Aided Enhanced Milieu Teaching to Increase Symbolic Communication Skills in Children with Autism Spectrum Disorder

Submitted by

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Bachelor of Speech Pathology (Honours)

Graduate Diploma in Education (Distinction)

A thesis submitted in total fulfilment of the requirements for the degree of Doctor of Philosophy

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Victoria, Australia

November, 2020

ABSTRACT

Autism spectrum disorder (ASD) is a neurodevelopmental condition that affects communication, social interaction, and behaviour. Children with ASD demonstrate a unique developmental profile, with communication for the purposes of regulating behaviour used with greater frequency than communication for declarative purposes. A substantial proportion of children with ASD do not develop functional speech, making them ideal candidates for augmentative and alternative communication (AAC) as their primary communication system. Historically, a focus in the ASD-AAC research literature has been on supporting children to develop functional communication skills, most often for the purpose of making object requests. Although important, and indicative of a strengths-based approach, a focus on developing communication for behavioural regulation does not reflect the range of pragmatic functions required for social interaction more broadly including the development of meaningful relationships with others.

The aim of this thesis was to develop an intervention to effectively teach children with ASD who used little or no functional speech – herein described as being minimally verbal – to use aided AAC for a range of pragmatic functions. To meet this aim, initially, a critical review and synthesis of the literature was undertaken, in the form of two systematic literature reviews, with analysis of the characteristics of aided AAC interventions that had been used in an attempt to develop varied communication functions. Concurrently, a social validity survey was constructed as a tool to ascertain the acceptability of aided AAC intervention goals, processes, and outcomes, needed for use in studies attempting to teach a broad range of communicative functions. An intervention was subsequently devised – aided enhanced milieu teaching (AEMT) – by drawing from the findings of the systematic reviews, that combined characteristics of effective interventions with aided AAC. The AEMT was

investigated in two experimental single case intervention studies that were conducted according to multiple baseline design.

The two systematic reviews of the ASD-AAC literature addressed the effectiveness and specific characteristics of interventions used to develop a range of communication functions in children with ASD. Identification of effective intervention characteristics (comprising setting events/antecedents, teaching strategies, reinforcement, and dosage), as well as determination of necessary characteristics to promote generalisation, in studies in which a range of functions had been taught, informed the development of the AEMT. Accordingly, the AEMT included a range of environmental arrangement features, interaction strategies, and specific prompts to elicit symbolic communication for varied social purposes. Following participation in the AEMT, all three child participants made clinically significant changes to their use of symbolic communication and range of functions expressed; but for only two participants were these changes significant. Given their critical role in facilitating communication development, parents were subsequently taught to implement AEMT. In response to structured parent training, parents acquired skills in use of at least two of the three core AEMT strategies, with some relationship between use of strategies and subsequent child symbolic communication. The social validity tool created, and subsequently implemented during evaluation of both AEMT studies, enabled families to communicate how they felt about the intervention, and identify their perception of meaningful change.

There are several important knowledge contributions arising from the body of work forming this thesis. Despite the historical focus in ASD-AAC research on teaching object requests, the findings of the systematic reviews indicated that children with ASD were able to learn to express other pragmatic functions. However, highlighted was the need to provide children with ASD and their families with interventions that are naturalistic, can be applied within daily routines, and reflect child preferences in order to develop skills that are meaningful to the child and relevant to their communication contexts. The results of the AEMT, which accommodated characteristics of effective, naturalistic ASD-AAC interventions, indicated that it holds promise as a means of developing symbolic communication skills and communication for varied pragmatic purposes, and can be implemented by either practitioners or parents. The new tool created in the form of the social validity survey allowed for measurement of social validity both for the AEMT studies within this thesis, as well as potentially within ASD-AAC intervention research more broadly. While this thesis provides evidence that children with ASD who are minimally verbal can be taught to use symbolic communication for pragmatic functions beyond object requests, further research is warranted to inform how to best support children to use their communication skills flexibly in typical environments and contexts.

DECLARATION OF AUTHORSHIP AND ETHICS STATEMENT

This thesis includes work by the author that has been published or accepted for publication as described in the text. Except where reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis accepted for the award of any other degree or diploma. No other person's work has been used without due acknowledgement in the main text of the thesis. This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

Studies reported in this thesis were approved by the College of Science, Health and Engineering, Latrobe University Human Ethics Committee for low risk (S15/50) and above low risk (15-056) components. As participants were sought from schools and local service providers, ethics approval was also obtained from the NSW Department of Education State Education Research Applications Process (2015226), the Aspect Research Approvals Committee (1719), and the Department of Education and Training Victoria (RISEC2015_002786).

This work was supported by an Australian Government Research Training Program and a La Trobe University Postgraduate Research Scholarship.

Kristy Logan

02/11/2020

PUBLICATION ARISING FROM THIS THESIS

Logan, K., Iacono, T., & Trembath, D. (2017). A systematic review of the use of aided AAC to increase social-communication functions in children with autism spectrum disorder. *Augmentative and Alternative Communication, 33*, 51-64. doi:10.1080/07434618.2016.1267795

MANUSCRIPTS IN PREPARATION

Logan, K., Iacono, T., & Trembath, D. (2020a). *Characteristics of interventions used to develop social communication functions in children with autism who use aided AAC*. Manuscript in preparation.

Logan, K., Iacono, T., & Trembath, D. (2020b). *Aided enhanced milieu teaching to develop symbolic and social communication skills in children with autism*. Manuscript in preparation.

Logan, K., Iacono, T., & Trembath, D. (2020c). *Acquisition of aided enhanced milieu teaching intervention strategies by caregivers of children with autism*. Manuscript in preparation.

PEER REVIEWED PRESENTATIONS

Logan, K., Iacono, T., & Trembath, D. (2018). Moving beyond object requesting with AAC: A communication intervention for children with autism spectrum disorder. *Paper presented at the International Society for Augmentative and Alternative Communication Conference*, July 24, Gold Coast, Australia

Logan, K., Iacono, T., & Trembath, D. (2017). Aided enhanced milieu teaching to develop use of communication functions in children on the autism spectrum who are minimally verbal. *Paper presented at the Asia Pacific Autism Conference*, September 8, Sydney, Australia.

Logan, K., Iacono, T., & Trembath, D. (2017). Aided enhanced milieu teaching to develop use of communication functions in children on the autism spectrum who are minimally verbal. *Paper presented at the Australian Group on Severe Communication Impairment 12th Biennial Conference*, May 20, Melbourne, Australia.

Logan, K., Iacono, T., & Trembath, D. (2015). Using Aided AAC to Develop a Range of Communication Functions in Children with ASD. *Paper presented at the Speech Pathology Australia National Conference 2015*, May 17-20, Canberra, Australia.

Logan, K., Iacono, T., & Trembath, D. (2015). Aided AAC for Children with ASD. *Paper presented at the Australian Group on Severe Communication Impairment 12th Biennial Conference*, May 13-16, Brisbane, Australia.

GRANTS AND SCHOLARSHIPS AWARDED DURING THESIS

Logan, K. (2013). La Trobe University Postgraduate Research Scholarship, $24653 per annum

Logan, K. (2015). La Trobe Rural Health School HDR Funding Support, $1435.20

Logan, K. (2016). La Trobe Rural Health School HDR Funding Support, $1064.35

Logan, K. (2019). La Trobe Rural Health School HDR Funding Support, $702.80

ACKNOWLEDGEMENTS

There are so many people who have supported me on this PhD journey over the past seven years. First and foremost, I am incredibly grateful to my supervisors, Professor Teresa Iacono and Associate Professor David Trembath. You have each been such a source of support, professional growth, knowledge, and inspiration. I feel most privileged to have had you as my supervisors and to have witnessed your skill and passion in your various roles. Thank you for being so available, endlessly patient, and so calm in response to my many moments of mild (or great) panic.

A special thank you goes to those who are closest to me. Kylie, thank you for making sure I eat, sleep, and exercise, and for being generally so kind and generous over the past few years. Thank you also to my fur 'kids', Dotty and Bones, who made sure that if I ever seemed to be spending too long at a computer screen, a paw would fall across my keyboard, a toy in my lap, or a cute puppy chin would find itself resting on my monitor. I must also extend gratitude to my parents, for instilling in me a love of reading and curiosity, and not making me play outside when all I wanted to do as a child was read - the ability (and preference) to stay indoors for long periods served me well over these years!

Thank you to my employers during the PhD, who were so gracious in providing flexible options while I combined work with study, as well as my colleagues, who patiently listened to my passionate talks about various aspects of my research over the years.

Thank you to Dr Suzanne Stevens, who was particularly helpful in making herself available for data reliability checks.

Finally, I am enormously indebted to the families who expressed interest in, and who later participated in my studies. You so graciously welcomed me into your homes and have each taught me so much about autism. It was a pleasure to be involved in your lives even for just a short while.

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Preface

Overview of Thesis

This thesis is organised into seven chapters. Three chapters are in a traditional format, one is a published journal article, and three are manuscripts in preparation for submission.

Chapter 1. This chapter comprises the statement of the problem. In this chapter, the characteristics of autism spectrum disorder (ASD) are explored, with the need for augmentative and alternative communication (AAC) interventions that support development of social communication skills highlighted.

Chapter 2. This chapter comprises the publication of systematic review of studies into the use of aided AAC interventions to develop social communication functions in children with ASD.

Chapter 3. In this chapter, the manuscript for the second systematic review is presented. The review was of instructional approaches followed to develop communication functions in children with ASD, with a focus on type, structure, effect size, reinforcement, and required dosage.

Chapter 4. This chapter contains an introduction to social validity as relevant to AAC interventions. The results of the systematic review in Chapter Two are used to examine existing social validity tools. Subsequently, a new social validity survey tool is created, with input from researchers, to include specific components of social validity recommended in evaluation of AAC interventions

Chapter 5. This chapter comprises the first intervention study. In this study, AEMT is introduced as a naturalistic intervention to develop symbolic communication and range of functions expressed in children with ASD. The study addresses the effectiveness of AEMT in three children with ASD who are minimally verbal.

Chapter 6. In this chapter, the second intervention study is presented, in which the effectiveness of parents learning to use and mediate AEMT across three parent-child dyads is evaluated. Child outcomes include change in symbolic communication in response to parental use of AEMT strategies.

Chapter 7. In this chapter, a general discussion is provided, with areas for further research highlighted and clinical implications addressed.

Repetition

Given the *with publication* nature of this thesis, it is inevitable that some repetition of content will occur. However, the purpose of each chapter has been described in order to provide a coherent structure and logical purpose for all included information.

Terminology

The focus of this thesis is on children with autism spectrum disorder (ASD) who use augmentative and alternative communication (AAC) systems and are minimally verbal. The following definitions were applied.

Autism spectrum disorder (ASD). ASD is a neurodevelopmental disorder characterised by impairments in social-communication and interaction across contexts, as well as restricted and repetitive interactions, activities or behaviours (American Psychiatric Association, 2013). Children described in the current research context were diagnosed with ASD according to the Diagnostic and Statistical Manual of Mental Disorders criteria (DSM-IV, DSM-IV-TR, or DSM-5; American Psychiatric Association, 1994; 2000; 2013). Various language has been used in in the field of ASD: in research, clinical practice, and in the community. Person-first language (e.g., children with ASD) has been adopted in this thesis, in line with convention in research (American Psychological Association, 2010) and clinical practice (e.g., Crocker &

Smith, 2019), but the preference for identity-first language amongst some autistic individuals and members of the autism community is respectfully acknowledged.

Augmentative and alternative communication (AAC). AAC systems are used as a supplemental or primary means of communication for individuals unable to express and/or understand communication through the spoken modality effectively (Mirenda, 2001). AAC encompasses both unaided systems, comprising manual signs and gesture, and aided systems, involving aids external to the body, such as picture boards, books, and speech-generating devices (Mirenda, 2003).

Minimally verbal. Tager-Flusberg and Kasari (2013) introduced the term in relation to children with ASD who demonstrate little or no functional speech. According to their operational definition, children or adults who are minimally verbal use no or very few words and/or phrases, predominantly use echolalia with little if any generative language, and/or apply their verbal repertoire in limited situations.

Chapter 1: Statement of the Problem

Overview

In this chapter, the use of aided AAC with children with ASD who are minimally verbal is introduced. A brief overview of the research literature is presented, with a rationale provided for the need for further research into how aided AAC can be applied in a way that increases use of a range of communication functions. In addition, the intervention approach that is the focus of the thesis is introduced.

Statement of the Problem

Autism Spectrum Disorder (ASD). ASD is a neurodevelopmental disorder characterised by impairments in social communication and interaction across contexts, as well as restricted and repetitive interactions, activities or behaviours (American Psychiatric Association, 2013). There has been a substantial increase in the number of individuals diagnosed with ASD in Australia (and globally) over the past 20 years, likely as a result of greater public and professional awareness (Leonard et al., 2010), changes in diagnostic criteria and reporting practices (Hansen, Schendel, & Parner, 2015), increased diagnoses of milder presentations (Whitehouse et al., 2017), and recognition of the co-existence of ASD with other conditions, such as intellectual disability (McDermott, Williams, Ridley, Glasson, & Wray, 2008). In Australia, it has been estimated that an ASD diagnosis costs a family A$34,900 per annum, with increases in symptoms resulting in increased annual costs (Horlin, Falkmer, Parsons, Albrecht, & Falkmer, 2015). Indeed, participants in Australia's National Disability Insurance Scheme have an average annualised support plan in excess of $30,000 (National Disability Insurance Agency, 2019). Lifetime societal costs have been estimated as falling within the range of US$1.4-$2.4 million (Buescher, Cidav, Knapp, & Mandell, 2014). Investigations into effective treatments for ASD have the potential to impact not only an individual's skills and participation, and hence, quality of life, but also ultimately to reduce societal costs (Koegel, Koegel, Ashbaugh, & Bradshaw, 2014).

Communication skills. Central to ASD is disordered social communication and interaction. According to the American Psychiatric Association (2013), individuals with ASD experience social communication difficulties in the following three areas:

1. Social-emotional reciprocity, resulting in difficulties with initiating communication, as well as interpreting, and responding to the thoughts, feelings, and expressions of others.
2. Nonverbal communicative behaviours, resulting in difficulties perceiving and using eye contact, body language, facial expressions, and gesture.
3. Relationships, whereby they have difficulty understanding how to adapt their own behaviour to form and maintain relationships in varying social contexts, or have limited interest in others.

Although ASD can occur with or without a language impairment (American Psychiatric Association, 2013), many individuals with ASD have significant communication difficulties. According to the Australian Survey of Disability, Ageing, and Carers, 51.2% of people with ASD were reported to experience profound or severe communication restrictions, affecting receptive and expressive communication (Australian Bureau of Statistics, 2017). There is evidence that a significant minority of individuals with ASD do not attain functional speech (Norrelgen et al., 2015; Rose, Trembath, Keen, & Paynter, 2016). In addition, people with ASD with the most severe communication difficulties have been found to be at risk of a poor long-term prognosis with respect to global functioning (Billstedt, Gillberg, & Gillberg, 2005; Howlin, Savage, Moss, Tempier, & Rutter, 2014).

Irrespective of language abilities, weaknesses in social communication skills occur universally in children with ASD (Rutter, 1978; Tager-Flusberg, 1981; Tager-Flusberg, Joseph, & Folstein, 2001). Research has shown that the impairments in social communication that occur in ASD are evident very early in development. For example, in comparison to those who are typically developing, infants later diagnosed with ASD have demonstrated reduced spontaneous orienting to social stimuli, such as responding to their own name or to the social attentions of others (Dawson et al., 2004). There is evidence that infants who go on to be diagnosed with ASD are less likely to initiate interactions or respond to the communication of others than are infants following typical development (Zwaigenbaum et al., 2005). Likewise, research has shown less responsivity to the social cues that indicate another person's object of attention, such as following the direction of the person's eye gaze, head turn, or pointing gesture (Sullivan et al., 2007). Macdonald et al. (2006) found that infants with ASD show reduced use of communication to direct another person's attention for sharing an experience, compared to age-matched peers.

Bruner (1975) argued that although language, as it develops, serves as the vehicle by which to control and facilitate emergent joint attention skills, typically developing infants will use extant skills to express communication intentions. Nonverbal behaviours, such as pointing or showing, for example, are used to direct and influence the attention of others: that is, to indicate meaning (Bates, Camaioni, & Volterra, 1975). Given that children with ASD demonstrate early impairments in responding to and initiating joint attention, it follows that they do not learn to communication intentionally (in both verbal and nonverbal modalities) in the same way as do their typically developing peers. A reduced range of communicative functions (i.e., for different purposes) has been found to be a core social-communication impairment associated with ASD. Research has shown that, in comparison with children following typical development, children with ASD communicate less (Shumway &

Wetherby, 2009; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby, Watt, Morgan, & Shumway, 2007) and for a reduced range of purposes (Shumway & Wetherby, 2009; Wetherby, Prizant, & Hutchinson, 1998; Wetherby, 1986; Wetherby & Prutting, 1984). Communication for social purposes has been found to be particularly difficult for children with ASD (Camaioni, Perucchini, Muratori, Parrini & Cesari, 2003). Conversely, children with ASD have shown relatively strong skills in using communication to regulate the behaviour of others (e.g., request objects) (Shumway & Wetherby, 2009).

Accounting for social communication difficulties. Several explanations have been proposed to account for the social communication difficulties associated with ASD. These explanations align with theories based on behavioural, cognitive, and/or developmental social-pragmatic models. Behavioural (learning) theories place emphasis on the environmental conditions that support the development of communication, and include a focus on the role of reinforcers on language development (Skinner, 1957). However, Bruner (1981) argued that behavioural theories of language acquisition do not account for the generative nature of language, or how language learners choose what to imitate and for which purposes. Cognitive theories, in which roles of theory of mind and executive function on social communication have been emphasised (e.g., Leslie, 1987; McEvoy, Rogers, & Pennington, 1993), have been argued to provide more complete accounts regarding the impact of joint attention impairments on later social communication difficulties (Charman et al., 2000). Nonetheless, cognitive theories have received criticism for difficulty explaining why infants with ASD show impaired social communication that precedes even the earliest proposed emerging precursors to theory of mind (Klin, Volkmar, & Sparrow, 1992) or demonstrate relatively intact communication for instrumental purposes in the presence of delays in other functions (Mundy & Stella, 2000). In contrast, developmental social-pragmatic theories have been proposed as best explaining the patterns of communication development in ASD (Mundy & Stella, 2000). These theories have been used to explain the mechanisms of joint attention and subsequent language development, which had not been evident in earlier cognitive or learning theories of language development (Carpenter & Tomasello, 2000).

According to developmental social-pragmatic theories, language development occurs in the context of a child's entry into a structured social environment: from birth, children engage in interactions in this social world in which they gradually learn to understand and interpret the actions of those around them (Carpenter & Tomasello, 2000). Within this model, language acquisition (i.e., understanding of symbols) is proposed to occur though exposure to and participation in shared social routines, which are largely common across cultures, and through this process children develop understanding that others have intentions (Bruner, 1981; Tomasello, 1992). Carpenter and Tomasello (2000), for example, suggested that developments in early social behaviours, such as joint attention, emerge in accordance with a developing understanding that the attention and behaviours of others can be shared, are meaningful, and represent mutual interest. Support for this contention can be found in several studies that have demonstrated an association between language development and opportunities to establish and maintain shared joint attentional foci with caregivers (e.g., Markus, Mundy, Morales, Delgado, & Yale, 2000; Tomasello & Todd, 1983). This research, therefore, aligns with transactional theory, in which the bidirectional, dynamic interactions between the child and their social environment are purported to influence chid development (Sameroff, 1975, 2009).

In children with ASD, early social processes, such as social orienting (e.g., attention to faces, response to socially relevant sounds), referential looking, social seeking and liking (e.g., joint attention through protodeclarative pointing, enjoyment of social praise) and social maintaining (e.g., appropriate turn taking responses) have been found to be impaired in relation to children with typical development (Barbaro & Dissanayake, 2009; Baron-Cohen, Baldwin, & Crowson, 1997; Charman, et al., 1997; Yirmiya & Charman, 2010). These impairments in social processing have been thought to have a compounding and combining effect by reducing the frequency of social experiences (i.e., fewer initiations of, responses to, or participation in the social transactions needed for language development, as per transactional theory), thereby leading to deficits in social communication skills (Chevallier, Kohls, Troiani, Brodkin & Schultz, 2012).

Thus, from infancy, there is evidence that children with ASD have differing responses to social stimuli, which change how they interact within their environment and limit social learning opportunities (Jones, Gliga, Bedford, Charman, & Johnson, 2014). A consequence, as well as manifestation of, these impairments in social communication development is reduced range and frequency of communication functions for social interaction and joint attention purposes in comparison with children following typical developmental patterns (Shumway & Wetherby, 2009).

Compensating for communication deficits through augmentative and alternative communication (AAC). Although the majority of children with ASD will learn to use spoken language to communicate, research indicates that up to 25-30% will remain *minimally verbal* (Anderson et al., 2007; Norrelgen et al., 2015; Rose et al., 2016). Children with ASD who have no spoken language, use an extremely limited range of words/phrases and in narrow contexts, or predominantly use echolalia (immediate or delayed repetition of the speech of others) are considered minimally verbal (Tager-Flusberg & Kasari, 2013).

The potential of children with ASD who are minimally verbal to learn to use alternative forms of communication was recognised in the 1970s. Early research included a focus on teaching children to use symbols for which they received food reinforcement (e.g., De Villiers & Naughton, 1974; McLean & McLean, 1974). Subsequently, over the past 50 years, AAC systems have increasingly been used with these children, as well as with others with impaired speech and/or language, as a supplemental or primary means of communication (Mirenda, 2001). There is growing empirical evidence to support the use of a range of AAC systems for individuals with ASD (e.g., Ganz, Earles-Vollrath et al., 2012; Iacono, Trembath, & Erickson, 2016; van der Meer & Rispoli, 2010; Wendt, 2009).

Rationale for aided AAC. AAC systems are classified according to whether they are aided, which involve use of equipment or materials (e.g., speech-generating devices, pictures on a communication board), or unaided, which do not require equipment but rather involve only the body (e.g., manual sign and gesture; Mirenda, 2003). For individuals with ASD, the AAC research focus has been on the use of aided rather than unaided systems (Ganz, 2015; Ganz, Earles-Vollrath et al., 2012; Iacono, et al., 2016; van der Meer & Rispoli, 2010; Wendt, 2009). Rationales have included that aided AAC (a) complements proposed relative strengths in visual rather than auditory processing (Quill, 1997); (b) requires little manual dexterity, addressing potential fine motor difficulties (Lloyd, MacDonald, & Lord, 2013); (c) adds permanency through providing a visual modality (such as through visual-graphic symbols) to accompanying transitory auditory input (i.e., speech, which people with ASD have been argued to have difficulty processing) (Mirenda & Schuler, 1988); and (d) benefits communication partners who can recognise or read written referents on graphic symbols (Mirenda, 2003).

Aided AAC intervention approaches. A variety of instructional approaches and strategies have been used with individuals with ASD that have been based on underlying theories of learning. Most have drawn on the principles of applied behavioural analysis (ABA), whereby behaviours are systematically taught through contingencies (Simpson, 2001). The Picture Exchange Communication System (PECS), for example, is a program approach in which behavioural strategies are used to teach children to initiate communicative acts using picture symbols to obtain an object within a social context (Bondy & Frost, 1994). Whilst PECS represents a manualised AAC intervention program, other approaches pair specific behavioural intervention strategies with AAC, such as prompting (e.g., Kagohara et al., 2012; Ostryn and Wolf, 2011), time delay (e.g., Sigafoos, Didden, & O'Reilly, 2003), and providing models of desired behaviours (e.g., Banda, Copple, Koul, Sancibrian & Bogschutz, 2010; Smith, Hand & Dowrick, 2014). Naturalistic interventions, such as naturalistic developmental behavioural interventions (Schreibman et al., 2015), pair established behavioural strategies to teach new skills and behaviours with learning experiences that are natural, developmental, and follow the child's lead (Prizant & Wetherby, 1998). These naturalistic approaches incorporate everyday experiences as the context for language learning, with the communication partner interacting in ways that support and facilitate communicative growth, using the child's interests as the basis for communicative exchanges, and facilitating, rather than directing communication (Prizant, Wetherby, & Rydell, 2000). Naturalistic approaches accommodate a large body of research indicating that children's learning is best facilitated in meaningful, developmentally appropriate contexts within which they are active participants (Schreibman, et al., 2015). Naturalistic interventions that have been used with AAC include milieu teaching (e.g., Nunes & Hanline, 2007; Ogletree, Davis, Hambrecht & Phillips, 2012; Olive et al., 2007) and aided language stimulation (e.g., Drager et al., 2006). They have been used to implement AAC instruction within the context of everyday routines and with the child's usual communication partners, including caregivers and peers (Adamson, Romski, & Barton-Hulsey, 2014).

Research Gaps

Efficacy of AAC interventions in developing social communication functions.

Initial AAC instruction for children with ASD was to teach use of symbols according to their meaning and form, rather than function (Kiernan, 1983). However, as theories of language development evolved, with the emergence of speech act theory and studies of developmental pragmatics in particular, the importance of context (i.e., language function) in expressing meaning was highlighted (Bates et al., 1975). For children with ASD, who experience difficulty expressing a range of (particularly social) functions (Wetherby & Prutting, 1984), instruction that includes development of declarative functions is arguably critical. Competence in use of a range of communication functions equips AAC users with the ability to express and refine meaning, and have successful, appropriate, and varied interactions with others (Light, 1989).

Extant research evidence indicates that introducing an AAC system to children with ASD can provide them with a successful alternative mode of communication, allowing them, for instance, to make choices and ask for objects (e.g., Chezan, Drasgow, Legg, & Hollborn, 2016; Son, Sigafoos, O'Reilly, & Lancioni, 2006). A relatively large evidence-base provides support for AAC interventions targeting communicative functions for behavioural regulation, whereby children have been taught to use AAC to increase their attempts to regulate the behaviour of another person in the form of requesting needs and wants (e.g., Ganz & Simpson, 2004; Sigafoos et al., 2013; van der Meer et al., 2013; van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012). Systematic reviews have provided synthesis of strong empirical evidence for the overall success of these interventions for children with ASD (e.g., Ganz, Davis, et al., 2012; Iacono et al., 2016; Lorah, Parnell, Whitby, & Hantula, 2015; van der Meer & Rispoli, 2010; Wendt, 2009). As noted, these regulatory functions have long been identified as a strength for children with ASD (Shumway & Wetherby, 2009).

Despite the evidence of success of AAC interventions in teaching behavioural regulation functions, in order to comprehensively address the social-communication difficulties of children with autism, AAC interventions must also result in increases in the frequency and effectiveness of communication for social interaction and joint attention purposes. Teaching children with ASD to communicate a variety of functions could have more far reaching benefits in terms of accessing social and educational opportunities than may be accrued by focussing on object requests. The extent to which varied pragmatic functions that extend individuals with ASD to communicate beyond requesting needs and wants is unclear from previous systematic reviews. Wendt (2009), for example, reviewed the literature with respect to the application of graphic symbols and speech-generating devices in AAC for children with ASD, finding that the majority of studies focused on teaching requests. However, the specific type of request (e.g., relating to behavioural regulation or a social outcome) or details about other communication functions that were dependent variables in included studies were not extracted. Consequently, it is not possible to determine from this review how often and with what level of success other communicative functions had been taught through the use of AAC. The same omission has been evident in other research reviews, in which the evidence for the efficacy of teaching object requests has been demonstrated, but with insufficient information to allow conclusions regarding the success of interventions with a focus on a broader range of communication functions (e.g., Kagohara et al., 2013; Schlosser, Sigafoos, & Koul, 2009; van der Meer and Rispoli, 2010).

Social validation of therapeutic interventions. Another consideration in the efficacy of aided AAC systems is that of social validity: that is, the significance of therapeutic goals to society in terms of how they genuinely reflect what clients, caregivers, practitioners, educators and the community, more broadly, desire, and whether associated treatment processes are acceptable (Wolf, 1978). Considerations of social validation enable a better understanding of the perceived importance of the goals of intervention, the acceptability of intervention procedures, and the significance of associated effects (Kazdin, 1977; Wolf, 1978). It has been suggested that attending to social validity is crucial to ensuring interventions result in real-life functionality (Horner et al., 2005). Although social validity has been recognised as an important aspect of AAC interventions (e.g., Schlosser, 1999), it has been overlooked in evaluations of intervention outcomes for children with ASD in the research literature (Callahan, Henson, & Cowan, 2008). Social validity has been considered one quality indicator for single case experimental design studies (SCEDs) (Horner et al., 2005), but often has been either omitted from discussion (e.g., van der Meer & Rispoli, 2010) or assumed for any intervention targeting functional communication skills (e.g., Ganz, Earles-Vollrath et al., 2012).

Ensuring interventions are socially valid requires addressing different facets, which, according to Schlosser (1999) include (a) perspectives of stakeholders, including direct, indirect, and the immediate and extended community; (b) intervention goals, including general social goals, as well as the level of response considered adequate to represent changes in behaviour and behavioural responses; (c) methods, including equipment and procedures; (d) outcomes, including those that are directly related to and presumed to occur as a result of intervention, in addition to changes in quality of life of the person receiving intervention and to the lives of stakeholders; and (e) validation methods, involving subjective evaluations by stakeholders and social comparisons to typically developing peers. Horner et al. (2005) argued that social validity considerations for interventions used with individuals with ASD includes the extent to which (a) socially important dependent variables are targeted; (b) interventions can be conducted by typical communication partners in everyday environments in reasonable amounts of time; (c) there is selection of interventions that meet a defined need; and (d) there is evidence that typical intervention agents find materials and procedures acceptable, effective, feasible, and feel they can be implemented without formal supports.

