement of 98% (range 80 to 100%). For Seth, the independent observer collected data on 41% of his sessions with a mean agreement of 99% (range 80 to 100%).

### **Procedural Fidelity**

During sessions when IOA was assessed, the independent observer also assessed whether the experimenter had correctly implemented the procedures using a checklist that described each step. The percentage of steps implemented correctly was calculated for each session. The mean percentage of correct implementation across sessions was 99% (range 92 to 100%). This high percentage of procedural fidelity was most likely due to the simplistic nature of the study, in that only one targeted response was measured for each session (i.e., action + item name), the data collectors were not blind to the study and given training prior to data collection consisting of full explanation of the data collection, and a task analysis of the procedures used for intervention. Additionally, each of the data collectors were experienced with operant

learning and the principles of applied behaviour analysis, and further had advanced experience in interventions that address manding skills.

### **Results**

Figure 3.3 shows the level of response recorded by the experimenter during each session. Ryan's results are displayed on the upper panel, Franny's results are displayed on the middle panel, and Seth's results are displayed on the lower panel.

For Ryan's four baseline sessions, he responded at the IR level, which indicated he did not independently use the SGD to produce the target mand for action. During the intervention phase he received a total of 25 sessions (i.e., opportunities) and 4 additional probes to assess for generalisation to a novel item. During the 25 intervention sessions, the most intrusive prompt used was a partial prompt, which he responded to on 3 sessions (12% of the opportunities). He responded to a verbal prompt on 1 session (4% of the opportunities), and a gesture prompt on 3 sessions (12% of the opportunities). He showed independent responding at the MO level on 18 sessions (72% of the opportunities). It is important to note that the majority of prompted sessions occurred during the initial sessions of intervention (i.e., during the first 8 sessions). After the eleventh sessions Ryan consistently responded at the MO level, which indicates a stable trend for learning the target mand. Of the three participants, Ryan showed a high level of generalisation. Specifically, during the first generalisation probe he showed response generalisation, but not stimulus generalisation. During the second generalisation probe he did not show any generalisation of the mand; however, on the following three probes he showed both forms of generalisation (response and stimulus). This indicated spontaneous

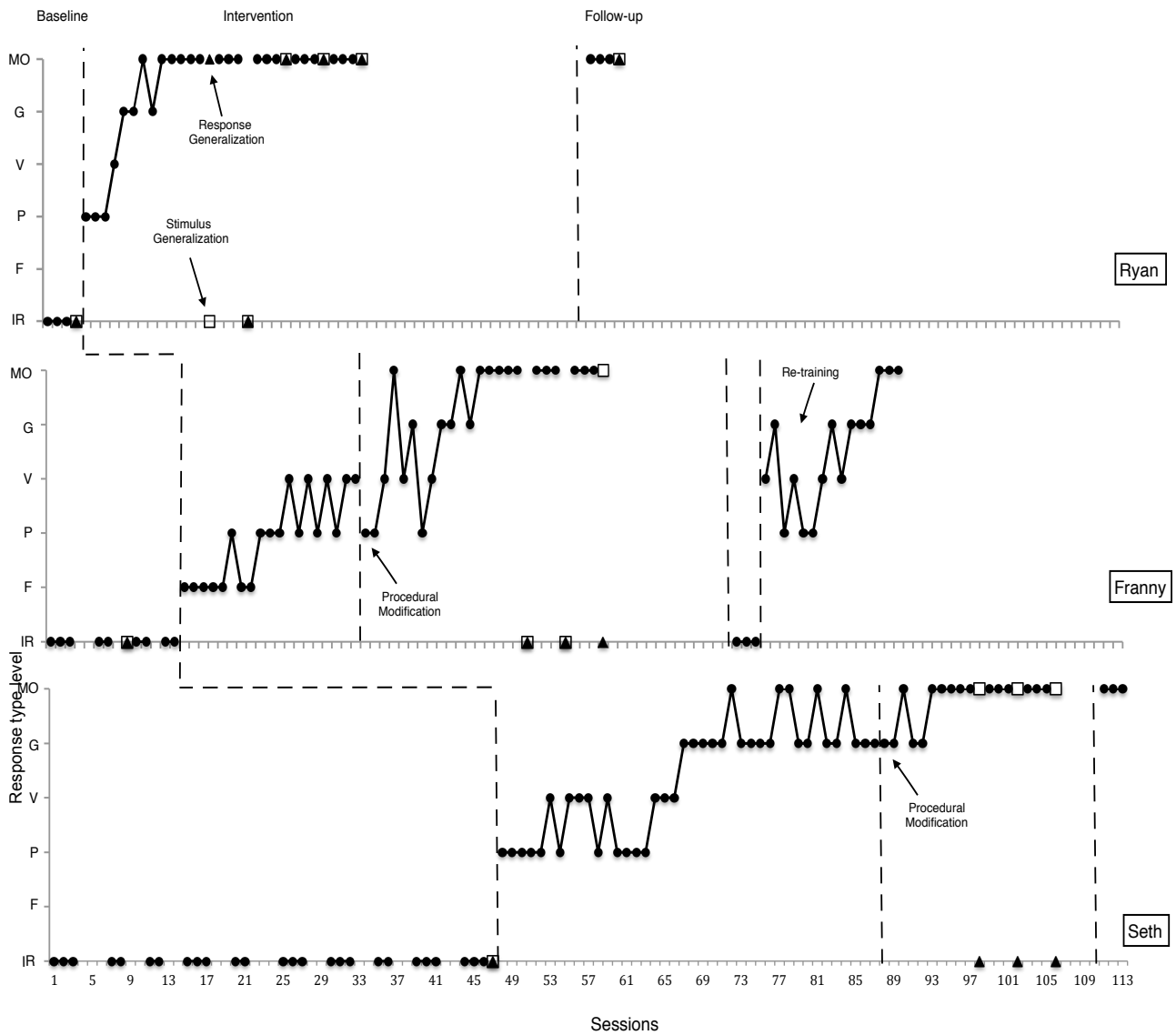
generalisation was achieved. During follow-up, his action mands occurred independently (i.e., at the MO level) across all four of the follow-up sessions.

During the 10 baseline sessions, Franny (middle panel) responded at the IR level across each sessions, which indicated she did not independently use the SGD to produce the target mand for action. During the 19 intervention sessions she required a full physical prompt on 7 sessions (i.e., 37% of the opportunities). She showed variability in prompt level altering from partial prompts on 7 sessions (37% of the opportunities) to verbal prompts on 5 sessions (26% of the opportunities). Due to the variability of responding levels, after 19 sessions of intervention, a procedural modification phase was added for 23 sessions with 3 additional generalisation probes. During the procedural modification phase variability in the level of prompt required was observed for 12 sessions. She required a partial prompt for 3 sessions (13% of the opportunities), a vocal was required on 3 sessions (13% of opportunities), and a gesture prompt was required for 3 sessions (13% of opportunities). During the procedural modification phase she demonstrated independent (i.e., MO level) responding on 13 sessions (57% of the opportunities). This ascending trend indicates that Franny learned to respond consistently at the MO level as a result of the procedural modification phase. However, she did not show generalisation, with the exception of response generalistaion observed during the last generalisation probe. She did not maintain the targeted action mand during the follow-up sessions. Consequently, she was given an extra teaching phase after follow-up for 15 sessions. During re-training she required a partial prompt on 3 sessions (20% of the opportunities), a vocal was required on 4 sessions (27% of opportunities), and a gesture prompt was required for 5 sessions (33% of opportunities). After re-training

she was once again able to perform the targeted action mand at the MO level after 13 training sessions. Specifically, she demonstrated independent (i.e., MO level) responding on 3 consecutive sessions (20% of the opportunities).

During the 27 baseline sessions, Seth (lower panel) responded at the IR level, which indicated he did not independently use the SGD to produce the target mand for action. During the 40 intervention sessions he required a partial prompt on 11 sessions (i.e., 28% of the opportunities). He responded to a verbal prompt on 8 sessions (20% of the opportunities), and a gesture prompt on 16 sessions (40% of the opportunities). He showed independent responding at the MO level on 5 sessions (13% of the opportunities). However, steady responding at the MO level was not observed (i.e., 3 consecutive session at the MO level); thus, a procedural modification phase was added for 16 sessions with 3 additional generalisation probes. During the procedural modification phase, variability in the level of prompt required was observed for 8 sessions. He required a gesture prompt on 4 sessions (25% of the opportunities). During the procedural modification phase he demonstrated independent (i.e., MO level) responding on 12 sessions (75% of the opportunities). He showed a trend of independent responding (i.e., performing the targeted action mand at the MO level) after 6 sessions. This steady trend of responding at the MO level continued for the remainder of this phase, which indicates the target mand was acquired as a result of the procedural modification phase. During generalisation probes he emitted the previously acquired action mand (“*Unlock the iPad*”), but did not produce a new form of the action mand (i.e., “*Unlock the iPod*”). He maintained independent manding (i.e., performing the targeted action mand at the MO level) during the three follow-up sessions.





**Figure 3.3.** Displays the action mand response by type (MO = Unprompted; G = Gesture; V = Verbal; P = Partial; F = Full) sessions for each participant.

## Discussion

Overall the results of this study could be viewed as largely positive in that each participant acquired the targeted mand for action during the intervention or modified phase. Acquisition was evidenced by showing independent responding (i.e., performing the targeted action mand at the MO level) across at least five consecutive sessions. Ryan showed the most rapid acquisition and also showed generalisation. Franny and Seth, however, showed little progress during their initial intervention phases, respectively. They did, however reach the acquisition criteria after some procedural modifications were made. In light of this eventual progress, it would appear that the use of pre-session practice trials was an effective procedural modification for Franny and Seth. Additionally, maintenance of skills over time was shown in two out of the three participants (i.e., Ryan and Seth). Franny did not show maintenance and therefore she received a final (booster-training) re-training phase in which she recovered the targeted mand at the MO level. The procedures in place during the booster-training phase appeared to have been effective in that Franny regained an independent level of responding (i.e., performing the targeted action mand at the MO level) after 13 sessions.

These results have a variety of potential implications in regards to using the BCIS to teach action mands to children with ASD who have limited or no speech development and who are thus candidates for using SGDs. First, the positive results of this study suggest that the BCIS and the least-to-most instructional procedures, with some procedural modifications for Seth and Franny, were largely effective in teaching the children to produce the targeted mand when it was needed to ensure continuation of the behaviour chain. This is not surprising given that the intervention

procedures involved the use of well-established instructional tactics (i.e., the BCIS, time delay, least-to-most prompting and contingent access to the next step in the chain). Contingent access to the next step in the chain was assumed to be an effective type of reinforcement for the action mand and the fact that the actions mands were eventually stable at the MO level over a number of intervention sessions suggests that continuation of the chain was in fact a functional reinforcer for the respective action mands.

This combination of procedures has been used in other studies and similar findings have been reported (e.g., Achmadi et al., 2012; Kagohara et al., 2012; Lorah et al., 2013; Sigafoos et al., 2013; van der Meer, Didden, et al., 2012; van der Meer, Kagohara, et al., 2012; van der Meer, Sutherland, et al., 2012). Collectively then, the data from this study and these previous studies thus suggests that an effective treatment package might consist of several elements, including attention to the learner's motivation or need, systematic instructional prompting with built-in prompt fading, and the use of contingent reinforcement. The data also suggest that using the BCIS is an effective way of creating the need or motivation for manding. Essentially, the application of basic behavioural principles that underlie these procedures can most likely account for the behaviour change observed in each participant. This includes the use of systematic teaching, prompting, and contingent reinforcement. These procedures are most likely responsible for the established relation between the antecedent, behaviour, and reinforcing consequence. Each participant's learned behaviour (i.e., mand for action) was most likely evoked by the antecedent (i.e., interruption of the behavoiur chain) and reinforced by the removal of the interruption to proceed to the next step of the chain. Removal of the interruption may be

conceptualized as a conditioned reinforcer since it led to the next step of the behaviour chain (i.e., gaining access to navigating to the game on the device or pushing the button to start the video), which then leads to the terminal reinforcer (i.e., playing the game or watching the music video).

While these findings are consistent with previous studies, the present study could also be seen as extending the existing literature on teaching manding to children with ASD by its focus on teaching more advanced action mands and the use of a new generation (i.e., iPad-based) SGD. Researchers have suggested the importance of mand training to establish communication repertoires (Sundberg & Michael, 2001), however it is also important to continue the development of these repertoires by training more advanced mand forms, as more advanced mand forms could be seen as essential to the child's effectiveness as a communicator. This research gives support to the idea of extending manding repertoires by addressing a more advanced form, such as a mand for action. Aside from the obvious increase in response form (i.e., the use of two symbols for Franny and Seth; or a short typed phrase for Ryan), teaching a mand for an action may enable the child to produce a more precise mand form that is thus less prone to misinterpretation. Although, there may be times within daily life where a simple mand can lead to the corresponding reinforcing outcome (e.g., asking for an iPad and a listener giving you an iPad), there might also be times when a more advanced, precise or specific mand is necessary, such as when a password is needed to access the game on an iPad, which would occasion the need for a mand for an action (i.e., "*Unlock the iPad*"). Further, since a mands allow a speaker to control the delivery of reinforcers, expanding communication via building upon the complexity

of a mand may be more reinforcing for a learner than expanding upon the complexity by targeting a different verbal operant, such as a tact.

Given the largely successful results, the present study seems to suggest that systematic instruction can also be an effective method for increasing the complexity of manding repertoires for children who use SGDs. This study also lends support to research suggesting that BCIS is effective for contriving MOs during various types of mand training (Albert et al., 2012; Betz, et al., 2010; Sundberg, et al., 2002; Sigafoos et al., 2013).

Although preliminary, these findings suggest that individuals who use both symbolic-based SGD format (i.e., selecting icons from the screen of the iPad to communicate) as well those who use an arguably more complex written/text-based SGD format (i.e., selecting letters to spell out a message) can develop specified mands for actions using systematic instruction. In particular, for each participant the use of systematic instruction within the context of a behaviour chain interruption (i.e., blocking access) appeared to be an effective approach for creating the need for manding and thus for creating effective opportunities for teaching the targeted mand for action.

The results of this study should be interpreted with caution for several reasons. First, the participants were not subjected to conditions in which an interruption did not occur as so it is not possible to determine if the children had also acquired the discrimination between when the mand for action should occur versus when it is not needed. That is, they were not exposed to behaviour chains where the device was not locked; it would be seen as an abolishing operation (AO), a condition under which no such action mand was necessary, and therefore the conditions under which no such

mand should occur. This may be considered as a limitation because it is not clear if the participant's mand was occasioned by the locked screen (i.e., the behaviour chain interruption) and was therefore under the relevant MO or whether the mand simply occurred in response to an interruption. In light of this limitation, future research may find it beneficial to assess conditions in which the interruption does not occur to ensure the learner's mand is differentially sensitive to the relevant MO.