Communication partners in aided AAC interventions. Schlosser and Lee (2000) argued that mechanisms to support generalisation must be embedded into the design of interventions, rather than assessed after treatment has occurred. In AAC research, individuals delivering intervention largely have been non-typical communication partners, for example, researchers and therapists (Granlund, Bjorck-Akesson, Wilder, & Ylven, 2008; Light & McNaughton, 2015). Schlosser and Lee (2000) observed that AAC research most often followed a "train and hope" (p. 208) approach to behaviour generalisation: that is, if typical communication partners are not involved in delivering intervention, researchers are then merely hoping that children will be able to use their new skills with familiar people. Involvement of typical communication partners, such as parents, is critical to fostering generalisation of AAC use (Ganz, 2015). There is a growing evidence base for the efficacy of parent-delivered AAC interventions in the ASD literature (e.g., Nunes & Hanline, 2007; Olive, Lang, & Davis, 2008; Park, Alber-Morgan, & Cannella-Malone, 2011), with further evidence for parent training in ASD interventions more broadly (Althoff, Dammann, Hope, & Ausderau, 2019; National Autism Centre, 2015; Nevill, Lecavalier, & Stratis, 2018). It has also been argued that intervention should occur in typical settings, because children with ASD can have difficulty transferring skills across settings (Camargo et al., 2014). It is becoming increasingly evident that interventions provided in typical settings, such as homes, can produce effective outcomes (Ganz, Rispoli, Mason, & Hong, 2012). Nonetheless, there remains a need for more AAC intervention studies that incorporate typical communication partners and settings in the delivery of interventions.

Effectiveness of naturalistic interventions in developing social communication skills. In naturalistic interventions, everyday activities and routines are used to create communication opportunities (Koegel, O'Dell, & Koegel, 1987). Naturalistic approaches within language interventions are underpinned by the transactional theory of language development; it has been argued that if children with communication difficulties can be supported to transition into use of intentional communication, then changes may occur in caregiver-child interactions, which then facilitate further language growth (Hancock &

Kaiser, 2006). As children use more communication with caregivers, caregivers in turn interpret, repeat and expand the child's utterances, leading to models of communication and further opportunities for communication growth (Warren et al., 2008).

Enhanced milieu teaching (EMT), a variation of milieu teaching, combines environmental arrangement, responsive interaction techniques, and milieu teaching to develop communication skills (Kaiser, Hancock, & Nietfeld, 2000). EMT, an example of a naturalistic developmental behavioural intervention, marries established behavioural learning principles with motivating, natural communication contexts and environments (Fey, Warren, Fairchild, Sokol, & Yoder, 2006). EMT language interventions involve several features: use of the child's communication interests, naturally occurring communication contexts, language prompting, natural consequences for communication, and embedded teaching in everyday interactions (Kaiser, Yoder, & Keetz, 1992). EMT is arguably well suited to the social-communication needs of children with ASD. For example, it is based on behavioural learning techniques that have had demonstrable efficacy with children with ASD (National Autism Centre, 2015), and intervention occurs in naturalistic contexts, thereby addressing a criticism of more traditional behavioural interventions that occur in contrived contexts (Camargo et al., 2014; Prizant & Wetherby, 1998).

There have been a number of investigations into the use of milieu communication teaching with children with ASD, but few that have combined this intervention with aided AAC. In studies in which variations of milieu communication teaching have been used, it has been reported that children with ASD have successfully increased targeted language use (Hancock& Kaiser, 2002), increased their rates of intentional communication (McCathren, 2010), and produced more complex and diverse language (Kaiser et al., 2000). In studies in which aided AAC has been combined with milieu teaching and its variants, communication outcomes have included increases in object requesting (e.g., Ogletree, et al., 2012; Olive et al, 2007), parent responsivity (Stiebel, 1999), and use of varied communication functions (Schepis, Reid, Behrmann, & Sutton, 1998).

In light of previous research that has demonstrated the effectiveness of both AAC and EMT, it could be predicted that, by combining these approaches, fruitful opportunities would be afforded to teach symbolic communication to children with ASD who lack functional spoken communication. In particular, given the naturalistic design of EMT and the preliminary research indicating that it can be used to teach a range of communication functions, combining EMT with AAC would potentially provide a communication system and intervention that could be used to develop functions that present the most difficulty for children with ASD (i.e., those other than object requests).

Aims

The overall objective of the thesis was to address the clinical need for an AAC intervention that could be used to teach children with ASD to use symbolic communication for varied communication functions.

Specifically, there were four aims of the thesis:

1. to critically review and synthesise the literature on developing social communication functions in children with ASD who use aided AAC to determine characteristics of effective interventions,
2. to apply identified characteristics of effective interventions (drawing on naturalistic interventions) with aided AAC to develop an intervention to improve use of symbolic and social communication functions in children with ASD who are minimally verbal,
3. to investigate the efficacy of this intervention when delivered by the researcher and parents, and
4. to determine the social validity of the intervention.

Research Questions

The following research questions were addressed:

1. Are aided AAC interventions effective in increasing varied communication functions produced by children with ASD? (Chapter 2)
2. To what extent have aided AAC interventions been evaluated beyond immediate effectiveness to address outcomes in terms of maintenance, generalisation, and social validity? (Chapter 2, 4)
3. Is there evidence of varied outcomes according to strategies implemented in teaching children with ASD using AAC? (Chapter 3)
4. Does practitioner-delivered aided enhanced milieu teaching (AEMT) increase use of symbolic communication for a variety of functions in children with ASD, and are effects (a) maintained, (b) generalised to another person, and (c) considered socially valid by caregivers? (Chapter 5)
5. Does parent training increase their implementation of the AEMT strategies of environmental arrangement and provision of models and prompts, and is parent implementation of AEMT strategies associated with increased symbolic communication of children with ASD? (Chapter 6)

Chapter 2: Systematic Review of the Literature

Overview

Chapter 2 contains the first publication arising from the thesis. A systematic review into the use of aided augmentative and alternative communication to develop communication functions in children with autism spectrum disorder beyond object requests was conducted.

Acknowledgement

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Publication

Logan, K., Iacono, T., & Trembath, D. (2017). A systematic review of research into aided AAC to increase social-communication functions in children with autism spectrum disorder. *Augmentative and Alternative Communication, 33*, 51-64. doi:10.1080/07434618.2016.1267795

Statement of Contribution

As co-authors of the following paper titled "A systematic review of research into aided AAC to increase social-communication functions in children with autism spectrum disorder," we confirm that Kristy Logan has made the following contribution: The systematic review was designed by the candidate in collaboration with her primary supervisor Professor Teresa Iacono and associate supervisor Associate Professor David Trembath. The candidate was solely responsible for data collection and analysis. Inter-rater agreement and reliability were completed by Professor Teresa Iacono and Associate Professor David Trembath. Kristy

Logan was responsible for writing the complete first draft of the manuscript, while Professor Teresa Iacono and Associate Professor David Trembath provided critical feedback of each draft prior to journal submission.

Signed: ____________________ Date: 03/11/2020

Professor Teresa Iacono

Signed: ____________________ Date: 03/11/2020

Associate Professor David Trembath

AUGMENTATIVE AND ALTERNATIVE COMMUNICATION, 2017
VOL. 33, NO. 1, 51–64
http://dx.doi.org/10.1080/07434618.2016.1267795

RESEARCH ARTICLE

A systematic review of research into aided AAC to increase social-communication functions in children with autism spectrum disorder

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ABSTRACT
Augmentative and alternative communication (AAC) interventions have been shown to be effective in supporting children with autism spectrum disorder (ASD) to communicate, particularly to request preferred items and activities. The aim of this systematic review was to examine the effectiveness of AAC interventions in supporting children to produce a broader range of communicative functions and determine the extent to which these interventions have been evaluated beyond immediate effectiveness to address maintenance, generalization, and social validity. A systematic search and application of inclusion criteria yielded 30 interventions that focused on communication functions beyond object requests. In many of the studies, flaws detracted from the certainty of evidence, and maintenance, generalization, and/or social validity were not addressed. Further research is needed to evaluate the extent to which AAC interventions can support children with ASD to communicate using a variety of communication functions, as well as to demonstrate sustained, transferable, and meaningful change.

ARTICLE HISTORY
Received 25 May 2016
Revised 4 November 2016
Accepted 28 November 2016

KEYWORDS
Augmentative and alternative communication; autism spectrum disorder; systematic review; communication functions; social validity

Introduction

Up to 25% of children with autism spectrum disorder (ASD) do not develop functional speech (Eigsti, de Marchena, Schuh, & Kelley, 2011; Rose, Trembath, Keen, & Paynter, 2016). These children have been referred to as being minimally verbal because they have little spoken language, use few words and/or phrases, predominantly use echolalia, and/or apply their verbal repertoire in limited situations (Tager-Flusberg & Kasari, 2013). Many rely on augmentative and alternative (AAC) communication systems and there is growing empirical support for this approach to intervention (Ganz, Davis, Lund, Goodwyn, & Simpson, 2012; Ganz, Earles-Vollrath, et al., 2012; van der Meer & Rispoli, 2010; Wendt, 2009). Despite a number of reviews on the use of AAC with children with ASD, the extent to which core social-communication impairments have been addressed through teaching functions beyond object requests, and whether AAC interventions result in sustained, transferable, and meaningful change remains unclear (Iacono, Trembath, & Erickson, 2016).

AAC interventions

For individuals with ASD, the AAC research focus has been on the use of aided rather than unaided systems. Rationales have included that aided AAC (a) complements relative strengths in visual rather than auditory processing (Quill, 1997), (b) requires little manual dexterity and so can accommodate potential fine motor difficulties (Lloyd, MacDonald, & Lord, 2013), and (c) benefits communication partners who can recognize or read written referents on graphic symbols (Mirenda, 2003). Ganz, Earles-Vollrath, et al. (2012), following a meta-analysis of single-case experimental design studies (SCEDs), reported strong effects for AAC interventions in improving communication for children with ASD. Variability in outcomes according to type of aid was found, but interventions incorporating speech-generating devices (SGDs) and the Picture Exchange Communication System (PECS) demonstrated the strongest effects. Ganz et al. noted the need for further research into the relative effects of different types of AAC systems and instructional approaches, as well as other child and intervention related factors that may account for differences in outcomes.

Instructional procedures used within the AAC/ASD literature vary, but generally draw on the principles of applied behavior analysis (ABA). Examples of the application of ABA in AAC interventions include PECS (e.g., Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Travis & Geiger, 2010) and functional communication training (e.g., Keen, Sigafoos, & Woodyatt, 2001; Olive, Lang, & Davis, 2008). In some cases, ABA techniques (e.g., discrete-trial training) have been used to teach specific communicative behaviors using AAC modalities (e.g., Kagohara et al., 2012; Marckel, Neef, & Ferreri, 2006; Nigam, Schlosser, & Lloyd, 2006). Regardless of the approach, there has long been recognition of the importance of implementing interventions in naturalistic contexts with

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Supplemental data for this article can be accessed here.

typical communication partners. Interventions should incorporate incidental communication opportunities within a child's preferred activities, follow a child's lead, and respond to a child's spontaneous communication (Prizant, Wetherby, & Rydell, 2000). Indeed, the incorporation of naturalistic intervention components may be critical to addressing core social-communication difficulties and, therefore, enabling children with ASD to engage in spontaneous and flexible communication required across varied everyday social interactions (Prizant & Wetherby, 1998).

Social-communication challenges associated with ASD

Impairments in social-communication skills in children with ASD may manifest in a limited range of communication functions, such as reduced use of communication acts to share interests and emotions and problems with appropriately initiating and responding to communication with others (American Psychiatric Association, 2013). To this end, Wetherby and colleagues noted that children with ASD demonstrate a predominant use of communicative acts for behavioral regulation (e.g., requests for objects and actions, and protests), with more limited use of those required for social interaction (e.g., requests for social routines and permission, showing off, greetings, calling, and acknowledgements) or signalling joint attention (e.g., comments, requests for information, and clarifications) (Wetherby, 1986; Wetherby & Prutting, 1984). Subsequent studies have replicated this finding (e.g., Shumway & Wetherby, 2009; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997). This pattern contrasts to that seen in children following typical development, whereby a range of communication functions develops concurrently even before speech (Wetherby, 1986).

There is a relatively large evidence-base for AAC interventions targeting communicative acts for behavioral regulation, whereby children have been taught to use AAC to increase their attempts to regulate the behavior of another person, in the form of requesting needs and wants (e.g., Ganz & Simpson, 2004; van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012; Sigafoos et al., 2013; Tincani, Crozier, & Alazetta, 2006; van der Meer et al., 2013). Systematic reviews have provided strong empirical evidence for the overall success of these interventions for children with ASD (e.g., Ganz, Davis, et al., 2012; van der Meer & Rispoli, 2010; Wendt, 2009). However, in order to comprehensively address the social-communication difficulties of children with autism, AAC interventions must result in increases in the frequency and effectiveness of communication for social interaction and joint attention purposes. Teaching children with ASD to communicate a variety of functions could have more far reaching benefits in terms of accessing social and educational opportunities than may be accrued by focussing on object requests.

The extent to which varied communication functions that extend beyond requesting needs and wants have been taught to individuals with ASD is unclear from previous systematic reviews. Wendt (2009), for example, systematically reviewed the literature with respect to the application of graphic symbols and SGDs in AAC for children with ASD, noting that the majority of studies focused on teaching requests. However, the specific type of request (e.g., relating to behavioral regulation or a social outcome) or details about other communication functions that were dependent variables in included studies were not extracted. Consequently, it was not possible to determine how often or with what level of success other communicative functions have been taught through use of AAC. The same challenge has been evident in other research reviews, in which the evidence for the efficacy of teaching object requests has been demonstrated, but information has been insufficient to draw conclusions regarding the success of interventions that focus on a broader range of communication functions (e.g., Kagohara et al., 2013; Schlosser, Sigafoos, & Koul, 2009; van der Meer & Rispoli, 2010).

Achieving meaningful and sustained outcomes

Concerns about a potentially narrow focus in AAC intervention on the communication function of requesting objects are also related to whether outcomes result in meaningful changes for children with ASD, such as supporting communication for social interaction, environmental influence, and societal participation (Light & McNaughton, 2014). Hence, important to considering the efficacy of aided AAC systems is social validity, that is, the significance of therapeutic goals to the individual and society in terms of how they genuinely reflect what clients, caregivers, interventionists, educators and the community more broadly desire, and also whether associated treatment processes are acceptable (Wolf, 1978).

Considerations of social validity enable interventionists to better understand the perceived importance of the goals of intervention, the acceptability of intervention procedures, and the significance of associated effects (Kazdin, 1977; Wolf, 1978). Horner et al. (2005) emphasized the importance of including measures of social validity to ensure interventions result in real-life functionality. Although recognized as an important aspect of AAC interventions (e.g., Schlosser, 1999), social validity largely has been overlooked in evaluations of AAC outcomes. Further, although social validity has been considered one quality indicator of SCED studies (Horner et al., 2005), it often either has not been included as a measure for evaluation in systematic reviews (e.g., van der Meer & Rispoli, 2010) or there appears to be an implicit assumption that any intervention targeting functional communication skills would be socially valid (e.g., Ganz, Earles-Vollrath, et al., 2012).

Magnitude of change in target skills is clearly important when evaluating intervention outcomes. Systematic reviews, especially those with meta-analyses, typically include measures of treatment effect sizes (e.g., Flippin, Reszka, & Watson, 2010; Ganz, Earles-Vollrath, et al., 2012). Such indices, however, do not address whether change is sustained over time, new skills are demonstrated across everyday situations with typical communication partners, or the interventions and outcomes are meaningful for the child and significant others. Consequently, Odom and Strain (2002) argued the importance of including measures of maintenance, generalization, and social validity when evaluating a study's quality. Although the size of change may have relevance to how meaningful such change will be, Odom et al. (2003) proposed that the outcomes of an intervention are more likely to be believable (i.e., adopted by the community for which it was designed) if social validity, as well as maintenance and generalization have been addressed.

Aims

The aims of the systematic review reported here were to examine the extent to which communicative functions other than object requests have been targeted in AAC interventions for children with ASD, and determine whether outcomes have been evaluated in terms of maintenance, generalization, and the social validity of goals, procedures and outcomes. The following research questions were addressed: (a) Are aided AAC interventions effective in increasing varied communication functions produced by children with ASD? (b) To what extent have aided AAC interventions been evaluated beyond immediate effectiveness to address believability of interventions and outcomes in terms of maintenance, generalization, and social validity?

Method

Search and selection procedures

The following databases were searched: Education Resources Information Center (ERIC), Cumulative Index to Nursing and Allied Health (CINAHL), Web of Science, Linguistic and Language Behavior Abstracts (LLBA), and PsycInfo. Search terms were autis* OR ASD OR "autism spectrum disorder" OR "Asperger" OR "PDD-NOS" OR "pervasive developmental disorder" AND "aided AAC" OR "AAC" OR "augmentative communication" OR "alternative communication" OR SGD OR "speech generating device" OR PECS OR "picture exchange communication system" OR VOCA OR "voice output communication." Additionally, hand searches were completed for journals that frequently publish content on ASD and AAC (see Supplemental Appendix A – online only). Finally, the reference lists of included studies identified through database searches were checked for potential additional articles (Schlosser, 2007).

Only group and SCED intervention studies published in English from January 1994 (corresponding to DSM IV, American Psychiatric Association, 1994), to June 2015 were included. Other inclusion criteria were (a) at least one study participant was a child (less than 18 years) diagnosed with ASD, autistic disorder, Asperger's disorder, or pervasive developmental disorder – not otherwise specified, (b) aided AAC was included in intervention, (c) at least one dependent variable was use of aided AAC for expressive communication, (d) communication functions other than or in addition to object requests were targeted, and (e) in studies in which children with and without ASD were included, sufficient data were available to determine treatment effects for children with ASD.

The initial search yielded 913 articles, and a further 11 were included from ancestry and hand searches. In all, 85 articles were retrieved that met the five inclusion criteria, and these were appraised in detail for assessment of use of communication functions. Of these, 55 were excluded due to a focus solely on communication for object requests. Accordingly, 30 articles proceeded to data extraction (Figure 1).

Data extraction

Each study was summarized according to experimental design and control, participant number and characteristics (age, communication skills), intervention (i.e., settings and agent), independent variable (type of aided AAC and intervention approaches or strategies), dependent variables (expressive communication targets), communication functions assessed, level of evidence, and outcome believability. Only information relating to the participants with ASD and the use of aided AAC within each study was extracted and reported.

In order to characterize communication functions, the categories described by Wetherby, Cain, Yonclas, and Walker (1988) were used. These functions comprised those associated with (a) behavioral regulation (requests for objects or actions, and protests), (b) social interaction (requests for social routines or permission, showing off, greeting, calling, and acknowledgement), and (c) joint attention (comments, requests for information, and clarification). Functions were generally categorized according to the description provided by the authors. An exception was for studies implementing Phases 5 and 6 of PECS, in which descriptions of communication behaviors considered to be comments differed to the definition provided by Wetherby and colleagues (Wetherby et al., 1988), that is, an act used to direct another's attention to an entity or event (p. 244). Therefore, for the current review, comments that were described as functioning to answer a *wh* question (e.g., what do you see?) (e.g., Cummings, Carr, & LeBlanc, 2012) were categorized as acknowledgment, that is, functioning to acknowledge the preceding utterance of the communication partner. The category of mixed was used when multiple communication functions were addressed in an intervention (in addition to or beyond object requests), but each type was not differentiated in the study results (i.e., outcome according to communication function was not a dependent variable). In these instances, the apparent target functions were also listed according to the included vocabulary on systems or the author's description. The category of mixed was also assigned when the function was unclear from the author's description (e.g., sharing, giving directions, initiations), as for example in the studies by Harrell, Kamps, and Kravits (1997) and McMillan (2008).

The extent to which interventions were effective in increasing varied communication functions - as well as evidence for maintenance, generalization, and social validity – was evaluated in two ways. First, studies were appraised for the strength of evidence, as characterized in previous reviews (e.g., Millar, Light, & Schlosser, 2006), with a focus on internal validity. The level of evidence was categorized as conclusive (i.e., no or only minor design flaws indicating that

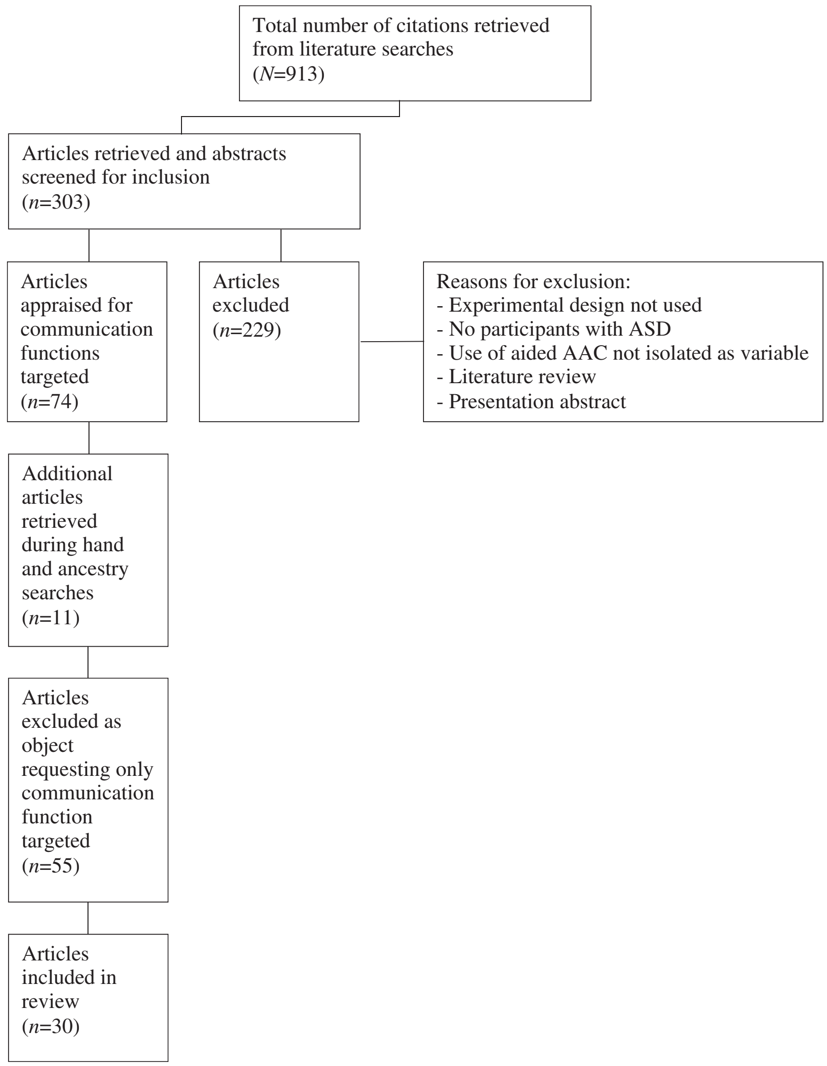

Figure 1. Study selection flow chart.

experimental control was demonstrated), preponderant (i.e., some minor design flaws, problems with inter-observer agreement and/or treatment integrity precluding an evaluation of conclusive, but the outcomes were likely to be the result of implementing the intervention), suggestive (i.e., a number of problems were evident in the design, inter-observer agreement and/or treatment integrity, but it is plausible that the outcomes were the result of the intervention), and inconclusive (i.e., there were significant design flaws).

Second, the criteria presented by Odom et al. (2003) were applied, which included measures of methodological rigor (e.g., intervention fidelity) as well as clinically relevant measures of outcome believability. Points were awarded for (a) demonstration of procedural fidelity, (b) reporting of data providing evidence of improvement over time, (c) inclusion of assessments of intervention maintenance and generalization, and (d) inclusion of measures of social validity of procedures and outcomes. A score of 11 (maximum) indicated that a study's outcomes met all criteria for being considered believable; lower scores indicated omission of aspects of outcome believability (see operational definitions and scoring in Supplemental Appendix B – online only).

Inter-rater agreement

The first author applied the inclusion/exclusion criteria to retrieved articles. The second and third authors independently applied these same criteria to 328 of the 913 articles (36%) from the initial search. Agreement was 96%. The first author then appraised the 85 articles meeting the five inclusion criteria, extracting information, determining the level of evidence, and calculating the outcome believability index for each. Of these, 21% ($n = 18$) (combined) were reviewed by the second or third author, resulting in item-item agreement with the first author of 90%. Disagreements were resolved through discussion and the first author then checked that the criteria were applied consistently across all studies. After this process of appraisal, only 30 articles were retained that included a focus on communication functions other than object requests. Inter-rater agreement regarding the level of evidence of these 30 articles was determined for 33% of SCED and 67% of Group studies, and found to be 88% and 100%, respectively. One disagreement in the case of SCED appraisal was resolved through discussion, and the first author again checked that the criteria were applied consistently across the remaining studies.

Results

Overview of included studies

Of the 30 studies included in the review, 24 were SCEDs and six were group studies. The summaries of SCED studies are presented in Table 1, inspection of which shows that the majority were of multiple baseline designs (MBD) ($n = 17$; 71%) and multiple probe designs (MPD) ($n = 4$; 17%). Combined MBD/MPD ($n = 2$; 8%) or alternating treatments design ($n = 1$; 4%) were also used, though infrequently. The summaries of group studies are presented in Table 2, inspection of which shows they comprised variations of randomized controlled trials (RCTs). Results from the same study were differentially analyzed across Gordon et al. (2011), and Howlin, Gordon, Pasco, Wade, and Charman (2007), and similarly across Yoder and Stone (2006), and Yoder and Lieberman (2010).

Aided AAC systems included those that were technology-based and incorporated visual-graphic symbols: (a) dedicated SGDs ($n = 5$; 21%), and (b) the iPad©/iPod© Touch[1] configured as SGDs ($n = 7$; 29%). Low-tech aids (e.g., boards or books) incorporating pictures ($n = 11$; 46%) and photos ($n = 3$; 13%) were also used. In some studies, more than one type of device was used. As presented in Tables 1 and 2, a diverse range of descriptions was used for the interventions, with naturalistic elements evident in many. For example, of the 30 studies, only 17% ($n = 5$) involved atypical settings (e.g., university clinics) as the primary intervention location, but atypical communication partners (e.g., researchers) frequently implemented the interventions (43%; $n = 13$). Intervention approaches are described in Tables 1 and 2. Descriptions were either according to the manualized PECS program (e.g., Charlop-Christy et al., 2002; Schreibman & Stahmer, 2014; Travis & Geiger, 2010), or according to author descriptions of the type of AAC used in combination with specific teaching strategies. For example, Schepis, Reid, Behrmann, and Sutton (1998) described the strategy used to teach the use of an SGD as "naturalistic teaching" (p. 567). These intervention descriptions varied in the level of detail provided (Tables 1 and 2). The extent to which interventions were situated in real-life settings also varied, with some studies occurring in segregated areas of a classroom, using adult-determined materials, and implemented by researchers (e.g., Lorah, Parnell, & Speight, 2014; Nigam et al., 2006).

In some studies, PECS was augmented by naturalistic strategies that were additional to those described in the manual, with the apparent aim of extending the functions targeted. Cannella-Malone, Fant, and Tullis (2010), for example, added peer training and prompting procedures to elicit communication functions not directly targeted in PECS, such as greetings. Kravits, Kamps, Kemmerer, and Potucek (2002) added social skills training with peers to typical PECS implementation with the aim of increasing children's range of social interaction behaviors.

[1]The iPad and iPod Touch are registered trademarks of Apple Inc., 1 Infinite Loop, Cupertino, CA, 95014, USA. www.apple.com

Level of evidence

Of the SCEDs, 12.5% ($n = 3$) were rated as suggestive, 75% ($n = 18$) were rated as preponderant, while 12.5% ($n = 3$) were rated as conclusive (see Table 1). Key reasons reducing certainty of evidence included failure to include adequate measures of treatment integrity (e.g., Charlop-Christy et al., 2002; Harrell et al., 1997; Xin & Leonard, 2005), lack of or inadequate inter-observer agreement (e.g., Kravits et al., 2002; McMillan, 2008; Trembath, Balandin, Togher, & Stancliffe, 2009), insufficient replications of treatment effect (e.g., Nunes & Hanline, 2007; Trottier, Kamp, & Mirenda, 2011), lack of blinding of all assessors (e.g., Drager et al., 2006; Olive et al., 2008), or insufficient data points within phases (e.g., Cannella-Malone et al., 2010; Marckel et al., 2006).

Of the group studies, one achieved a rating of conclusive (Kasari et al., 2014), four achieved a rating of preponderant evidence, while one (Gordon et al., 2011) demonstrated suggestive evidence. Features reducing certainty of evidence included lack of blinding of assessors (Gordon et al., 2011; Howlin et al., 2007; Schreibman & Stahmer, 2014; Yoder & Stone, 2006), differences between groups at baseline (though these were accounted for in analysis) (Gordon et al., 2011; Howlin et al., 2007; Yoder & Lieberman, 2010), and lack of or indeterminate inter-observer agreement (Gordon et al., 2011; Howlin et al., 2007; Yoder & Lieberman, 2010). Classification of the level of evidence for each study is presented in Table 2.

Outcome believability

These data are reported in Tables 1 and 2. Of the SCEDs, the outcome believability mean appraisal score was 5.17, with a range of 0.5–11. A number of studies lost points for failure to assess procedural integrity ($n = 7$; 29%). In terms of experimental control, although all studies were SCEDs, experimental control was not always demonstrated for communication functions other than requests for objects or for participants with ASD (the focus of this review).

Of the group studies, the mean outcome believability appraisal score was 4.33, with a range of 1.5–8. Several studies lost points for failing to include measures of treatment integrity (Gordon et al., 2011; Howlin et al., 2007), while in one study (Schreibman & Stahmer, 2014), credit was given for only partial fidelity of intervention, as a criterion of only 80% was applied by the researchers for the demonstration of treatment integrity (i.e., lower than that required for full demonstration when applying the criterion based on Odom et al., 2003) (see Supplemental Appendix B).