Additionally, the two participants who used symbolic-based displays (Seth and Franny) did not show much progress in the initial intervention phase. In light of this, their intervention procedures were modified. There are a few possible explanations as to why these two participants showed no progress during the initial intervention and thus why the procedural modification was implemented. First, it is possible that preference and motivation for the terminal reinforcer was diminished due to repeated exposure. For example, playing a game may be more reinforcing early on in an intervention, than towards the end of the intervention. Second, it is also possible that the increased response requirements (i.e., the use of multiple symbols with screen navigation) required for the action mand may have accounted for their relatively slower in acquisition. That is, perhaps the response demands were initially too large. Prior to intervention both participants most often engaged in single symbol mands. Thus, it is possible that the new response sequence, which required more than one response, may have caused slower acquisition as suggested by Lovass (1977). Third, it may also be possible that the participants' behaviour had not come under the control of the locked screen per se, which should have evoked a response for the action mand from the participant. In any event, the use of the pre-session practice trials appeared to have been an effective procedural modification, perhaps because

these trials might have helped to strengthen stimulus control by highlighting the point of interruption and signaling more precisely the response that was required to continue the activity.

Another limitation is lack of maintenance for Franny, which may indicate the need to train for greater fluency of acquisition skills for some individuals. Although it is unknown why she did not maintain the skill over time, it should be noted that when the extra teaching phase was implemented, her rate of acquisition was faster than her initial learning. It is possible that booster training was necessary because she needed more exposure to the intervention to become fluent in the mand and thus the booster training was effective because she was able to recoup the target mand, replicating the initial results of the intervention.

These results from the generalisation probes were mixed in that Ryan spontaneously showed generalisation to novel stimuli in the context of the original behaviour chain (i.e., manded for an iPod to be unlocked.) and Franny and Seth did not show generalisation. It may be possible that since both Franny and Seth required procedural modifications, in which one component included highlighting the relevant  $S^D$  of the mand for action (i.e., the locked screen on the device) that they may have had issues associated with attending to stimuli. Thus, it may be possible that they were not fully attending to the new stimuli used to assess generalisation. Another potential explanation for the lack of generalisation for Franny and Seth may be that the trained action mand became a conditioned step of the behaviour chain, and in such a case could be considered as a type of rote responding. Regardless of issues responsible for the lack of generalisation for Franny and Seth, it is likely that additional training of novel similar items would have been beneficial to promote

generalisation of the action mand. Further research related to stimulus generalisation of action mands may be valuable. Additionally, future research addressing generalisation across behaviour chains might also be valuable to explore. For example, it may be useful to develop interventions that teach multiple scenarios where an action, such as unlock, might be needed since various items can be locked (e.g., doors, cabinets, cars, iPads®, computers, etc.).

Further, there may also be limited generalisability of these findings with regards to the participant's response topography, since Ryan used written expression (i.e., typing words from the keyboard feature of Proloquo2Go®) rather than the symbolic communication system that was used by Franny and Seth. The difference in response topography may also account for the varying rates of acquisition, as Ryan's acquisition rate was quite faster than Franny and Seth. Thus, future research on comparing response topography and acquisition rates may be beneficial.

Lastly, although feedback from the parents and teachers was given with regards to the indirect preference assessment and the action mand selected for intervention, formal or direct social validity data was not collected and thus may be seen as a potential limitation. Although some research on the social validity of SGDs has been conducted (see Achmadi et al., 2015) further investigation of intervention strategies used to teach SGD use to children with ASD is needed.

Despite these limitations results were promising and indicate there could be value in future research. Future research could aim to replicate with other participants, chains and types of action mand. In particular, it may be valuable teach children discrimination of the mand for action under establishing operations (EO; when an interruption has occurred) and abolishing operations (AO; when an interruption has



not occurred) conditions. Lastly, it is important to continue to expand communication repertoires for children who use SGDs thus future research should investigate interventions that address other verbal operants, such as tacting (i.e., commenting skills) and intraverbal exchanges (i.e., conversational skill).

## CHAPTER 4

### STUDY 2: Teaching Mands for Information

#### Introduction

Asking questions could be conceptualized or defined as a kind of mand (i.e., as a request for information; Skinner, 1957). This type of mand would seem to be very common and perhaps even essential for effective social communication, adaptive functioning, and for acquiring new and necessary information (Raulston et al., 2013; Ostryn & Wolf, 2011). Generally, mands for information emerge around 2 to 3 years of age among typically developing children (Brown, 1968; Brown, Cazden, & Bellugi-Klima, 1969; Panico, et al., 2011). However, children with ASD and other developmental disabilities often have delayed communication development. Specifically, these children might have significantly delayed acquisition, or even a complete lack of acquisition, of mands for information (Koegel & Koegel, 1995; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby, 1986; Wetherby & Prutting, 1984).

As discussed in Chapter 2, Skinner's (1957) analysis of verbal behaviour classifies communication responses in terms of functional properties rather than in terms of its form (e.g., nouns, verbs, adjectives). A mand, for example, is a type of communication behaviour that is controlled by deprivation or aversive stimulation and reinforced by consequences that abolish that state of deprivation or enable the speaker to reduce, avoid, or escape from the impinging aversive stimulation. Mands are considered to be of direct beneficial to the speaker. For example, if someone engages in a mand (i.e., a request) for coffee and is thus reinforced by the listener giving his or her the requested coffee, then the speaker was the direct beneficiary of

the mand. Additionally, a mand is unique in that it is the only verbal operant that is under the functional control of deprivation or aversive stimulation, which are examples of motivating operations (MO). Mands are also the only type of verbal operant that are maintained by specific consequences (Michael, 1988; Skinner, 1957). Given that manding is directly beneficial to the speaker, in enabling him or her to alleviate deprivation and/or aversive stimulation, it is not surprising that many communication interventions for children with ASD priorities the teaching of mands (Sundberg & Micheal, 2001). However, while communication interventions for children with ASD often prioritise the teaching of mands, interventions that target, what might be viewed as the more advanced mand, requesting information, should also be taught. Skinner (1957) noted that question-asking can be classified as a type mand for information.

It would seem important to include instruction to develop mands for information due to the potential benefits of this skill. These potential benefits include (a) increased social opportunities, (b) precision within environments, and (c) access to unknown information. Children with ASD often appear to have limited opportunities for social interaction, perhaps due to communication and social skills difficulties (Koegel et al., 2010; Lechago & Low, 2015; Raulston et al., 2013). They might also be less able to precisely specify what they want and need due to limited manding skills (Albert et al., 2012; Sundberg & Michael, 2001). More specifically, if a child cannot mand for information, they may lack an important and ubiquitous way of gaining information from others. Thus children with ASD may benefit from learning to mand for information (Koegel et al., 2010; Ostryn & Wolfe, 2011; Raulston et al., 2013).

Several studies have focused on teaching mands for information to children

with ASD. For example, Endicott, and Higbee (2007) investigated teaching two types of mands for information, *Where?* and *Who?* The mands were taught using the missing-item format, which in some instances could be classified as a type BCIS. Participants were four children with ASD, aged 3 to 5 years. A multiple baseline across participants design was used to evaluate the effects of the interventions. Sessions involved giving 30 s access to a preferred item, then taking the participant away from the learning area while the item was hidden. When the participant was brought back to the learning area, they were told to *Get [item]*. Sessions consisted of five trials using a highly preferred item, followed by the least preferred item. During invention sessions, if the participant did not produce the mand *Where [item]?* within 30 s, a vocal prompt was delivered in an effort to evoke the mand, which could then be reinforced. After the participant emitted the mand, the experimenter would tell the child the location of the item and the participant would go retrieve the item. The child was then given 30 s of access to the item as the terminal reinforcer for completing the chain (i.e., manding for information and then using that information to retrieve the item). Positive results were reported in that each participant acquired the mand for information using the form *Where [item]?* when a highly preferred item was missing. In addition, two of the three participants also acquired this mand when a low-preferred item was missing. Additionally, two participants generalised their use of the *Where [item]?* mand from a clinical to the home setting. Each participant also acquired mands for information using a different response form (i.e., *Who has [item]?*) with respect to both high and low-preferred items.

In another relevant study, Lechago et al. (2010) also used the missing-item format to teach mands for *Where* and *Who* to three children with ASD, aged 4 to 7 years. A non-concurrent multiple baseline design across participants was used to

evaluate the effects of the intervention on acquisition of two mand frames (i.e., *Where is the [item]?* and *Who has the [item]?*). Sessions involved various activities (e.g., making a volcano, playing with a doll, eating ice cream) that were interrupted by hiding a needed item (i.e., spoon) or giving that item to someone, so that the child could not continue the activity without manding for information as to where it was or who had it. All participants showed positive results in that they each acquired the targeted mands for information.

In a review of this literature, Raulston et al., (2013) identified 21 studies that focused on teaching mands for information to children with ASD. To date, the most common types or forms of question asking that have been taught have been *What?* and *Where?* questions. Such questions are among the first to appear in the speech of typically developing children (Bloom et al., 1982; Raulston et al., 2013; Tyack & Ingram, 1977). The most commonly used procedures involved contriving an MO, providing relevant reinforcement (e.g., using information to access preferred or needed item), and systematic prompting (e.g., echoic prompting) and fading. Of the reviewed studies, acquisition outcomes were mainly positive, however results on the effects of intervention in promoting generalisation were mixed. Some limitations to the current research base discussed in this review were related to the lack of diversity of the listeners (i.e., mainly adults rather than peers), underrepresentation of studies that have addressed *how* and *why* questions, and including participants who alternative modes of communication, such as, SGD.

In another review of the literature Lechago and Low (2015) extended the work of Raulston et al. (2013) by focusing on the MOs and contingency arrangements that were used in interventions to teach mands for information. Their review suggested that careful arrangement of a relevant MO was critical to the success of any

intervention aimed at teaching mands for information.

There are about 30 studies that have demonstrated effective procedures for teaching basic manding skills to children with ASD who are minimally verbal and who are learning to communicate using a SGD (or other AAC modality; see Lorah, Parnell, Whitby, & Hantula, 2014; Schlosser & Koul, 2015; van der Meer & Rispoli, 2010 for reviews). However, there are relatively very few studies on teaching mands for information to such children (Lechago & Low, 2015; Raulston et al., 2013). Thus, the present study aimed to extend the literature on teaching mands to children with ASD who are minimally verbal and who are learning to communicate using a SGD, by investigating the use of the BCIS and systematic instructional procedures for teaching mands for information to such children. The two studies reported in this chapter also aimed to evaluate the extent to which newly acquired mands for information would generalise to novel stimuli.

## **Study 2.1**

### **Methods**

#### **Participants**

Participants were the same children from Study 1 (see Chapter 3). Parents provided their informed consent for their child's participation in this intervention, which had been approved by the relevant university ethics committee.

#### **Setting and Sessions**

Sessions for Ryan and Franny were conducted in a small conference room at their respective schools. The rooms were equipped with a table and chairs, with cabinets and shelves. Sessions for Seth were held in a university-based clinic room, which was equipped with child-sized chairs, a cabinet, and two-way mirror. Each session consisted of completing one behaviour chain (i.e., one activity) and lasted

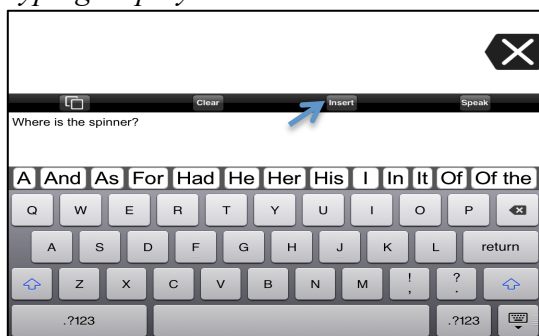
approximately 5 to 10 min. During each session, participants sat across from the experimenter at the table and a second experimenter typically sat a few feet away from the participant on one side of the room. This second person was present to assess the reliability of data collection and check on the fidelity (accuracy) of procedural implementation. Sessions were held two or three times per day and 2 to 3 times per week for each participant.

### **Speech-generating Devices**

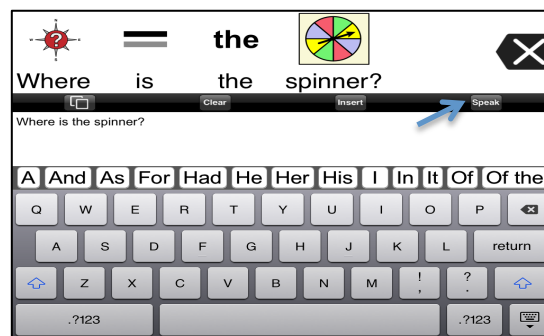
Participants in this study were taught to use the same SGDs that were used in Study 1 (i.e., Apple iPad® mini equipped with the application Proloquo2Go®; McNaughton & Light, 2013; Sennott & Bowker, 2009). To compose the targeted mand, Ryan used the keyboard feature of Proloquo2Go® to type out the targeted mand form (i.e., typing the letters of the targeted mand form, inserting the message into the sentence strip, and activating the message to produce the corresponding synthesized speech output). Seth and Franny, in contrast, used a symbolic icon display with sentence strip feature of Proloquo2Go®. They were required to (a) navigate across screens of the SGD to find the correct icons, (b) select the correct icons from the screen pages, which moved the selected icons to the sentence strip, and then (c) activate the sentence strip so as to produce the corresponding synthesized speech output. Icons were selected from the Proloquo2Go® library, except for cases when relevant icons were not found in the library. In those cases, icons were created and added to the Proloquo2Go® library by taking photographs of the corresponding items that were needed to compose the targeted mand (i.e., game pieces and related to the items needed for the activities). Additional icons were programmed from the library that were related to navigation across the different screen pages (i.e., a icon representing a “*BACK*” function) and the mand questions *Where?* and *Why?*. Figure

4.1 shows the displays and response sequences in the behaviour chains that were used with each participant.

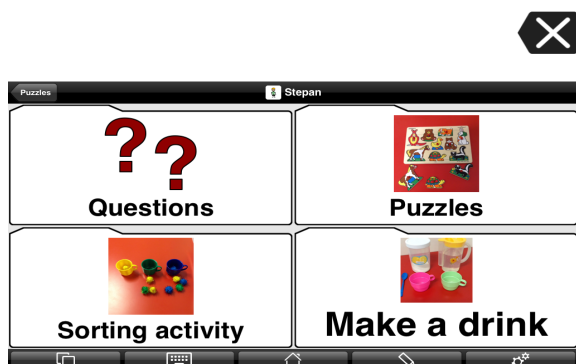


*Typing display*

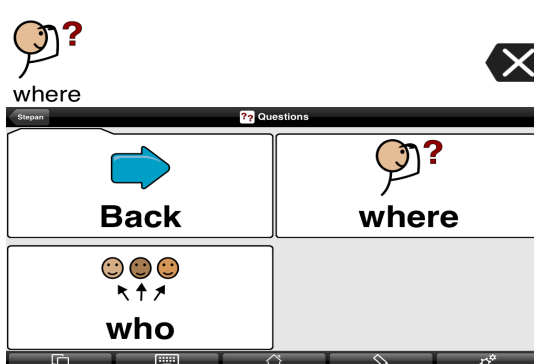
Typed message is inserted into the sentence strip.