Effectiveness in increasing communication functions

Across the 30 articles, over two thirds included a focus on object requests ($n = 22$; 73%) in addition to other functions. Of additional functions, within the category of behavioral regulation (Wetherby et al., 1988), 10 studies (33%) targeted requests for action, while two (7%) included the function of protest. Of functions related to social interaction, intervention targets were requests for social routines ($n = 1$; 3%), greetings

Table 1. Summary of SCED studies on the effects of aided AAC on use of communication functions in children with ASD.

Study	Design	Participants	Intervention setting/ agents	AAC intervention strategies	Expressive communication dependent variable	Functions	LoE rating/ OB appraisal score
Harrell et al. (1997)	MPD nested within MBD	6–7 years, minimally verbal or used up to 2–4 word utterances ($n = 3$)	School/peers	Peer network social skills training with pictures	Time spent using AAC; frequency and duration of social interaction	Mixed (included greet, acknowledge, call, request object, request action, comment)	Prepond/5
Schepis et al. (1998)	MPD	3–5 years, minimally verbal ($n = 4$)	School/teaching staff	Naturalistic teaching with an SGD	Frequency of communicative interactions	Mixed (included request object request action, acknowledge, comment)	Prepond/4
Keen et al. (2001)	MPD	3–7 years, minimally verbal ($n = 4$)	Classroom/researcher	Functional communication training variation with photos	Frequency of use of communication function	Request object; request action; acknowledge	Prepond/2.5
Charlop-Christy et al. (2002)	MBD	3–12 years, minimally verbal ($n = 3$)	Clinic room, university, classroom, and home/ researcher	PECS with pictures	*N* trials to reach criterion in each phase; *N* minutes until criterion met	Request object; acknowledge	Prepond/5
Kravits et al. (2002)	MBD	6 years, minimally verbal ($n = 1$)	Home and school/ researcher, parent, and peer	PECS plus social skills training with pictures	Frequency of use of symbolic communication; length of interaction	Mixed (included request object, request action, comment)	Prepond/1
Drager et al. (2006)	MBD	4 years, minimally verbal ($n = 2$)	Daycare centre/ researcher and therapist	Aided language modelling with pictures	Frequency of correct use of visual-graphic symbols	Comment	Prepond/5
Marckel et al. (2006)	MBD	4–5 years, unspecified communication skills ($n = 2$)	Home/therapist	Improvisation training with pictures	Frequency of independent requests	Request action	Prepond/7
Nigam et al. (2006)	MPD	7–11 years, minimally verbal ($n = 2$)	Classroom/researcher	Matrix strategy and the mand-model procedure with pictures	Frequency of correct use of action-object visual-graphic symbol combinations	Comment	Prepond/4.5
Nunes and Hanline (2007)#	MBD	4 years, minimally verbal ($n = 1$)	Home/parent	Naturalistic intervention with pictures	Frequency of visual-graphic symbol use	Mixed (included request object, acknowledge)	Suggest/4
McMillan (2008)	MBD	8–12 years, minimally verbal or unintelligible speech ($n = 4$)	School/teacher	Multiphase teacher professional development package with an SGD	Frequency of use of SGD initiations and responses	Acknowledge; mixed (included request object)	Prepondt/5
Olive et al. (2008)	MPD	4 years, communication delay ($n = 1$)	Home/parent	Functional communication training with an SGD	Frequency of requests	Request action	Prepond/9
Trembath et al. (2009)	MBD	3–5 years, minimally verbal ($n = 3$)	Preschool/peers	Peer-mediated naturalistic teaching with an SGD	Frequency of communicative behaviors per minute	Mixed (included request object, request action, protest, acknowledge, comment)	Prepond/3
Cannella-Malone et al. (2010)	MBD	6–14 years, minimally verbal ($n = 2$)	Classroom, home/peers and researcher	PECS with peers with pictures	Frequency of communication acts	Greet; request object; acknowledge	Prepond/7.5
Travis and Geiger (2010)	MBD	9 years, minimally verbal ($n = 2$)	School/researcher and education staff	PECS with pictures	Frequency of requesting and commenting	Request object; comment	Prepond/7.5
Ostryn and Wolfe (2011)	MBD	3–5 years, minimally verbal ($n = 3$)	Preschool/researcher	Most to least prompting procedure with photos	Frequency of use of visual-graphic symbols	Request information	Conclu/11
Trottier et al. (2011)#	MB/MPD	11 years, minimally verbal ($n = 2$)	School/peers	Peer mediated instruction with an SGD	Communicative acts per minute	Mixed (included request object, request action, comment, call, request information)	Prepond/7

(*continued*)

Table 1. Continued

Study	Design	Participants	Intervention setting/agents	AAC intervention strategies	Expressive communication dependent variable	Functions	LoE rating/OB appraisal score
Cummings et al. (2012)	MBD	8–11 years, minimally verbal ($n = 3$)	School/researcher	PECS with pictures	Frequency and percentage of correct PECS exchanges	Request object; acknowledge	Conclu/3
Kagohara et al. (2012)#	MPD	13–17 years, minimally verbal ($n = 2$)	Classroom/researcher	Time delay, least to most prompting, and differential reinforcement intervention with an iPod and iPad	Correct responses with SGD	Acknowledge	Prepond/4.5
van der Meer et al. (2013)#	ATD	10–11 years, minimally verbal ($n = 2$)	Home and school/parent and researcher	Correspondence training and a least to most prompting hierarchy with photos, pictures, and an iPod	Frequency of communicative responses	Request object; greet; acknowledge	Sugg/5
Lorah et al. (2014)#	MBD	4–6 years, minimally verbal or up to 1–2 word phrases ($n = 2/3$ with ASD)	Therapy centre/researcher	5-s time delay, with full physical prompts with an iPad©	Percentage of independent acts	Comment	Prepond/3
Strasberger and Ferreri (2014)	MBD	5–13 years, minimally verbal ($n = 4$)	School/peers	Peer-assisted communication application training with an iPod©	Frequency of requests and responses	Request object; acknowledge	Prepond/10
Waddington et al. (2014)	MBD	7–10 years, minimally verbal ($n = 3$)	University/researcher	Systematic instruction using a least-to-most prompting sequence combined with time delay and error correction with an iPad	Use of 2–3 step communication sequence	Request object; acknowledge	Prepond/5
Xin and Leonard (2015)	MBD with AB phases	10 years, minimally verbal ($n = 3$)	School/teacher	Least to most prompting hierarchy with an iPad	Use of SGD to communicate specific function	Request object; acknowledge	Sugg/0.5
Lorah et al. (2015)	MBD	8–12 years, minimally verbal ($n = 2$)	Therapy centre/researcher	5-s time delay with full-physical prompts with an iPad	Frequency of independent responses with SGD	Acknowledge	Conclu/5

All participants met the criteria of having ASD unless otherwise indicated. Experimental designs included multiple probe designs (MPD), multiple baseline designs (MBD), and alternating treatment designs (ATD). Experimental control was defined as a design that allowed for ≥ 3 replications of experimental effect within or across participants for the specific variable of interest in the current study (social-communication functions). Five studies did not demonstrate experimental control for the variable of interest, indicated by # above. LoE = Level of evidence: suggestive (sugg.), preponderant (prepond.) or conclusive (conclu.) AAC interventions are described either according to author descriptions of the intervention or the manualized PECS program. LoE judgment considered inclusion of inter-observer agreement, data points, blinding of assessors, and replications of treatment effect. OB = Outcome believability (comprising treatment integrity, improvement over time, maintenance, generalization, social validity). Higher OB scores indicate higher outcome believability. Further information regarding ratings is available from the authors upon request.

($n = 3$; 10%), calling ($n = 2$; 7%), and acknowledgements, which usually involved answering *wh* questions ($n = 19$; 63%). Communication for joint attention (Wetherby et al., 1988) was taught in the form of comments ($n = 14$; 47%) and requests for information ($n = 2$; 7%). In eight studies (27%), complete details about all specific communication functions targeted could not be extracted, thus it is possible they included additional communication functions not specified.

In six of the SCEDs (25%), evidence was provided of at least partial improvement over time, and in 18 (75%) there was evidence of improvement in all participants over time. Notably, all targeted communication functions improved to some extent. In each of the group studies of PECS (Table 2), improvements were found consistently for teaching object requests, but inconsistently for other functions. PECS was found to be effective for increasing the frequency of comments, as categorized by the researchers (Schreibman & Stahmer, 2014) and initiation of joint attention for children who had demonstrated very few joint attention acts at the beginning of the study (Yoder & Stone, 2006). In contrast, Gordon et al. (2011) did not find evidence for significant changes in comments or requests for social purposes using PECS, while in the remaining two group studies, the specific impact of PECS on communication functions for social interaction and joint attention was not reported. Communication for requests, protests, and comments increased significantly following the JASPER intervention implemented by Kasari and colleagues (Kasari et al., 2014) (see Table 2).

Maintenance, generalization, and social validity

Maintenance

Assessment of intervention maintenance was included in 12 SCED studies (50%) (see Table 1). In all of these, at least partial maintenance was demonstrated (i.e., of some dependent variables or participants). In the group studies, four included assessment of intervention maintenance, but it was demonstrated in only two (see Table 2). Where maintenance did occur, it was demonstrated in performance on communication assessments (e.g., Schreibman & Stahmer, 2014), or varied according to communication behavior (e.g., demonstration of maintenance of production of comments over time versus attenuation of effects on other dependent variables; Kasari et al., 2014).

Generalization

Of the SCED studies, 12 (50%) included assessment of generalization, with all demonstrating it to some degree (see Supplemental Appendix B for definition). Generalization was addressed in only two group studies (33%). Schreibman and Stahmer (2014) included a generalization setting in their intervention, but did not report specific information about transfer of effects. In a follow-up to Yoder and Stone (2006), Yoder and Lieberman (2010) reported generalization for a far-treatment measurement context (i.e., with the use of a different examiner, setting, activity, and materials).

Table 2. Summary of group studies on the effects of aided AAC on use of communication functions in children with ASD.

Study	Design	Participants	Intervention setting/ agents	AAC/Intervention strategies	Expressive communication dependent variable	Functions	LoE rating/OB appraisal score
Yoder and Stone (2006)	Randomized trial	1.5–5 years, minimally verbal ($n = 36$) (19 in PECS treatment group)	University/researcher	PECS	Frequency of requests and joint attention initiation	Request object; request action; acknowledge; comment	Preponderant/5
Howlin et al. (2007)	Group RCT	4–11 years, minimally verbal ($n = 84$)	School/teaching staff	PECS	Frequency of communication initiations; use of AAC	Request object; request action acknowledge; comment	Preponderant/2
Yoder and Lieberman (2010)	Randomized trial	1.5–5 years, minimally verbal ($n = 36$) (19 in PECS treatment group)	University/researchers	PECS	Number of picture exchanges	Request object; acknowledge; comment	Preponderant/5
Gordon et al. (2011)	Group RCT	4–10 years, minimally verbal ($n = 84$)	Classroom/teaching staff	PECS	Frequency of child-initiated communication; communication using AAC; communication functions	Request object; request social routine; comment	Suggestive/1.5
Kasari et al. (2014)	Sequential multiple assignment randomized trial	5–8 years, minimally verbal ($n = 28$)	University/ therapist	JASP + EMT	Number of spontaneous communicative utterances; word roots; comments	Comment; mixed (including request object, protest)	Conclusive/4.5
Schreibman and Stahmer (2014)	Randomized clinical trial	$\bar{x} = 29.21$ months, minimally verbal ($n = 39$) (19 in PECS treatment group)	Home/researcher	PECS	PECS phase taught	Request object; acknowledge	Preponderant/8

All participants met the criteria of having ASD unless otherwise indicated. LoE = level of evidence (suggestive, preponderant, conclusive, or, inconclusive). LoE judgment considered inclusion of interobserver agreement, data points, blinding of assessors, and replications of treatment effect. OB = outcome believability (comprising treatment integrity, improvement over time, maintenance, generalization, social validity). Higher OB scores indicated higher outcome believability. Further information regarding ratings is available from the authors upon request.

Social validity

Of the SCED studies, six (25%) included assessment of social validity for procedures, and nine (38%) for outcomes (see Table 1). All demonstrated social validity at least partially for procedures and outcomes. Social validity was not assessed or included in five of the six group studies (83%). In contrast, Schreibman and Stahmer (2014) surveyed parental satisfaction, finding that although highly satisfied with the PECS intervention, parents of children who received the intervention rated it as significantly more difficult to implement than did parents of children who received Pivotal Response Training, an intervention that did not include aided AAC.

Discussion

The 30 articles that met inclusion criteria for the current systematic review collectively demonstrated emerging evidence that AAC interventions can be used to teach a variety of communication functions to children with ASD. The finding is consistent with previous reviews (e.g., Ganz et al., 2011; Wendt, 2009) that have focused on the use of AAC primarily to support communication to make object requests. Functions taught across studies in this review included other forms of requests, specifically requests for action, information, and social routines, as well as commenting and greeting. Despite variations in the interventions implemented across studies, all resulted in at least partial improvements in these different communication skills (i.e., according to the criteria applied). The importance of this finding lies in the demonstration that children with ASD can be taught communication functions more likely to lead to socially-focused outcomes, which are often difficult for them, in addition to object requests with tangible outcomes, which they readily learn (Wetherby, 1986).

Given this finding in light of the known lag in communication functions for social ends in children with ASD (e.g., Stone & Caro-Martinez, 1990; Wetherby, 1986; Wetherby, Yonclas, & Bryan, 1989), the persistent application of AAC interventions to teach object requesting suggests a great deal of redundancy across many of the studies reviewed. In fact, of the 30 articles in which diverse communication functions were targeted, most (73%) also directly included object requests as a dependent variable, or included measurement of object requests as part of the mix of communication functions addressed. This tendency to target object requests may simply reflect the early development of communication for behavioral regulation, and that this skill represents a strength for children with ASD (Wetherby et al., 1988). Hence, object requests could be considered a developmentally appropriate and strengths-based goal for children who are minimally verbal. On the other hand, communication for more social purposes, as evidenced by the emergence of joint attention and declarative pointing, also emerges early in life in children who are developing typically, but is a known area of deficit for children with ASD (Charman, 2003). There is potential for AAC to help address these early social-communication difficulties, yet the fact that these functions have been targeted in only relatively few studies means that clinicians, educators, and parents are left with a very limited evidence base on which to make decisions regarding the use of such interventions.

Although functions other than object requests were taught successfully in the studies reviewed here, little diversity was found in communication behaviors that were targeted. In particular, there was no evidence of directly targeting showing off, clarification, or requesting permission (although they could have been included in the mixed category). The most frequently targeted socially oriented functions taught through aided AAC included acknowledgements, and commenting. Wetherby (1986) suggested that communication functions develop sequentially in children with ASD, moving from non-interactive (including object requests) to interactive functions (including comments). Teaching even rudimentary skills in more social communicative functions in combination with non-interactive functions that relate to established strengths for children with ASD could be key to eventually increasing communication for purely social ends and consequences (Wetherby, 1986). Examples would be utilizing skills in requests, but directing these towards more socially oriented outcomes (e.g., requests for social games/routines), or responses (e.g., greetings, acknowledgement of *wh* questions). Encouragingly, these functions are emerging as research targets.

Research quality and social validity

Although the studies meeting inclusion criteria in the current systematic review followed experimental designs, methodological shortcomings were evident, with most studies demonstrating a preponderant level of evidence at best. As a result, threats to internal validity were evident. Critical elements of internal validity were frequently omitted, such as interobserver agreement, compromising confidence in the success of interventions in facilitating acquisition of social-communication functions. Of greatest concern was the finding that procedural fidelity could not be established in almost a third of studies, including those in which PECS was implemented, despite PECS being manualized. Lack of measurement of treatment fidelity leaves doubt as to whether the intervention was implemented as described, and thereby was responsible for behavior change (Sanetti & Kratochwill, 2007). Further, the detail with which interventions were described varied, with implications for their replicability. Given the diversity of described intervention methods, comprehensive description of treatment enables researchers to determine the critical aspects that result in changes to the dependent variable (Law, Garrett, & Nye, 2003). The need to provide such detailed information about intervention components and delivery is not unique to ASD, but represents a challenge in studies of language interventions more broadly.

In addition to threats to internal validity were methodological problems that reduce confidence in the long term benefits, generalizability and meaningfulness of interventions and their outcomes. Failure to address maintenance was frequently noted as a limitation by researchers. Reasons were often logistical, such as not being able to extend intervention and data collection beyond school terms. Nonetheless, some researchers managed to include a maintenance phase. Kagohara et al. (2012), for example, assessed maintenance at four weeks following intervention implemented in a school. Inclusion of such assessment is critical to anticipating both short and long term gains of an intervention. Notably, the effects of intervention on some skills were not maintained in some studies (e.g., Howlin et al., 2007; Kasari et al., 2014).

A failure of AAC interventions to promote generalization was identified almost 30 years ago by Calculator (1988), who noted a tendency in research to focus only on instructional strategies and not the extent to which learned behaviors were then demonstrated in everyday communication settings. The use of naturalistic settings and approaches has been argued to address this problem with behavioral interventions for individuals with ASD (Cowan & Allen, 2007). Certainly, in the reviewed studies, eclectic approaches were evident: for example, using discrete trial teaching in response to incidental and child-led opportunities within typical settings (e.g., McMillan, 2008; Nunes & Hanline, 2007; Schepis et al., 1998). Less evident was direct measurement of generalization. Such measurement may be most crucial in studies that are far removed from real-life settings or situations, such as those that lack naturalistic components that can help bridge the gap from intervention to real-life. Therefore, studies conducted in an atypical environment, such as a university clinic, by an atypical communication partner, such as a researcher, and within adult-led interactions, may be particularly dependent on generalization data to demonstrate their potential to result in changes that extend outside the clinic or classroom. Indeed, Schlosser and Braun (1994) long ago argued the need to assess generalization in terms of these multiple variables, regardless of the intervention approach used. Despite these early calls, the need for a greater focus on generalization of outcomes has been raised in previous reviews (Flippin et al., 2010; Hart & Banda, 2010; Snell et al., 2010; van der Meer & Rispoli, 2010) and as a limitation for both SCED (Kagohara et al., 2012; Keen et al., 2001; Kravits et al., 2002) and group studies (Howlin et al., 2007).

In terms of social validity, all studies included goals and treatment processes incorporating procedures that appeared acceptable (such as communication based around child-preferred activities), and outcomes that were socially relevant (Schwartz & Baer, 1991). As noted, the focus on object requests as targeted in most interventions, for example, has been argued to appeal to the motivations and preferences of children with ASD. However, as Light and colleagues observed, "There's more to life than cookies" (Light, Parsons, & Drager, 2002, p. 187). It would seem, then, that the broader social-communication impairments seen in children with ASD have been somewhat neglected in the AAC intervention research and a stronger focus on them is long overdue.

Encouragingly, some researchers incorporated measurement of social validity into study designs. For example, Ostryn and Wolfe (2011) examined the social validity of intervention procedures, while Strasberger and Ferreri (2014), and Trottier et al. (2011) went further by assessing the social validity of outcomes. Even when studies did not directly include assessment of social validity, goals appeared appropriate and treatment methods acceptable. However, limitations were evident. For example, input regarding the selection of intervention goals could also be provided by other community stakeholders, such as siblings, peers, wider members of the child's therapeutic and educational team, and other AAC users, but generally was confined to researchers, parents, teachers, and therapists in included studies. Further, measures of social validity were typically limited to parent or teacher surveys about acceptability of procedures and outcomes (e.g., Ostryn & Wolfe, 2011; Strasberger & Ferreri, 2014), but could potentially involve a range of measures, such as judgement of changes in behaviors in pre-post videos of the child. Identification of the need for and importance of comprehensive assessment of social validity is not new (e.g., Schlosser, 1999). However, the finding that approximately one quarter of SCED studies, and one of the six group studies, only, included assessment of social validity reflects those from previous reviews. Schlosser (1999), for example, found that only 12.5% in AAC research more broadly assessed social validity.

There are several reasons why social validity may not be evaluated, or only to a limited degree in research. The first is logistical: consultation with the community requires additional time, while identification of intervention goals by a professional may be more efficient. Another reason may reflect the relatively limited application of aided AAC in the broader field of ASD (Iacono et al., 2016). If research is largely confined to teaching children with ASD who are minimally verbal to request objects, then the goals most likely to result in meaningful outcomes using procedures that can be readily implemented in real world settings remains unknown. Furthermore, the lack of social validity appears to reflect broader limitations in interventions for children with ASD (Callahan, Henson, & Cowan, 2008).

Clinical implications

Practitioners working with children with ASD are reliant on research to inform their clinical decision-making. Although limited, the current review provides examples of studies in which various aided AAC interventions have been used to elicit the communication functions that are particularly problematic for children with ASD. Currently, there is some indication from this research that applied behavioral techniques incorporated into everyday activities and routines with a variety of communication partners, and resulting in natural consequences can be used in intervention for a broader spectrum of communication functions than has been the focus of much of the research in this area. In the meantime, given the emergent nature of this research, practitioners must apply their clinical expertise to developing and tailoring interventions in their practice, with careful monitoring of response to intervention in each child. What is evident from the research is that naturalistic strategies have the potential to lead to generalized skills, at least to a greater extent than when intervention is provided in artificial settings and with unfamiliar partners, as occurs when discrete-trial teaching is used, for example (Paul, 2008). The application of ABA principles in naturalistic contexts, as was the case in many reviewed studies, reflects the dual contribution of these approaches in extending (socially valid) communication skills in children with ASD (Schreibman et al., 2015).

Limitations and research directions

Unaided AAC interventions were omitted from the current study, given the preference for aided AAC systems for children with ASD evident in recent literature (e.g., Ganz, Earles-Vollrath, et al., 2012). It is possible that including both aided and unaided AAC in the review may have resulted in different findings. For example, Wendt's (2009) review indicated that communication functions for which manual signs were used included comments and responses to partner communication, in addition to requests. In contrast, in their review that included studies of manual sign, van der Meer, Sigafoos, O'Reilly, and Lancioni (2011) found that requests were most frequently taught to children with ASD. In addition, the inclusion of studies incorporating use of unaided AAC may have revealed differences in instructional strategies, communication goals (and functions) targeted, and greater reflection of social validity in goals, procedures and outcomes.

There appears to be an ongoing need to call for greater rigor in AAC research for individuals with ASD (e.g., Flippin et al., 2010; Millar et al., 2006). In this review, failure to provide sufficient details about instruction or demonstrate procedural integrity were particularly evident. Addressing these concerns can ensure greater confidence in the relationship between intervention and outcomes in future research.

Areas of future research that emerge from this review include investigation into the most effective instructional strategies for eliciting communication for social interaction and joint attention, as well as the range of behavioral regulation functions. We found a lack of systematic attempts to determine comparative effectiveness or outcome believability of teaching strategies. Exceptions included the study by Yoder and Stone (2006), who, in comparing PECS with Responsive Education and Prelinguistic Milieu Teaching (RPMT), found that while both were effective, differential improvements were seen according to the pre-baseline skills of the children. Comparative studies can inform clinical and educational practice in terms of intervention selection and methodology. In addition to child-related factors (joint attention, object use) that may predispose children to benefit more from one intervention than another, the type, setting, frequency, and requirements of different interventions may also mediate outcomes. For instance, a treatment rated more difficult to implement by parents may have less likelihood of use by communication partners, with implications for social validity.

There is also a need to demonstrate that AAC interventions are sustainable, generalizable, and meaningful. A further direction for research is to incorporate multiple levels of social validity (i.e., stakeholder consultation to plan and implement goals, procedures and outcomes), and measures of change over time to determine whether such change is meaningful and lasting. Currently, there is some empirical evidence for the efficacy of researchers and teachers conducting interventions, but limited support for other potential intervention agents, such as parents and other communication partners, who are arguably well placed to take on this role. Finally, research has shown that interventions can be conducted successfully in schools, and sometimes at home, but there has been little research into the benefits of using other everyday settings, such as those in the community.

Conclusions

The findings of this review demonstrate emerging support for the effectiveness of aided AAC interventions in teaching children with ASD a variety of communication functions beyond requests for objects. Evident from the review was a need for further research focused on varied and also socially motivated communication functions so as to improve the quality, quantity, and consistency of the evidence base, as well as its relevance to addressing the most significant communication and learning needs of children with ASD. There is also a need to determine if certain interventions enhance some functions better than others through studies with rigorous designs. Finally, empirically demonstrated maintenance, generalization, and social validity of interventions and outcomes remains a challenge for AAC intervention research. Addressing these issues offers the potential to reduce the social-communication challenges faced by children with ASD to a far greater extent than has been evident in AAC research to date.

Acknowledgements

This systematic review was completed in partial fulfillment of PhD requirements of the first author.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

Funding

David Trembath is supported by a National Health and Medical Research Council ECR Fellowship (GNT1071881).

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Appendix A - Chapter 2[1]

List of Hand-Searched Journals

Augmentative and Alternative Communication

Focus on Autism and Other Developmental Disabilities

Journal of Autism and Developmental Disorders

Developmental Neurorehabilitation

Journal of Applied Behavior Analysis

Journal of Developmental and Physical Disabilities

Education and Training in Autism and Developmental Disabilities

Research in Autism Spectrum Disorders

[1] Appendix available as supplementary material- online to the published paper. Refer to https://www-tandfonline-com.ez.library.latrobe.edu.au/doi/suppl/10.1080/07434618.2016.1267795?scroll=top)

Appendix B - Chapter 2[1]

Table 1

Operational Definitions of Outcome Believability Point System

Component	Fully demonstrated (score = 1)	Partially demonstrated (score = 0.5)	Not demonstrated (score = 0)
Independent variable assessed	Direct evidence of formal checking of procedural reliability	N/A	Procedural fidelity not assessed or percentage data not reported
Fidelity of intervention (treatment integrity) (from calculated average if multiple scores provided)	Mean = >90% (from calculated average if multiple scores provided)	Mean = >70% <90%	Mean<70% fidelity OR no reported data =0
Evidence of improvement over time	SCEDs: All participants with ASD demonstrated improvement in expressive use of aided AAC over time in *all* areas of expressive AAC use assessed. On visual analysis, features used to determine improvement comprised level, trend, variability, immediacy of effect, overlap, and consistency of data patterns across similar phases Group studies: In experimental group, there is evidence of improvement over time, demonstrated by significant result/superior outcome in experimental group/ evidence of treatment efficacy	SCEDs: Some participants with ASD demonstrated improvement in expressive use of aided AAC over time; or, improvement occurred in some, not all, areas of expressive aided AAC use that were assessed Group studies: Partial not possible to score due to insufficient level of description in group studies	SCEDs: No evidence of improvement over time in expressive use of aided AAC in any participants with ASD Group studies: No evidence of improvement over time (i.e. results lack significance; no evidence of treatment efficacy; outcome in experimental group not superior)

[1]Appendix available as supplementary material- online to the published paper. Refer to https://www-tandfonline-com.ez.library.latrobe.edu.au/doi/suppl/10.1080/07434618.2016.1267795?scroll=top)

Component	Fully demonstrated (score = 1)	Partially demonstrated (score = 0.5)	Not demonstrated (score = 0)
Evidence of intervention maintenance	SCEDs: All participants with ASD in which it was assessed demonstrated maintenance of intervention in all communication behaviors assessed relating to expressive use of AAC. Maintenance demonstrated as either continued upward trend in expressive use of aided AAC DV, OR maintenance of DV performance greater than that of baseline (determined through visual analysis or other measurement)	Some participants with ASD in which it was assessed demonstrated maintenance of intervention; or, maintenance of intervention demonstrated in some, not all, communication behaviors relating to expressive use of AAC	Maintenance not demonstrated
Intervention generalization assessed	Generalization assessed in all participants with ASD: DVs measured across at least one of setting, communication partner, or stimuli either immediately post-intervention or once treatment effect has been demonstrated	Generalization assessed in some, not all, participants with ASD	Generalization not assessed
Evidence of intervention generalization	All participants with ASD in which it was assessed demonstrated generalization of intervention when measured as a variable, demonstrated as positive measured DV result during changes to setting, communication partner and/or stimuli	Some participants in which it was assessed demonstrated generalization of intervention	Generalization of intervention not demonstrated in any participants
Social validity of intervention procedures assessed	Some direct measure or assessment of SV of procedures (i.e., intervention approach/strategies) was performed. Typically, this is through one or more questions in a survey requiring stakeholders to comment on the acceptability of procedures (e.g., whether these would be recommended to others, whether they were practical, socially acceptable and cost effective), or by otherwise formally soliciting information from stakeholders	N/A	SV of procedures not assessed

Component	Fully demonstrated (score = 1)	Partially demonstrated (score = 0.5)	Not demonstrated (score = 0)
Evidence of social validity of outcomes	Evidence from direct measure or assessment that outcomes were unanimously rated as socially valid for participants. Examples of socially valid outcomes would be positive reporting/scoring relating to whether intervention outcomes involved typical social contexts and socially meaningful communication goals	SV of outcomes not wholly positively scored/reported by all stakeholders	Outcomes assessed by stakeholders as not being socially valid or no direct measures of SV of outcomes undertaken

Note. ASD= autism spectrum disorder; AAC= augmentative and alternative communication; DV= dependent variable; SV= social validity

Chapter 3: Systematic Review of Aided AAC Interventions for Children with ASD

Overview

Chapter 3 is presented as a manuscript prepared for journal submission. It comprises a second systematic review of studies for intervention strategies used to develop communication functions beyond object requests in children with ASD.

Manuscript in Preparation

Logan, K., Iacono, T., & Trembath, D. (2020a). *Characteristics of interventions used to develop social communication functions in children with autism who use aided AAC*. Manuscript in preparation.

Statement of Contribution

As co-authors of the following paper titled "Characteristics of interventions used to develop social communication functions in children with autism who use aided AAC," we confirm that Kristy Logan has made the following contribution: The systematic review was designed by the candidate in collaboration with her primary supervisor Professor Teresa Iacono and associate supervisor Associate Professor David Trembath. The candidate was responsible for data collection and analysis. Inter-rater agreement was completed by Professor Teresa Iacono. Associate Professor David Trembath and Professor Teresa Iacono performed a Spearman's analysis, the results of which Kristy Logan incorporated into the paper's results. Kristy Logan was responsible for writing the complete first draft of the manuscript, while Professor Teresa Iacono and Associate Professor David Trembath provided critical feedback of each draft in preparation for journal submission.