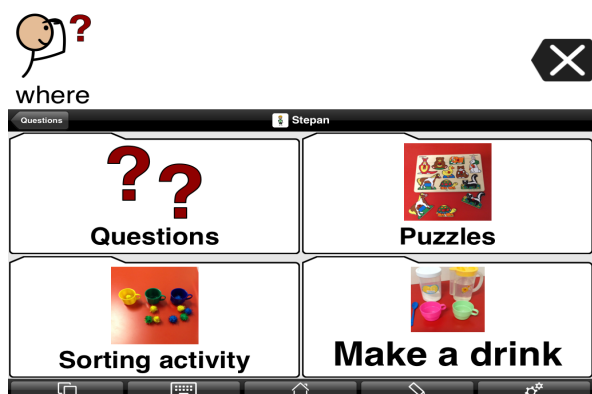
Sentence strip message is activated to produce digitized speech.

*Symbolic Display*

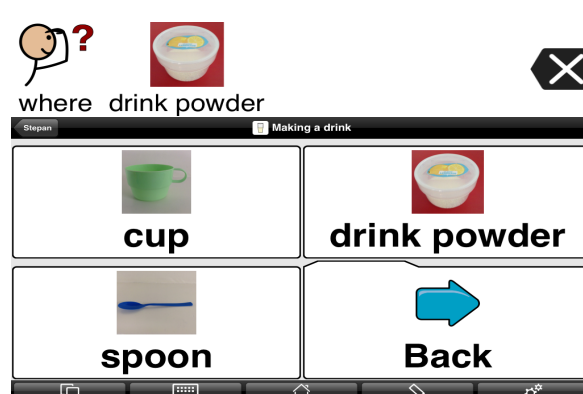
Main Screen: Participant selects the question folder.



Question Folder: Participant selects the corresponding question (e.g., where). And navigates to the main screen using the back button.



Main Screen: The participant selects the corresponding activity (e.g., make a drink).

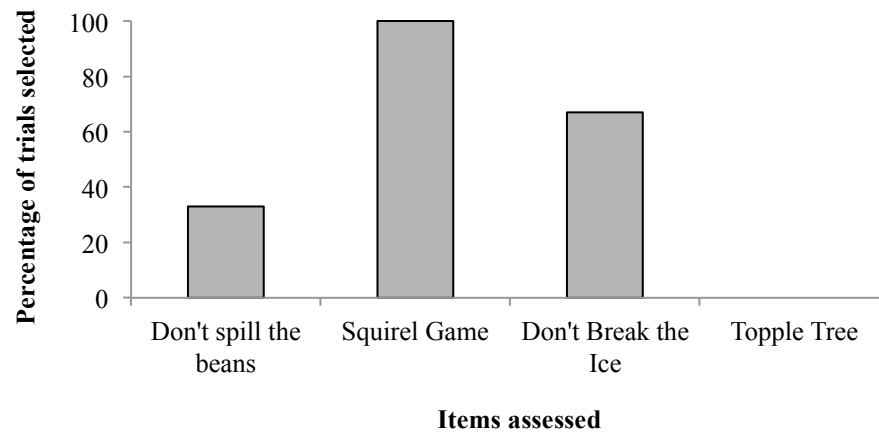
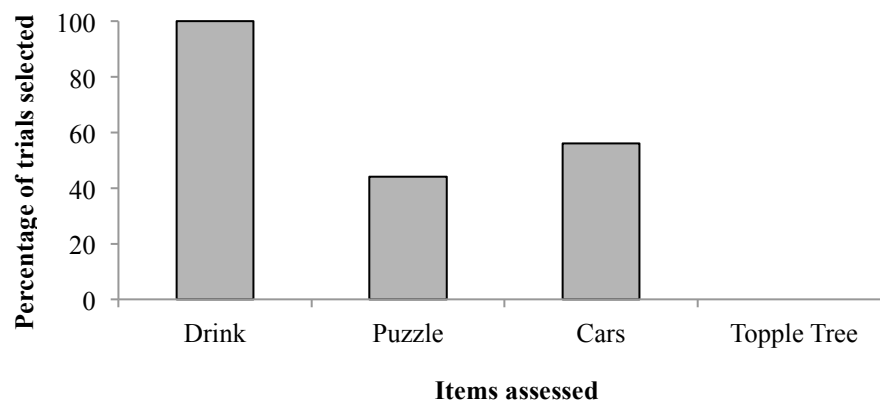
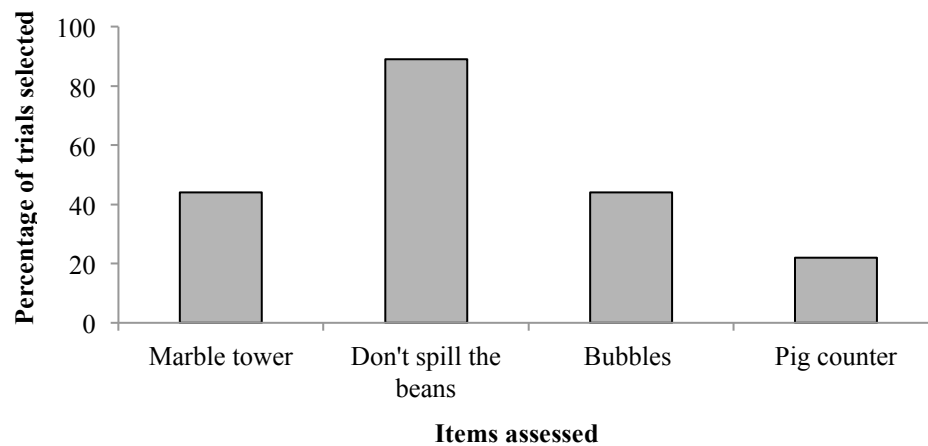


Drink Activity Screen: The participant selects the corresponding missing item (e.g., spoon), then activates the sentence strip to produce digitized speech.

**Figure 4.1.** Display type and response chain

### **Identifying Preferred Activities**

Preferred activities were identified for each participant through the same two-part preference assessment (Kang et al., 2013) that was used in Study 1. Specifically, the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher, et al., 1996) was followed by a direct preference assessment using a pairwise preference assessment protocol (Fisher et al., 1992). Activities from the RAISD were systemically tested in pairs so as to cover all possible combinations. For each trial of the pairwise preference assessment, the item that was selected by the child was recorded. Three sessions were conducted. Each session consisted of six trials. Results of the pairwise preference assessment identified one high-preferred activity for each participant with “high-preferred” defined as the item that was selected most often during the pairwise preference assessment. The results indicated that Ryan’s highest preferred item was a board game, The Sneaky Squirrel Game™. For Seth, the highest preferred activity was making lemonade. For Franny, her most preferred activity was also a board game, Don’t Spill the Beans™. Results of the pairwise preferences assessment are shown in Figure 4.2.

*Ryan's Results**Seth's Results**Franny's Results***Figure 4.2** *Study 2.1 Preference Assessment Results*

## Behaviour Chains

After identifying a preferred activity for each participant (see Figure 4.2), a task analysis of the activity was developed that outlined the sequence of steps (responses/behaviours) that were required to complete the activity. Completing the chain led to the terminal consequence and presumed reinforcer for having completed the chain. Each behaviour chain involved the participant retrieving the items needed for the activity. Materials for the selected activities included the board games The Sneaky Squirrel Game™ and Don't Spill the Beans™, the items that were needed to make lemonade (i.e., water pitcher, two cups, spoon, and lemonade mix), and various coloured (i.e., blue, green, purple, and pink) containers that were used to hide the missing items for Seth and Franny.

The author identified the point in the chain at which an interruption would be created by ensuring that a needed item was missing. This interruption was also the point in the task analysis at which the child was to be taught to produce the mand *Where [item]?*. The *Where [item]?* mand was intended to function as a request for information as to the location of the missing item. Table 4.1 outlines the task analyzed behaviour chains that were created for each participant.

**Table 4.1.** *Description of Targeted Behaviour Chains*

Participant	Behaviour Chain	Description	Terminal Reinforcer
Ryan	Sneaky Squirrel Game	Gets game from bin Takes it to the table Opens game *Sets up game Plays board game	Play game
Seth	Make Lemonade	Takes items out of bin Gets drink powder *Scoops drink powder Pours and mixes water Drinks lemonade	Drink lemonade
Franny	Don't Spill the Beans game	Gets game from bin Takes it to the table Opens game *Sets up game Plays board game	Play game

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\* Denotes point of interruption

### **Receptive Identification and Tact Probes**

After the preference assessments were completed, but prior to the baseline phase, each participant was assessed to determine if he or she could receptively identify the items that were required for their respective behaviour chains (e.g., the game-related pieces, cup, spoon, etc.). The procedures were the same as described in Chapter 3, Study 1. Additionally, for Seth and Franny, receptive checks on identifying the coloured boxes that were used to hide the missing items were conducted. For the receptive assessments, discrete trial format was used, which consisted of the experimenter placing an array of three items (i.e., materials used in the activities) and delivering the verbal instruction *Give me [item name]*. Correct responses (i.e., independently handing the corresponding item to the experimenter) were followed by descriptive social praise (e.g., *Nice, that is a spoon.*) and incorrect responses were ignored. Each participant scored 100% accuracy on the receptive identification tests.

For Ryan, assessments were also conducted on his ability to receptively identify the locations in the conference room where items were to be hidden (e.g., the desk, window sill, and cabinet). Each item/location was tested three times in a discrete-trial format and in random order. Additionally, Ryan was tested to determine if he could correctly spell out the names for the materials involved in his preferred activity. The procedures for these assessments were consistent with those described in Chapter 3. Results showed that Ryan could spell the names for all of the items except *acorn* and *spinner*. Training was then provided until he spelled these words correctly and independently across five consecutive trials.

### **Prerequisite Training**

After assessing for preference and developing the task analyses for the behaviour chains, each participant was taught to complete their respective behaviour

chain. Participants were taught to set up the materials and complete each step of the behaviour chain to gain the terminal reinforcer. Each session consisted of one full behaviour chain that ended with access to the terminal reinforcer (i.e., playing a board game and drinking lemonade). During this prerequisite training, the behaviour chain was not interrupted by having a missing item and participants were never prompted to produce the targeted mand for information. The start of each session was initiated by the experimenter saying a relevant instruction (e.g., *Let's play The Sneaky Squirrel Game*) to initiate the start of the behaviour chain. Least-to-most prompting was used to train the behaviour chains using the same procedures described in Study 1 (Chapter 3). Two or three training sessions were given 2 times a week. Each participant achieved complete independence in completing each step of his or her respective behaviour chain within 6 training sessions.

### **Response Definition and Data Collection**

The dependent variable was defined as producing the mand frame *Where [item name]?* In each session, the experimenter(s) recorded if the participant produced this mand within 5 s of being interrupted (MO level of responding) or whether the mand was produced after receiving a prompt. If the latter, the level of prompting that was used to evoke the mand was recorded. Responses were coded independent (MO) if the participant emitted or began to emit the mand (e.g., *Where is the spinner?*, *Where drink powder?*, or *Where beans?*) within 5 s of the point in the chain when the interruption occurred (i.e., when all of the materials were set up, but one item that was need for the task was missing). If an independent response did not begin to occur within the 5 s interval, then the experimenter followed a least-to-most prompting hierarchy until the response was successfully evoked. The least-to-most prompting hierarchy was as follows: (a) gesture, (b) vocal, (c) partial, and (d) full.

Prompted responses were recorded as F when a full prompt was needed (i.e., the use of full physical guidance with verbal prompt), a P when a partial physical prompt was needed (i.e., partial physical guidance to activate the correct symbols), as V when a vocal prompt was used (i.e., *Press [symbol name]* or *Say, Where is the spinner?*), or as G when a gesture prompt was used (i.e., gesturing towards the device or appropriate symbol). If the participant did not produce the mand with one level of prompting within 5 s, then the experimenter advanced to the next level of prompting in the order: gesture, vocal, partial physical, and full physical. During baseline, prompting was not provided, thus opportunities that ended without the participant making a response or opportunities in which the participant made an incorrect response (i.e., activating an irrelevant symbol) were both coded as IR for incorrect response.

### **Experimental Design**

A concurrent probe multiple baseline design across participants was used to evaluate the effect of the intervention (Gast, 2009). The design included the following sequence of phases: (a) baseline, (b) intervention, and (c) training for generalisation. This design was selected to evaluate if the targeted mands for information were acquired (i.e., occurred at the MO level) during the course of the intervention. Baseline was introduced concurrently for each participant to document that they did not already perform the targeted mand at the MO level. Then, baseline probes were taken intermittently in an effort to demonstrate that performance remained below the acquisition (MO) level over time, but in the absence of intervention. This was intended to provide some control for experience, practice, and opportunity effects. After the first participant acquired the targeted mand (i.e., responding at the MO level over three intervention sessions), the intervention phase was introduced to the second



participant (i.e., Seth). When he showed acquisition of the targeted mand, the intervention was introduced to the last participant (i.e., Franny).

## **Procedures**

For each session, the following variables remained constant: (a) time of day, (b) materials used in the behaviour chains, and (c) presence, location, and display settings on the SGD.

**Baseline.** For baseline, each session began with the experimenter giving a relevant instruction (e.g., saying *Let's play The Sneaky Squirrel Game*) to initiate the start of the behaviour chain. Descriptive verbal praise was given for the participant completing each step of the chain prior to the point of interruption (e.g., *Nice job getting out the game pieces.*). At the point of interruption, when a needed item was missing, the experimenter said, *Oh no, something is missing.* and then waited 10 s to allow for the participant to make the targeted mand response (i.e., to produce the mand *Where [item]?*). Prompts were not given to produce the mand for information, but any response at the MO level — an independent response — (i.e., *Where is the spinner?* or *Where spoon?* or *Where beans?*) would have resulted in the experimenter providing the location of the missing item to enable continuation of the behaviour chain. Incorrect responses were ignored, and after a 10 s interval, the behaviour chain was terminated and a neutral activity was presented (i.e., puzzle, colouring book, etc.).

**Intervention.** Intervention was similar to baseline except that at the point of interruption of the behaviour chain, a 5 s time delay and the least-to-most prompting procedure was used to ensure the participant produced the targeted mand for information when the chain had been interrupted. The wait time was shortened from the 10 s used in baseline to 5 s for intervention in an effort to prevent errors given that the

baseline data suggested that MO level responding was highly unlikely to occur during the initial stages of intervention, even if a 10 s time delay was used. Therefore, it was decided to provide prompting if an independent (MO level) mand did not occur within 5 s of the interruption. If an independent (MO level) response (i.e., mand for *Where [item]?*) to occurred or began to occur within the 5 s interval, then the experimenter provided the information (i.e., location of the missing item). If the participant did not respond correctly within 5 s of the interruption, then the experimenter followed least-to-most prompting sequence (i.e., gesture, then verbal, then partial physical, and finally the full physical prompt) until the participant made the targeted mand for information. This sequence was based on a prior evaluation of participants' reactions to gesture, vocal, and physical prompts during the standardized assessments (as discussed in Chapter 3). Thus, the prompting hierarchy included gesture prompt (e.g., pointing towards the device, correct navigational button, or the correct symbol), followed by a verbal prompt (e.g., *Say, Where is the spinner?* or *Press the where symbol*), and lastly two levels of physical prompting (using the least amount of physical guidance necessary or using full hand over hand guidance). Differential social reinforcement associated to the level of prompt used was given in an effort to prevent prompt dependency. For example, prompted responses gained neutral verbal praise (e.g., *The spoon is in the blue bin.*) and independent (i.e., unprompted and correct) responses resulted in enthusiastic verbal praise (e.g., *Nice asking! The acorns are on the desk.*).