Signed: ____ Date: 03/11/2020

Professor Teresa Iacono

Signed: ____ Date: 03/11/2020

Associate Professor David Trembath

Abstract

Aided augmentative and alternative communication (AAC) interventions have been shown to be effective in teaching children with autism spectrum disorder (ASD) to communicate for a range of pragmatic functions. However, currently little is known about the specific characteristics of interventions that can be used to teach functions other than object request. The aim of this study was to conduct a systematic review of extant ASD-AAC research to determine whether outcomes varied according to intervention strategies used, communication functions and behaviours targeted, treatment intensity, and participant characteristics. Eighteen studies were identified and appraised for constituents and outcomes. Intervention components varied widely, as did behaviours targeted, participant characteristics, dosage, and outcomes. There was evidence that a range of functions and communication behaviours could be taught successfully in highly structured, context-bound routines, with the teaching strategies of time delay and prompting applied most frequently. A small correlation was found between dosage and effect size. Further research on the range of factors that may potentially influence outcomes, such as participant characteristics and dosage, is warranted in future research.

Characteristics of Interventions used to Develop Social Communication Functions in Children with Autism who use Aided AAC

Children with autism spectrum disorder (ASD), many of whom remain minimally verbal beyond pre-school years (Eigsti, de Marchena, Schuh, & Kelley, 2011; Rose, Trembath, Keen, & Paynter, 2016), have been found to benefit from aided forms of augmentative and alternative communication (AAC). As a result, there has been burgeoning research in this area (Iacono, Trembath, & Erikson, 2016), particularly in the application of aided AAC to teach object requests (e.g., Kagohara et al., 2013; van der Meer & Rispoli, 2010; Wendt, 2009). Only recently has a review of the research shown emerging evidence that aided AAC interventions could also be used to teach a variety of pragmatic functions in addition to object requests for children with ASD (Logan, Iacono, & Trembath, 2017). Use of a broad range of communication functions is considered critical to social competence (Light & McNaughton, 2014). However, for children with autism, use of social, rather than regulatory functions, represents an area of core impairment (Tager-Flusberg, Paul, & Lord, 2005).

Theories of Pragmatic Development in ASD

Several theories have been proposed to account for the social communication difficulties associated with ASD. Behavioural theories include a focus predominantly on the role of reinforcers on language and pragmatic development (Skinner, 1957). However, they have been subject to criticism for failing to account for the generative nature of language, or how language learners choose what to imitate and for which purposes (Bruner, 1981). Developmental social-pragmatic theories, in contrast, have been proposed as providing a more comprehensive account of the patterns of communication development in ASD (Mundy & Stella, 2000). According to developmental social-pragmatic models, language acquisition occurs through exposure to and participation in social routines (Bruner, 1981). For children with ASD, who have been found to show reduced responsivity to social stimuli, it has been proposed that deficits in social development occur due to the cumulative effect of reduced social experiences, and consequently, lack of scaffolded interactions and social feedback (Chevallier, Kohls, Troiani, Brodkin & Schultz, 2012).

Impairments in social development manifest as differences in the development of pragmatic functions, namely, reduced range and frequency of use in comparison with children following typical developmental patterns (Shumway & Wetherby, 2009). In particular, declarative functions, relating to the use of communication for social interaction (i.e., requests for social routines and permission, and showing off, greetings, calling, and acknowledgement) and joint attention (i.e., comments, clarification, and requests for information), occur much less frequently than functions for behavioural regulation (i.e., requests for objects and actions, and protests) in children with ASD than in typically developing children (Shumway & Wetherby, 2009; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby, Cain, Yonclas, & Walker, 1988). Wetherby (1986) suggested that children with ASD develop communication functions sequentially, and according to resultant consequences: earlier developing functions are associated with an environmental consequence (e.g., a tangible object), or form part of an expected routine (e.g., greetings, acknowledgement), with later emerging, less often developed functions associated with purely social outcomes. Subsequent research has been supportive of this pattern of development for communication functions (e.g., Shumway & Wetherby, 2009; Wetherby, Watt, Morgan, & Shumway, 2007).

Models of Intervention in ASD

Instructional procedures used in ASD research vary, and are influenced by theoretical models, such as behavioural (e.g., Lovaas, 1987; Lovaas & Smith, 1989) and developmental social-pragmatic theories (e.g., Greenspan & Wieder, 1997). The translation of behavioural theory to clinical practice – in the form of applied behaviour analysis (ABA) - includes the provision of spoken, gestural, or physical prompts (e.g., Ostryn and Wolfe, 2011; Kagohara et al., 2012), mands (e.g., Barlow, Tiger, Slocum & Miller, 2013), or provision of models (e.g., Banda, Copple, Koul, Sancibrian & Bogschutz, 2010; Smith, Hand & Dowrick, 2014) to elicit target behaviours, followed by various forms of reinforcement when those behaviours are produced (e.g., Achmadi et al., 2012; Franco et al., 2009). An example can be found in the Picture Exchange Communication System (PECS, Bondy & Frost, 1994): this is a published, manualised and systematic instructional approach that utilises the key components of Antecedent, Behaviour, Consequence (ABC) of ABA. Example components include creating a need or opportunity for the child to communicate using strategies, such as placing desired objects out of reach (A), to encourage the child to use a picture in exchange for the object (B), which is then followed by reinforcement in the form of access to a preferred object (C).

The development of ABA interventions for children with ASD in the 1960s to 1980s was instrumental in establishing a range of teaching strategies and methods for evaluating progress that continue to inform modern approaches (e.g., Lovaas, 1987; Lovaas, Schreibman, & Koegel, 1974). Nevertheless, early approaches have been criticised for being adult-led, delivered outside typical settings and/or with atypical communication partners, and resulting in reinforcers that may not be related to the target behaviour (Paul, 2008). In contrast, developmental social-pragmatic approaches, which emerged in the 1980s, emphasise developing communication in transactions, using a flexible structure, turn taking, and motivating and meaningful activities, within a developmental framework (Prizant & Wetherby, 1998; Prizant, Wetherby, & Rydell, 2000; Schuler, Wetherby, & Prizant, 1997). ABA has evolved over time in recognition of the value of developmental social-pragmatic (i.e., naturalistic) interventions (including recently described naturalistic developmental behavioural interventions), which often include opportunities for the child to lead and/or initiate interactions, embedded teaching within incidental opportunities, and the provision of reinforcers that are considered natural according to the environmental context (Prizant & Wetherby, 1998; Schreibman et al., 2015). These naturalistic approaches that embed ABA instructional strategies include enhanced milieu teaching (EMT) (Kaiser, Yoder, & Keetz, 1992) and pivotal response training (Koegel, O'Dell, & Koegel, 1987).

Aided AAC Intervention for Children with ASD

Aided AAC research for children with ASD to date has largely focused on teaching the function of object request (e.g., Ganz, Earles-Vollrath et al., 2012), a relative communication strength. Perhaps of greater importance in addressing weaknesses in social communication are declaratives. Identifying teaching strategies that are most effective in teaching declarative functions remains unexplored, particularly in comparison with those used to teach imperatives (i.e., object requests). In their systematic review, Logan, et al. (2017) identified 30 intervention studies addressing communication functions other than, or in addition to, object request, appraising these for quality, validity, and outcome believability. They noted that AAC interventions could be used to teach varied communication functions, but did not differentiate the intervention approaches used. Given this gap in the evidence-base, a need was identified: to determine features of interventions with demonstrated effectiveness in teaching the socially oriented communication functions that children with ASD find the most challenging.

Efforts to identify teaching strategies for social communication functions can be built on previous intervention studies targeting behavioural regulation. Gevarter et al. (2013), for example, reviewed components of AAC interventions, finding five studies that compared the effectiveness of different instructional strategies incorporating AAC for children with ASD. Their findings suggested that different instructional strategies, such as those with the aim of increasing motivation and providing video models, may be particularly effective in teaching picture exchange to request preferred objects. Limitations of this review were the inclusion only of studies in which requests for preferred objects were taught and strategies within the same participant sample were compared, thereby limiting the number of studies and participants included. Still, Rehfeldt, Whelan, May and Dymond (2014) also detailed teaching strategies as part of their systematic review of high-tech AAC for children with ASD, finding that the majority of their 16 included studies involved ABA techniques, such as prompting. The researchers also noted the types of reinforcement delivered as the consequence of communicative behaviours: most commonly preferred objects were provided, with occasional use of verbal praise. Again, a limitation of this review was the focus on teaching requests.

There have been other attempts in the literature to classify instructional strategies used in AAC interventions that extended beyond behavioural regulation as the target behaviour. Lynch, McCleary, and Smith (2018) reviewed instructional strategies used in AAC interventions. They labelled intervention strategies according to the terminology used by each study’s authors; as a consequence, the strategies described (e.g., aided language stimulation, narrative-based intervention, eclectic approach) were not analysed for constituents (i.e., intervention components). It was unclear from this review which individual or combination of strategies may have been responsible for outcomes. Further, although this review revealed evidence that aided language stimulation was effective in teaching the use of graphic symbols, a criterion for inclusion was absence of social communication impairment, thereby excluding studies with children with ASD as participants. Gevarter and Zamora (2018) also investigated instructional strategies used in aided AAC interventions, particularly naturalistic interventions. Although they documented both intervention approach (e.g., peer-mediated intervention, aided modelling, milieu teaching) and specific teaching strategies (e.g., prompting, modelling, environmental arrangement), only effective strategies for speech-generating device instruction were included, rather than a broader range of aided AAC approaches. Further, the review went beyond children with ASD, making it difficult to extract results specific to this group. Further, although the percentage of request versus non-request communication functions were reported, there was no detailed evaluation of how intervention strategies were used to elicit a range of specific communication functions.

In addition to the strategy used, treatment intensity may play a role in the extent to which any one or group of strategies is effective. Warren, Fey, and Yoder (2007) argued that intervention intensity must be measured in terms of five domains: (a) dose - the number of teaching episodes within an intervention session; (b) dose form - the task or activity used within teaching episodes; (c) dose frequency - the number of times a dose of intervention is provided per day/week; (d) total intervention duration - the amount of sessions and time period over which an intervention is delivered; and (e) cumulative intervention intensity - the combined total of dose, dose frequency, and intervention duration. Research into treatment intensity has implications for service delivery in terms of ensuring, for example, the distribution of teaching episodes required for skill acquisition, and the optimal intervention dosage required according to treatment strategies (Warren et al., 2007). Such information on aspects of treatment intensity also facilitates comparisons across intervention studies (Reichle, 2011). Within aided AAC research, the only published systematic review of interventions and treatment intensity was that by Simacek, Pennington, Reichle, and Parker-McGowan (2018). They reviewed the literature on aided AAC treatment intensity for people with severe, profound, and multiple disabilities. Despite elements of treatment intensity being reported, for most studies Simacek et al. found it impossible to calculate cumulative intervention intensity. A limitation of this review in terms of relevance for children with ASD was that only six of 59 participants across the included studies had this diagnosis. Whether recommendations can be made for treatment intensity for aided AAC users who have ASD remains unknown.

An additional consideration in terms of treatment efficacy may relate to the characteristics of participants used for study inclusion. The impact of age and diagnoses (e.g., Ganz, Davis et al., 2012; Ganz, Mason et al., 2014) and communication skills (Flippin, Reszka, & Watson, 2010) on outcomes has been considered in research reviews. However, these reviews have focused on particular interventions (e.g., PECS; Ganz, Earles-Vollrath et al., 2012) or type of AAC (such as speech generating devices; Ganz, Rispoli, Mason, & Hong, 2014). Recently, Sievers, Trembath, and Westerveld (2018) conducted a systematic review to explore child-related factors associated with outcomes in ASD-AAC research. They found emerging evidence for six factors: cognitive ability, ASD severity, language comprehension, language use, communication competence, and composite measures (e.g., performance in developmental domains). Although this review yielded potential predictors, the number of studies included was limited to children aged 2-5 years, with group-based research designs as an inclusion criterion. The impact of participant characteristics on aided AAC intervention efficacy for the range of children with ASD under 18 years has not yet been established.

Given previous reviews have indicated AAC interventions are effective for children with ASD (e.g., Ganz, Earles-Vollrath et al., 2012; Logan et al., 2017), it is now critical to identify which strategies are suited to teaching social-communication functions so as to determine how to better tailor strategies to targeted outcomes. To date, there have been no systematic attempts to differentiate the most effective strategies according to the target communication functions for children with ASD. Of particular interest is how instructional strategies affect use of functional communication produced using symbolic forms. In addition, information regarding the dosage of intervention necessary for successful outcomes, as well as the characteristics of children who are responsive to social-communication interventions is required.

Aim

The aim of this study was to review research into the use of aided AAC with children with ASD through exploration of the intervention strategies and procedures followed according to communication functions targeted and treatment intensity. Extending the previous review by Logan et al. (2017), the following research questions were addressed: Which aided AAC intervention strategies have been used with children with ASD to teach symbolic communication functions other than object requests? and Is there evidence of varied outcomes according to intervention strategies used, dosage, and participant characteristics?

Method

Literature Search and Selection Strategy

The literature search was conducted as specified by Logan et al. (2017), whose search period was January 1994 to June 2015, with an extension to February 2019. The databases searched were Education Resources Information Centre, Cumulative Index to Nursing and Allied Health, Web of Science, Linguistic and Language Behavior Abstracts, and PsycInfo. Search terms were ASD and its variants (autism spectrum disorder, autis*, Asperger, PDD-NOS pervasive developmental disorder), which were combined with aided AAC (both low and high technology). Additional inclusion criteria were (a) participants included one or more children (<18 years) diagnosed with ASD, with previously used diagnostic terms also accepted (i.e., autistic disorder; Asperger's disorder; or pervasive developmental disorder – not otherwise specified); (b) aided AAC was used as part of the intervention; (c) at least one dependent variable related to the use of aided AAC to express a communication function; (d) at least one dependent variable was the use of symbolic communication for functions other than object requesting, which could be discerned in the data; (e) studies included controls in the form of single case experimental design (SCED) or control versus intervention group comparisons; and (f) the strength of evidence of the article had been rated as preponderant or conclusive by Logan et. al. (2017) if included in that review, with studies published subsequently rated using the same criteria. As per Logan et al. (2017), hand searches of relevant journals were also completed (Appendix - Chapter 3), and the reference lists of included studies identified through database searches were checked for potential additional articles (Schlosser, Wendt, & Sigafoos, 2007).

Combined, the two searches yielded 1469 articles. The first author applied the inclusion/exclusion criteria to retrieved articles. The second and third authors independently applied the inclusion/exclusion criteria to 466 of the 1469 articles (32%) from the initial search (Schlosser et al., 2007). Agreement was 96%. After applying the inclusion criteria to the abstracts, 49 were retained with appraisal of the entire article required to determine inclusion. Of the 49, 31 were excluded, leaving 18 for data extraction (Figure 1).

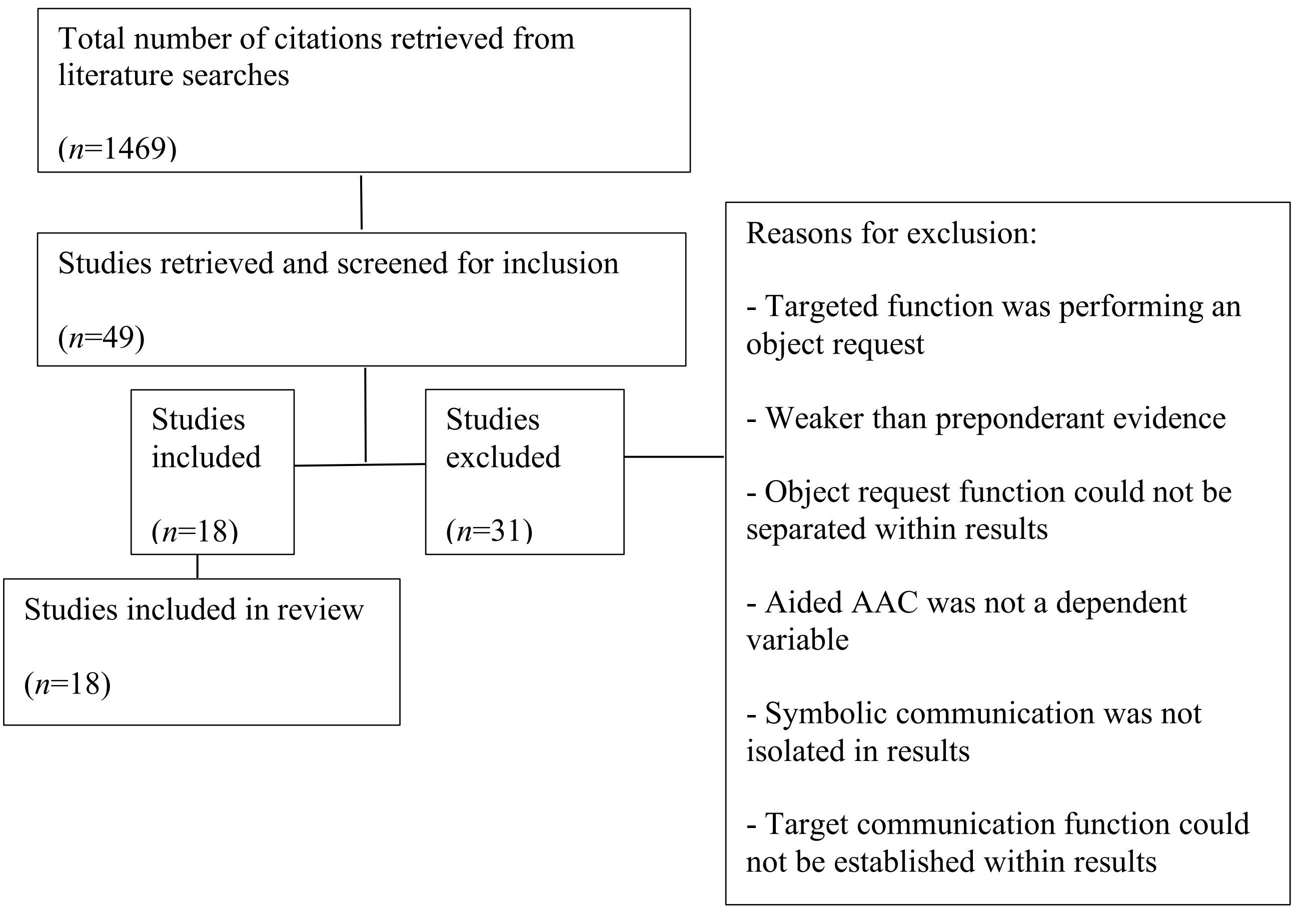

Figure 1. Study selection flow chart

Data Extraction

As per Logan et al. (2017), all studies were assessed for targeted communication functions that were categorised from descriptions provided in studies according to Wetherby et al. (1988). For studies that included object requests, information specific to this function was excluded for further review. Results within studies pertaining to unaided AAC or participants without ASD were also excluded. An additional category - mixed - was used when multiple communication functions (other than object requests) were addressed in an intervention, but types were not individually specified and/or separated in the results. Definitions of communication functions are provided in Table 1.

The methodological rigour of each study was evaluated in terms of certainty of evidence (Millar, Light, & Schlosser, 2006). Studies with significant design flaws (i.e., experimental outcomes were suggestive or inconclusive) were excluded. Levels of evidence that were categorised as conclusive (study demonstrated experimental control), and preponderant (some minor design flaws affecting experimental control, but the outcomes were likely a result of the intervention) were included in the review. For further details regarding application of the rating system, refer to Logan et al. (2017). To determine and compare the components of interventions, each intervention described in each study was summarised according to antecedent events and strategies (A), the behaviour (broad function) being targeted (B), and the consequence following demonstration of the target behaviour (C); multiple target behaviours were listed separately. Antecedent events and strategies are listed in Table 2, and target functions are listed in Table 1.

Table 1

Definitions of Communication Functions Targeted in Included Studies

Imperatives	Declaratives	
Behavioural regulation	Social interaction	Joint attention
Action request: for an action to be completed	Social routine request: command another to start or continue a social game or routine that involves interaction between the child and communication partner	Comment: direct another's attention to an object or event to inform, label, or describe
Protest: refuse an undesired object or request to cease an undesired action	Show off: purposefully attract the attention of another to something they are doing with their body or with a prop	Information request: find something out about an object, event, or utterance
	Greet: notice and acknowledge another's arrival and presence	Clarification: further explain what has been said, either solicited or self-initiated
	Call: gain the attention of another person, usually to pre-empt another communication act to follow	
	Acknowledge: notice, answer, or respond to another's communication, requiring a shift in focus of attention on the communication partner and the communication partner's message	
	Permission request: seek another's consent to complete an action	

Note. Definitions based on Wetherby, Cain, Yonclas, and Walker (1988)

To determine categorisation of antecedent events and strategies, a process of content analysis was used (Krippendorff, 1980). After reading through the procedures for each study, categories were created, with new categories added if procedures had not appeared in a previously reviewed study. Interventions (e.g., PECS) were not named; rather, their components were determined and included within the table. Definitions were initially created using descriptions of intervention components provided by authors; these were then matched to existing definitions within the research literature for coding reliability and consistency.

Three types of consequences (sometimes in combination) were provided to participants: (a) access to a preferred object, whereby the participant was given a desired object unrelated to the message they had expressed; (b) praise, whereby the child was provided with a verbal positive evaluation relating to the target behaviour; and (c) natural, whereby the child was given an object related to the message they had expressed, or the communication partner responded according to the message that the child had communicated (e.g., continued attention and interaction, provision of requested objects/actions, and attention to a specific topic; Fey, Warren, Bredin-Oja, and Yoder, 2017).

Dosage parameters were extracted for each study as outlined by Warren et al. (2007) in terms of amount (teaching episodes and session duration), frequency (number of times the dose was provided), and total intervention duration (total time period of the intervention or number of sessions provided). Cumulative intervention intensity (trials x frequency x duration) was calculated if sufficient information was reported. Only information pertaining to the involvement of the child with ASD was included in dosage parameters (i.e., session information relating to training of communication partners was omitted), and only data for sessions in which the communication focus was on functions other than object requests were reported. The range from minimum to maximum number of teaching episodes was reported for variation in the number of teaching episodes across participants in any one study, with the mean *n* teaching episodes also calculated.

Although visual analysis has traditionally been used to determine intervention success for SCED studies, it has been argued to be insufficient as an objective measure of the size of treatment effects (Parker, Hagan-Burke, & Vannest, 2007). Further, a metric was required to enable comparison of effectiveness across studies and to determine any relationship between dose and effectiveness. Consequently, the percentage of all non-overlapping data (PAND), the percentage of data remaining after removing the least amount of data points to eliminate all overlap (Parker, Vannest, & Davis, 2011) was calculated. PAND allows for calculation of non-overlap beyond chance level (x – 50 = percentage beyond chance level; Parker et al., 2007). Phi was calculated concurrently with the percentage of non-overlapping data to yield an effect size (Parker et al., 2007). Scruggs and Mastropieri's (1998) rubric of effect sizes was used to determine magnitude of effect: .90 or greater was indicative of very effective treatments, .70 to .89 was moderate, .50 to .69 was debatable, and less than .50 was deemed not effective. Generalisation and maintenance phase data were excluded as the efficacy of the intervention itself was the primary outcome of interest. As a consequence, only the effectiveness of the intervention compared to baseline was considered. Whether any correlation existed between effect size and dosage was subsequently determined by the use of Spearman's rank correlation. For group studies, effects reported by authors were extracted.

Participant characteristics and qualitative information relating to the communication function were also extracted. Participant characteristics were included as per the outcome predictors described by Sievers et al. (2018), in addition to the number of participants, their age, previous experience with AAC, and whether any pre-requisites were needed for inclusion.

Only data pertaining to the results of children with ASD were extracted and included in the results: data for other participant groups were not extracted or their data included in effect size calculations. Results that were not relevant to the aims of the current review were omitted, as were results for teaching the request of objects. If instructional modifications were made for some participants, these results were taken out so that effect sizes related to the instructional strategies specified in a study's method. If assessment of multiple functions was included, functions for each were reported and appraised separately.

Table 2

Components of AAC Interventions

Antecedents	
Setting events	Teaching strategies
Typical partner: At least one communication partner involved in intervention was one that the child would commonly interact with, such as caregiver, teacher, sibling, or peer	Expectant waiting: The communication partner was positioned in front of the child in close proximity, while looking at the child's face and demonstrating through facial expression and brief pausing to demonstrate that a response or initiation of communication is expected (e.g., Kaiser & Hampton, 2017)
Typical setting: At least one setting that intervention occurred in was one that was frequently used by the child: e.g., classroom, home, or preschool. Excluded withdrawal of a child from a school or preschool into an office space or empty room	Time delay: The communication partner waited for a designated time for the child to perform a communicative behaviour before providing a cue or proceeding (e.g., Fey et al., 2017)
Typical activity: The activity(ies) selected for intervention were those that the child would regularly perform at home, in education, or in the community	Prompting: The communication partner evoked the target behaviour from the child using verbal or visual (including gestural) cues, or verbal, visual, and physical cues sequentially according to the child's response (e.g., Schreibman et al., 2015)
Preferred activity: Intervention included the child's mostly highly preferred objects and activities, specifically identified and matched to that child	Modelling: The communication partner provided examples of how to use symbols to communicate by pointing to relevant symbols as the child engaged in activities, with no obligation that the child imitate (e.g., Hepting & Goldstein, 1996). If the communication partner showed the relevant picture to the child as an elicitation strategy, this was categorised as a prompt
Environmental arrangement: The child's therapeutic environment was set up in a way that encouraged the need for communication: e.g., objects were in sight but out of reach, the child was given small amounts or short turns, and/or objects that required an adult's help were used (e.g., Kaiser, Ostrosky, & Alpert, 1993)	Manding: The communication partner provided a spoken command for the child to use a specific symbol (e.g., Rogers-Warren & Warren, 1980)

Antecedents	
Setting events	Teaching strategies
Child led: The child was provided the opportunity to select the order and manner of engagement with toys and activities (e.g., Fey et al., 2017)	Errorless learning: Upon being presented with a communication opportunity, the child was immediately given physical assistance to touch a target symbol (i.e., there was no opportunity for mistakes in symbol use; e.g., Quatch & Beukelman, 2010)
Incidental teaching: The communication partner used naturally occurring opportunities during an activity or as part of the child's routine to teach use of symbols (words and visual-graphic representations) (e.g., Hart & Risley, 1975)	Error correction: The child was physically assisted to use the correct symbol if they made an error in symbol selection (e.g., Gevarter et al., 2013)
Responsive interaction: Any or all of the following four strategies were used- (a) engaging the child in interactive play (b) engaging the child in conversation during play (c) allowing the child to initiate interactions, and (d) taking turns with and sharing materials with the child (e.g., Weitzman, Girolametto, & Drake, 2017)	Video modelling: The child observes a video recorded model of the target behaviour (e.g., McCoy & Hermansen, 2007) Video self-modelling: The child observes a video recorded model of him/herself performing the target behaviour (e.g., Buggey, 1995)
Consequences	
Access to preferred object: The adult provided access to a preferred object identified through a reinforcement assessment (e.g., Watling & Schwartz, 2004) that was unrelated to what the child was communicating about	
Praise: The adult provided a verbal positive evaluation of the child's performance (e.g., Kanouse, Gumpert, & Canavan-Gumpert, 1981)	
Natural: The communication partner responded with what would be typically expected in this context: e.g., giving what was requested, answering the child's question, returning a greeting, continuing to chat, acknowledging what the child had communicated, or expanding on the child's communication (e.g., Fey et al., 2017)	

Inter-rater Agreement

The first author appraised the 18 studies that met inclusion criteria. Of these, 33% (*n*=6) were reviewed by the second author, with point-by-point comparison applied to extracted data to determine agreement/disagreement for all items coded (i.e., values within each column in Table 2). The mean inter-rater agreement was 93% (range 88-100%).

Results

In total, 18 studies (SCEDs, *n*=16; group studies, *n*=2) met inclusion criteria and were subsequently summarised and appraised. These extracted data are presented in Table 3 (SCED studies) and Table 4 (group studies). Within these tables, studies were ordered by magnitude of effect size in order to facilitate detection of potential association with intervention characteristics. As is evident from these tables, most SCED studies provided preponderant evidence (*n* =15) (Table 3), while only one SCED and the group studies provided conclusive evidence (Table 4). Within included studies, there were 21 examples of functions that were addressed either within one or across multiple studies within the same study.

Intervention Characteristics

Setting events. As seen in Tables 3 and 4, in many studies, there was an attempt to replicate, at least partially, situational factors necessary to create a realistic communication environment through use of a typical setting (*n*=11, 52%), typical communication partner (*n*=8, 38%), and/or typical activity (*n*=8; 38%). In some studies, situations were created that were likely to elicit communication through environmental arrangement (*n*=8; 38%), and use of activities of high interest (preferred) to the child (*n*=7; 33%). Incidental teaching opportunities (*n*=3; 14%), teaching as part of structured interactions (*n*=3; 14%), or allowing the child to lead activities (*n*=2; 8%) occurred in fewer studies. Studies varied in inclusion of a range of setting events, and in two studies with interventions found to be very effective

(Lorah et al., 2014; Lorah et al., 2015), no setting events catering to a child's typical environment or interests were used.

Teaching strategies. Researchers adopted a variety of teaching strategies, overall, but most often time delay (*n*=18; 86%) and prompting (*n*=17, 81%), and, with the exception of five studies, these were always used together, irrespective of the function targeted. Time delay and prompting were used in studies ranging from very effective to ineffective. The teaching strategies with the least frequency of use were expectant waiting (*n*=2; 10%), modelling (*n*=4; 19%), errorless learning (*n*=1; 5%), and variations of video modelling (*n*=2; 10%). The number of teaching strategies used ranged from 1-4, with most studies applying two to three strategies within interventions.

Behaviours targeted. Acknowledgement was the most frequently targeted communication function (*n*=13; 62%), either on its own or as one of a number of functions. As specified in Tables 5 and 6, which include detailed descriptions and examples of target behaviours, a number of behaviours functioned as acknowledgements, such as responding to a *wh* question to label an object (e.g., Kagohara et al., 2012), and answering novel social questions (e.g., Thirumanickham et al., 2018). Other functions were less frequently targeted, such as comment (*n*=4; 19%), request action or information (*n* =3; 14%), protest (*n* = 1; 5%), and greet (*n* =1; 5%). For all functions, there was a great deal of variability in the associated behavioural demonstration. For example, Kasari et al. (2014) described a comment as an unprompted, generative utterance to share information, Lorah and Parnell (2017) included as a tact (assigned as a comment in the current review as per Wetherby et al.'s 1988 classification) to label an object upon seeing it, and Finke et al. (2017) considered describing events, such as an object's actions, to be a comment.

Table 3

Intervention Characteristics and Outcomes of Single Case Experimental Design Studies

Study	Setting events (A)								Antecedents- teaching strategies (A)									Behaviour targeted (B)	Consequence (C)			Dosage (D)					Effect size (E)
LoE	TP	TS	TA	PA	EA	CL	IT	RI	EW	TD	Pr	Mo	Ma	EL	EC	VM	VSM	Function	Access to preferred object	Praise	Natural	Session length (min)	Trials per session	Frequency/ period of intervention	Duration (*n* sessions per child)	Cumulative intensity (*n* teaching episodes)	Phi (effectiveness) (apparent on visual analysis)
Lorah, Parnell, and Speight (2014) P										x					x			Acknow		x		-	10	1 per day/-	5-8 $\bar{x}$=7	50-80 $\bar{x}$=65	1 very Y
Kagohara et al. (2012) P		x								x	x		x					Acknow		x		15	12	2-4 per week/-	8-19 $\bar{x}$=14	96-228 $\bar{x}$=162	0.94 very Y
Lorah, Karnes, & Speight (2015) C										x					x			Acknow		x		-	3-4	Up to 2 per day/-	9-17 $\bar{x}$=13	27-52 $\bar{x}$=40	0.92 very Y
Nigam, Schlosser, & Lloyd (2006) P		x								x	x	x	x					Acknow		x		15-20	9	1 per day, 3+ days per week/-	30	270	0.91 very Y
Finke et al. (2017) P		x	x	x				x		x	x	x	x					Comment		x	x	15	20+	-/-	7-12 $\bar{x}$=7	140-240+ $\bar{x}$=180+	0.9 very Y
Marckel, Neef, & Ferreri (2006)[1] P		x		x	x					x	x				x			Request action		x	x	-	10	-/-	30-38 $\bar{x}$=34	300-380 $\bar{x}$=340	0.89 moderate Y
Therrien and Light (2018) P	x		x				x	x	x		x							Mixed (including acknow, comment, request inform)		x	x	5-20	10	1-3 per week/3 months	6-8 $\bar{x}$=7	60-80 $\bar{x}$=68	0.82 moderate P

Study	Setting events (A)								Antecedents- teaching strategies (A)									Behaviour targeted (B)	Consequence (C)			Dosage (D)					Effect size (E)
LoE	TP	TS	TA	PA	EA	CL	IT	RI	EW	TD	Pr	Mo	Ma	EL	EC	VM	VSM	Function	Access to preferred object	Praise	Natural	Session length (min)	Trials per session	Frequency/ period of intervention	Duration (*n* sessions per child)	Cumulative intensity (*n* teaching episodes)	Phi (effectiveness) (apparent on visual analysis)
Sigafoos et al. (2018)[1,2] P					x					x	x							Protest			x	5	10	1-2 per week/5 months	16	160	0.81 moderate Y
Strasberger and Ferreri (2014)[1] P	x									x	x				x			Acknow.			x	-	10	Up to 3 per day/-	5-6 $\bar{x}$=6	50-60 $\bar{x}$=55	0.8 moderate Y
Olive, Lang, and Davis (2008)[1] P	x	x		x							x			x				Request action			x	5	-	-/-	32	-	0.66 debatable P
Lorah and Parnell (2017) P	x	x	x							x					x			Comment		x		2	2	2-3 per day/-	4-6 $\bar{x}$=5	8-12 $\bar{x}$=10	0.65 debatable Y
Drager, et al. (2006) P		x	x	x		x						x						Acknow.			x	15-20	4	2 per week/5 months	21-27 $\bar{x}$=24	84-108 $\bar{x}$=138	0.63 debatable P
Cannella-Malone, Fant and Tullis (2010)[1,2] P	x	x	x	x	x					x	x		x					Greet	x		x	15	-	-/-	11-14	-	0.6 debatable P
Thirumanickham, Raghavendra, McMillan, and van Steenbrugge (2018)[3] P										x	x						x	Mixed (acknow., request inform)			x	-	2	3-4 per week/-	9	18	0.6 debatable P
Cannella-Malone, et al. (2010)[1,2] P	x	x	x	x	x					x	x		x					Acknow.			x	15	-	-/-	4	-	0.59 debatable N
Sigafoos et al. (2018)[1,2] P					x					x	x							Request action			x	-	5	1-2 per week/6 months	35	175	0.58 debatable Y
Waddington et al. (2014) P				x	x					x	x		x					Acknow.			x	10	10	-/-	8-11 $\bar{x}$=10	80-110 $\bar{x}$=95	0.52 debatable Y

Study	Setting events (A)								Antecedents- teaching strategies (A)									Behaviour targeted (B)	Consequence (C)			Dosage (D)					Effect size (E)
LoE	TP	TS	TA	PA	EA	CL	IT	RI	EW	TD	Pr	Mo	Ma	EL	EC	VM	VSM	Function	Access to preferred object	Praise	Natural	Session length (min)	Trials per session	Frequency/ period of intervention	Duration (*n* sessions per child)	Cumulative intensity (*n* teaching episodes)	Phi (effectiveness) (apparent on visual analysis)
Thirumanickham, et al. (2018)[3] P										x	x					x		Mixed (acknow., request inform)			x	-	2	3-4 per week/-	9	18	0.47 ineffective P
McMillan (2008)[1] P	x	x	x		x		x		x	x	x							Acknow.		x	x	30	-	-/-	13-27 $\bar{x}$=18	-	0.23 Ineffective N

Note. LoE (level of evidence; C= conclusive, P= preponderant), TP (typical partner), TS (typical setting), TA (typical activity), PA (preferred activity), EA (environmental arrangement), CL (child-led), IT (incidental teaching), RI (responsive interaction), EW (expectant waiting), TD (time delay), Pr (prompting), Mo (modelling), Ma (manding), EL (errorless learning), EC (error correction), VM (video modelling), VSM (video self-modelling), acknow. (acknowledgement), inform (information), Y= yes, P= partially, and N=no.

[1]Only the information relevant to functions other than object requesting was coded and evaluated

[2]Information reported for separate functions was appraised individually, so studies appear twice

[3]Study compared two interventions, these are reported separately

Table 4

Intervention Characteristics and Outcomes of Group Design Studies

Study	Setting events (A)								Antecedents- teaching strategies (A)									Behaviour targeted (B)	Consequence (C)			Dosage (D)					Effect size (E)
LoE	TP	TS	TA	PA	EA	CL	IT	RI	EW	TD	Pr	Mo	Ma	EL	EC	VM	VSM	Function	Access to preferred object	Praise	Natural	Session length (min)	Trials per session	Frequency/ period of intervention	Duration (*n* sessions per child)	Cumulative intensity (*n* teaching episodes)	
Kasari et al. (2014)[1] C	x		x		x	x	x	x		x	x	x						Comment			x	60	-	2-3 per week/6 months	48-60	-	(Cohen's *d*) Week: 12, *d*=0.51 24, *d*=0.44 Small to medium
Gilroy, Leader, and McCleery (2018) C		x								x	x				x			Acknow.	x	x		15	-	-/4 months	-	-	(*np2*) No sig effect (*np2*=0.033, *p*=0.294)

Note. LoE (level of evidence; C= conclusive, P= preponderant), TP (typical partner), TS (typical setting), TA (typical activity), PA (preferred activity), EA (environmental arrangement), CL (child-led), IT (incidental teaching), RI (responsive interaction), EW (expectant waiting), TD (time delay), Pr (prompting), Mo (modelling), Ma (manding), EL (errorless learning), EC (error correction), VM (video modelling), VSM (video self-modelling), and acknow. (acknowledgement)

[1]Only the information relevant to functions other than object requesting was coded and evaluated

There was variation in the semantic and syntactic demands of target communicative behaviours, in addition to the pragmatic load (i.e., number and complexity) of target functions within a study. Vocabulary on device displays varied, from a single picture symbol being present on a page (e.g., Sigafoos et al., 2018) to much larger arrays (e.g., 25-30 symbols; Finke et al., 2017), although the number of symbols presented on devices was not always specified (e.g., Gilroy et al., 2018; Kasari et al., 2014; Thirumanickham et al., 2018). In some studies, participants needed only to select a single symbol to demonstrate the target skill, while in others they were required to improvise on how symbols were used (e.g., Marckel et al., 2006), or combine symbols to create phrases (e.g., Finke et al., 2017; Nigam et al., 2006). Notably, in some studies, participants required procedural modifications due to difficulty with symbol meanings (e.g., Waddington et al., 2014), or the number of symbols required to use sequentially (Strasberger & Ferreri, 2014). Studies varied in how many social interaction/joint attention functions were taught, from one (e.g., Lorah et al., 2014), to several consecutively (e.g., Sigafoos et al., 2018), to multiple concurrently (e.g., Thirumanickham et al., 2018). One participant in the study by Cannella-Malone et al. (2010) was reported to discontinue use of a function when a new function was introduced.

Consequences. Natural consequences, as detailed in Table 2, were most frequently used in studies (*n*=16; 76%), such as performing the requested action (e.g., Olive, et al., 2008), responding to a greeting (e.g., Cannella-Malone, et al., 2010), answering a question (e.g., Drager et al., 2006, McMillan, 2008), confirming a child’s response or affirming and repeating the message expressed (e.g., Finke et al., 2017), or using an expected social response (e.g., “You’re welcome,” Waddington et al., 2014). Praise was also frequently used (*n*=10, 48%) (e.g., Lorah et al., 2015; Lorah & Parnell, 2017). In some studies, multiple forms of reinforcement were provided concurrently. In only two studies was access to an unrelated preferred object provided, and this was in conjunction with natural reinforcement (e.g., the return of a greeting; Cannella-Malone et al., 2010) or praise (Gilroy et al., 2018).

Effectiveness and Intervention and Participant Characteristics

As seen in Tables 3 and 4, interventions that were most effective (i.e., with moderate to large effect sizes) predominantly targeted the function of acknowledgement. For the most effective interventions, this target involved answering a *wh*- question relating to something visible (see Tables 5 and 6). There were exceptions, however, in which answering a *wh*-question relating to an observation was part of interventions found less effective or ineffective (e.g., Drager et al., 2006; Gilroy et al., 2018). Inspection of participant characteristics of more and less successful interventions targeting similar functions and behaviours was inconclusive (see Tables 5 and 6) in that no clear patterns emerged. Failure to consistently report participant information and the variability of communication assessments completed prior to interventions hindered efforts to identify a relationship. However, in one study (Thirumanickham et al., 2018), one child who failed to respond, and consequently lowered the overall combined effect size of the intervention, presented with the lowest language age in formal assessment results.

In most SCED studies (Table 3), visual analysis was consistent with effect sizes in that for all very effective interventions, the extent of their effectiveness was apparent from inspection of data depicted in figures, while for those with debatable effectiveness, visual inspection of depicted data most often showed only partial success. In one study (Nigam et al., 2006), although the reported results indicated a very effective intervention, the results for one participant who had failed to respond were omitted, and therefore could not be included when calculating the effect size. It is likely that had these results been available, the intervention effect size would have been reduced.

Table 5

Description of Target Behaviours- SCEDs, and Participant Information (in order of effect size)

Function	Description	No. setting events/teaching strategies used	Participant characteristics					Study (effect size)
			Number; age in years	Communication skills	Cognitive ability	Previous experience with AAC	Comprehension of symbols as prerequisite	
Acknowledge	Answering *wh* question ("What do you see?"; "What do you have?") using two picture symbols from choice of 5-6	0/2	*n*= 3; 5-6	5-10 words; 1-2 word requests; ability to label in response to *what* question	NS	No	No	Lorah et al. (2014) (1)
	Answering *wh* question ("What is this?") from choice of 4-6 picture symbols	1/3	*n*=2; 13-17	Expressive language age equivalence <2.5 years	Severe ID *n*=1; NS *n*=1	Yes	No	Kagohara et al. (2012) (0.94)
	Answering a question ("How old are you?"; "What is your favourite toy?"; "Where do you live?"; "What is your favourite food?") from choice of five picture symbols	0/2	*n*= 2; 8- 12	Non-verbal *n*=1; 1-2 word requests *n*=1	NS	Yes, *n*=1	No	Lorah et al. (2015) (0.92)
	Answering *wh* question ("What am I doing?") using two picture symbols from choice of 12	1/4	*n*= 2; 7- 11	Able to understand simple commands; able to request and respond to simple questions symbolically	Moderate ID *n*=1; NS *n*=1	Not determined	Yes- target unknown symbols taught prior to intervention	Nigam et al. (2006) (0.91)
Comment	Object-action combination to denote events (e.g., "Sid eat"; Jay Jay fly") using at least two symbols from choice of 25-30	4/4	*n*= 6; 8-12	Expression of 15+ single symbol messages; 5 or < spoken words; use of 2 different communication functions	NS	Yes	No	Finke et al. (2017) (0.9)

Function	Description	No. setting events/teaching strategies used	Participant characteristics					Study (effect size)
			Number; age in years	Communication skills	Cognitive ability	Previous experience with AAC	Comprehension of symbols as prerequisite	
Request action	Requesting to perform action associated with preferred object (e.g., eat) in a 3 word sentence from a choice of 24-25 picture symbols	3/3	*n*= 2; 4-5	Independent use of picture symbols to request; matching skills	NS	Yes	No	Marckel et al. (2006) (0.89)
Mixed, including request information, acknowledge, comment	Initiating or responding to a peer using prestored messages (e.g., "What is that?'; "Look at that bug"; "I love dogs") from a choice of 1-4 hotspots on visual scene display	4/2	*n*= 4; 3-5	Receptive language: <0.1-2nd percentile on PPVT-4; Expressive language: Use of 1-120 words; intentional with emerging symbolic skills	NS	Yes	No	Therrien and Light (2018) (0.82)
Protest	Stating "No thank you" when presented with a non-preferred food item from a choice of two symbol pages	1/2	*n*= 1; 9	Receptive language age equivalence 1;2; Expressive language age equivalence 1;6	NS	No	No	Sigafoos et al. (2018) (0.81)
Acknowledge	Answering *wh* question ("What is your name?") using two symbols from choice of four	1/3	*n*= 4; 5-12	No to limited symbolic communication	Cognitive impairment *n*=1; NS *n*=3	Yes	No	Strasberger and Ferreri (2014) (0.8)
Request action	Requesting adult to stay by selecting correct picture symbol from choice of four	3/2	*n*= 1; 4	Receptive language age equivalence 39 months; Expressive language age equivalencies 21-40 months	NS	No	No	Olive et al. (2007) (0.66)
Comment	Labelling known item in a book (e.g., hippo) by selecting correct picture symbol from choice of three	3/2	*n*= 3; 3-4	Ability to request and label using AAC	NS	Yes	Yes	Lorah and Parnell (2017) (0.65)

Function	Description	No. setting events/teaching strategies used	Participant characteristics					Study (effect size)
			Number; age in years	Communication skills	Cognitive ability	Previous experience with AAC	Comprehension of symbols as prerequisite	
Acknowledge	Answering *wh* question (“What is this?”) from choice of six picture symbols	4/1	*n*= 2; 4	Expressive language 10-20 words used; Receptive language comprehension of 41-57 words; matching skills; ability to fast map	Cognitive abilities: 12-26 months	NS	No	Drager et al. (2006) (0.63)
Greet	Greeting peer with “hi” by selecting an appropriate picture symbol (*n* NS)	5/3	*n*= 2; 6-14	Minimally verbal, some use of AAC	NS	Yes	No	Cannella-Malone et al. (2010) (0.6)
Mixed (acknowledge; request information)	Answering a question based on generic topics (food, holiday, movie, colours, recess, weekend), and asking a follow up, open question (“What about you”/ “What’s yours?” using customised or intermediate vocabulary on Proloquo2go (*n* NS)	0/3	*n*= 4; 11-18	Language age <2.0 (using function request objects) to 6;3 (using functions request and comment)	NS	Yes	No	Thirumanickham, et al. (2018) (0.6)
Acknowledge	Responding to peer’s offer of preferred item by selecting an appropriate picture symbol (*n* NS)	5/3	*n*= 2; 6-14	Minimally verbal, some use of AAC	NS	Yes	No	Cannella-Malone et al. (2010) (0.59)
Request action	Requesting a break during tasks from a choice of two symbol pages	1/2	*n*= 1; 7	Receptive language age equivalence 1;2; Expressive language age equivalence 0;8	NS	No	No	Sigafoos et al. (2018) (0.58)

Function	Description	No. setting events/teaching strategies used	Participant characteristics					Study (effect size)
			Number; age in years	Communication skills	Cognitive ability	Previous experience with AAC	Comprehension of symbols as prerequisite	
Acknowledge	Responding to receipt of preferred item with "thank you" using picture symbol from choice of four	2/3	*n*= 3; 7-10	Expressive language age equivalence 0;8-1;6; some use of symbolic communication to make requests	NS	Yes	No	Waddington et al. (2014) (0.52)
Mixed (acknowledge; request information)	Answering a question based on generic topics (food, holiday, movie, colours, recess, weekend), and asking a follow up, open question ("What about you"/ "What's yours?" using customised or intermediate vocabulary on Proloquo2go (*n* NS)	0/3	*n*= 4; 11-18	Language age <2.0 (using function request objects) to 6;3 (using functions request and comment)	NS	Yes	No	Thirumanickham, et al. (2018) (0.47)
Acknowledge	Responding to comment or question using picture symbol (*n* NS)	5/3	*n*= 4; 8-12	Significant language delays with limited, unintelligible, or no speech; some use of AAC to make requests	Moderate to severe ID	Yes	No	McMillan (2008) (0.23)

Note. The term picture symbol applies to any visual-graphic symbol used in the study (e.g., colour pictures, line drawings, photos). NS= not stated. *n* NS= number of symbols to choose from not specified in study.

Table 6

Description of Target Behaviours- Group Studies, and Participant Information

Function	Description	No. setting events/teaching strategies used	Participant characteristics					Study
			Number; age in years	Communication skills	Cognitive ability	Previous experience with AAC	Comprehension of symbols as prerequisite	
Comment	Unprompted, generative utterances directed to a partner to share information using picture symbol (*n* NS)	6/3	n= 31; x̄= 6.44	Receptive language equivalent to at least 24 months; Expressive language <20 spontaneous words or minimally verbal	Average Brief-IQ standard score of 68.18; average nonverbal cognitive scores 4.00 years	At least 2 years of therapy intervention; nil proficient use of SGD	No	Kasari et al. (2014)
Acknowledge	Response to *wh* question (e.g., What do you hear?") using two picture symbols from total *n* NS	1/3	*n*=35; 5-13	Low to zero functional communication; social and communicative functioning 1+ SD below mean on ABAS-3	No primary ID	NS	No	Gilroy et al. (2018)

Note. The term picture symbol applies to any visual-graphic symbol used in the study (e.g., colour pictures, line drawings, photos). NS= not stated. *n* NS= number of symbols to choose from not specified in study.

Interventions that targeted more naturalistic language behaviours seen in typical social interactions tended towards demonstrating only small effects. These included greeting by saying “Hi” (Cannella et al., 2010), requesting information by asking a follow-up question, such as “What about you?” (Thirumanickham et al., 2018), acknowledging with “Thankyou” when an item had been given (Waddington et al., 2014), answering generic conversational questions (Thirumanickham et al., 2018), and unprompted, generative comments to share information (Kasari et al., 2014). Most participants in interventions showing limited effectiveness had experience with AAC prior to the study.

To explore a possible association between cumulative intensity and effect size, a Spearman’s correlation was calculated for SCED studies using the mean of data on the number of teaching episodes provided, where this could be calculated (n = 15). A small positive correlation of $\rho = .32$ was obtained between cumulative intensity and effect size obtained (Cohen, 1988). No comparable index could be calculated for the group studies because there were only two, data on teaching episodes was not provided, and effect size measures varied.

Discussion

In the current systematic review, 18 studies of preponderant or conclusive research quality were appraised, in which the pragmatic target for children with ASD was other than object request. Cumulatively, these studies provided 21 examples of communication functions targeted across interventions. Intervention components varied widely in terms of setting events, qualitative description of behaviour targeted, and dosage, as did the characteristics of participants involved across and within studies. The teaching strategies implemented remained relatively consistent across studies, despite differences in the functions targeted. There was evidence that a range of functions and associated communicative behaviours could be taught successfully, and that dosage was associated to a small degree with the sizes of the effects obtained, although these varied considerably from being large to small or negligible.

Intervention Strategies

The finding that the most frequently employed teaching strategies were time delay and prompting is consistent with past systematic reviews. Still et al. (2014) found prompting to be used in nearly all studies, although they had limited their review to studies targeting only the request function. Gevarter and Zamora (2018) also found that prompting and time delay were frequently implemented as AAC teaching strategies, irrespective of the dependent variable (and associated communication function). It should be noted, however, that in their reviewed studies, overall, few children with ASD were included as participants. The current review contributes to growing evidence that prompting and time delay can be considered to be useful teaching strategies across a spectrum of communication functions. Prompting and time delay were also commonly used in conjunction with other teaching strategies. For example, error correction was always combined with time delay, while manding was consistently applied with both time delay and prompting in interventions. This frequent pairing of types of intervention strategies points to time delay and prompting being foundational AAC strategies for children with ASD, with others potentially added according to the communication behaviour targeted or child-related factors. Indeed, previous research into AAC intervention strategies has suggested that intervention effectiveness may be enhanced by tailoring strategies according to individual child needs, skills targeted, and the activity in which the intervention occurs, rather than by increasing the quantity of strategies used (Gevarter and Zamora, 2018).

When considering the intervention strategies used less frequently, there were some incongruent findings in comparison with other systematic reviews of AAC research. Modelling, for instance, was used in only four of the 21 studies (19%), but has been reported far more frequently in studies containing participants with a range of diagnoses (e.g., 63-69%; Gevarter & Zamora, 2018) or in reviews in which participants with ASD were excluded (>50%; Lynch et al., 2018). Given that aided language stimulation, with associated modelling of picture symbols, is considered an evidence-based practice in AAC (Lynch et al., 2018), it is unclear whether this is also the case for children with ASD. Of note, modelling occurred in conjunction with time delay and prompting in all but one study in the current review, and in the single study in which it was used in isolation, demonstrated only a debatable effect size. As a result, there is insufficient research evidence regarding the effectiveness of modelling as a stand-alone intervention strategy for teaching varied functions to children with ASD.

In many studies, there was an attempt to create naturalistic contexts as part of the interventions in an effort to support generalisation of skills. These contexts included typical settings with usual communication partners and activities, in addition to preferred activities, and environmental engineering to create communication opportunities. However, the inclusion of naturalistic setting events varied widely across studies, and in some very effective interventions, there was no inclusion of naturalistic elements (Lorah et al., 2014; Lorah et al., 2015). As a result, in some studies, the extent to which outcomes were meaningful and functional in typical communication contexts (i.e., natural environments and situations) remains unknown.

Efficacy of Target Functions and Behaviours

Although a range of communication functions were taught across the reviewed studies, the most consistently targeted functions related to social interaction, predominantly acknowledgement of another person's utterance. Notably, most of the interventions found to be very effective were used to teach acknowledgements. This pattern is reflective of research into the development of communication functions in children with ASD, for whom joint attention is impaired, such that functions associated with drawing attention to the self or an object (e.g., comments) remain the most difficult and least-occurring (Shumway & Wetherby, 2009; Wetherby et al., 2007). The success with which acknowledgement could be taught suggests a communicative strength for children with ASD for this specific social function. However, there is insufficient research into other functions that appear to be more complex for children with ASD. The findings of the current review indicate that within ASD-AAC research, it may be possible to identify a continuum of functions from easy to most challenging, consistent with proposed models of function development for children with ASD (Wetherby, 1986).

For interventions demonstrating some degree of effectiveness, the associated communicative behaviour frequently involved (a) answering a *wh* question from a limited range of presented picture symbols to acknowledge (e.g., Lorah et al., 2014; Kagohara et al., 2012); (b) naming an object or action as a comment (e.g., Finke et al., 2017; Lorah & Parnell, 2017); or (c) participating in a social routine, for example, acknowledging by stating "thank you" (Cannella et al., 2010), or providing a greeting (Waddington et al., 2014). In each of these example behaviours, communication occurred in a practiced routine, in which the target was prompted and elicited in a systematic way with a limited number of possible symbols from which to choose made available. The reason these communication behaviours (and associated target functions) were successful could relate more broadly to pragmatic development in children with ASD. Wetherby (1986), for instance, argued that more socially interactive communication functions may initially emerge in contextually-bound routines, whereby functions are used to complete an expected routine, rather than being truly generative. This pattern of communication development may be the reason why many of the spontaneous and/or initiated communicative behaviours (e.g., answering questions relating to generic topics; responding to comments that arose naturally during peer interactions; and unprompted, and generative utterances; Kasari et al., 2014; McMillan, 2008;

Thirumanickham et al., 2018) were associated with only mild to moderate effect sizes within interventions, or, in some cases, with lack of effect (e.g., McMillan, 2008).

Additional Factors Associated with Communication Outcomes

Dosage. The small, but positive correlation between dosage and effect size pointed to higher dosages facilitating intervention effectiveness. The size of this correlation may have been an artefact of the small sample of studies that included dosage parameters, as, similarly to Simacek et al.'s (2018) findings, dosage parameters in AAC research were inconsistently reported. It is possible that a larger correlation may have been obtained had all studies included full data parameters, and an appropriate metric could have been applied to compare across the group studies.

The failure to include comprehensive dosage parameters in intervention studies has several implications. When dosage is insufficiently specified, the replicability of studies is compromised. Interventions may be abandoned due to poor response, whereas altering dose frequency, or number of teaching trials, may yield improvement in a child's response to intervention. Comprehensive reporting of data parameters is vital in order to contribute to a robust evidence base for AAC instruction for children with ASD, and to allow for comparison of interventions and improved understanding of what contributes to large effects. Another consideration in ascertaining the effect of dosage on outcomes relates to individual variability. Effect sizes were calculated according to the mean, but variability in children's response to intervention in a study could have contributed to the variability in the relationship between dosage and efficacy.

Reinforcement. Predominantly, reinforcement provided in interventions were natural, reflecting a contextually-based response that matched the communication function expressed, or social, in which praise was provided. Only two studies involved providing a tangible object unrelated to the communicative exchange. The successful outcomes occurring alongside the use of natural reinforcement and praise suggests that many communication functions can be taught without the need for contriving an artificial reinforcer to encourage a behaviour. All studies with the highest effect sizes incorporated praise as a reinforcer (suggesting this is effective reinforcement for children with ASD), while studies with more modest effect sizes tended towards inclusion of natural reinforcement. Yet to be established is whether particular characteristics of children with ASD would make them more responsive to certain types of behavioural reinforcement in AAC interventions, or if outcomes of interventions might differ with manipulation or addition of particular reinforcers.

Child characteristics. Although all studies included some participant information, there was wide variation in the information that was reported about children, and also the tools or methods used to assess their skills prior to intervention. Consequently, it was not possible to discern patterns relating to child characteristics. Information reflecting the six participant characteristics identified by Sievers et al. (2018) to be associated with outcomes, was, at best, partially included in studies reviewed. Cognitive ability, in particular, was infrequently reported. There may be several reasons for this omission. Studies spanned a 17-year time period, over which different assessment tools have been developed and used. Time constraints in the duration over which intervention studies could occur may have negatively impacted on the amount of time available to spend on assessments. The design of SCED studies, whereby participants provide their own experimental control, may have reduced the need for detailed cognitive assessment, as this assessment was not necessary for measurement of the dependent variable (i.e., experimental outcomes). Finally, participants may have had varying capacities to participate in formal assessments.

Despite the lack of detail, from the participant information that was available, it was evident that participants within and across studies varied in terms of cognitive ability (from no primary intellectual disability to severe intellectual disability), language age and abilities

(0;8 to 6;3 months/years; no words to up to 120 words), and previous exposure to, and competence with, picture symbols. Systematic analyses, including meta-analysis of AAC outcomes with finely grained participant information could elucidate those characteristics most closely linked to outcomes. Consistent with Sievers et al.'s (2018) conclusion, the findings of this review show that ASD-AAC research is not yet at the point at which clinically relevant factors, in particular participant characteristics, can inform decisions regarding AAC intervention selection.

Limitations and Research Directions

As noted, information regarding dosage and child characteristics was inconsistently reported; as a consequence, a clear answer to the second research question was not possible. Detailed and consistent specification of dosage parameters and participant characteristics is needed in ASD-AAC intervention research. Comprehensive information specifying these clinically relevant factors can then be collectively appraised in future analytical review to determine association with intervention outcomes.

Given that a strength for children with ASD has previously been identified as making object requests (e.g., Shumway & Wetherby, 2009), studies in which the object request function was unable to be separated from results were excluded, so as not to artificially inflate effectiveness measures in relation to the research focus. However, it is possible that inclusion of these studies may have provided further information to determine AAC dosage requirements and the impact of participant characteristics on outcomes. Additionally, given the focus on symbolic communication, studies were excluded if results did not allow for determination of symbolic communication separate to intentional communication acts. Nonetheless, information on use of functions via intentional communication acts could provide information of relevance to teaching pragmatic skills needed as a precursor to symbolic communication (and thus be linked to greater effectiveness of interventions).