**Generalisation probes.** During baseline and intervention phases, generalisation was assessed within the context of the already existing behaviour chain. Procedures were consistent with baseline except for the use of a different missing item. For the generalisation assessment, a different needed item within the

behaviour chain was arranged to be missing. For Ryan, and The Sneaky Squirrel Game™, during regular sessions it was the game spinner that was missing, but in the generalisation sessions, the spinner was present and the game pieces (i.e., acorns) were missing. For Seth (i.e., making lemonade), rather than having a missing spoon, it was the drink mix that was missing. And for Franny's generalisation sessions for the Don't Spill the Beans™ game, rather than having game pieces (i.e., beans) missing, it was the stand needed to put the beans on that was missing.

**Training for generalisation phase.** Because generalisation was not observed when assessed during the intervention phase, an additional training phase was implemented following the intervention phase. For this training phase, the procedures were the same as the previous intervention phase, however the interruption was arranged with the new missing item; not with the item that was missing during the regular intervention sessions.

### **Interobserver Agreement**

A second independent observer collected data on the participant's responses and the level of prompting used during each session and each phase of the study. Mand responses were coded in terms of occurrence and the level of prompting used (i.e., MO, G, V, P or F or IR). An agreement was scored if the experimenter and the independent observer had recorded the same level of prompting. Any discrepancy was counted as a disagreement. The following formula was used to calculate a percentage of agreement for each session and for each participant:  $\text{Agreements} / [\text{Agreements} + \text{Disagreements}] \times 100\%$ . For Ryan, the independent observer collected data on 55% of his sessions with a mean agreement of 97% (range 80 to 100%). For Seth, the independent observer collected data on 68% of his sessions with a mean agreement of

98% (range 80 to 100%). For Franny, the independent observer collected data on 57% of the sessions with a mean agreement of 97% (range 80 to 100%).

### **Procedural Fidelity**

During sessions where IOA was collected, the independent observer also assessed procedural fidelity using a checklist that described the procedures that should have been followed in each session. The percentage of correctly completed steps was calculated for each session. The mean percentage of correct implementation across sessions was 98% (range 89 to 100%) for each participant.

### **Results**

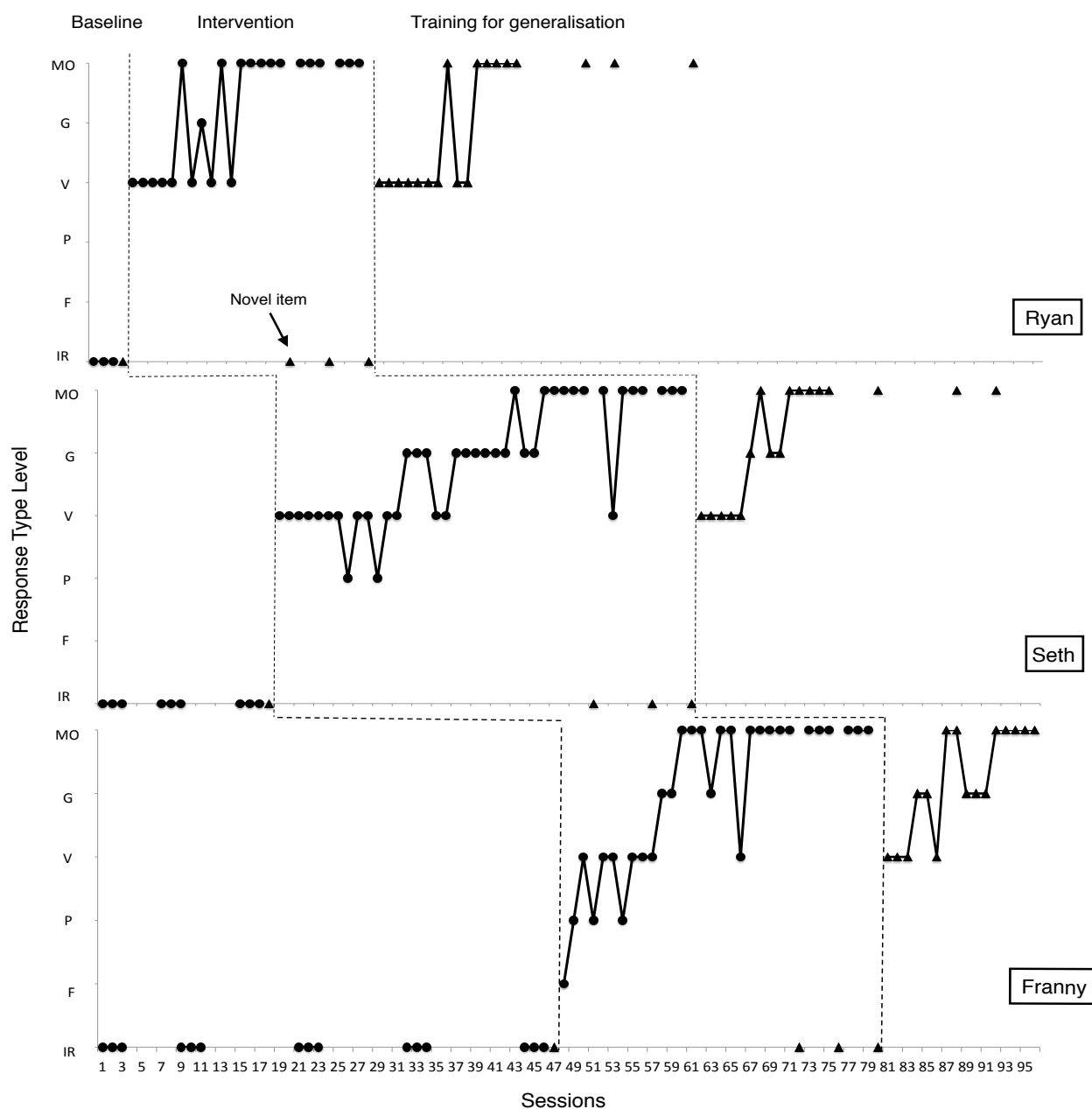
Figure 4.3 displays the level of response type (i.e., level of prompting) recorded for each session. Ryan's results are displayed on the upper panel, Seth's results are displayed on the middle panel, and Franny's results are displayed on the lower panel.

For Ryan's four baseline sessions, he responded at the IR level, which indicated he did not independently use the SGD to respond with the targeted mand for information. During the intervention phase he received a total of 22 sessions (i.e., opportunities) and 3 additional probes to assess for generalisation to a novel item. During the 22 intervention sessions, the most intrusive prompt used was a verbal prompt, which occurred on 8 session (36% of the opportunities). He responded to a gesture prompt on 1 session (5% of the opportunities). He showed independent responding at the MO level on 13 sessions (59% of the opportunities). Similar to Study 1 (Chapter 3), the majority of prompted sessions occurred during the initial sessions of the intervention phase (i.e., during the first 11 sessions). After 12 sessions of intervention, Ryan consistently responded at the MO level, which indicates acquisition of an independent mand for information. However, during the three

generalisation probes, Ryan responded at the IR level, indicating spontaneous generalisation to a novel item did not occur. Thus, an additional phase aimed at training for generalisation was implemented. During the subsequent training for generalisation phase, 18 sessions of training were conducted. The only prompt used during this phase was a verbal prompt, which occurred on 9 sessions (50% of the opportunities). He showed independent responding at the MO level on 9 sessions (50% of the opportunities). A steady trend of responding at the MO level was observed after 11 of these sessions, indicating that acquisition of the mand for information to the novel item occurred.

During the ten baseline sessions Seth (middle panel) responded at the IR level across each session, which indicates he did not use the SGD to emit the targeted mand for information. During the 40 intervention sessions the most intrusive prompt required was a partial prompt, which was given on 2 sessions (5% of the opportunities). For the remaining intervention sessions a verbal prompt was given on 14 sessions (35% of the opportunities) and a gesture prompt was given on 11 sessions (27.5% of the opportunities). He showed independent responding at the MO level on 13 sessions (32.5% of the opportunities). However, for the three generalisation probes conducted during the intervention phase, he responded at the IR level, which indicated the need for an additional training phase. During this subsequent training phase (i.e., training with a novel item), 17 training sessions were conducted. A verbal prompt was used on 5 sessions (29% of the opportunities) and a gesture prompt was used on 7 sessions (18% of the opportunities). He showed independent responding at the MO level on 9 sessions (53% of the opportunities). Further, a steady trend of responding at the MO level was observed after 10 of these sessions, indicating that acquisition of the mand for information to the novel item occurred.

During the 16 sessions of baseline probes, Franny (bottom panel) responded at the IR level across each session, which indicates she did not use the SGD to emit the targeted mand for information. During the 30 intervention sessions the most intrusive prompt required was a full physical prompt, which was given on 1 session (3% of the opportunities). For the remaining intervention sessions, a partial prompt was given on 3 sessions (10% of the opportunities) a vocal prompt was given on 7 sessions (23% of the opportunities), and a gesture prompt was given on 3 sessions (10% of the opportunities). She showed independent responding at the MO level on 16 sessions (53% of the opportunities). She showed steady trends of responding at the MO level after 20 intervention sessions. However, she responded at the IR level for the three generalisation probes conducted in the phase, which indicated the need for an additional training phase. During this last phase (i.e., training for generalisation to a novel item), 16 training sessions were conducted. A verbal prompt was used on 4 sessions (25% of the opportunities) and a gesture prompt was used on 5 sessions (31% of the opportunities). Independent responding at the MO level was shown on 7 sessions (44% of the opportunities). A steady trend of responding at the MO level was seen after 12 of these sessions, which indicated that acquisition (of the mand for information to the novel item) occurred.



## Discussion

The positive results of this study suggest that children with ASD who are minimally verbal and who are learning to communicate using an SGD can acquire mands to find out the location of a missing item. Each participant acquired the targeted mand form with intervention that involved a single missing item, but did not show generalisation when a second (untrained) item was arranged to be missing instead of the original missing item.

These findings suggest that an effective MO can be contrived by using the missing-item format and that a mand for information relevant to that MO can be taught by using a combination of time delay, least-to-most prompting, and natural reinforcement (i.e., giving the child the requested information). These findings are consistent with prior research that has used similar procedures to teach SGD-based manding to children with ASD who are minimally verbal (e.g., Lorah et al., 2013; Sigafoos et al., 2013; van der Meer, Didden, et al., 2012; van der Meer, Kagohara, et al., 2012; van der Meer, Sutherland, et al., 2012; Waddington et al., 2014) as well as previous research investigating the teaching of mands for information to children with ASD (e.g., Koegel et al., 2010; Lechago et al., 2010; Ostryn & Wolfe, 2011; Sundberg et al., 2002). Moreover, these findings are important in that they extend the previous literature investigating procedures for teaching mands to children with ASD who are minimally verbal and who are being taught to use SGDs. The extension includes the present focus on teaching what could be viewed as a more complex type of mand (i.e., mands for information) as compared to teaching a more basic mand (request) for a highly preferred toy or edible item. As discussed by previous researchers (e.g., Lechago & Low, 2015; Raulston et al., 2013) manding for information is highly functional for the child and thus extending research into the



teaching of this new kind of mand is important, especially perhaps for children with ASD who are minimally verbal and who are being taught to use SGDs.

Each participant was able to extend their manding repertoire by acquiring the mand for information, however generalisation of the mand to a different missing item did not occur, so an additional training phase was provided. While successful acquisition of the mand for information when a different (second) item was missing provides a degree of replication the effects of the first intervention phase, it does not constitute generalisation. Generalisation failures may to be common in research of this type. Raulston et al. (2013), for example, noted limited results related to generalisation in their review of studies on teaching mands for information. With regards to the present study, the failure to generalise might have resulted from using insufficient exemplars during intervention, since only one missing item was used. If so, generalization might be more likely by arranging for a number of different items to be missing, an approach known as training sufficient exemplars (Stokes & Baer, 1977). Over time, such training might establish a generalised mand for information, rather than what seems to have been a specific mand for information regarding the location of one item, and later (after the additional training phase) another item.

Although positive, these findings are preliminary and not without limitations, thus future investigations into the teaching of mands for information to children with ASD who are minimally verbal and learning to communicate with an SGD would be warranted. One obvious limitation is the small number of participants, which begs the question as to whether similar results would be found with other children. In addition each child was only taught to mand for information in the context of a single activity (i.e., behaviour chain). Thus, the results are limited in scope because participants were taught to mand for information initially only when one item was ever missing and

later when a second item was missing. It is not clear therefore if they has learned to mand for information generally or only to mand for information regarding the location of one and then later a second item.

In terms of the rapidity of the intervention effects, Ryan's rate of acquisition could be seen as more rapid compared to Seth and Franny. There may be a few possible explanations for this. First it may be the case that Ryan had greater overall communication abilities. Indeed, his assessed communication skills were higher than the other participants. He was also able to respond by typing, which is arguably a higher level of ability then touching a graphic icon. Even though Seth and Franny reached acquisition in a relatively short period of time, there may be value in future research aimed at identifying factors that might improve acquisition rates for children who progress particularly slowly. Another limitation is that the study focused on only one form of a mand for information (i.e., *Where [item]?*). Given that little research has evaluated procedures for teaching other forms of this mand (e.g., *What*, *Who*, *How*, *When* and *Why*), studies on how to teach such forms would seem useful.

While the children in Study2.1 learned to ask where a missing item was from a single communication partner, it is often likely to be the case that that listener might not know where the item is, but that a second or their listener might. Thus it would seem useful to teach children to seek out a second listener and repeat the mand for information when the first listener indicates the he or she does not have the answer. One could view this as a type of persistence training. There appear to be no studies that have aimed to obtain this type of persistence in manding for information. In light of this, a follow-up study was conducted that aimed to teach this type of persistence in the use of the mand for information (i.e., *Where [item]?*). In this second study, the listener to whom the mand was first directed responded by saying that she did not

know the location of the missing item. This was done in an effort to determine if the participant would then repeat the mand to a second communication partner. If not, then this would provide the context for teaching the participant to repeat the mand for information, but this time directing it to a second communication partner.

Demonstrating effective procedures for teaching this type of persistence was viewed as one way of ensuring that newly acquired mands for information would remain functional when the inevitable encounter with an ignorant listener occurred.

## **Study 2.2**

### **Methods**

#### **Participants, Settings, Sessions, and SGDs**

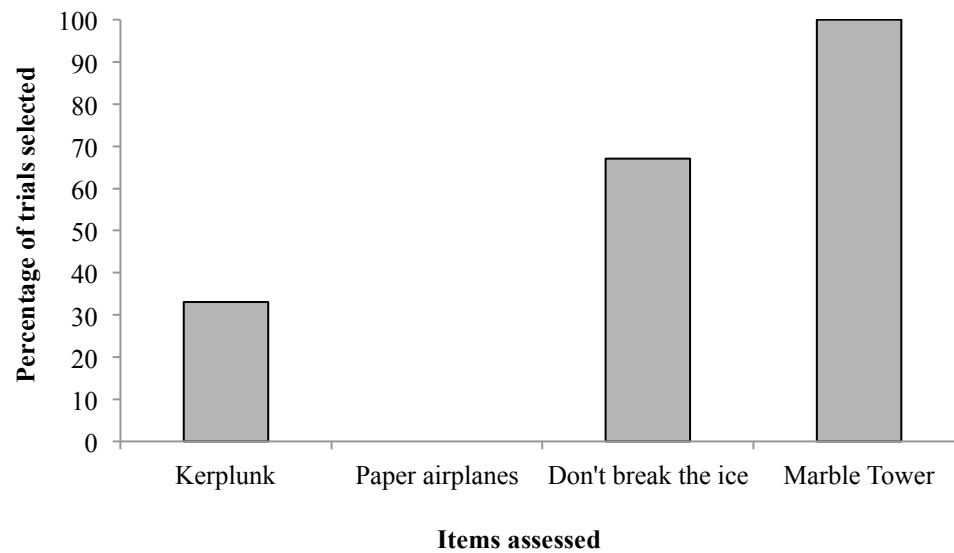
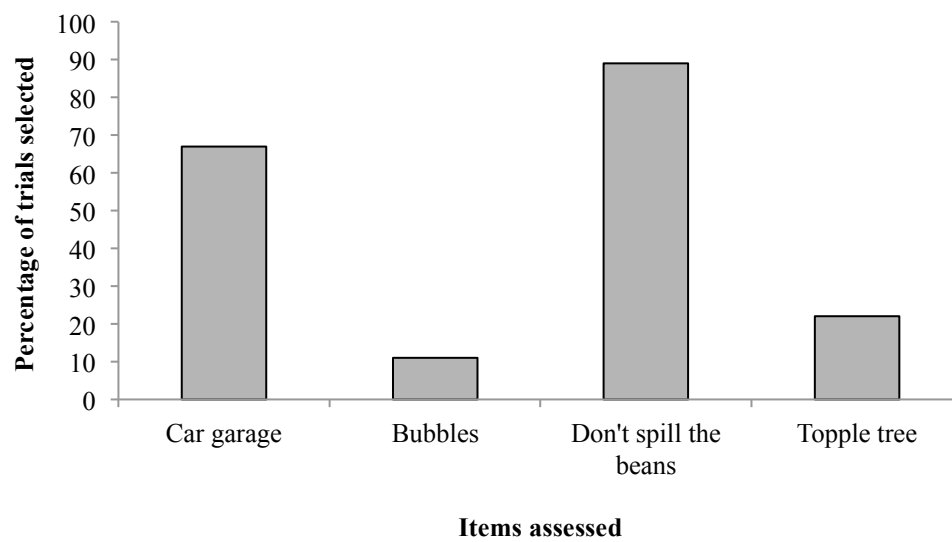
Shortly after completing the first study, Ryan and Seth participated in this follow-up study. Franny was unable to continue her participation in Study 2.2 because she had moved to a distant school. The settings for Ryan and Seth were the same as in Study 2.1 (i.e., Ryan's sessions were conducted at his school; Seth's sessions were held in a university clinic).

Similar to the previous study, each session consisted of one behaviour chain (i.e., targeted activity) and lasted approximately 5 to 10 min. Two or three sessions were conducted per day, 2 to 3 times per week. Each participant continued to use an iPad-based SGD as described in the previous study (see Figure 4.1).

#### **Behaviour Chains**

Two preferred behaviour chains were identified for each participant using the same preference assessment methods described in the previous study (i.e., indirect parent questionnaire and pairwise preference assessment). Ryan's preferred activities were building a marble tower and playing the game Don't break the ice™. Seth's preferred activities were playing the game Don't spill the beans™ and playing with a

set of toy cars and garage (see Figure 4.4). Prior to baseline, the participants were assessed and trained on the steps involved in each behaviour chain (e.g., retrieving item, setting up the game pieces, and putting it away when finished) with the same approach used in Study 2.1. See Table 4.2 for a description of the targeted behaviour chains.

*Ryan's Results**Seth's Results***Figure 4.4.** *Study 2.2 Preference Assessment Results*

**Table 4.2.** *Description of Targeted Behaviour Chains*

Participant	Behaviour Chain	Description	Terminal Reinforcer
Ryan	Behaviour Chain 1 Marble Tower	Gets game from bin Takes it to the table Opens bin *Sets up the marble tower Plays with the marble tower	Plays marble tower
Ryan	Behaviour Chain 2 Don't break the Ice game	Gets game from bin Takes it to the table Opens bin *Sets up game Plays game	Plays game
Seth	Behaviour Chain 1 Don't Spill the Beans game	Gets game from bin Opens game *Sets up game Plays game	Plays game
Seth	Behaviour Chain 2 Toy car garage	Opens bin Gets garage out of bin *Get the cars out of the garage Plays with toy car set	Plays with car set

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\*Denotes point of interruption

### **Receptive Identification and Tact Probes**

Prior to baseline, both participants were assessed to determine if they could receptively identify the items involved in their respective behaviour chains (e.g., related game pieces and toys). Ryan was also assessed for his ability to tact the materials to ensure he was able to correctly identify and spell the names of these items. Procedures for these assessments were consistent with those used in the previous study. Each participant scored 100% accuracy on the receptive identification tests. However Ryan needed five training trials on the spelling of the word *ice blocks*.

### **Prerequisite Training for *Where [item?]* mands**

Prior to baseline, each participant was assessed and trained to use the *Where [item]?* mand in the context of an interrupted behaviour chain for the two selected behaviour chains. This training was consistent with procedures used in the intervention phase of the previous study, and continued until the participants had reached the criterion of three consecutive independent mands for information (i.e., manding at the MO level) across both behaviour chains. Ryan required six training sessions to acquire the mand for his first behaviour chain (i.e., building a marble tower) and eight training sessions for his second behaviour chain (i.e., playing the game Don't break the ice™). Seth required 9 training sessions to reach independent (i.e., MO level) responding for his first behaviour chain (i.e., playing the game Don't spill the beans™) and 11 training sessions to reach independent (i.e., MO level) responding for his second behaviour chain (i.e., playing with toy cars and a garage).

### **Response Definition and Data Collection**

The dependent variable was defined as repeating the *Where [item name]?* mand (i.e., persistence in the use of the mand) to a second communication partner (or relevant communication partner during generalisation sessions) when the first

communication partner (or second during generalisation sessions) indicated that she did not know where the missing item was (i.e., *I don't know*). To repeat the mand, the participant had to approach the second communication partner within 5 s of being told by the first communication partner that she did not know where the item was located. For generalisation two types of sessions were evaluated: (a) targeting a novel second listener or (b) a third listener for persistence (i.e., the first and second communication partners do not know the answer). Similar to the previous study, in each session, the experimenter(s) coded the participant's repetition of the mand using the following categories: (a) IR, meaning no response was made within 5 s of being told *I don't know* (by the relevant communication partner); (b) G, meaning a gesture prompt (i.e., pointing towards the second communication partner) was used to prompt the mand; (c) V indicating a vocal prompt (i.e., "Go ask [name of second communication partner]" or "Go ask someone else.") was used; (d) P indicating a partial physical prompt (i.e., partially physically guiding the participant to second communication partner) was used; (e) F indicating a full physical prompt was used (i.e., fully physically guiding the participant to the second communication partner); and (f) MO indicating that the mand *was repeated* to a second communication partner (or relevant partner during generalisation sessions) independently and within 5 s of being told I don't know by the first listener (or relevant partner during generalisation sessions).

### **Experimental Design**

A concurrent probe multiple baseline design across behaviour chains, embedded into a multiple baseline across participants design, was used to evaluate the effects of teaching the persistence of mands for *Where [item]?* in the context of an interrupted behaviour chain strategy (BCIS; Gast & Ledford, 2009). More specifically, the design included the following sequence of phases: (a) baseline, (b)



intervention, (c) training to obtain generalisation (Ryan only), and (d) follow up. Baseline was introduced concurrently for each behaviour chain and each participant, which also included a probe for generalisation to a novel stimulus (i.e., a second [different] item that was needed for completing the behaviour chain was missing). After a stable baseline was established in the first participant's first behaviour chain, the intervention phase was introduced. When the first participant (i.e., Ryan) had acquired the targeted response (i.e., persistence of the *Where [item]? mand*) in his first behaviour chain (i.e., marble tower), the intervention phase was introduced to his second behaviour chain (i.e., Don't Break the Ice™ game). When he acquired the target behaviour (i.e., persistence of the *Where [item]? mand*), the intervention was extended to the second participant (i.e. Seth) for his first behaviour chain (i.e., Don't Spill the Beans™ game). When he acquired the target behaviour (i.e., persistence of the *Where [item]? mand*), the intervention was extended to his second behaviour chain.

## Procedures

The following variables remained constant during each session: (a) time of day, (b) materials with the behaviour chain, (c) presence, location, and display settings on the SGD, and (d) presence of the second communication partner.

**Baseline.** Similar to the previous study, sessions began with the experimenter (first listener) saying *Let's build a marble tower* or other relevant instruction to initiate the start of the behaviour chain, however a second listener was present during each session. Descriptive verbal praise was given for the participant completing each step of the chain prior to the point of interruption (e.g., *Nice job getting the game*). After the participant responded to the interruption (i.e., manding for information regarding the location of the missing), the experimenter (first listener) responded by

saying, *I don't know* and a 10 s time delay was used to determine if the participant would persist by approaching the second communication partner and repeating the mand. During baseline, the participant was not given any prompts to repeat the mand to the second communication partner. Incorrect responses were ignored and after 10 s, the behaviour chain was terminated and a neutral activity was presented (i.e., puzzle, colouring book, etc.). Additionally, during baseline, two types of probes for generalisation were assessed: (a) novel second communication partner, and (b) third communication partner (see generalisation probe section for procedures).

**Generalisation probes.** During each phase of the study, generalisation with respect to persistence of the mand was assessed to a novel and third communication partner for each behaviour chain and for each participant. Sessions were conducted similar to baseline in that prompting did not occur. During generalisation probes to a novel second communication partner, a different unfamiliar person was in the room. During generalisation to a third communication partner, conditions were also similar to baseline with the exception of a third person now present (different from the novel person). And during these sessions, if the child asked the second partner the *Where [item]?* question, the second person responded by saying *I don't know*.

**Intervention.** Intervention training was similar to baseline conditions except after the experimenter (first listener) responded by saying *I don't know* to the child's initial mand, a 5 s time delay was given followed by a least-to-most prompting procedure to assist the participant to ask the *Where [item]?* question to the second communication partner. After the participant asked the second communication partner where the missing item was located, he was told where it was by the second communication partner. With this information, the participant was then able to retrieve the item and complete the remaining steps of the behaviour chain and thus

access the terminal consequence, which was presumed to be an effective type of reinforcement for completing the chain.

**Training for generalisation to a third communication partner.** Training for generalisation was conducted for Ryan to teach persistence of the mand for *where* to a third communication partner because generalisation did not occur during the probe sessions in the intervention phase. Training sessions were conducted in a manner that was similar to the intervention phase, however after asking the second listener *Where [item]?* and being told, *I don't know.*, the participant was prompted to ask the third person using the least-to-most prompting procedures.

**EO/AO post-tests.** After the conclusion of the intervention phase and after generalisation training for Ryan, post-tests were conducted to assess whether it was the presumed MO (i.e., establishing operation; EO) was in fact influencing the mand for information, rather than the verbal cue *Oh no, something is missing*, that was used by the experimenter to signal the start of the interruption. Conditions for these tests were similar to baseline, except that the verbal signal (i.e., the experimenter saying, *Oh no, something is missing*) was not given. Three such test probes were conducted for each participant. Additionally, 10 EO/AO tests, 5 for each behaviour chain, were conducted to assess the participants' ability to conditionally discriminate between the two conditions (i.e., discriminate when the item is missing [EO] versus when the item is not missing and clearly visible and within reach of the participant [AO]). These probes or tests were similar to the initial EO post-tests in that a verbal cue from the experimenter was not provided at the point of the interruption. For the EO condition, the item was missing. The AO condition was similar, except that the normally missing item was actually present and visible to the child and easily within reach.

This AO test was intended to assess whether the mand would occur even when it was not needed.

### **Interobserver Agreement**

A second independent observer collected data on the participant's responses and the level of prompting used across each phase of the study. Persistence of the mand for *Where [item]?* was coded as independent or prompted and the level of prompting was recorded (i.e., MO, G, V, P or F or IR). An agreement was scored if the experimenter and independent observer both recorded the same response/prompt level for each session, whereas any discrepancy was counted as a disagreement. The following formula:  $\text{Agreements} / [\text{Agreements} + \text{Disagreements}] \times 100\%$  was used to calculate a percentage of interobserver agreement for each session. Interobserver agreement was collected on 100% of the sessions for Ryan and 52% of sessions for Seth. For Ryan, the mean of agreement was 99% (range 80 to 100%). For Seth, the mean of agreement was also 99% (range 80 to 100%).

### **Procedural Fidelity**

Procedural fidelity was assessed during sessions where interobserver agreement was collected by the same independent observer. This was done to assess the degree to which the experimenter correctly implemented the procedures of the study. The percentage of steps implemented correctly was calculated for each session. The mean percentage of correct implementation across sessions was 96% (range 82% to 100%).

## **Results**

Figure 4.5 displays the results of the study. The two upper panels represent Ryan's two behaviour chains and the lower two panels represent Seth's two behaviour chains.

For Ryan's first behaviour chain (upper panel) he responded at the IR level during the five baseline sessions/probes, indicating he did not engage in persistence of the *where* mand to a second communication partner. During the intervention phase he had a total of 27 sessions plus 6 sessions (i.e., probes) assessing generalisation to a novel communication partner and a third communication partner. During the 27 intervention sessions (i.e., opportunities), the most intrusive prompt level used was at the verbal prompt level, which occurred on 3 sessions (11% of the opportunities). The remaining prompted sessions used a gesture level, which occurred on 4 sessions (15% of the opportunities). Responding at the MO level was seen on 20 of the 27 sessions (74% of opportunities). Similar to the previous studies, sessions in which prompt was required occurred in the initial intervention sessions. A trend of consistent independent responding at the MO level was seen after 8 intervention sessions. Further, during the three generalisation probes to a novel (second) communication partner he responded consistently at the MO level. However, during the generalisation probes to a third communication partner responding at the IR level occurred, which indicated a need for an additional phase to training for persistence of the mand to the third partner. For this additional intervention phase, Ryan received a total of 8 sessions. The only prompting required occurred on 2 sessions (25% of the opportunities), which consisted of a verbal prompt. Responding at the MO level occurred for the remaining 6 sessions (75% of the opportunities). After 3 training sessions he began showing a trend of consistent responding at the MO level.