Although the strategies of time delay and prompting were used in studies with moderate to large effect sizes, they were also employed in studies found to be ineffective. As identified within this review, there were numerous additional factors that likely impacted on intervention success, such as those relating to the child and the communicative behaviour targeted (e.g., semantic, syntactic, and pragmatic complexity). In future research, determining which strategy or combination of strategies is effective for specific communication goals, as well as ascertaining if effectiveness improves when strategies and dosage are matched to the characteristics of individual children, will support practitioners in selecting interventions most likely to yield successful outcomes.

Evaluation of the generalisation of outcomes was not within the scope of the current review, but is salient, nevertheless. Given that many of the most successful interventions targeted communication behaviours using highly structured context-bound routines, exploring how well the pragmatic function itself, rather than discrete behaviour measured, is generalised to typical contexts is warranted to determine the generalisability of findings.

Finally, sufficient methodological rigour was demonstrated in only 18 studies, however, as noted in Figure 1, many were excluded because of considerable design flaws. In future research, improving methodological rigour as per Millar et al.'s (2006) classification will reduce threats to internal validity and increase confidence in the associated findings.

Clinical Implications

The current review provides evidence that a broad range of pragmatic functions can be taught successfully to children with ASD by including the teaching strategies of time delay and prompting within the predictable structure of an expected communication behaviour and a repetitive, routine context. These are features that can be readily accommodated into early childhood intervention settings, as well as in home-based activities. Careful mapping of individual response to intervention, which could include systematic manipulation of dosage and teaching strategies, is needed to determine variation in responsiveness across children in lieu of research addressing this relationship. The means by which trials are delivered may need to be varied according to the teaching context, however, such as being filtered throughout routine home and educational settings.

Conclusion

Children with ASD demonstrate a strength in communication for requesting objects, however, the current review provides evidence that children with ASD who use aided AAC can learn an expanded range of communication functions. Irrespective of pragmatic function targeted, interventions that include time delay and prompting, and teach skills in highly structured, context-bound routines, are likely to demonstrate greater effectiveness. Manipulation of dosage parameters, such as increasing the number of teaching trials or their distribution, offers the potential for the best outcomes. Ongoing research is needed to further determine the impact of other factors on outcomes, such as participant characteristics, target skill complexity, and reinforcement, as well as to establish how readily skills taught in interventions generalise into typical contexts.

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Appendix - Chapter 3

List of Hand-Searched Journals

Augmentative and Alternative Communication

Focus on Autism and Other Developmental Disabilities

Journal of Autism and Developmental Disorders

Developmental Neurorehabilitation

Journal of Applied Behavior Analysis

Journal of Developmental and Physical Disabilities

Education and Training in Autism and Developmental Disabilities

Research in Autism Spectrum Disorders

Chapter 4: Social Validity in AAC Interventions and Development of a Social Validity Survey

Overview

This chapter expands on the findings of the systematic review detailed in Chapter 2, within which the lack of consistent measurement of social validity in ASD-AAC intervention research was discussed. The purpose of this chapter was to report on the use and content of social validity tools within ASD-AAC intervention research. Specifically, the 85 articles identified within the systematic review in Chapter 2 (including those that addressed object requests, which were omitted for detailed appraisal in the systematic review) were further reviewed to determine use of social validity tools. The development of a social validity survey is then described. This review and subsequent survey creation, thereby, informed assessment of the social validity of the AEMT reported in Chapters 5 and 6.

Use of Social Validity as an Outcome Measure in Aided AAC Interventions for Children with ASD

Since the late 1970s, there has been recognition that effective interventions must result not only in statistically measurable changes, but also those that are clinically relevant and obvious, and which improve a person's everyday functioning (Kazdin, 1977). Research into social validity, which includes an emphasis on the acceptability of interventions to consumers and other stakeholders (Schwartz & Baer, 1991), has subsequently gained traction. When determining the social validity of an intervention, importance is placed on whether associated goals reflect what stakeholders desire, the extent to which treatment processes are acceptable, and the functional significance of the effects of an intervention (Wolf, 1978). Inclusion of measures of social validity are required, not only for determining these aspects from stakeholder perspectives, but also to inform and ultimately provide the reason to change practice: that is, to implement any modifications suggested by social validity data (Schwartz & Baer, 1991). Socially valid interventions – that is, those that meet the needs of stakeholders, result in functional outcomes, and involve acceptable procedures – arguably, are more likely to be adopted (Gresham, Cook, Crews, & Kern, 2004).

Social Validity in Previous Research

Historically, there has been limited consideration of aspects of social validity within both AAC and ASD intervention research. Over two decades ago, Schlosser (1999) noted that only 12.5% of surveyed studies within the journal *Augmentative and Alternative Communication* included any measures of social validity. More recently, in their systematic review of ASD-AAC research, Logan, Iacono, and Trembath (2017) found that within the 24 included single case experimental design studies, the social validity of intervention procedures was assessed in only 25%, while information regarding the social validity of outcomes was obtained in 38%. In five of the six group studies (83%), no measure of social validity was included. Given that only high quality studies met inclusion criteria for Logan et al.'s (2017) systematic review, the absence of social validity measures may be more pronounced in the wider research literature. More broadly, in the ASD intervention research, there has been a comparable lack of attention to social validity. Callahan et al. (2017) reviewed established evidence-based and emerging practices as identified by the National Autism Centre and National Professional Developmental Centre on Autism Spectrum Disorders. They found that only 26.7% of 828 studies reviewed included any measurement of social validity and, of those included, the measures used were limited in scope.

Schlosser (1999) argued that addressing social validity is critical to determining the utility of AAC interventions in order to ensure that (a) goals reflect what stakeholders want (i.e., AAC users and key individuals in the AAC user's life), (b) there will be adherence to intervention procedures, and (c) change represents something meaningful to stakeholders.

Nonetheless, social validity measures within ASD-AAC research have inadequately captured these three elements (e.g., omission of social validity of procedures; Logan et al., 2017). This situation raises cause for concern as consumer satisfaction with the goals of an intervention and the acceptance of the methods used to deliver it have been purported to influence consumer adoption of an intervention (Callahan, Henson, & Cowan, 2008; Proctor et al., 2011; Wolf, 1978) and to affect its outcomes (Carroll et al., 2007).

McConachie and colleagues (2015) conducted a systematic review of tools used in research to measure progress and outcomes, particularly those of potential importance to children with ASD and their families. The researchers observed a lack of outcome measurement that reflected both the needs of the user (e.g., researcher versus educator) and the acquisition of skills. For instance, most measures were of global changes in ASD characteristics and development, but did not include information that parents or educators may seek (such as changes in participation or quality of life). In contrast, determining social validity necessitates the measurement of changes to skills that are valued by relevant stakeholders, such as children with ASD and their parents or teachers. In AAC social validity research, most often the tools that have been used were developed for the purposes of the specific studies, such as in the form of surveys, which allow for measurement of outcomes that are meaningful to stakeholders, as well as capture information that may facilitate or impede engagement with an intervention (Wainer & Ingersoll, 2013). Within the ASD-AAC literature, however, there has been little consistency in either the tools used or information captured (Logan et al., 2017).

Review of Social Validity Tools in Intervention Studies

Using the 85 aided AAC studies identified in the systematic review by Logan et al. (2017; Chapter 2), a further review was undertaken to identify tools used within studies to measure social validity. This focused review was followed by a content analysis to ascertain the extent to which the information included within these tools addressed the three components of social validity (as recommended by Schlosser, 1999). Evaluation was conducted of tools that had been made available either within publications or could be accessed from details provided. The evaluation focused on the nature and extent to which the following information was considered in each tool: (a) evaluation from multiple stakeholders, including those who directly or indirectly contribute to uptake of an AAC system and intervention (i.e., AAC user, family, and others involved in the user's life, education, or care); (b) evaluation of intervention goals, including measures relating to broad social goals, as well as performance relating to specific skills, allowing for descriptions of the AAC user's response to intervention; (c) evaluation of intervention treatment, including the AAC tool used, the strategies used, and how the procedures were delivered; and (d) measurement of effects of the intervention and broader outcomes.

Twenty studies (of the 85) were identified within Logan et al.'s (2017) review in which a tool had been used to obtain social validity information (refer to Table 1). Of these, most involved a survey developed by researchers specifically for the intervention study; in only a few, a published tool was used in its original form or was adapted to meet the aims of the study. In seven studies, the tool was included or a link to the published source provided (Flores et al., 2012; Greenberg, Andree, Tomaino, & Charlop, 2012; Olive, Lang, & Davis, 2008; Ostryn & Wolfe, 2011; Park, Alber-Morgan, & Cannella-Malone, 2011; Strasberger & Ferreri, 2014; Tincani, 2004). Most tools included were designed to obtain feedback regarding acceptability of procedures and outcomes. As evident in Table 1, in many studies it was unclear whether information was sought from stakeholders regarding the acceptability of goals. In studies in which this information was included, the number of questions varied from four (e.g., Cihak, Smith, Cornett, & Coleman, 2012) to more than 20 (e.g., Greenberg, et al.,

Table 1

Summary of Content of Social Validity Measures from Studies Included in Logan et al. (2017)

Study	Description of tool within study	Included or reference available	Assessed social validity aspects		
			Goals	Procedures	Outcomes
Banda, Copple, Koul, Sancibrian, and Bogschutz (2010)	Five question survey on 5-point Likert Scale -feasibility of research in the classroom - importance of requesting skills - use of the treatment strategy - use of speech-generating device - child gains following treatment	N	Y	Y	Y
Boesch, Wendt, Subramanian, and Hsu (2013)	Treatment Acceptability Rating Form (Reimers & Wacker, 1988), modified to include 12 Likert-type questions and one open ended question - treatment effectiveness - acceptability of treatment - negative side effects of treatment - longevity of outcomes - need for treatment - child preferences relating to treatment	N (modified version not included or available)	?	Y	Y
Cannella-Malone, Fant, and Tullis (2010)	Questionnaire (format not specified) - importance of treatment - effectiveness of treatment	N	Y	Y	Y
Carre, Grice, Blampied, and Walker (2009)	Questionnaire (format not specified) - treatment effects - treatment tools	N	?	?	Y
Chaabane, Alber-Morgan, and DeBar (2009)	Questionnaire (format not specified) - ease of treatment	N	?	Y	Y

Study	Description of tool within study	Included or reference available	Assessed social validity aspects		
			Goals	Procedures	Outcomes
	- outcomes of treatment - generalisation - ongoing use of treatment				
Cihak, Smith, Cornett, and Coleman (2012)	Questionnaire with 4 short-answer questions - treatment effects - type of treatment - continued use of treatment	N	?	?	Y
Copple, Koul, Banda, and Frye (2015)	Five question survey on 5-point Likert Scale - value of research at home - importance of requesting skills - use of treatment strategy - use of speech-generating device - child gains following treatment	N	Y	Y	Y
Dogoe, Banda, and Lock (2010)	Questionnaire (format not specified) - understanding of treatment - acceptability of treatment - effectiveness of treatment - cost of treatment - associated disadvantages of treatment - permanent improvements from treatment - treatment fitted to typical routine - treatment applicable to other settings	N	?	Y	Y
Flores et al. (2012)	Questionnaire with 4-item Likert Scale with an open-ended question - need for AAC - benefits of SGD - stakeholder interest in SGD - extant experience with SGD	Y	Y	Y	Y

Study	Description of tool within study	Included or reference available	Assessed social validity aspects		
			Goals	Procedures	Outcomes
	- outcomes of treatment - ease of use of SGD - child preferences regarding AAC modality - likelihood of continuing with SGD - experiences with SGD				
Greenberg, Andree, Tomaino, and Charlop (2012)	Questionnaire with 16-item Likert Scale with 4 open-ended questions - need for system - outcomes - acceptance of treatment - ease of treatment - cost of system - likelihood of recommending system	Y	Y	Y	Y
Jurgens, Anderson, and Moore (2009)	Questionnaire (format not specified) - outcomes - ease of implementation - need for parent involvement	N	?	Y	Y
Marckel, Neef, and Ferreri (2006)	Rating of goals and outcomes on a scale of low to high	N	Y	?	Y
Olive, Lang, and Davis (2008)	Behaviour Intervention Rating Scale (Elliot & Treuting, 1991) with 15 items regarding acceptability and 9 items relating to effectiveness - outcomes - likelihood of recommending treatment - acceptance of procedures	Y	?	Y	Y
Ostryn and Wolfe (2011)	Questionnaire with 6 questions on a Likert Scale - ease of use of treatment - naturalistic outcomes	Y	N	Y	Y

Study	Description of tool within study	Included or reference available	Assessed social validity aspects		
			Goals	Procedures	Outcomes
	- child's satisfaction with treatment - willingness to use treatment - likelihood of using in typical settings				
Park, Alber-Morgan, and Cannella-Malone (2011)	Questionnaire with nine questions on a 5-point Likert Scale - value of treatment - ability to be implemented by parents - feasibility of treatment at home - outcomes following treatment - value of ongoing use of treatment	Y	Y	Y	Y
Schreibman and Stahmer (2014)	Survey using a 7-point scale (not further specified) - treatment effectiveness - treatment techniques and type - child outcomes	N	?	Y	Y
Smith, Hand, and Dowrick (2014)	Questionnaire (format not specified) on all aspects and phases of the study	N	?	?	?
Strasberger and Ferreri (2014)	Behaviour Intervention Rating Scale (Elliot & Treuting, 1991) - acceptability and appropriateness of treatment - likelihood for generalisation - treatment outcomes - likelihood of recommending and using again - need for treatment - acceptance of treatment procedures - longevity of treatment	Y	Y	Y	Y
Tincani (2004)	Questionnaire with short answer questions - importance of treatment - preferred treatment	Y	Y	Y	Y

Study	Description of tool within study	Included or reference available	Assessed social validity aspects		
			Goals	Procedures	Outcomes
	- feasibility of treatment - likelihood of implementing - treatment outcomes				
Trottier, Kamp, and Mirenda (2011)	Questionnaire with Likert-type scale (not further specified) - perceptions of treatment - enjoyment of treatment - likelihood of using again	N	?	Y	?

N=no; Y=yes; ?= insufficient information reported to determine; SGD = Speech Generating Device.

2012). Response formats included Likert-type scales, short-answer questions, or a combination of these; for some tools reported in studies, the format could not be determined.

There were seven studies in which the content of tools was available, either within the study or in reference to a publication. Subsequently, tool contents were analysed and categorised, with results presented in Table 2. Eight main categories emerged from this analysis, corresponding with the social validity of goals, treatment processes, and outcomes. Overall, broadly captured within these main categories were many of the elements of social validity discussed by Schlosser (1999). However, the evaluation of tools indicated several areas that were inadequately addressed, indicating that none were sufficient in their current form to provide a comprehensive measure of social validity for AAC interventions for children with ASD. As might be anticipated, stakeholders in these studies usually comprised adults involved in the child's life, but not the child, likely because of the children's significant communication difficulties. Stakeholder feedback generally involved obtaining their perceptions of treatment tools and strategies (e.g., Greenberg et al., 2012; Olive et al., 2008; Park et al., 2011; Strasberger & Ferreri, 2014; Tincani, 2004). The social validity of treatment was generally addressed only partially, predominantly in terms of the materials used, whereas information regarding how the treatment was delivered was often missing (e.g., Flores et al., 2012). For some tools, input from stakeholders about acceptability of the target skill/goals was not sought (e.g., Ostryn & Wolfe, 2011; Tincani, 2004). In addition, tools were usually not specific to the needs of AAC users, such as by failing to include questions about the acceptability of AAC materials (e.g., the Behaviour Intervention Rating Scale, Elliot & Treuting, 1991, used by Olive et al., 2008 and Strasberger & Ferreri, 2014). Given that no tool was identified in the literature to comprehensively address the multiple facets of social validity, there was a need to create one for subsequent use in the ASD-AAC intervention studies reported in this thesis. The purpose of this tool would be to capture explicit information about the acceptability of goals, procedures, and outcomes, as recommended in the literature (e.g., Kazdin, 1977; Schlosser, 1999; Wolf, 1978) and obtain feedback on the content through expert review, to increase the rigour of the tool (Snodgrass, Chung, Meadan, & Halle, 2018).

Table 2

Content Analysis of Available Social Validity Tools (n=7)

Social validity component	Theme	Components
Relating to goals	Need for skill development	- Importance of skills - Need for treatment - Need for system
Relating to treatment process	Setting/context	- Feasibility of research in typical settings - Value of research in typical settings - Likelihood of use in typical settings - Consistent with typical routines
	Stakeholder/consumer	- Need for parent involvement in treatment - Ability of treatment to be implemented by parents - Child's satisfaction with treatment - Child preferences relating to treatment
	AAC modality	- Stakeholder/consumer interest in modality - Benefits of modality - Experience with modality - Ease of use - Child preferences - Likelihood of ongoing use
	Strategies	- Acceptability - Importance - Tools - Ease of use - Preferred type - Understanding of methods - Effectiveness - Cost/value - Willingness to use - Appropriateness - Feasibility - Perceptions - Enjoyment - Child preferences and satisfaction - Likelihood of ongoing use - Applicability to other settings

Social validity component	Theme	Components
	Side effects	- Negative side effects - Associated disadvantages from engaging in treatment
Relating to outcomes	Effectiveness	- Treatment effects - Treatment outcomes - Naturalism - Longevity/permanence of outcomes - Generalisation
	Recommendations to others	- Likelihood of recommending system/strategies - Likelihood of using again

Development of the Social Validity Survey

Based on the recommendations from Schlosser (1999) and incorporating common themes within existing social validity tools, a draft Social Validity in AAC Intervention Survey (SVAIS) was developed (see Appendix A - Chapter 4). A survey design was selected to measure social validity to allow for sharing of subjective information (Schwartz & Baer, 1991). Survey questions were developed to probe the social validity of intervention goals, procedures, and outcomes specific to AAC from the perspective of the stakeholders involved with ASD-AAC intervention participants (e.g., caregivers, educators). Input from children was not included as part of this survey design due to their age and complex communication needs, therefore, other measures of social validity were deemed to be more relevant for them, such as observations of their willingness to participate in an AAC intervention or spontaneous use of AAC (i.e., direct observations; Schlosser, 1999). Questions were designed to reflect areas of communication difficulty known to be associated with ASD. Specifically, the following areas were addressed in the SVAIS content:

- Goals: broad social goals (relevance of AAC and communication interventions for children with ASD), behaviours (relating to enhancing communication participation), and discrete responses within behaviours (indicators of improvement in communication skill).

- Methods: acceptance of materials (e.g., picture symbols), context (e.g., setting, activity type), and procedures (e.g., teaching strategies).
- Outcomes: satisfaction with effects (short and long improvements related directly to target behaviours, and willingness to continue with the intervention), and outcomes (unplanned or non-targeted changes, capacity to state negative outcomes).
- Stakeholders: inclusion of perspectives of range comprising individuals both direct (AAC users), and indirect (other people in the AAC user's life).

The original version of the SVAIS comprised 31 questions, incorporating a 5-point rating scale anchored by strongly agree (5) and strongly disagree (1). Scores were calculated by tallying responses, such that higher scores indicated higher social validity (with score reversals for two items). In addition, three questions requiring open-ended responses were included to capture any information missed in the closed-answer format: they invited general feedback and comments about what stakeholders liked and/or disliked about the intervention.

Survey feedback. Ethics approval was obtained from the La Trobe University Human Ethics Committee (S15/50) to approach ASD-AAC researchers to obtain feedback on the draft SVAIS. Participants who demonstrated experience with evaluation of social validity in ASD-AAC interventions were sought for this feedback. Inclusion criteria were that (a) participants had been the lead author for at least one published peer-reviewed intervention study relating to the use of aided AAC for children with ASD; (b) at least one of these studies included assessment or consideration of social validity; and (c) first author current contact details were available. Potential participants were identified using the results from Logan et al. (2017): lead authors across all studies appraised reviewed for the communication functions targeted (*n*=74) and additional articles identified using hand and ancestry searches (*n*=11). Contact details for potential participants were sourced from both the published studies and internet searches to ascertain current e-mail addresses. Following this process, 16 potential participants were identified, who were each sent an invitation to participate via e-mail.

Feedback questions relating to the utility of the SVAIS were developed and disseminated using a web-based platform (www.qualtrics.com.au). The feedback questionnaire was sent via an anonymous link, with no personal or identifying information collected from participants. Upon accessing the link to the feedback questionnaire, participants were provided with a participant information statement and written information about social validity (see Appendix B - Chapter 4), followed by 10 questions, each requiring short answers, regarding the usefulness of the SVAIS (e.g., most and least useful aspects, and potential use in research and clinical contexts; see Appendix C - Chapter 4).

Participants were asked to complete the task within one month, with a reminder e-mail sent two weeks after the initial invitation. Feedback obtained was then incorporated into a revised draft (Appendix D - Chapter 4) and sent out to the same participants who had responded to the first draft for further comments. Participants were again sent the participant information statement, as well as the revised SVAIS, and a link to the feedback questions through another anonymous Qualtrics link. Following the second round of feedback, the SVAIS was finalised (see Appendix E - Chapter 4).

There were five respondents to the initial request for feedback on the SVAIS, but only three completed the feedback questionnaire. Two participants provided feedback on all nine questions, and one on questions 1-7 only. Responses were grouped into categories.

All three respondents agreed that the draft SVAIS allowed for sufficient judgement regarding the social validity of goals. With respect to opportunities to allow for judgement of intervention processes, all agreed that opportunities were provided, but one participant added the caveat that the SVAIS appeared to be designed with parents in mind. The suggestion was made to change wording to reflect potential respondents other than parents (e.g., teachers). All participants agreed that the SVAIS addressed the social validity of intervention effects and outcomes. There were contrasting responses regarding using the SVAIS in clinical practice. One participant described the SVAIS as too lengthy, another stated it was thorough, while the third felt that it provided a good foundation for social validity assessment, but may need to be refined to increase specificity. Two participants recommended the SVAIS as appropriate for research, with one describing it as comprehensive and easy to understand, while the third thought it could be too general, and may need adjusting for use in research. With respect to the functionality of the SVAIS to inform AAC intervention design, all three participants felt that it could have research utility. However, one participant queried the use of the SVAIS in practice given the existence of similar surveys, but did not name any. When asked about the most useful aspects, comments from the two participants who completed this question were that the Likert scale increased ease of completion, there was a good balance of questions, and the option for open-ended responses provided the opportunity to obtain relevant information that may have not been captured by the close-ended questions. One participant described the least useful aspect to be the neither agree nor disagree option on the Likert scale, with a not applicable option recommended instead.

Revised SVAIS. The SVAIS was revised to incorporate participant suggestions. Specifically, the language was amended to reflect that a teacher may also be completing the survey, the neither agree nor disagree option was removed from the response scale, and a category for not applicable provided. In addition, questions 25 and 26, which respectively asked whether the child could engage in activities at home or pre/school more easily after therapy, were combined to reflect the physical setting that the person completing the form occupied (i.e., home or school). See Appendix D - Chapter 4 for details.

The revised version of the SVAIS was distributed to the same 16 researchers who had been invited to provide feedback to the original. They were again sent the participant information statement, a copy of the revised version of the SVAIS, and an anonymous link via Qualtrics that contained written information regarding social validity and the feedback questionnaire. Three researchers subsequently participated. One other researcher contacted the candidate via e-mail in response to the request to participate in a second round of feedback to state that s/he did not see the need, having already provided feedback on the draft SVAIS, which included that it was “great.”

All three participants provided responses to questions 1-9 of the feedback questions (Appendix C - Chapter 4). As per feedback relating to the original SVAIS, feedback questions addressed the usefulness of the revised version and potential application, and required short, written answers. The feedback questionnaire was closed on Qualtrics three months after the invitation to participate.

Responses indicated that participants felt that the revised version of the SVAIS allowed for judgement of the social validity of goals, procedures and outcomes. However, one of the three participants also acknowledged that the revised SVAIS was reliant on an adult’s subjective judgement of a child’s enjoyment of the intervention. Two participants reported that the revised version of the SVAIS was acceptable in terms of exploring the social validity of communication outcomes, while the other expressed the need to consider outcomes relating to social interactions separate to using AAC to make requests for immediate needs. All participants indicated that the revised SVAIS was a useful tool for both clinical and research contexts, with one commenting on its ease of use and brief time required to complete. One participant also described the utility of the revised SVAIS in determining parent/teacher acceptance, while another noted it would form only one component of a social validity assessment. The most useful aspects of the revised version of the SVAIS were reported to be the use of a Likert scale, the thoroughness of the tool, and the combination of question types. Recommendations from participants regarding the least useful aspects were to provide an option for “unsure” on the response scale and to use it in conjunction with other measures of social validity (e.g., pre- and post- intervention video recordings of a child’s communication), while another questioned the value of the open-ended items.

Final version of the SVAIS. The final revision of the SVAIS incorporated most suggestions from the second round of feedback. A further consideration was that the planned intervention studies were to be conducted in the home setting with parents participating as communication partners to varying degrees – therefore, they were the direct stakeholders (Schlosser, 1999). The survey was further revised to reflect parents as the key audience for the SVAIS: For example, questions pertaining to educators were removed, as was use of the term *student*, and parent-friendly terminology was used where appropriate (e.g., the verb *participate* was used instead of *engage*). An additional question was added to reflect whether children could communicate for purposes other than making object requests following intervention.

Discussion

The focus of this chapter was on the development of a measure of social validity for use in ASD-AAC intervention studies in this thesis following a review of the literature that failed to reveal a suitable alternative (Logan et al., 2017). It is noteworthy that less than a quarter of studies in Logan et al.’s (2017) systematic review had included measures of social validity. In the absence of social validity evaluation, it is arguably difficult to establish whether an intervention found to be effective in terms of narrowly defined target outcomes meets relevant needs, or results in meaningful change for AAC users and other relevant stakeholders (Callahan et al., 2017). Plausibly, then, some evidence-based AAC interventions used with children with ASD, such as those reviewed by Callahan et al (2008), may not be acceptable to them or other stakeholders in their intervention – most notably parents. As noted by Odom et al. (2003), the likeliness of adoption of an intervention is questionable in the absence of information about the relevance of targeted skills to an AAC user's needs and life.

Despite the limited sample of researchers experienced in AAC or ASD research who provided feedback regarding the tool, there was general consensus that it would offer benefit to individuals providing AAC interventions to children with ASD. The final version of the SVAIS addressed a gap in intervention research in the provision of a tool specific for AAC users with ASD, which measured the range of elements associated with social validity, but there are caveats to its use.

As has been the case in previous research (Snodgrass et al., 2018), the SVAIS was designed to address the specific focus of the intervention studies, with their focus on parents as direct stakeholders. Completing a survey was not deemed appropriate for the child participants in the planned intervention studies, who would each have significant communication disorders; it is likely that this was the reason for excluding children from responding to measures of social validity in previous research (Hanley, 2010). As a result, the SVAIS cannot be used in research in isolation as the sole measure of social validity, but would need to be supplemented by other forms of assessment (e.g., observation). Additionally, the language and questions of the SVAIS would need to be amended for use with wider stakeholders, such as educators.

It is possible that additional social validity tools may have been identified if the search was broadened beyond the focus of research into aided AAC interventions for children with ASD. Further, many of the tools identified in the review were not published or included within published studies, and, hence, could not be analysed according to content, and, consequently, evaluated for comprehensiveness. In addition, there was only a limited response to the invitation to researchers who met the inclusion criteria to provide feedback on the SVAIS in its original and revised versions. Widening the search criteria to include AAC and/or ASD researchers more broadly may have resulted in alternative or additional feedback from a larger group of researchers, with greater variability in their research areas and expertise.

Given that, in its final state, the SVAIS resulted in generally positive feedback from participants, the tool appears to have face validity (Mosier, 1947). As a consequence, it met an immediate need for the candidate's planned intervention studies, but evaluation of its content validity and reliability is suggested as a next step. Concurrent validity of the SVAIS by comparing results to more objective measures, such as through observations and monitoring stakeholder selection of ongoing use of an intervention (Schwartz & Baer, 1991) will aid in determining whether the survey accurately and comprehensively captures social validity. As acknowledged by Schlosser (1999) and reiterated by two participants in their feedback, surveys should form only a part of an assessment of the social validity of an intervention. There is a need to combine the results obtained using the SVAIS with other measures, such as social comparison and having consumers and a variety of stakeholders provide subjective judgements (Schlosser, 1999). Addressing the perspective of the child using means that cater for their communication skills is necessary, such as observations of their willingness to participate in AAC interventions and their spontaneous and continued use of AAC systems.

Conclusion

Measures of social validity remain an under-utilised potential source of information that may prove critical in determining whether interventions have a meaningful and valued influence on children and their families, and thus likely to be adopted by those for whom they have been designed. Development of a comprehensive tool in the form of the SVAIS provides ASD-AAC researchers and practitioners with a means of obtaining information regarding consumer satisfaction with an intervention and its outcomes. As a result, the SVAIS can provide information relevant to either justify choice of intervention in a clinical or educational setting, or indicate redesign is necessary. Evaluation of the SVAIS through piloting and establishing reliability and validity is recommended prior to further use.

Appendix A - Chapter 4

Social Validity in AAC Intervention Survey (SVAIS): Original version

Child:________________________________ Relationship to child: ____

What were your child's communication goals?