For the second behaviour chain (second panel) during Ryan's seven baseline sessions, he had seven responses at the IR level, meaning he did engage in persistence of the mand for information. During the intervention phase he had a total of 26 sessions plus an additional 7 sessions/probes assessing generalisation to a novel

communication partner and a third communication partner. During the 26 intervention sessions, he responded to a verbal prompt on 1 session (4% of the opportunities) and a gesture prompt on 2 sessions (8% of the opportunities). He responded at the MO level for the remaining 23 sessions (88% of the opportunities). Specifically, a trend of independent responding at the MO level was seen after 4 sessions. Generalisation was seen across both behaviour chains to the novel (second) and third communication partners during the three generalisation probes.

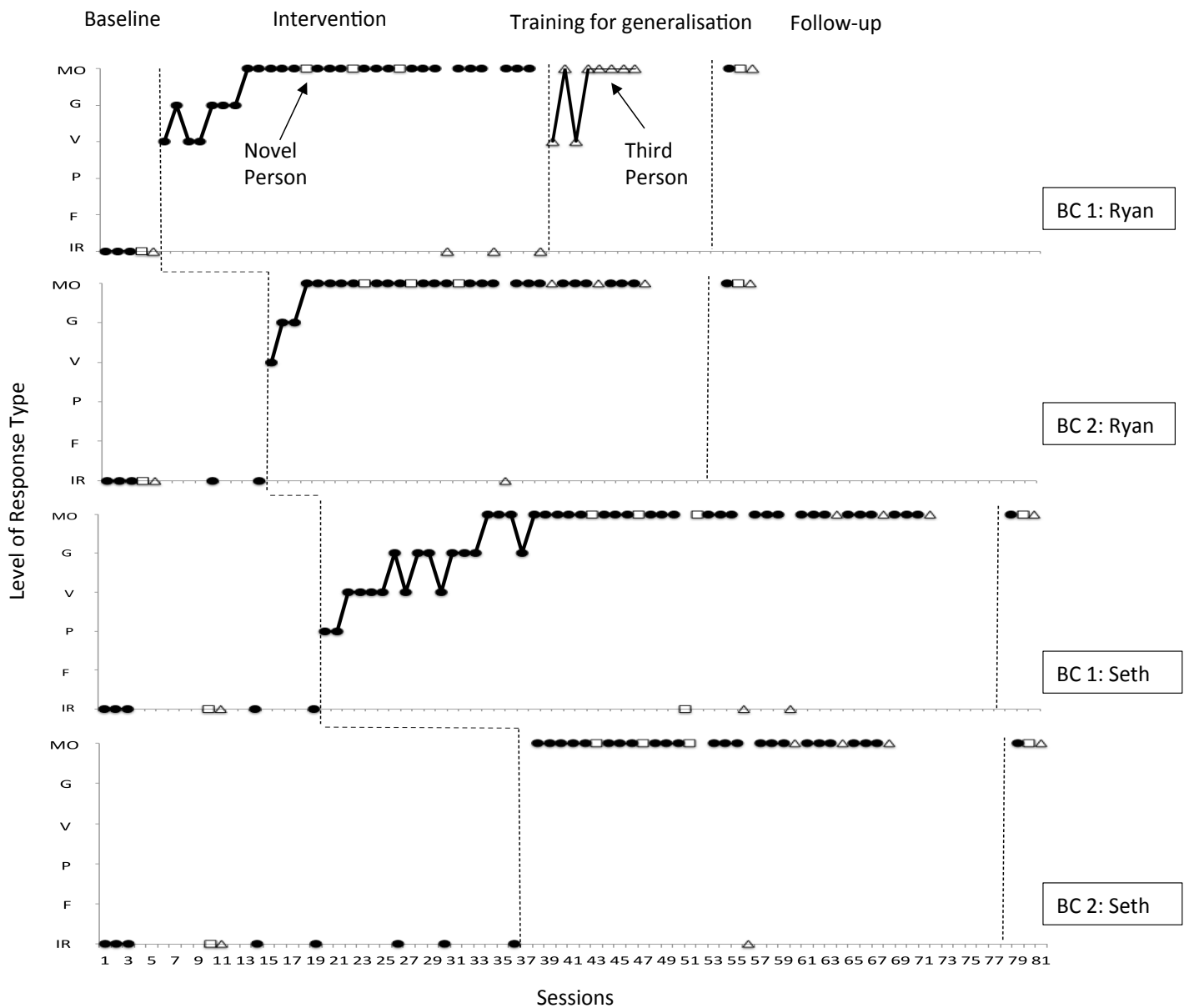
During Seth's seven baseline sessions, he had seven responses at the IR level, which indicated he did not engage in persistence of the mand for information. During the intervention phase he received a total of 44 training sessions plus an additional 9 sessions/probes to assess generalisation to a novel communication partner and to a third communication partner. During the 44 intervention sessions, he responded to a partial prompt on 2 sessions (4% of the opportunities), a verbal prompt on 6 sessions (14% of the opportunities), and a gesture prompt on 7 sessions (16% of the opportunities). He responded at the MO level on 29 of the 44 sessions (i.e., 66% of the opportunities). A trend of independent responding was observed after 19 intervention sessions. Generalisation at the MO level was seen across both behaviour chains to the novel (second) communication partner in 3 out of 4 probes (75% of the opportunities) and to the third communication partners during 3 out of 5 generalisation probes (60% of the opportunities).

For Seth's second behaviour chain (last panel) during the 10 baseline sessions, he had 10 responses at the IR level, meaning he did engage in persistence of the mand for information. During the intervention phase he had a total of 23 sessions plus an additional 7 sessions/probes assessing generalisation to a novel communication partner and a third communication partner. During the 23 intervention sessions, he

responded at the MO level for the remaining 23 sessions (100% of the opportunities).

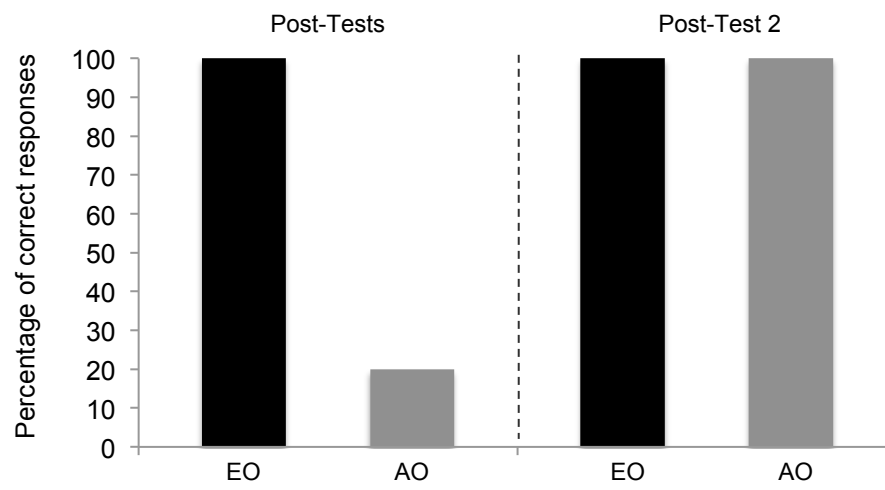
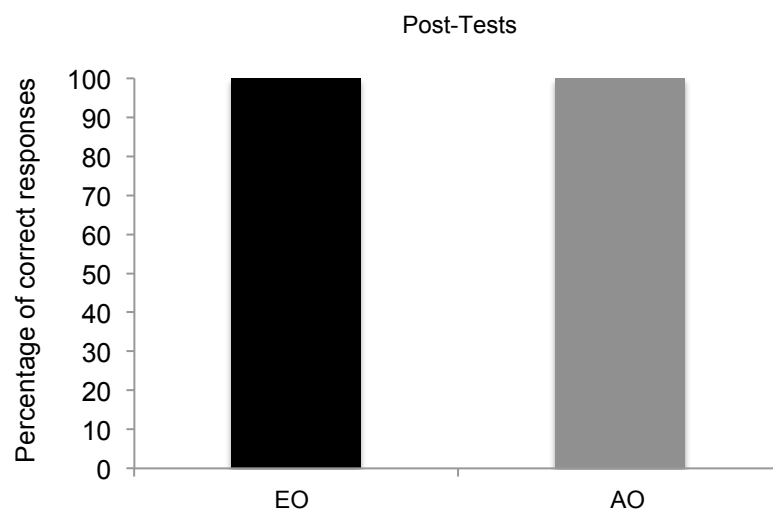
Specifically, he did not require training sessions because he was observed to independently use the mand for *Where [item]?* in the second behaviour chain.

Generalisation at the MO level was seen across both behaviour chains to the novel (second) communication partner on 3 out of 4 sessions (75% of the opportunities) and to a third communication partner on 3 out of 3 sessions (100% of the opportunities) during generalisation probes.



**Figure 4.5.** Displays the persistence of the mand for information response by type (MO = Unprompted; G= Gesture; V= Verbal; P= Partial; F= Full; IR= Incorrect response or no response) across sessions for each participant.



*Ryan's Results**Seth's Results*

**Figure 4.6.** *EO/AO Pre and Post-Test Results*

## Discussion

The results suggest the participants had learned an important degree of persistence in the use of the targeted mand. That is, they learned to repeat the mand to other listeners when the initial listener did not know the answer. The intervention procedures also seem to have led to an important degree of generalisation of the targeted mand across behaviour chains for Seth. The relevant influence of the MO on the mand seems to have occurred via the intervention, in that the participants performed the mand when the MO (EO condition) was present, but were less likely to use the mand when the MO was absent (AO condition). These results are consistent with previous research that has evaluated teaching mands for *where* to children who communicate using spoken language using the BCIS to contrive the MO (Betz, et al., 2010; Raulston et al., 2013; Sundberg, et al., 2002; Sigafos et al., 2013).

Persistent use of the mand in the first behaviour chain was acquired in 8 sessions for Ryan and in 15 sessions for Seth. Acquisition for the second behaviour chain occurred without intervention for Seth, which suggests that there was spontaneous generalisation from the first chain to the second chain. However, Ryan needed training in both chains to reach acquisition. These findings suggest, that some individuals may benefit from teaching across more than one behaviour chain to achieve use of the same mand across more than one chain/activity/interruption.

With regards to assessing the influence of the EO and AO conditions, these findings highlight the potential benefit of assessing for conditional discrimination of the mand for information. For example, one of the two participants (i.e., Ryan) required training, albeit relatively little training, to discriminate at the 100% level between when the mand was needed (EO) versus when it was not needed (AO). Thus, in some cases it may be more beneficial to teach the mand for information across

these two conditions to ensure the mand is under the control of the relevant antecedent (Betz, et al., 2010; Lechago & Lowe, 2015). A potentially important empirically question is whether both establishing (i.e., EO) and abolishing (i.e., AO) conditions should be included (and alternated) from the beginning stages of intervention, or whether the AO condition should be introduced only after acquisition has occurred in the EO condition. This would be an interesting question for future research.

Few studies have evaluated procedures for teaching the persistence of communication skills. In one relevant study, Ganz et al. (2008) taught a child with ASD, to persist in using a picture exchange system to make requests for preferred objects. Other researchers have examined other forms of promoting the persistence of communication skills. For example, Grosberg and Charlop (2014) investigated the use of portable video modeling to teach persistence within social initiations to four children with autism. Specifically, this study targeted teaching persistence of a mand to play, when the initial mand to play was declined by a peer. Persistence was defined as approaching up to three peers for play after being declined by the first peer. Positive results (100% accuracy across two consecutive sessions) were reported for each participant, and showed maintenance of the skill over a one- and two-month follow up period. However, persistence in the manding for information has not specifically been addressed in any previous research. The present study could therefore be seen as helping to extend the limited research on persistence of communication skills by evaluating the use of the BCIS format and systematic instructional tactics (i.e., prompting and prompt fading, and contingent reinforcement) for teaching persistence in the use of mands for information.

Persistence of communication skills may be important for children with ASD because they may often face communication breakdowns due to their limited communication skills (Keen, 2005). Learning to persist in using a communication skill might be one way to repair a communication breakdown (Sigafoos et al., 2004). Although these findings are preliminary, these data could be seen as providing some preliminary support for a strategy in which children are taught to repeat their initial communication attempt to a second communication partner as a way of attempting to repair a communication breakdown that arises when their first communication partner does not, or cannot, reinforce their communication response. This repetition strategy is a common type of communication repair that is prevalent among individuals with and without disabilities (Brady & Halle, 2002; Halle, Brady, & Drasgow, 2004; Wetherby, Reichle, & Pierce, 1998). Thus, the findings of this study may give some support to the potential utility of teaching this specific type of repair strategy. In the present study, this repair strategy appears to be easily taught to the participants, perhaps due to the fact that is simply involved repeating an already learned behaviour.

Despite the favorable outcomes of this study, there are limitations with regards to interpreting these results. For example, Seth showed generalisation across behaviour chains that unfortunately compromises the integrity of the at least one element of the multiple baseline design. Although, spontaneous generalisation of a skill across activities would generally be seen favorably to practitioners, from a research design standpoint this may be seen as a limitation to the replication effect, as only once replication was observed (i.e., across only two participants). Further the small number of participants also affects the ability to claim any degree of degree of generality regarding these findings. Thus, the present results should be interpreted with caution until future research can replicate these effects with other children and

with designs that are better suited for isolating generalisation effects. Future research might also seek to investigate topic extensions of the manding for information. For example, it is likely that in a social context, manding for information to a peer would be a beneficial skill. Additionally, future research should also look at extending this topic to a variety of environments where the need for persistence might be expected to arise naturally, such as a noisy classroom or playground.

## CHAPTER 5

### General Discussion and Conclusion

The findings of the present research suggest that children with ASD who are minimally verbal can learn to use a SGD to mand for actions and to mand for information. Each study yielded generally positive results with regards to the acquisition of the targeted mands (i.e., mands for action, mands for information, and persistence in the use of mands for information). However, mixed results were seen with respect to generalisation.

For Study 1, which involved teaching mands for actions to three participants using SGDs, each participant gained independent responding (i.e., responding at the MO level), although two of the participants (i.e., Seth and Franny) received a procedural modification before the achieved acquisition of the targeted mand for action. With respect to generalisation in Study 1, Ryan was the only participant that showed generalisation to a novel item. Ryan and Seth showed evidence of maintenance of the skill across time, but Franny did not. Therefore she participated in a re-teaching (booster training) phase in which she appeared to have regained acquisition of the targeted mand.

For Study 2, which taught manding for information using a *Where [item]?* question form, each participant gained independent responding of the targeted mand. However, after testing for generalisation to a novel stimulus within the trained behaviour chain, which showed limited generalisation, an additional phase was implemented in an attempt to train for generalisation to the novel stimulus. With this additional training, each participant showed independent responding. In a follow-up study (Study 2.2) with Ryan and Seth, the intervention was provided in an effort to promote persistence in the use of the mand for information. In this study, both

participants showed independent responding of the targeted responses (i.e., emitting the mand *Where [item]?* to a second communication partner when the first communication partner did not provide the requested information). Moreover, Seth showed generalisation of the skill across behaviour chains. Ryan did not show generalisation and therefore he received training to acquire the persistence of the response in second behaviour chain. Additionally, both participants showed generalisation across a novel second communication partner, as well as a third communication partner, although Ryan required initial training for this in his first behaviour chain.

More evidence of generalisation was obtained in Study 2.2 compared to Study 1 and Study 2.1. Specifically in Study 2.2, both participants showed some generalisation, whereas generalisation outcomes were limited in the other study. The better generalisation in the final intervention (i.e., Study 2.2) might be accounted for the by fact that that study only involved Ryan and Seth. These two children generally showed better generalisation than Franny in the previous study. In addition, by the end of the intervention phase in Study 2.2, Ryan and Seth would have had considerable experience and training in using mands when behaviour chains had been interrupted. This experience and training could have facilitated generalisation in Study 2.2. This explanation is similar to the learning to learn effect described by Lovaas (1977), in which exposure to initial learning conditions increases performance on subsequent learning conditions. Thus, these findings might highlight the potential value of providing a sequence of interventions that include opportunities for generalisation and additional training when generalisation does not occur. Indeed, the mixed results for generalisation suggest there would have been value in more active programming for generalisation during the intervention phases of Studies 1 and 2, as

suggested by Stokes and Baer (1977). One approach for this could have been to teach the mands across various stimuli (i.e., relevant items) and various behaviour chains (i.e., activities). Stokes and Baer (1977) referred to this as *Training Sufficient Exemplars*. The better generalisation in Study 2.2 could thus be an example of having trained sufficient exemplars. That is, by that stage, sufficient exemplars might have been trained.

Overall, these results suggest that using the BCIS, in conjunction with systematic instruction and contingent reinforcement was effective for teaching these advanced mand forms to children with ASD who were minimally verbal and who were learning to communicate using a SGD, but that the training produced mixed results with respect to generalisation. The following sections will discuss some theoretical implications of these studies, their limitations, as well as areas for future research and the overall contribution that this thesis makes to the research literature.

### **Implications**

There are several possible theoretical implications that warrant discussion from the findings presented in the current thesis. In particular, the studies included in this thesis would seem to provide some support for (a) the application of Skinner's (1957) analysis of verbal behaviour, (b) the use of preference assessment with attention to the MO, and (c) the application of operant learning theory (i.e., behavioural principles) in communication interventions for children with ASD.

#### **Skinner's (1957) Analysis of Verbal Behaviour**

Skinner's analysis of verbal behaviour (1957) has been used in the design of communication interventions for children with ASD and other developmental disabilities (Duker, Didden, & Sigafoos, 2004; Sundberg & Michael, 2001; Sundberg, 1998). In line with these previous examples, the studies in this thesis aimed to make



use of his analysis of verbal behaviour in several ways. First, the Skinnerian analysis was used as the main theoretical framework for defining the communication skills that were taught to the participants in these studies. The target skills were defined and conceptualized as *mands* in that they relate to ensuring a listener (a) performed a needed action for the child (Study 1), and (b) provides the needed information (Study 2.1 and Study 2.2). The *mand* is arguably the most unique operant because, as noted by Skinner (1957), it is the only verbal operant that is of direct benefit to the speaker due to its relation to a characteristic consequence (i.e., asking for water is reinforced with water from a listener). Because the mand direct beneficial to the child, it would seem to be an important priority to target for instruction when beginning a communication intervention programme (Reichle, York, & Sigafoos, 1991). Essentially, learning new forms of mands is considered to be one way that an individual can express their wants and needs. Although mands can simply be described as requesting or rejecting, Skinner also described other kinds of mands that are intended to evoke a specific response from the listener. These other types of mands include mands for actions and mands for information. When considering the utility or functionality of these kinds of mands, it is arguable that these kinds of mands could enable the speaker to engage in a more precise way with the environment. For example, a child given his or her favourite package of chips after manding for chips might need assistance to open the bag. In this scenario, the child would benefit from learning to mand for the listener to deliver the needed assistance (e.g., *Please open the bag.*). Most previous research has focused on teaching children with ASD who use SGDs to communicate only the former type of mand, that is to request that the listener present him or her with a specific object (e.g., Duker et al., 2004; Lorah, et al., 2013; Waddington et al., 2014). The present thesis could be seen

as extending the existing literature by focusing on what can be viewed as two other types of more advanced mands, that is, mands for actions and mands for information.

### **Motivating Operations**

Unlike other verbal operants, Skinner (1957) argued that the mand is the only type of verbal behaviour that is under the functional control by motivational variables (i.e., deprivation or aversive stimulation). Thus, when conceptualizing the design of interventions that focus on teaching mands, it is arguably necessary to consider and ensure that there are effective motivational operations in place that will establish the need for the mand. In the present study, the MO was created by interrupting a chain of behaviour that ultimately led to a terminal consequence that was presumed to be an effective type of reinforcement for the child. The interruption appeared to create an effective, albeit mild, state of aversive stimulation and thus created the need for a mand to alleviate that aversive stimulation. This use of an interruption (i.e., using it to contrive an MO for manding) is consistent with previous research in which similarly arranged MOs were effective in creating the need for mands (e.g., Albert et al., 2012; Shillingsburg, Valentino, Bowen, Bradley, & Zavatkay, 2011; Sundberg et al., 2002). That is, the present studies also provide additional support for the use of the BCIS as an effective and practical way to create the motivation or need for manding (Albert et al., 2012; Hall & Sundberg, 1987; Hunt & Goetz, 1988). The present thesis could be seen as helping to extend these previous studies by showing that the BCIS could also be used to create the motivation or need for more advanced manding skills (i.e., manding for actions and manding for information).

From a theoretical perspective, the use of a BCIS could be conceptualized as an operation for contriving a conditioned MO, which in turns provides an opportunity for teaching new mand forms. Specifically, in the first study, the use of a blocking

access BCIS might be classified as a Reflexive-Conditioned MO (CMO-R; Albert et al., 2012; Michael, 1993; Shafer, 1994). It would seem then that the CMO-R could be viewed as having been responsible for the behaviour altering effect (i.e., increasing the need for, or probability of, the targeted mands for action) for each participant (Michael, 1993; Shafer, 1994). Specifically, when blocking access to the terminal reinforcer within a behaviour chain, the removal of the block may represent a reduction in aversive situation. This could potentially make the removal of the block and reinstatement of the flow of the behaviour chain a conditioned reinforcer. And this, in turn, would establish the need for the mand. For example, if a door leading to the playground is locked and is blocking a child's access to a playground, then that blocking (interruption) would likely make the opening of that door an effective type of reinforcement. This would then increase the probability of any behaviour that has previously resulted in the door being opened, such as increasing the probability of a relevant mand such as *Please open the door*. Therefore, when contriving CMO-Rs to teach a mand for action, considering the value of the terminal reinforcer might be useful. A practical recommendation flowing from this conceptualization is that activities should be selected that create a situation where completing the final step of the chain leads to an effective type of reinforcement, and thus the individual will be motivated to mand for an action that will enable him or her to continue the chain of behaviour to its end point (i.e., obtaining the terminal reinforcer).

The type of BCIS used in Study 2 could be conceptualized as an example of the missing-item format. This format was used as a way of creating (or contriving) a conditioned MO, so as to provide an opportunity for teaching the children to mand for information (i.e., teaching the children to ask *Where [item]?*). The missing-item format might be classified as a type of Transitive-Conditioned MO (CMO-T; Albert

et al., 2012; Michael, 1993; Shafer, 1994). For example, in the context of a behaviour chain, to contrive a CMO-T, an item within a chain, which might have initially been a neutral stimulus (e.g., a spoon), is made momentarily more valuable (i.e., reinforcing) because of its relation to the terminal reinforcer of the chain (e.g., eating ice cream). Thus, an individual is perhaps more likely to be motivated to mand for the location of a spoon when reaching the point of interruption where it is needed, but missing. However, if eating ice cream is not a reinforcer for individual at that time (e.g., perhaps because he or she has been satiated from eating a large meal), then he or she might not be motivated to eat ice cream and thus is unlikely to ask where he or she could find the spoon that is needed for eating ice cream. Therefore, when contriving CMO-T, assessment of the terminal reinforcer is crucial in ensuring the terminal consequence is an effective type of reinforcement at the time.

Although, each child's preference for the terminal outcomes associated with each behaviour chain used in these studies was assessed, the children's preference was assessed only prior to the start of each study. It is therefore possible that in some sessions, the participants were not motivated and the interruption was not an effective learning/teaching opportunity. However, overall the interruptions created in these studies appeared to be effective because the participants gradually became more independent in producing the targeted mands. While each participant eventually acquired the mands targeted in each study, two of the participants (i.e., Seth and Franny) had relatively slower acquisition rates, perhaps due to a diminishing level of motivation for the activity as a result of their repeated exposure of the behaviour chain. It is uncertain to what degree, if any, this affected the rate of acquisition because, as mentioned before, preference for the terminal consequence was not assessed prior to each session, only at the beginning of the study. It may have been

beneficial to assess for preference prior to each session to ensure that an effective MO was in place. Drasgow, Halle, and Sigafoos (1999) argued for the importance of ensuring motivation for each and every learning/teaching opportunity in order to promote acquisition. Lack of motivation might also account for mixed generalisation results. However, while ensuring motivation may facilitate acquisition, it is not clear if motivation is in fact necessary for learning to occur. Premack (1976), for instance, argued that reinforcement is a performance variable, meaning that a child might learn even when he or she not sufficiently motivated to perform the behaviour. One might test Premack's claim by comparing acquisition and performance under conditions when the relevant MO is present versus absent.

### **Operant Learning Theory**

The generally positive results from these studies would seem to give some additional support to the use of operant-based (systematic) instructional procedures for teaching manding skills to children with ASD who have limited communication repertoires (Duker et al., 2004; Kagohara et al., 2010; Sigafoos, Doss, & Reichle, 1989; Snell & Brown, 2014). Each study presented in the current thesis utilized several operant –based instructional strategies, specifically: (a) contriving motivation using a BCIS, (b) presenting distinct discriminative stimuli for responding, (c) using effective response prompts and prompt fading techniques, and (d) the use of reinforcement contingencies. Again, the approach for creating motivation was via the establishment of a behaviour chain pertaining to a preferred activity and then interrupting that chain at a point when continuation of the chain required a mand from the child. It was hoped that interruption of the chain would eventually come to function as a discriminative stimulus for responding. However, as indicated in baseline, interruption alone was not sufficient to ensure that the children would

produce the required mands. Instead, the mand forms had to be taught directly. This was accomplished by applying the operant-based systematic instructional procedures (e.g., least-to-most prompting, prompt fading, and contingent reinforcement). The presumed initial reinforcer for the child's mand for action was having the action preformed by the listener (Study 1) or providing the requested information (Study 2) and the terminal reinforcer was likely to have been the resulting access to the activity itself. This combination of interruption, systematic instructional procedures, and reinforcement contingencies represent a well-established instructional package that has been successfully used in numerous other studies to teach a range of skills, including communication skills, to children with ASD who are minimally verbal, as well as children with other developmental disabilities (Duker, et al., 2004; Ganz et al., 2012; Snell & Brown, 2014; van der Meer & Rispoli, 2010; van der Meer et al., 2012b; Waddington et al., 2014). It is therefore not surprising that the application of this set of procedures was effective for teaching the mands targeted in the present series of studies. In light of this, the instructional methods could be viewed as making use of well-established and empirically-validated procedures. In particular, these studies add to the evidence base for both empirically-validated teaching procedures within the scope of applied behaviour analysis, and also the evidence base for teaching mands using SGDs for children with ASD. Further discussion on evidence-based practices (EBPs) will be addressed within the limitations and future directions section of this chapter.

With regard to Study 1 (i.e., manding for actions), there may have been some problems in establishing a particular type of stimulus control over the action mands being taught. Specifically, while the children acquired the targeted action mands and produced the mand only when the chain had been interrupted, it remains unclear

whether it was in fact the locked screen on the device that evoked the mand for action or merely the act of being interrupted. Simply stated, did the child merely learn to press an icon on the SGD whenever an interruption occurred? This seems unlikely because participants then waited for the action to be performed and continued with the chain, suggesting the mand was functionally related to their need for the listener to perform a specific action. Additionally, the response topography on the SGD required multiple behaviours, such as navigation and discrimination of icons to create the targeted response (Seth and Franny) or typing a written message (Ryan). Given the response effort involved in producing the mand, it was probably unlikely that the interruption did not create an MO. Still, the fact that the precise stimulus controlling the actions mands taught in Study 1 was not assessed could be viewed as limitation that makes it difficult to ascertain exactly what the children had learned. In either case, the children used the action mand only when interrupted, which suggests that they had learned a functional response and used it when it was needed. Future research could be improved by attempting to assess the actual stimulus conditions that came to control the children's action mands. In the second, manding for information, study (i.e., *Where [item]?*), stimulus control was assessed to some extent by removing the verbal cue (i.e., *Oh no, something is missing!*) during the MO post-intervention trials. The results of this assessment suggested that the participants had in fact learned to respond to the context created when a needed item was missing, rather than only having learned to respond when that verbal cue had been given.

As previously mentioned (Study 2.2), another issue that may limit the findings of this research was that the extent to which the children had acquired the conditional discrimination of responding in the presence of the MO, but not in its absence (i.e., in the presence of an AO) was unclear. This was not assessed in Study 1, and

consequently it is not clear if the participant would have manded for the action when the chain was interrupted, or when the action was not required. If so, such data would suggest that it was not the state of the device (i.e., it needed to be unlocked), rather, the interruption that evoked the response. In light of this possibility, and after completing the intervention phase of Study 2.2 in the manding for information study (Study 2), performance under both an MO (i.e., item is missing) and an AO (i.e., item is present) condition was assessed to ensure that the participants' mands were under the influence of the relevant MO (i.e., a needed item was missing). The results indicated that Seth showed such a conditional discrimination without the need for any additional training. Ryan needed only one teaching trial to acquire this discrimination. That is, during the AO condition, the experimenter explained to Ryan that if the item was present, he did not need to ask where it is. After receiving this explanation, Ryan manded for information only when the item was missing (MO) and not when it was visible (AO), suggesting that the mand was in fact evoked by the MO and inhibited by the AO.