____

____

Please rate to what extent you agree or disagree with the following statements.	Strongly disagree	Disagree	Neither agree, nor disagree	Agree	Strongly agree
1. The therapy goals were relevant to my child	1	2	3	4	5
2. I was involved in developing communication goals for my child	1	2	3	4	5
3. My child needs pictures to communicate	1	2	3	4	5
4. It is important that caregivers learn communication strategies to help their child with ASD	1	2	3	4	5
5. It is important that educators learn communication strategies to help a child with ASD	1	2	3	4	5
6. The therapy included activities or toys that were relevant or important to my child	1	2	3	4	5
7. It was easy to use the pictures during therapy	1	2	3	4	5
8. My child enjoyed the activities or toys used during therapy	1	2	3	4	5
9. My child enjoyed using the pictures during therapy	1	2	3	4	5
10. I found find the communication therapy easy to do	1	2	3	4	5
11. I enjoyed participating in the communication therapy	1	2	3	4	5
12. I found the therapy to be appropriate for my child's needs	1	2	3	4	5
13. I would continue to use the communication therapy when the study has finished	1	2	3	4	5
14. I will continue using pictures at home to help my child's communication when the study has finished.	1	2	3	4	5
15. I will use pictures in other settings (outside of home) to help my child's communication	1	2	3	4	5
16. Therapy occurred during typical daily routines and activities	1	2	3	4	5

	Strongly disagree	Disagree	Neither agree, nor disagree	Agree	Strongly agree
17. It is important that parents use this communication therapy	1	2	3	4	5
18. I found the therapy time consuming	1	2	3	4	5
19. The therapy was costly to implement	1	2	3	4	5
20. The therapy fitted into my family's everyday routines and activities	1	2	3	4	5
21. My child's communication skills improved during therapy	1	2	3	4	5
22. I learned strategies to help my child's communication skills	1	2	3	4	5
23. My child will find it easier to communicate with familiar people after therapy	1	2	3	4	5
24. My child will find it easier to communicate with unfamiliar people after therapy	1	2	3	4	5
25. My child is able to engage in activities at home more easily after therapy	1	2	3	4	5
26. My child is able to engage in activities at pre/school more easily after therapy	1	2	3	4	5
27. My child is able to engage in activities out in the community more easily after therapy	1	2	3	4	5
28. My child has made lasting improvements in their communication as a result of therapy	1	2	3	4	5
29. I would recommend this communication therapy to another parent	1	2	3	4	5
30. It is important that parents use this communication therapy with their children with ASD	1	2	3	4	5
31. Other people have noticed improvements in my child's communication	1	2	3	4	5

Additional comments (open-ended responses)

What did you like most about the communication intervention?

What did you dislike about the communication intervention?

Please write any other comments you have about the intervention in the space below.

Thank you for taking the time to complete this survey.

Appendix B - Chapter 4

Information on social validity provided to potential participants and Participant Information Statement

Social validity

Social validity addresses the significance of therapeutic goals to society in terms of how they genuinely reflect what clients, caregivers, interventionists, educators and the community more broadly desire, and also whether associated treatment processes are acceptable (Wolf, 1978). Considerations of social validation allow for interventionists to better understand the perceived importance of the goals of intervention, the acceptability of intervention procedures, and the significance of associated effects (Kazdin, 1977; Wolf, 1978). Attending to social validity has been considered crucial to ensuring interventions result in real-life functionality (Horner et al., 2005).

Wolf (1978) argued that social validity must be considered on three levels: the social significance of the goals; the social appropriateness of the procedures; and the social importance of the effects. Schlosser (1999) applied these levels to the interventions of AAC, proposing that within AAC considerations included: stakeholders both proximal (e.g., client, family, educators) and distal (community members, experts); intervention goals (encompassing society values as well as specific behavioural demonstrations of a target); intervention methods (equipment and processes of an intervention); intervention outcomes (immediate effect of an intervention on behaviour as well as more broad changes for the individual and client group); and validation methods (including evaluations of participants, experts and peers).

Participant Information Statement

Project: AIDED ENHANCED MILIEU TEACHING TO DEVELOP COMMUNICATION FUNCTIONS IN MINIMALLY VERBAL CHILDREN WITH AUTISM SPECTRUM DISORDER

This doctoral research is being conducted by Kristy Logan, under the supervision of Professor Teresa Iacono, College of Science, Health and Engineering, La Trobe Rural Health School, La Trobe University, Bendigo VIC 3552; Ph: (03) 5448 9110; Email: t.iacono@latrobe.edu.au; and Dr. David Trembath, School of Allied Health Sciences and Menzies Health Institute Queensland, Griffith University, Gold Coast QLD 4222; Ph: (07) 5678 0103; Email: d.trembath@griffith.edu.au. Kristy is a candidate for the Doctor of Philosophy (Rural Health) at La Trobe University.

The aim of the study is to investigate the efficacy of aided augmentative and alternative communication (AAC) for children with autism spectrum disorder, and the effectiveness of one intervention approach in particular (aided enhanced milieu teaching). You are invited to participate in the first part of the study, which is to develop a survey tool that can be used to determine the social validity of this intervention, and aided AAC interventions, more broadly.

Social validity assessment is used to determine the significance of therapeutic goals to a variety of stakeholders, and the acceptability of treatment processes and outcomes. In the current study, participants have been selected who are considered experts in the field, and will be asked to provide feedback regarding draft versions of the social validity survey. Participation will involve the completion of two questionnaires regarding the survey. Responses to each questionnaire will inform the further development of the survey so that it better reflects the components considered necessary in determining social validity.

Your participation in this study is voluntary. If you consent to participate, follow the link given in this e-mail to be directed to the on-line Qualtrics questionnaire. Consent will be assumed following submission of questionnaire responses. The draft social validity survey is attached to this e-mail. Each questionnaire should take approximately 20 minutes to complete. This feedback will be used to inform a subsequent version, which you will again be sent. As with the first version, you will be asked to complete another Qualtrics on-line questionnaire. Your responses will be received by the researchers without identifying information.

If you would like to participate in this study, please follow the link in this e-mail to be directed to the Qualtrics questionnaire. No penalties, disadvantages or adverse consequences will be involved if you do not wish to participate. You have the right to withdraw from active participation in this project after providing consent. However, if you do decide to participate, it will not be possible to later withdraw information collected as the researchers will be unable to determine an individual's data. By consenting, you agree that research data provided by you during the project may be included in a thesis, presented at conferences and published in journals on the condition that neither your name nor any other identifying information is used.

Any questions regarding this project may be directed to Kristy Logan, PhD candidate, La Trobe Rural Health School, at k2logan@students.latrobe.edu.au, or Prof. Teresa Iacono (E: t.iacono@latrobe.edu.au, T: 03-5448-9110).

This project has received ethics approval from the College of Science, Health and Engineering, La Trobe University Human Ethics Committee. If you have any complaints or concerns about your participation in the study that the researcher has not been able to answer to your satisfaction, you may contact the Senior Human Ethics Officer, Ethics and Integrity, Research Office, La Trobe University, Victoria, 3086 (P: 03 9479 1443, E: humanethics@latrobe.edu.au). Please quote the application reference number S15-50.

Appendix C - Chapter 4

Feedback questions provided to participants

Questions

1. Does the survey allow for sufficient opportunity to judge the social desirability of goals to all involved stakeholders (i.e., children, peers, caregivers, educators, therapists, community members)? If not, please provide suggestions as to how to better determine whether the goals are socially desirable for all relevant stakeholders.
2. Does the survey allow for sufficient opportunity to judge the acceptability of therapy procedures from the perspective of all involved stakeholders (i.e., children, peers, caregivers, educators, therapists, community members)? If not, please provide suggestions as to how the survey could better provide opportunities where the acceptability of therapy procedures can be judged.
3. Does the survey adequately assess the social validity of the effects of intervention? If not, please provide suggestions regarding how the social validity of the effects of intervention could better be assessed in the survey.
4. Are the communication outcomes of AAC interventions adequately assessed in the survey? If not, please provide suggestions regarding how to better assess communication outcomes in the survey.
5. Would you recommend to clinicians to use this tool in clinical practice? If not, please describe why.
6. Would you recommend this tool for use in research examining AAC treatment outcomes? If not, please describe why.
7. Do you think the results of this survey, when used in intervention studies, will have the potential to inform the design of AAC interventions: (a) in practice; (b) in research; and/or (c) both? Please indicate why or why not.

8. Please describe what you think are the most useful aspects of the social validity survey in its current form.
9. Please describe what you think are the least useful aspects of the social validity survey in its current form and suggest any improvements.

Appendix D - Chapter 4

Revised version of the Social Validity in AAC Intervention Survey (SVAIS)

Child:___________________________________ Relationship to child: ____

What were the communication goals for your child/student?

____

____

Please rate to what extent you agree or disagree with each of the following statements.	Strongly disagree	Disagree	Agree	Strongly agree	Not applicable
1. The therapy goals were relevant to my child/student	1	2	3	4	N/A
2. I was involved in developing communication goals for my child/student	1	2	3	4	N/A
3. My child/student needs pictures to communicate	1	2	3	4	N/A
4. It is important that caregivers learn communication strategies to help their child with ASD	1	2	3	4	N/A
5. It is important that educators learn communication strategies to help a child with ASD	1	2	3	4	N/A
6. The therapy included activities and materials (e.g., toys) that were relevant or important to my child/student	1	2	3	4	N/A
7. It was easy to use the pictures during therapy	1	2	3	4	N/A
8. My child enjoyed the activities and materials used during therapy	1	2	3	4	N/A
9. My child/student enjoyed using the pictures during therapy	1	2	3	4	N/A
10. I found find the communication therapy easy to do	1	2	3	4	N/A
11. I enjoyed participating in the communication therapy	1	2	3	4	N/A
12. I found the therapy to be appropriate for my child/student's needs	1	2	3	4	N/A
13. I would continue to use the communication therapy when the study has finished	1	2	3	4	N/A
14. I will continue using pictures at home/school to help my child/student's communication when the study has finished.	1	2	3	4	N/A
15. I will use pictures in other settings (outside of home/school) to help my child's communication	1	2	3	4	N/A
16. Therapy occurred during typical daily routines and activities	1	2	3	4	N/A
17. It is important that parents/educators use this communication therapy	1	2	3	4	N/A

	Strongly disagree	Disagree	Agree	Strongly agree	Not applicable
18. I found the therapy time consuming	1	2	3	4	N/A
19. The therapy was costly to implement	1	2	3	4	N/A
20. The therapy fitted into my family/class's everyday routines and activities	1	2	3	4	N/A
21. My child/student's communication skills improved during therapy	1	2	3	4	N/A
22. I learned strategies to help my child/student's communication skills	1	2	3	4	N/A
23. My child/student will find it easier to communicate with familiar people after therapy	1	2	3	4	N/A
24. My child/student will find it easier to communicate with unfamiliar people after therapy	1	2	3	4	N/A
25. My child/student has been able to participate in activities at home/school more easily after Therapy	1	2	3	4	N/A
26. My child/student has been able to participate in activities out in the community more easily after therapy	1	2	3	4	N/A
27. My child/student has made lasting improvements in his/her communication as a result of therapy	1	2	3	4	N/A
28. I would recommend this communication therapy to another parent/teacher	1	2	3	4	N/A
29. It is important that people use this communication therapy with children with ASD	1	2	3	4	N/A
30. Other people have noticed improvements in my child/student's communication	1	2	3	4	N/A

Additional comments (open-ended responses)

What did you like most about the communication therapy?

What did you dislike about the communication therapy?

Please write any other comments you have about the therapy in the space below.

Thank you for taking the time to complete this survey.

Appendix E - Chapter 4

Final version of the Social Validity in AAC Intervention Survey (SVAIS)

What were the communication goals for your child?

____

____

Please rate to what extent you agree or disagree with each of the following statements.	Strongly disagree	Disagree	Agree	Strongly agree	Unsure
1. The therapy goals were relevant to my child	1	2	3	4	U
2. I was involved in developing communication goals for my child	1	2	3	4	U
3. My child needs to use pictures to communicate	1	2	3	4	U
4. It is important that caregivers learn communication strategies to help their child with ASD	1	2	3	4	U
5. The therapy included activities and materials (e.g., toys) that were relevant or important to my child	1	2	3	4	U
6. It was easy to use the pictures during therapy	1	2	3	4	U
7. My child enjoyed the activities and materials used during therapy	1	2	3	4	U
8. My child enjoyed using the pictures during therapy	1	2	3	4	U
9. I found find the communication therapy easy to do	1	2	3	4	U
10. I enjoyed participating in the communication therapy	1	2	3	4	U
11. I found the therapy to be appropriate for my child's needs	1	2	3	4	U
12. I would continue to use the communication therapy when the study has finished	1	2	3	4	U
13. I will continue using pictures at home to help my child's communication when the study has finished.	1	2	3	4	U
14. I will use pictures in other settings (outside of home) to help my child's communication	1	2	3	4	U
15. Therapy occurred during typical daily routines and activities	1	2	3	4	U
16. It is important that parents use this communication therapy	1	2	3	4	U

	Strongly disagree	Disagree	Agree	Strongly agree	Unsure
17. I found the therapy time consuming	1	2	3	4	U
18. The therapy was costly to implement	1	2	3	4	U
19. The therapy fitted into my family's everyday routines and activities	1	2	3	4	U
20. My child's communication skills improved during therapy	1	2	3	4	U
21. I learned strategies to help my child's communication skills	1	2	3	4	U
22. My child will find it easier to communicate with familiar people after therapy	1	2	3	4	U
23. My child will find it easier to communicate with unfamiliar people after therapy	1	2	3	4	U
24. My child has been able to participate in activities at home more easily after Therapy	1	2	3	4	U
25. My child has been able to participate in activities out in the community more easily after therapy	1	2	3	4	U
26. My child has made lasting improvements in his/her communication as a result of Therapy	1	2	3	4	U
27. My child is able to communicate for reasons other than requesting objects after Therapy	1	2	3	4	U
28. I would recommend this communication therapy to another parent	1	2	3	4	U
29. It is important that people use this communication therapy with children with ASD	1	2	3	4	U
30. Other people have noticed improvements in my child's communication	1	2	3	4	U

Additional comments

What did you like most about the communication therapy?

What did you dislike about the communication therapy?

Please write any other comments you have about the therapy in the space below.

Thank you for taking the time to complete this survey.

Chapter 5: Aided Enhanced Milieu Teaching to Develop Symbolic and Social Communication Skills in Children with ASD who use AAC

Overview

This chapter presents the first intervention study, in which the information gained on characteristics of effective AAC interventions used to teach social communication skills from the previous two systematic reviews was applied. The efficacy of an aided form of enhanced milieu teaching was investigated with three participants with ASD. Details regarding the rationale for this intervention, methodology for implementation, outcomes, and implications are presented.

Manuscript in Preparation

Logan, K., Iacono, T., & Trembath, D. (2020b). *Aided enhanced milieu teaching to develop symbolic and social communication skills in children with autism*.

Statement of Contribution

As co-authors of the following manuscript titled "Aided enhanced milieu teaching to develop symbolic and social communication skills in children with autism," we confirm that Kristy Logan has made the following contribution: The study was designed by the candidate in collaboration with her primary supervisor Professor Teresa Iacono and associate supervisor Associate Professor David Trembath. The candidate was solely responsible for data collection and analysis. Inter-rater agreement was conducted by Dr Suzanne Stevens, and procedural fidelity was completed by the candidate and Dr Suzanne Stevens. Kristy Logan was responsible for writing the complete first draft of the manuscript, while Professor Teresa Iacono and Associate Professor David Trembath provided critical feedback of each draft prior to thesis inclusion.

Signed: ______________________ Date: 03/11/2020

Professor Teresa Iacono

Signed: ______________________ Date: 03/11/2020

Associate Professor David Trembath

Abstract

Children with autism spectrum disorder (ASD) who lack functional spoken language are candidates for augmentative and alternative communication (AAC). Both the use of aided AAC and naturalistic interventions offer the potential to extend the communication functions demonstrated by children with ASD. Intervention research has been limited, however, in that AAC interventions have often targeted a small range of communication behaviours taught in highly structured, and hence, decontextualised environments. Further, little attention has been paid to the social validity of interventions or their outcomes. The aim of this study was to investigate the efficacy of an intervention that combined aided AAC with a naturalistic intervention – enhanced milieu teaching (AEMT) - to increase symbolic communication in children with ASD. A further aim was to evaluate the social validity of the intervention. Three children with ASD participated in a multiple probe, multiple baseline design, in which three communication functions with specified vocabulary were targeted using the AEMT. The intervention further incorporated a combination of least-to-most prompting and various environmental arrangement strategies and interaction features. Results showed increases in the use of symbolic communication from baseline to intervention phases, which were found to be statistically significant for two of the three participants (phi 0.7-0.81; $p<0.001$). Intervention outcomes were generalised to a communication partner not involved in the intervention and maintained over time for all participants. Caregivers regarded the intervention and its outcomes to be socially valid. The study demonstrated that although children could be taught communication functions beyond object requests, an intensive, systematic, multi-element approach implemented across activities was required.

Aided Enhanced Milieu Teaching to Develop Symbolic and Social Communication Skills in Children with Autism

Augmentative and alternative communication (AAC) has been shown to support expression in children with autism spectrum disorder (ASD) who are minimally verbal (e.g., Ganz, Earles-Vollrath et al., 2012; Lorah, Parnell, Whitby, & Hantula, 2015). Most often, the target of AAC intervention has been communication for the purposes of making object requests, with associated positive outcomes (e.g., Ganz, Earles-Vollrath et al., 2012; van der Meer & Rispoli, 2010; Wendt, 2009). More recently, the importance of targeting a broader range of communication functions has been highlighted, with systematic reviews providing evidence that these functions can be taught successfully (Logan, Iacono, & Trembath, 2017; 2020a, Chapters 2 and 3, respectively). However, obtaining experimental control in some studies (e.g., conducted in research clinics and restricting activities) has come at the expense of more natural interactions, which create contexts in which a broad range of communication functions can be targeted (Logan et al., 2020a). An absence of generalisation data has historically been recognised as a concern (e.g., Harris, 1975; Schlosser & Lee, 2000) and is reflected in AAC research, which has been characterised by a narrow range of communication targets and a lack of inclusion of naturalistic elements within interventions (Logan et al., 2020a). As a result, there remains a question as to whether the communication functions typically used within a child's natural environments can be taught effectively. There have long been calls for research into the effectiveness of incorporating more naturalistic elements in combination with systematic teaching strategies to develop contextually-relevant and flexible communication skills, a fundamental objective of AAC instruction (Mirenda, 2003).

Social Communication Development in Children with ASD

Children with ASD demonstrate a core difficulty with social communication (American Psychiatric Association, 2013), which becomes apparent very early in development. For example, in comparison to those who are typically developing, infants with ASD have been observed to respond to communication by others less frequently (e.g., Bruinsma, Koegel, & Koegel 2004; Mundy, Sigman, Ungerer, & Sherman, 1986), demonstrate a lack of spontaneous imitation (e.g., Zwaigenbaum et al., 2005), and less frequently exhibit pointing, engagement and social sharing (Barbaro & Dissanayake, 2012; Osterling & Dawson, 1994). These difficulties are presumed to have a compounding effect by reducing social experiences, thereby leading to continuing deficits in social communication skills (Chevallier, Kohls, Troiani, Brodkin & Schultz, 2012).

These early impairments in social communication development may reflect an underlying difference in motivation to use communication for different purposes (i.e., functions). Research into how children with ASD acquire pragmatic functions has demonstrated a unique profile of a restricted range, with reliance on communication to regulate the behaviour of others to obtain an environmental end, and little communication for the purpose of attracting or directing attention of others as the primary goal (Shumway & Wetherby, 2009; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby & Prutting, 1984). In contrast to typical development, communication functions appear to develop sequentially, rather than concurrently, for children with ASD (Wetherby & Prutting, 1984). Wetherby (1986) proposed a developmental model in which children with ASD first demonstrate imperative functions (involving behavioural regulation, such as requesting an object or protesting), followed by emergence of functions that draw and maintain attention to the self (e.g., greeting or requesting a social routine); and lastly declarative functions (e.g., commenting), which represent the most difficulty for children with ASD. Subsequent research has provided support for this developmental sequence (e.g., Stone & Caro-Martinez, 1990). Cognitive skills and level of ASD severity have been proposed as influencing the use of communicative functions, such that children with poorer cognitive skills who demonstrate greater difficulties associated with ASD may not progress to using declaratives or use them infrequently (Stone & Caro-Martinez, 1990).

Augmentative and Alternative Communication Interventions

Up to 30% of children with ASD do not acquire adequate speech (Anderson et al., 2007; Rose, Trembath, Keen, & Paynter, 2016) and require AAC systems to support expression. Aided AAC, involving visual-graphic symbols, has often been used with children with ASD, in particular, because they require little manual dexterity in the face of potential fine motor difficulties (Lloyd, Macdonald, & Lord, 2013) and symbol meanings are arguably more transparent to communication partners than those produced using unaided AAC, such as manual sign (Mirenda, 2003). The use and benefits of aided AAC to develop communication in children with ASD have been well established (e.g., Alzrayer, Banda, & Koul, 2014; Ganz, Davis, Lund, Goodwyn, & Simpson, 2012; Ganz, Earles Vollrath et al., 2012; Still, Rehfeldt, Whelan, May, & Dymond, 2014). Reviews of the literature have indicated a strong focus in intervention studies on the communication function of object request (Ganz, Earles-Vollrath et al., 2012; van der Meer & Rispoli, 2010), but there is evidence, albeit limited, that a broader range of functions can be taught (Logan et al., 2017).

In several research reviews, AAC intervention strategies that can be used to teach different communication functions to children with ASD have been explored. For studies involving teaching of requests as well as more social functions, strategies based on applied behavioural analysis (ABA) techniques have been found effective. These have included errorless learning, modelling, prompting, environmental arrangement, use of reinforcement, and time delay (e.g., Alzrayer et al., 2014; Gevarter et al., 2013; Gevarter & Zamora, 2018;

Logan et al., 2020a; Still et al., 2014). Although these ABA-based teaching strategies have yielded positive outcomes when teaching a range of communication functions, there have been concerns that the skills taught do not reflect typical communication exchanges in a child's life. For example, in their systematic review of AAC interventions, Logan et al. (2020a) found that efforts to create naturalistic communication contexts varied widely, with symbolic communication skills frequently taught using highly structured context-bound routines, not representative of typical interactions. To increase generalisation and flexibility in use of skills, it has been argued that teaching strategies should be implemented in naturalistic contexts, such as during typical activities in familiar environments (Schreibman, et al., 2015). Indeed, actively incorporating intervention elements and strategies that support skill generalisation has been proposed as vital in AAC interventions (Schlosser & Lee, 2000).

Naturalistic Interventions

A range of techniques have been implemented to encourage generalisation when employing naturalistic therapy interventions. These include the use of everyday activities and routines, in addition to child-preferred activities, to create communication opportunities in natural contexts (Koegel, O'Dell, & Koegel, 1987; Koegel, Dyer, & Bell, 1987). Enhanced milieu teaching (EMT) is an example of a naturalistic intervention, combining core elements of environmental arrangement, responsive interaction techniques, and milieu teaching (Hemmeter & Kaiser, 1994; Kaiser & Hampton, 2017; Kaiser, Hancock, & Nietfeld, 2000). In EMT, behavioural learning principles are combined with motivating, naturally occurring communication situations (Kaiser & Hancock, 2003). Elicitation and generalisation of communication skills are encouraged through building on child interests, being responsive to child communication, using naturally occurring communication situations, implementing prompting strategies, providing natural consequences, and embedding teaching in everyday interactions (Kaiser, Yoder, & Keetz, 1992).

EMT, a variant of milieu teaching, and prelinguistic milieu teaching have been used with success to develop communication skills in children with ASD. Application of these approaches has resulted in improvements in range, diversity, and spontaneity of language produced (Christensen-Sandfort & Whinnery, 2013; Hancock & Kaiser, 2002; Kaiser et al., 2000), as well as development of language-related behaviours, such as joint attention (Yoder & Stone, 2006) and intentional communication (Franco, Davis, & Davis, 2013). There has been some evidence that aided AAC can be combined with EMT to develop symbolic communication skills in children with ASD. With respect to requests, both Olive et al. (2007), who combined EMT with a speech-generating device, and Ogletree, Davis, Hambrecht, and Phillips (2012) who used milieu teaching to elicit photograph exchange, found that children increased their object requests in response to milieu teaching. Results have been mixed for other communication functions, which predominantly have involved application of milieu teaching variants with speech-generating devices. McMillan (2008) found little change in frequency of responses, while Kasari and colleagues (2014), who combined EMT with a joint attention and symbolic play intervention, found a small to moderate effect size for use of comments.

Increasing Symbolic Communication Using EMT

EMT might provide a viable means to develop symbolic communication for varied pragmatic functions for children with ASD. It involves application of ABA teaching strategies, which have demonstrated success in developing functional communication through the use of AAC. Further, as a naturalistic intervention, EMT incorporates key features that enhance spontaneity and generalisation of new behaviours. Previous research has focused largely on the application of EMT with children with language disorders who demonstrated prerequisites considered predictive of success, such as use of single words and verbal imitation skills (Hancock & Kaiser, 2006; Kaiser & Hampton, 2017). Through providing a means of symbolic expression in the form of AAC to children with ASD who are minimally verbal, recommendations for application of the EMT intervention with a broader population may be justified.

As with other structured interventions, implementation of an aided AAC EMT intervention would involve adherence to an intervention protocol, with an associated significant time commitment by children with ASD and their families. Given this relative cost, it is incumbent on researchers to demonstrate that those involved see intervention goals as relevant, procedures as acceptable, and outcomes as impactful. Social validity accounts for the functionality of changes in behaviour, acceptability of intervention procedures, and relevance of intervention goals to key people, such as participants themselves and interactants (Kazdin, 1977; Wolf, 1978). Hence, consideration of this construct is arguably critical in determining the potential uptake (and thus utility) of interventions. Evaluation of the social validity of interventions provides useful information regarding whether interventions will be used in typical environments (Horner et al., 2005) and if strategies will be applied by typical communication partners (Callahan, Henson, & Cowan, 2008). Further, for AAC users, social validity provides evidence that communication outcomes in response to intervention reflect meaningful change (Light, 1999; Schlosser, 1999). Consequently, the translation of efficacy research into practice is likely to be enhanced by evaluation of multiple aspects of social validity.

Aim

The aim of this study was to combine intervention elements previously found effective in increasing both symbolic communication and a range of communication functions produced by children with ASD who were minimally verbal: EMT paired with aided AAC. The specific aim was to test the effectiveness of such a combined approach, referred to as aided enhanced milieu teaching (AEMT), according to immediate improvements in communication. Further aims were to determine the generalisation, maintenance and social validity of the intervention and its outcomes. On the basis of previous research, it was predicted that:

1. AEMT would improve symbolic communication in children with ASD who were minimally verbal,
2. AEMT would improve use of a range of communication functions in the symbolic communication of children with ASD,
3. outcomes would be generalised to different communication partners and maintained over time, and
4. caregivers would regard the AEMT as socially valid.

Method

Ethics Approval

Approval for this study was obtained from La Trobe University Human Ethics Committee (15-056), the Aspect Research Approvals Committee (1719), and the NSW Department of Education State Education Research Applications Process (2015226).

Design

A modified multiple baseline across participants design was used in the form of a multiple-probe technique (Horner & Baer, 1978). The independent variable was the AEMT. The dependent variable was the frequency of spontaneous, unprompted symbolic communication behaviours. Social validity was determined through a survey analysed descriptively.

Participants

Selection criteria. Children met the following criteria for inclusion: (a) were aged less than 8 years (corresponding with the early childhood development period which is considered to be the most important developmental phase; Irwin, Siddiqi, & Hertzman, 2007); (b) had previously received a diagnosis of ASD based on DSM-IV/TR/5 criteria (American Psychiatric Association, 1994; 2000; 2013), as confirmed by psychological or paediatrician written assessment reports and administration of the Gilliam Autism Rating Scales (GARS) (Gilliam, 2014); (c) were minimally verbal, defined as having fewer than 10 different words identified as "understands and says" on the MacArthur-Bates Communicative Development Inventories (CDI) (Fenson, Marchman, Thal, Reznick, & Bates, 2007), and confirmed by researcher observation; (d) used at least one intentional communication act (ICA) during preferred activities, assessed via researcher administration of communication temptations (Wetherby & Prizant, 1989); (e) had completed a previous hearing assessment indicating no loss reported and had no recorded uncorrected vision impairments; and (f) English was their preferred language, established according to parent reports of the language used at home with their child.

Inclusion criteria for caregiver participants were that they were (a) a primary caregiver of the participating child; and (b) willing to commit to home-based sessions for the duration of the study.

Recruitment. Information leaflets were sent to early childhood intervention centres, autism-specific service providers, developmental paediatricians, and schools for specific purposes (special schools) in Sydney, Australia (refer to Appendix A- Chapter 5). Interested caregivers then contacted the researcher who interviewed them via phone to ascertain their child's current communication skills and potential appropriateness for the study. Caregivers then met with the researcher, who provided a written participant information statement (refer to Appendix B- Chapter 5), further explanation of the study and opportunities to answer questions. The caregivers signed a consent form for their own participation and that of their child (refer to Appendix C- Chapter 5). Child assent was indicated by each child's willing participation in each session.

Description. Three children were recruited for the study; their developmental information, adaptive behaviour, and severity of ASD is presented in Table 1. Imran was a 7;4-year-old boy. Imran communicated mainly by vocalising, touching objects he wanted, placing another's hand on a desired object, pushing non-preferred items away, or bringing desired objects to a person. He attended a school for children with moderate to severe intellectual disabilities five days per week. He was also attending several ABA therapy sessions per week, occupational therapy on a fortnightly basis, and music therapy on a weekly basis. At school, his mother reported that Imran was exposed to a number of AAC supports, including photos, manual sign, and communication books. He did not use any form of AAC at home. Imran's family spoke English and Bengali at home, but English was reported by his parents to be his preferred language. Imran did not use any words in response to communication temptations (see below) or during observation. He had a vocal repertoire of many different consonants and vowels, although these were not produced as recognisable words.

Lachlan was a 2;2-year-old boy. He generally communicated by vocalising, pointing, handing over an object, and leading a person to what he wanted. Lachlan's care was shared by his parents and a nanny (two days per week), and he also attended childcare for one day each week. Lachlan attended speech pathology twice per week, occupational therapy once per week, and ABA therapy several days per week. He did not use AAC in any setting (including during therapy). Lachlan's family spoke English as their primary language at home. Lachlan used the following spontaneously, but not consistently: "ouch" and "uh oh." He had a vocal repertoire comprising a number of different consonants and vowels, although these were not usually produced as readily recognised words.