### **Considerations in the Use of the BCIS**

A behaviour chain can be described as a sequence of responses that make up a completed task or activity. Completing each step of the chain creates the discriminative stimulus for the next step and also functions as conditioned reinforcement. All of this is conceptualized as enabling the responses to be linked in sequence and thus permit seamless progression to the terminal-reinforcing outcome (Cooper, et al., 2007). As previously described in the literature review of BCIS (see Chapter 2), this strategy involves utilizing a familiar behaviour chain and interrupting it at a pre-determined step (generally in the middle of an ongoing chain) in order to establish the natural consequences of a specific mand as a reinforcer (Carter &



Grunsell, 2001; Goetz, Gee, & Sailor, 1985; Hunt & Goetz, 1988). The present thesis research supports the utility of this strategy for creating learning/teaching opportunities. However, it should be noted that a BCIS without the use of operant-based instructional procedures (i.e., prompting, fading, contingent reinforcement), would most likely not be sufficient to ensure acquisition of a new skill. Thus, it is perhaps best to view the BCIS as a type of motivational strategy, not as a type of direct instructional technique. As a motivational strategy, the BCIS could be viewed as a way of arranging the environment to create the need or motivation for a response, which can then be prompted and reinforced by the teacher. Over time, the response prompts are faded until the response occurs in the presence of the interruption without prompting. The BCIS could be viewed as useful in part because ASD is often associated with lack of motivation. This lack of motivation might explain why children with ASD have been described as difficult to teach (Charlop-Christy & Haymes, 1998; Koegel & Mentis, 1985). Thus it seems important to find ways to motivate them (Koegel & Mentis, 1985; Sundberg & Michael, 2001). As previously discussed, the BCIS appears to be one way to do so. However, research has also demonstrated successful ways of teaching mands without the explicit use of a BCIS (Kagohara et al., 2010; Olive et al., 2007; Sigafoos, Couzens, Pennell, Shaw, & Dudfield, 1995). For example, Sigafoos et al. (1995) taught mands for missing items to three children (ages 4 to 6) with developmental disabilities. Sessions were conducted in discrete-trial format (i.e., 5 massed trials) and verbal and physical prompts were used to recruit the correct response from the children. The results indicated that each child learned to request the missing item even though no specific behaviour chain interruption had occurred. Instead, a needed item was simply missing at the start of each session and obtaining the item was necessary to access the

reinforcers (e.g., a straw was needed to drink the juice from a juice box). While perhaps not explicitly an example of a BCIS, the procedure used by Sigafoos et al. could be viewed as a type of interruption in the sense that the child was prevented from accessing the reinforcer until he or she had the missing item. However, other studies have investigated teaching mands for information using methods that do not seem to have included any type of interruption strategy (Endicott & Higbee, 2007; Koegel, et al., 2010). For example, Endicott and Higbee (2007) taught mands for information (i.e., Study 2.1) to four verbal children (ages 3 to 5) with autism. The effectiveness of the intervention was measured via a multiple baseline across participants design. A brief preference assessment was conducted each day to identify highly preferred verses lower preferred items. Sessions included 10 total training trials (i.e., five trials using the highly preferred item followed by five using the least preferred item). Sessions began with the participant having brief access with the item, then the item was hidden in a designated spot while the child was out of the area. After returning to the instructional area, the child was told to get their item. If the participant did not mand *Where [item]?* within 30 s, they were verbally prompted to do so. When the participant engaged in the mand for information, the experimenter would provide the location of the item.

Although these examples are not specific to minimally verbal children learning mands for actions or mands for information, they do suggest that procedures that do not seem to be a direct example of the BCIS were also successful in teaching advanced manding skills to children with ASD. Still, the hiding of a needed item could be seen as a type of MO that created effective opportunities for teaching mands and may be an important aspect of an intervention.

Efficient use of the BCIS may depend on the extent to which the participant has

had prior exposure to the behaviour chain and has experienced the reinforcing outcome at the end of the chain. Ensuring such experience may be beneficial for several reasons. First, prior history of reinforcement with the terminal reinforcer might help to strengthen the motivation to continue the behaviour chain past the point of interruption. For example, if an individual was going to engage in a behaviour chain related to making an ice cream sundae, but had never been contacted the terminal reinforcer of the behaviour chain (i.e., eating the ice cream), he or she might not have learned that there is a need to ask for a missing spoon. Second, with regards to a previous history of the behaviour chain, it is most likely beneficial to the learning, when targeting a new skill with a BCIS that the other behaviours that are involved to complete the chain (i.e., each step of the behaviour chain) are not at an acquisition level. For example, in the context of making toast, if the learner does not know how to locate and retrieve the bread used to make toast, a missing toaster is likely to be irrelevant. Thus, it is suggested that a BCIS is more likely to be an effective and efficient teaching context when the chain is a familiar activity for the learner. Although research has yet to evaluate the use of the BCIS related to unfamiliar behaviour chains, it may be the case that there would be a lack of conditioned reinforcement and lack of discriminative stimuli available to the learner, at least at the beginning of instruction. This unfamiliarity could possibly lead to more errors, which could hinder acquisition. Consequently, some type of error-less teaching strategy might be indicated when intervention occurs in the context of an unfamiliar behaviour chain (Duker, et al., 2004).

### **Limitations and Future Research**

Based on the findings of the presented research, there are some limitations that provide directions for further research and warrant discussion. First, the generality or

external validity of the findings may be limited due to the few number of participants. Thus, replication of these findings would be beneficial in strengthening the research base for teaching advanced mand using SGDs. In particular, Horner et al. (2005) suggested that a well-established evidence base for studies using single-case experimental designs requires replication of an intervention effect across a minimum of five studies, conducted by at least three different research teams, and involving at least 20 participants. In line with these guidelines, the BCIS and the systematic instructional procedures used in the present set of studies would be classified as well established, empirically validated, or evidence-based (Wong, et al., 2015). So too would the evidence base related to teaching mands to children with ASD who are minimally verbal and the use of SGDs in communication interventions for such children (Ganz et al., 2012; van der Meer & Rispoli, 2010; Wong, et al., 2015). However, the evidence base related to using the BCIS, systematic instruction, and SGDs to teach advanced manding (i.e., mands for action and mands for information) skills to children with ASD who are minimally verbal, must at present be seen as promising, but not yet well established. This is because there does not yet appear to be five such studies, from three independent teams, and involving at least 20 participants (Horner et al., 2005). The present study does, however, provide a useful start to the accumulation of that amount of evidence. In light of the promising results obtained in this thesis, it would seem that additional replications by independent researchers would be valuable for helping to assess the generality of the findings, and thus might eventually be classified as a well-established, empirically-validated, or evidence-based approach for teaching advanced manding skills to children with ASD who are minimally verbal and who are learning to use a SGD to communicate. Whether this approach eventually proves to have such generality, and whether this

approach proves to be more effective than other approaches, will depend on the outcome of future studies.

Second, the mixed results with respect to generalisation, as previously mentioned, is a limitation that suggests another potentially useful direction for future research. Specifically, future research should investigate issues related to the generalisation of newly acquired advanced manding skills. Recall that in Study 1, both Seth and Franny did not show generalisation of the skill to a different item, and in Study 2.1, generalisation of the skill to a novel item was not observed for any of the participants. These results suggest the potential value of more explicit programming for generalisation and future research could evaluate the relative effects of using various approaches to promote generalisation, such as the various approaches suggested by Stokes and Baer (1977). Along these lines, such programming was undertaken to some extent in Study 2.1, in that an additional phase to train for generalisation to a novel item was included. Rates of acquisition were faster for each participant, with Franny and Seth having a substantially faster rate (i.e., almost 50% faster). Because there are generally multiple stimuli within one behaviour chain, when teaching mands for actions or mands for information, several items within a chain could be targeted to promote generalisation of the targeted mand. However, it is unknown if this should be done by creating multiple interruptions (i.e., several missing items), which may diminish the MO, or multiple items should be targeted by changing the missing item from session to session. Further research is needed to provide direction on these possibilities. Future research could also investigate interventions that involve actively programming for multiple stimulus training (Stokes and Baer, 1977) in the contexts of teaching advanced manding.

Third, there was a relatively limited amount of maintenance data collected. This was because of practical issues, such as end of school terms, and the need to complete data collection so as to be able to finish this PhD thesis before having to return to the USA. Still, the limited amount of maintenance data collected could be viewed as a limitation. An obvious direction for future research, would therefore, be to include longer follow-up to determine if the newly acquired mands for action and information would be maintained over time in the absence of continued intervention. If not, then future research could evaluate the effects of various strategies to promote maintenance, such as overlearning, scheduling practice sessions, and ensuring natural opportunities to mand for actions and information (Barton & Harn, 2012).

Finally, although formal social validity assessments were not conducted, which is a limitation, there are some data suggest that SGDs are a generally accepted method of communication (i.e., are social valid) (see Achmadi et al., 2015). Future research would be improved by undertaking more formal assessment of social validity, including assessing the social validity of the form of the mands targeted for intervention, the social validity of the intervention strategies, and the social validity of the mode of verbal behaviour (e.g., iPad-based SGDs versus other types of SGDs).

### **Contribution of Research and Conclusion**

The current thesis aimed to extend previous research related to teaching mands within the context of the BCIS to children with ASD who were minimally verbal and who were being taught to communicate using SGDs. In particular, these studies contribute to the existing body of research by replicating the findings of studies that addressing mand training for children with ASD, and extending the research by evaluating more complex SGD-based mands (i.e., mands for actions and mands for information).

These results contribute to research in the field of applied behaviour analysis, and the education of children with ASD and other developmental disabilities in several ways. First, these studies, on a theoretical level, provide further support for the application of Skinner's (1957) analysis of verbal behaviour to communication interventions for children with ASD. The results suggest that this analysis — when combined with strategies to create relevant MOs for manding and the application of systematic, operant-based teaching strategies — was an effective framework for intervention. These findings can also be considered as further support of the use of systematic teaching combined with the use of a BCIS to teach new, and more advanced, types of mands to children with ASD. Further, the present series of studies can be viewed as both an important replication and extension of previous communication intervention studies in the ASD area, in that advanced mands were taught (i.e., mand for action and mand for information) to children with ASD who were not only lower functioning or minimally verbal, but who were also learning to use a new generation of iPad-based® SGDs to communicate.

Overall, the results of this research suggest that children with ASD who are minimally verbal can be taught to use an SGD to produce advanced mands within the context of a BCIS. In spite of the positive results, the data should be interpreted with caution. The findings must be considered preliminary due to the small number of participants and the relatively modest scope of the project (e.g., only a few mands were taught and only a few behaviour chains were used as the instructional context). Further, Ryan used a display option (i.e., typing display) that was topographically different from Seth and Franny who used a symbolic display, which may also limit the generality of the findings. Finally, there was limited maintenance data collected and generalisation results were mixed. Still, this appears to be the only thesis (study)

that has sought to teach advanced manding skills to children with ASD who were also lower functioning or minimally verbal and who were learning to use a SGD to communicate. The generally positive results of this thesis research thus offer some data-based guidance to parents, clinicians, speech-language pathologists, and teachers of children with similar intervention needs.



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## Appendix A

### Indirect Reinforcer Assessment Interview Protocol

Child's name: \_\_\_\_\_ Date of interview: \_\_\_\_\_

Person interviewed: \_\_\_\_\_ Name of interviewer: \_\_\_\_\_

#### Description and Purpose:

The purpose of this interview is to identify foods/drinks, toys, and sensory objects and activities that are highly preferred by your child. I will ask you 10 questions about various things that your child might like or prefer. For each question try to think of at least three things that you think your child really likes. In some cases we may ask a follow-up question to clarify how the child uses a particular item (e.g., What does she do when she plays with a mirror?).

#### Questions:

1. Some children really enjoy looking at things such as a mirror, bright lights, shiny objects, TV etc. What are the things your child most likes to look at?

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2. Some children really enjoy different sounds, such as listening to music, car sounds, whistles, beeps, sirens, clapping, people singing, etc. What are the things your child most likes to listen to?

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3. Some children really enjoy different smells such as perfume, flowers, coffee, pine trees, etc. What are the things your child most likes to smell?

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4. Some children really enjoy certain snack foods and beverages such as ice cream, pizza, juice, biscuits, crackers, etc. What are the things your child most likes to eat and drink?

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## Appendix A

5. Some children really enjoy physical play or movement such as being tickled, wrestling, running, dancing, swinging, being pulled on a scooter, etc. What activities does your child most enjoy?

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6. Some children really enjoy touching things of different temperatures, cold things like snow or an icepack, or warm things like a hand warmer, or a cup containing hot tea or coffee. What activities like this does your child enjoy?

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7. Some children really enjoy feeling different sensations such as splashing water in a sink, feeling vibration against the skin, or the feeling of air blowing on the face from a fan. What activities like this does your child enjoy?

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8. Some children really enjoy it when others give them attention such as a hug, a pat on the back, receiving applause, being told they did a “good job”, etc. What forms of attention do you think your child most enjoys?

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9. Some children really enjoy certain toys such as puzzles, toy cars, balloons, comic books, flashlights, bubbles, etc. What are some of your child’s favourite toys or objects?

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## Appendix A

10. What are other items or activities that your child really enjoys?

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### Data Analysis and Summary:

After completing the survey, list the top six foods/drinks and top six play items/sensory stimuli. For this list indicate items/stimuli that could be presented to the child during intervention sessions in a typical home or classroom setting (e.g., a toy could be presented, but it would not be practical to take the child horseback riding).

A. The top six food/drink items are:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_

B. The top six play items/sensory stimuli are:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_

## Appendix B: Ethics Approval Letters



Phone 0-4-463 5676  
 Fax 0-4-463 5209  
 Email Allison.kirkman@vuw.ac.nz

### MEMORANDUM

TO	Amarie Carnett
COPY TO	Larah van der Meer Donna Achmadi Michelle Stevens Laura Roche Flaviu Hodis Jeff Sigafoos
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	5 June 2014
PAGES	1
SUBJECT	<b>Ethics Approval: 20948</b> Teaching Advanced Manding Skills to Children with Autism Spectrum Disorder Using Systematic Instruction, Speech-Generating Devices, and Skinner's Analysis of Verbal Behavior

Thank you for your application for ethical approval, which has now been considered by the Standing Committee of the Human Ethics Committee.

Your application has been approved from the above date and this approval continues until 1 July 2016. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Allison Kirkman  
 Human Ethics Committee



Phone 0-4-463 5676  
 Fax 0-4-463 5209  
 Email Allison.kirkman@vuw.ac.nz

## MEMORANDUM

TO	Amarie Carnett
COPY TO	Flaviu Hodis Jeff Sigafoos
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	11 March 2015
PAGES	1
SUBJECT	<b>Ethics Approval: 20948</b> Teaching Advanced Manding Skills to Children with Autism Spectrum Disorder Using Systematic Instruction, Speech-Generating Devices, and Skinner's Analysis of Verbal Behavior

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

Your application has approval until 1 July 2016. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Allison Kirkman  
 Human Ethics Committee



Phone 0-4-463 5480  
Email [susan.corbett@vuw.ac.nz](mailto:susan.corbett@vuw.ac.nz)

## MEMORANDUM

TO	Amarie Carnett
COPY TO	Anastasia Sawchak Hannah Waddington
FROM	AProf Susan Corbett, Convener, Human Ethics Committee
DATE	25 June 2015
PAGES	1
SUBJECT	<b>Ethics Approval: 20948</b> Teaching Advanced Manding Skills to Children with Autism Spectrum Disorder Using Systematic Instruction, Speech-Generating Devices, and Skinner's Analysis of Verbal Behavior

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

Your application has approval until 1 July 2016. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Kind regards



Susan Corbett  
Convener, Victoria University Human Ethics Committee