Nicholai was a 7;5-year-old boy. He communicated mainly by leading another person to what he wanted; he also demonstrated challenging behaviours, such as hitting himself and

Table 1

Participant Information

	Age	GARS	Words	VABS-II	DP-3
Imran	7	107 (very likely); Very substantial	0	52 (0.1), Low RL: 0;10 EL: 0;9	<40 (<0.1), Delayed
Lachlan	2	95 (very likely); Substantial	2	ABC: 73 (4), Moderately Low RL: 1;3 EL: 0;7	44 (<0.1), Delayed
Nicholai	7	106 (very likely); Very substantial	1	ABC: 56 (0.2), Low RL: 2;5 EL: 0;9	<40 (<0.1), Delayed

Note. GARS= Gilliam Autism Rating Scales (Gilliam, 2014); Words= number of words reported using MacArthur-Bates Communication Development Inventory (Words and Gestures; Fenson et al., 2007); VABS-II= Vineland Adaptive Behaviour Scales-II Adaptive Level (Sparrow, Cichetti, & Balla, 2005); DP-3= Developmental Profile-3 (Alpern, 2007); RL= Receptive language age equivalence; EL= Expressive language age equivalence.

vocalising loudly when frustrated. Nicholai attended an autism-specific school five days per week and speech pathology on a fortnightly basis, in addition to bimonthly psychology support. In the past, Nicholai had also been enrolled in ABA therapy, which had ceased two years prior to the current study. At school and home, he was learning to use Proloquo2go™ on an iPad® to request objects. However, he did not use this system spontaneously or with independence at home. Nicholai's family spoke English as their primary language at home, although he was also exposed to Russian through his extended family. Nicholai did not use any words spontaneously in response to communication temptations or during observation. He presented with a restricted phonemic inventory, with no clear word-like productions.

There were five caregiver participants in total. Imran's primary caregiver was his mother, Lachlan's primary caregivers were his mother and father, with additional care provided by a nanny, and Nicholai's primary caregiver was his mother.

Setting

Sessions for each of the participants were conducted in their respective homes. The room location was negotiated with caregivers: for Imran and Nicholai, this was in a playroom, while seated at a table; for Lachlan, it was in a lounge room, while seated on a mat. The researcher sat alongside or opposite participants during each session, with her body oriented towards the child at all times. A Sony® Digital HD Video Camera Recorder (HDR PJ230) was set up on a tripod approximately 1m away from participants to record sessions.

Materials

Six communication boards were developed that corresponded to six preferred everyday activities, individualised for each child and determined through parent interview. In order to identify these activities, the Reinforcement Inventory (Autism Spectrum Australia, 2016) was used. Procedures for generating the words represented by symbols was according to that described by Goossens, Crain, Elder (1992). Vocabulary was selected that allowed the communication partner to provide a commentary on what was happening during the activity and included what a child might potentially say in that activity. Each A4-sized laminated communication board contained 16 visual-graphic symbols organised according to a 4 rows by 4 columns layout. The visual-graphic symbols were produced using Boardmaker™ (Mayer-Johnson, 2004). For each graphic symbol, there was a second copy attached on top using Velcro™, allowing for removal and physical/visual highlighting of symbols (via showing). Picture communication symbols (Mayer-Johnson, 2004) were selected for several reasons: (a) they provided the means for expression of abstract concepts (e.g., verbs and attributes) needed for the communication boards; (b) they provided generic and consistent representation of objects that allowed for the same symbol to be used across children that was not specific to their particular equipment and setting, and able to be used with flexible meaning according to the communication context; (c) the symbol sets were those frequently used in clinical practice and education in Australia, and (d) research has indicated that increased symbol iconicity does not improve learning of early and unknown words (Namy, Campbell, & Tomasello, 2004; Sevcik, Barton-Hulsey, Romski, & Fonseca, 2018).

Each communication board contained 11 symbols that were consistent across activities (core vocabulary) and five symbols specific to the given activity (fringe vocabulary). In this way, although preferred activities differed according to child preferences, most visual-graphic symbols remained consistent across activities and participants. The core vocabulary symbols on each board were *WHAT*, *WANT*, *YOU*, *OPEN*, *HEY*, *UH OH*, *CHOOSE*, *TURN*, *LOOK*, *MORE*, and *FINISHED*. Table 2 provides a list of each child's reinforcing activities in addition to fringe vocabulary. Three vocabulary items with target functions were selected as a focus concurrently across participants to provide equal exposure to varied functions: one from functions relating to behavioural regulation (request action - *OPEN*), one from functions relating to social interaction (calling - *HEY*), and one from functions relating to communication for joint attention (commenting - *UH OH*).

Intervention Researcher

The candidate was the researcher who administered intervention procedures. At the start of the study, she had 12 years' experience working as a speech pathologist, and 3.5 years working as a special education teacher, both with children with ASD. She had Hanen™

Table 2

Children's Preferred Activities and Associated Fringe Vocabulary

Communication Board	Participant		
	Imran	Lachlan	Nicholai
Bubbles: blow, lots, a little, pop, bubbles	✓	✓	✓
Water play: swim, splash, water, pour, water play	✓	✓	✓
Surprise box: give, take out, help, wow, surprise box Contents: Imran (car magazines, slinky, vibrating toys, and squishy balls); Lachlan (wind-up toys, vibrating toys, and puzzles); and Nicholai (slinky, vibrating toys, and squishy balls)	✓	✓	✓
Play dough: make, squish, shapes, roll, play dough	✓		✓
Cars: drive, fast, slow, crash, car	✓		
Sand: make, put, mess, shapes, sand	✓		
Balloons: blow, fly, big, let it go, balloon			✓
Snack: eat, taste, yummy, yucky, food Contents: Mentos™, rice crackers, popcorn			✓
Books: read, count, turn the page, like, book Contents: *n*=3 number/counting-themed books		✓	
Shape sorter: give, put in, take out, blocks, did it		✓	
Ball run: give, put in, roll, ball, little		✓	

certification for the It Takes Two To Talk™ program, which is utilised in the responsivity education component of EMT (Fey, Yoder, Warren, & Bredin-Oja, 2013).

Procedures

Participants were randomly assigned a participant number for entry into the study. A minimum of three baseline data points was required prior to the start of the intervention phase. When a response to intervention was observed in one participant, determined as the spontaneous use of two instances of symbolic communication, the next participant was engaged in 3 baseline probe sessions over one week, before proceeding to the intervention phase.

Baseline. During baseline probes, the researcher interacted with the child during three of the activities that were selected for intervention. The communication board relevant to the activity was present. No instruction regarding the aided AAC materials was provided at this time. If the child used a communication board communicatively (i.e., as a symbol), the researcher provided a neutral comment (e.g., "that's interesting"). Imran, participated in three baseline probes, Lachlan four, and Nicholai five.

Intervention. Each participant received 20 sessions of the AEMT. Sessions initially occurred four to five times per week, but the intensity reduced after the first few weeks of intervention so that all participants were able to complete the same number of intervention sessions and phases within a similar timeframe. Twenty sessions were selected as a minimum as per Hancock and Kaiser's (2006) recommendation for EMT. Sessions were approximately 30 min in duration, to allow for at least a 20 min sustained period to focus on direct AEMT with the child. A minimum of three activities was selected for each session (determined according to child interests).

For the AEMT, three functions were selected as targets across activities, which were cycled through as foci during activities. Selected functions were request action (represented by the symbol *OPEN*), calling (represented by *HEY*), and commenting (represented by *UH OH*). The choice of function and frequency of use varied according to the child's interests and opportunities that arose naturally during play. Other communication functions were also demonstrated during the intervention as opportunities arose. A correct response was the child's spontaneous use of any symbolic communication without prompting. The total number of correct responses per coded segment was recorded.

AEMT. Components of the AEMT included environmental arrangement, features of the researcher-child interaction (responsive interaction and aided milieu language teaching), and the use of aided language elicitations, which comprised prompts to elicit symbolic language.

Environmental arrangement. During intervention, the environment was set up in a way that promoted communication opportunities. The strategies described in Table 3, adapted from Ostrosky and Kaiser (1991), were cycled through during activities.

Features of the interaction. Interaction techniques were selected to promote interaction and communication between the researcher and the child. During all interactions, spoken language was accompanied by pointing to related visual-graphic symbols representing key words, with frequent pausing and expectant waiting used to demonstrate to the child when a communication turn was expected. The strategies implemented were adapted from Hancock and Kaiser (2006) and are described in Table 4.

Aided language elicitation (prompting sequence). The following strategies, adapted from Alpert and Kaiser (1992) and Hancock and Kaiser (2006), were used in a least-to-most support method to elicit symbolic language from participants:

1. Time delay. The adult showed the child the appropriate picture by pointing to it, or holding it in front of the child, and then waited five seconds for the child to respond.

2. *Manding*. If no response occurred in response to time delay, the researcher requested a response (e.g., “You need to tell me”).

3. *Mand-Modelling*. If no response occurred from the provided mand, the researcher provided another mand, accompanied by a verbal model and by tapping the relevant graphic symbol (e.g., “Say *OPEN*”).

4. Prompting symbol use. A physical prompt was used as the most maximally supportive prompt to elicit a correct response (e.g., gently guiding the child's hand to the correct picture on the communication board).

Table 3

Environmental Arrangement Strategies used in the AEMT

Strategy	Description
Use of materials of interest to children	Materials present in the room were those relating to target AEMT activities. Materials were of high interest to the child, and the child demonstrated obvious engagement.
Objects in sight but out of reach	During each session, preferred equipment or toys were placed in view, however inaccessible (e.g., out of reach, in the control of the researcher, or in a locked container)
Communication activity boards within child's reach	The aided AAC was within an arm reach of the child during activities
Insufficient provision of portions	During activities in which a turn or portion were involved, the researcher provided only a short turn or small portion of the object
Choice making opportunities	Choices were provided both within and between activities (e.g., between "big" or "little" bubbles during this activity, or between activities such as "play dough or surprise box")
Creation of communication opportunities within the session: the need for assistance, sabotage, or the element of surprise	The researcher devised situations where the child would initiate communication through need or desire, comprising: needing help to commence or continue with an activity, doing something to interrupt the continuation or start of an activity, or doing something unexpected during the activity
Turn taking with materials	The researcher created sequences where materials were shared within activities

Table 4

Interaction Strategies used in the AEMT

Strategy	Description
Expectant looking	The researcher looked at the child and waited with raised eyebrows to let the child know that she was waiting for the child's response or initiation.
Language modelling using communication boards	The researcher pointed to pictures on the communication activity board while speaking to match what the child was doing or what was happening.
Language stimulation	The researcher commented, described and interpreted what the child was doing as the child was doing it. The researcher modelled words that matched what was happening.
Child-led interactions	The researcher focused on what the child was attending to in order to establish joint attention, allowed the child to participate in activities according to his interest, and responded to the child's communication and behaviour. The researcher provided opportunities for the child to communicate by pausing, looking at the child, and not monopolising the activity with excessive talking.
Language matching and imitation	The researcher used simple language, at the same level, or slightly above, what the child used to express himself. This also involved imitating the child and copying the sounds, words, or pictures he used.
Expansion	The researcher imitated/repeated and added extra words/symbols to expand the length of the child's message. If the child did not point to any pictures but communicated a message through his actions (e.g., moving away, pointing), the researcher expanded this to a symbolic communication form (by pointing to an appropriate visual-graphic symbol). Verbal expansions were also provided (e.g., if the child pointed to *WANT*, the researcher might verbally expand the message to, "you want the ball."
Provision of natural consequences to child's communication and behaviour	The researcher provided access to items or activities requested within the activity, gave further interaction, or provided verbal feedback for child's actions, such as acknowledgement and response.
Time to respond	The researcher paused after commenting or questioning, waiting for the child to respond

Generalisation

Following the AEMT, a 1-week generalisation phase was conducted, comprising three 30 min sessions. Generalisation to a caregiver as the communication partner was assessed. For Imran and Nicholai, their mothers participated in the generalisation phase; for Lachlan, his mother, father, and nanny each participated in one of three respective generalisation sessions because his care was shared. All generalisation sessions occurred in the same setting as baseline and intervention.

Maintenance

After the AEMT intervention phase, there was a 4-week break from data collection. During these four weeks, participants received no further training in the use of AEMT and did not have access to their communication boards used in the study. After this break, two 30 min sessions were conducted with each child. The researcher re-introduced the aided AAC system across activities that had been targeted for intervention, using the same procedures as those implemented during intervention. Participant demonstration of target behaviours at a higher rate than the first two intervention sessions was considered to indicate maintenance. The reason for re-instating intervention procedures during maintenance was to provide additional learning opportunities if the dependent variable was not consistently demonstrated by participants (Finke et al., 2017). Further, in the situation in which skills demonstrated during intervention and generalisation were not apparent, it was deemed ethically appropriate and socially valid to continue to provide learning opportunities for participants.

Data Collection and Coding

In keeping with repeated measures time series designs, data collection occurred during each baseline, intervention, maintenance, and generalisation session. For each session, 20 min was selected from which to code the child's use of symbolic communication. An instance of symbolic communication was defined as spontaneously pointing to a picture relating to the target communication function or saying the associated word, without the researcher providing any of the teaching prompts. The 20 min to be coded commenced when the child sat down to begin the initial activity and ended 20 min later. As the intervention was child-led, the session was ended if participants did not appear engaged in activities; as a result, for participant three (Nicholai), two sessions ended prior to 20 min of coding time (18 and 19 min, respectively). All sessions were video-recorded. Information coded from the videos comprised the symbol used, time stamp, communicative function, level of prompt required (if relating to the target symbols/functions of *OPEN* - request object, *HEY* - call, and *UH OH* - comment), and whether the prompting sequence was implemented with fidelity. The child's use of symbolic communication was depicted graphically, in addition to his use of target symbols/functions. An operational definition of symbolic communication is provided in Appendix D - Chapter 5.

Fidelity checks. Fidelity of the researcher's use of the prompting sequence was assessed by the researcher using video recordings of intervention sessions and a checklist (refer to Appendix E - Chapter 5). Fidelity of implementation of the prompting sequence was 95% (range 79-97%). Fidelity of the researcher's use of AEMT strategies (environmental arrangement and features of the interaction) was also assessed using a checklist (refer to Appendix F - Chapter 5). The purpose of this checklist was to ensure that the researcher used a range of strategies from those detailed in Tables 3 and 4 across the coded intervention segment. The researcher coded use of strategies using the checklist, with this information presented in Tables 5 and 6. Fidelity was further checked by determining inter-rater agreement with a clinical researcher (PhD-qualified clinical psychologist) who was independent of the study. This clinical researcher scored 30% of randomly selected digital recordings of intervention sessions. Point-by-point comparison was used to determine percentage of agreement versus disagreement for correct application of features of the intervention. For the prompting sequence, agreement was 99% (range 99-100%), for use of environmental arrangement strategies it was 87% (range 83-91%), and for features of the interaction it was 88% (range 86-89%).

Inter-rater reliability. The same clinical researcher completed inter-rater reliability checks on coding of the dependent variables. Reliability checks occurred for 31% of randomly selected digitally recorded sessions across baseline, intervention, generalisation, and maintenance phases (refer to Appendix E - Chapter 5 for coding specifications). Agreement was defined as both coders scoring the same instance of communication as symbolic, while disagreement was scored if one coder recorded an instance as symbolic, and the other did not. Inter-rater agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100. The mean inter-observer agreement for participants' use of symbolic communication was 86% (range 60-94%). Agreement for Nicholai's symbolic communication was lower (at 60%) than that of the other two participants as his behaviours were less consistent and consequently more difficult to assign as symbolic or non-symbolic. Inter-observer agreement for the function of participants' use of symbolic communication was 95% (range 94-100%).

Analysis

According to convention for analysing data from experimental single case designs, two methods were applied: (a) visual analysis of graphic representation of the data was used to judge intervention effectiveness (inspected for changes in level of performance, trend, variability, immediacy of effect, overlap, and consistency of data patterns across similar phases) (Kratochwill et al., 2010); and (b) percent of all non-overlapping data (PAND) in combination with Phi to quantify treatment effects (Parker, Hagan-Burke, & Vannest, 2007). In calculating PAND, data points that overlap are removed, with the percentage of data remaining determined to calculate non-overlap beyond chance level. PAND is scaled from 50-100, with 50 representing chance level ($x - 50$ = percentage beyond chance level; Parker et al., 2007). Phi is then calculated from PAND by removing the minimum number of data points that overlap across baseline and intervention, halving that minimum number to create two ratios for baseline and intervention phases, and then submitting these ratios in a 2x2 table to cross-tab analysis, yielding phi (Parker et al., 2007). Scruggs, Mastropieri, Cook, and Escobar's (1986) qualification of outcomes was used for the effect size.

Social Validity

A survey designed for the purpose of this study- the Social Validity in AAC Intervention Survey (SVAIS)- was used to determine the social validity associated with the AEMT. Its purpose (as described in Chapter 4) was to address the elements of social validity proposed by Kazdin (1977) and Wolf (1978) and adapted for AAC interventions by Schlosser (1999). Specifically addressed were the validation of goals, methods, and outcomes from the perspective of the stakeholders involved with participants. The SVAIS included 30 questions, answered on a 4-point scale from strongly disagree to strongly agree (with an option for unsure), in addition to three open-ended questions (see Appendix G - Chapter 5). It was administered to caregivers after the last generalisation session of the AEMT. During analysis, responses to the Likert-scales were tallied, such that higher scores indicated a more acceptable intervention (with score reversals for some items). Content grouping was also used to provide a descriptive summary of responses to open-ended questions.

Results

Figure 1 displays the results for the three participants across baseline, intervention, generalisation, and maintenance phases. Inspection of Figure 1 shows that although all participants demonstrated a response to intervention in terms of increases in production of symbolic communication, Imran and Lachlan showed the most pronounced changes. In

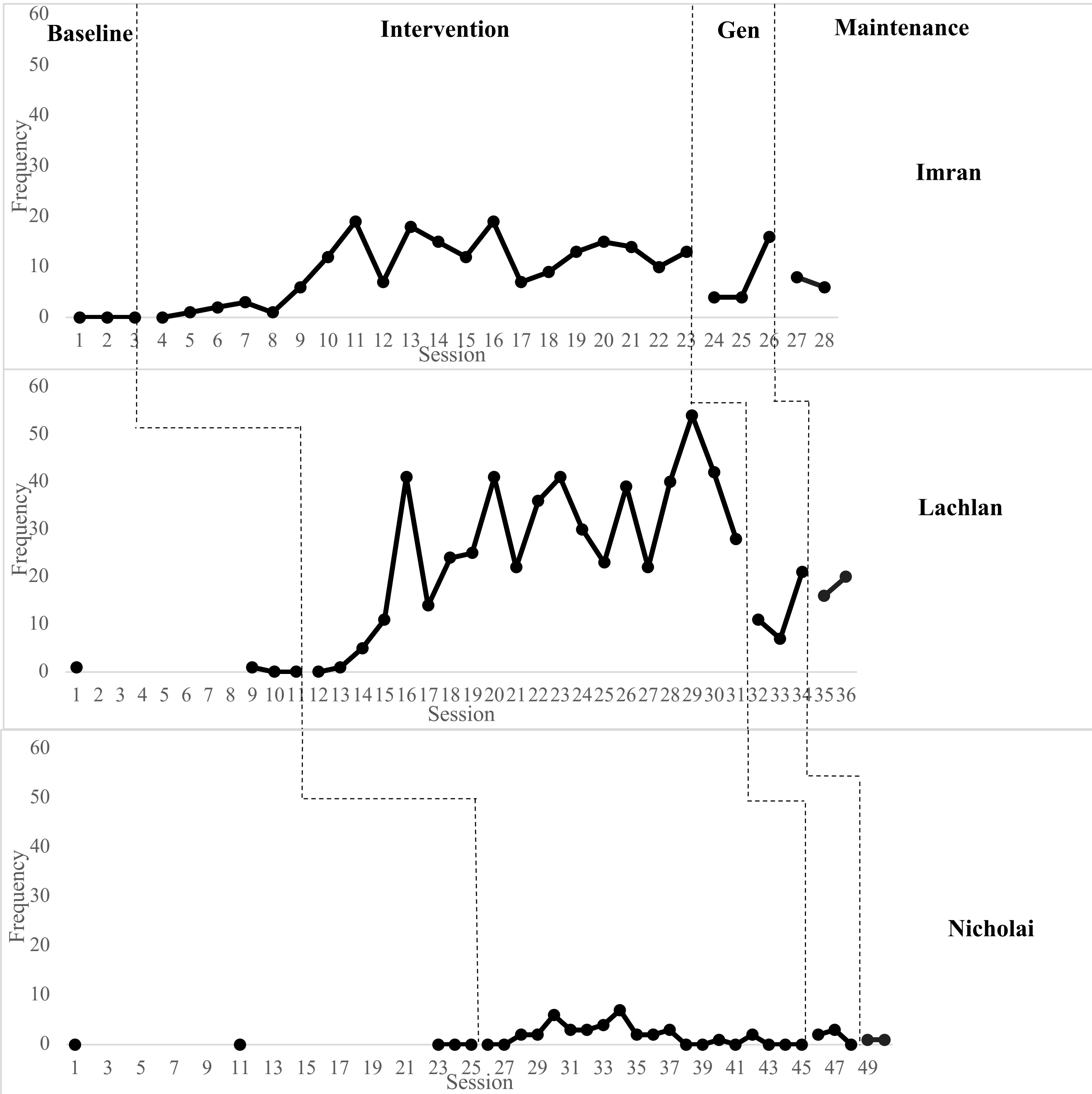

Figure 1. Participant use of symbolic communication

contrast, Nicholai demonstrated an initial response, which lessened over time, returning to baseline levels by the end of intervention. For all participants, responses to the AEMT were seen by the third intervention session.

Symbolic Communication

Across baseline sessions, the children produced from 0 (Imran and Nicholai) to one (Lachlan) instance of symbolic communication, but all demonstrated increases following implementation of the AEMT. It is evident from Figure 1 that results varied across participants. During the intervention phase, Imran produced a range of 0-19 instances of symbolic communication (in the form of use of visual-graphic symbols and occasional use of spoken words), with a mean of 9.8. Lachlan produced a range of 0-54 examples of symbolic communication (using a combination of visual-graphic symbols and spoken words), with an average of 27 across sessions. Nicholai produced a range of 0-7 instances of symbolic communication (in the form of visual-graphic symbols), with an average of 1.9 per session. All participants met the criterion for demonstrating a response to intervention (i.e., two instances of symbolic communication within a session) in their third intervention session.

Children's use of symbols was analysed according to type in order to explore acquisition of vocabulary and the types of words they most readily learnt. Average use of targeted and non-targeted symbols was calculated by tallying the number of instances of symbolic communication and dividing the total across all sessions in that study phase. During intervention, Imran used target symbols (i.e., *OPEN, HEY, UH OH)* on average 5.6 times per session, and non-target symbols (e.g., *WANT*) 4.7 times per session. For both Lachlan and Nicholai, non-target symbols were used most frequently, with Lachlan using 18.9 non-target (e.g., *COUNT*, *WHAT*) versus 8.5 target symbols on average per session, and Nicholai using 1.4 non-target (e.g., *MORE*), versus 0.5 target symbols on average per session.

An effect size was calculated for each of the participants. For Imran, a PAND of 95.7 was obtained, which was 45.7% above chance level. The associated phi was 0.81 (p<0.001), indicating the intervention was effective (Scruggs, et al., 1986). For Lachlan, PAND was 91.7, which was 41.7% above chance; phi was 0.7 (p<0.001), indicating an effective intervention (Scruggs, et al., 1986). For Nicholai, PAND was 68, which was 18% above chance level. The associated phi was 0 (p=1), indicating statistically nonsignificant results.

Inspection of Figure 1 indicates that while Imran and Lachlan demonstrated a sustained response to intervention over time, Nicholai's performance in the intervention phase decreased from session 13 onwards. This decrease coincided with Nicholai becoming unwell, no longer being motivated by his key preference item of food. Also at this time, Nicholai developed a regular, repetitive head movement, which did not appear to cause him distress. Medical assessment for this movement was recommended by the researcher but not pursued by the family. This head movement had markedly reduced by the maintenance phase.

Varied Pragmatic Functions

During baseline, Lachlan was the only child to use symbolic communication, which was for the purposes of protest ($\bar{x}$=0.5) and comment ($\bar{x}$=0.5). During intervention, all participants demonstrated symbolic use of multiple pragmatic functions. Imran predominantly produced symbolic communication for the purposes of requesting objects ($\bar{x}$=2.6) and actions ($\bar{x}$=5.9), with infrequent, but some use to acknowledge ($\bar{x}$=0.3), call ($\bar{x}$ =0.1) or comment ($\bar{x}$=1.1). Lachlan predominantly produced symbolic communication to request objects ($\bar{x}$=2.8), actions ($\bar{x}$=14.5), information ($\bar{x}$=1), and to make comments ($\bar{x}$=4.5) and call his communication partner ($\bar{x}$=3.8). Lachlan less frequently used symbolic communication to request social routines ($\bar{x}$=0.1) or acknowledge ($\bar{x}$=0.5). The main purpose of Nicholai's symbolic communication was to make object requests ($\bar{x}$=1.1), with infrequent use to request actions ($\bar{x}$=0.5), acknowledge ($\bar{x}$=0.1), or comment ($\bar{x}$=0.2).

Generalisation

Both Imran and Lachlan demonstrated generalised use of symbolic communication with different communication partners at a higher rate than observed during baseline (Figure 1). Nicholai generalised use of symbolic communication for two of the three generalisation probes. It should be noted that communication partners present for generalisation probes had not received training in the intervention, and therefore did not necessarily provide opportunities for spontaneous and initiated communication as had occurred during the AEMT. Generalisation data were combined across participants in order to provide at least 20 data points, considered sufficient to calculate PAND (Parker et al., 2007). The PAND obtained was 95.2, indicating findings that were 45.2% above chance level with phi of 0.9 ($p<0.001$).

Maintenance

Following a 4-week break from intervention, all participants demonstrated maintenance of intervention response. Maintenance was demonstrated by higher use of symbolic communication than observed during the equivalent intervention period of the initial two intervention sessions, with all data points for all participants exceeding the maximum achieved during these two sessions. PAND could not be calculated for the maintenance phase because of insufficient data points.

Intervention Strategies Across Children

The researcher's use of environmental arrangement strategies is summarised in Table 5, with application of target interaction features depicted in Table 6. As can be seen in these tables, there was little variance in some strategies across participants (e.g., provision of communication boards, application of target interaction features), however use of environmental arrangement strategies varied according to relevance to types and characteristics of preferred activities selected by participants. Use of environmental arrangement and interaction features also differed across participants at times according to behaviours demonstrated. For example, Imran periodically removed himself from activities to seek out affection from his mother, while Nicholai needed regular, short breaks to manage challenging behaviours (e.g., screaming, crying, self-injurious behaviours). These behaviours

Table 5

Use of Environmental Arrangement Strategies during Intervention across Participants

Strategy	Average across session intervals where strategy use observed		
	Imran	Lachlan	Nicholai
Materials of interest	19.2	20	18.3
Objects out of reach	12.4	7	18.7
Communication boards available	19.1	19.8	19.2
Less portions than needed	3	3.7	8
Offering choices	3.6	3	6.5
Assistance, sabotage, surprise	13.4	11.2	15.6
Turn taking	6	2.8	2.3

Note. Strategy was coded as occurring or absent during 1 min intervals; average use refers to number of intervals during which strategy use was observed per 20 min coded portion of session.

were sometimes demonstrated in response to being unable to access a preferred object or when something unexpected happened (which was the case when two of the teaching strategies were implemented). In situations in which Nicholai demonstrated challenging behaviours, the researcher checked with Nicholai and his parents to determine if they wanted to continue with the session. Two sessions were ended prematurely (prior to obtaining 20 min of footage for coding) as Nicholai's challenging behaviours were interpreted by the researcher and his parents to indicate that he wished to finish the session.

Participant behaviours also influenced application of the least-to-most prompting sequence. For example, participants sometimes had difficulty maintaining attention for the four levels of prompting, removing themselves from the activity or diverting their attention to something else. Nicholai sometimes became distressed at the time needed to move through levels of prompting, as indicated by his challenging behaviours during the process. During these instances, the prompting sequence was sometimes left incomplete. The researcher's use of the least-to-most prompting sequence for target vocabulary/functions for each participant is depicted in Table 7. The need for prompts varied according to participants' use of spontaneous communication: for participants who less frequently demonstrated spontaneous

Table 6

Application of Target Interaction Features during Intervention across Participants

Strategy	Average across session intervals where strategy use observed		
	Imran	Lachlan	Nicholai
Expectant looking	19.9	19.4	19.4
Language modelling using communication boards	17.2	19	17.8
Language stimulation	19.3	19.7	18.4
Opportunities for child to lead	19.3	19.6	17.7
Language matched to child	18.2	19.5	16.9
Child's language expanded	18.3	19.5	16.8
Natural consequences to child's communication and behaviour	18.7	19.6	18.1
Child given time to respond	19.7	19.7	19.1

Note. Strategy was coded as occurring or absent during 1 min intervals; average use refers to number of intervals during which strategy use was observed per 20 min coded portion of session.

symbolic communication, more prompts were needed, and therefore provided. Variation in prompting also occurred with respect to the child's interests and responses during each session.

Social Validity

Caregivers indicated agree to strongly agree for each of acceptability of intervention goals, procedures, and outcomes, with a mean rating of 3.4 out of a possible 4 (range 3-3.6). In response to what was liked about the intervention, caregivers reported it to be "fun," have a "good method," that it allowed for "engagement between therapist and child," and it "allowed [the] child to feel understood for the first time." When asked what was disliked about the method, responses included "nothing," "takes practice to implement," and "too many pictures." For some survey items regarding outcomes, participants expressed uncertainty, particularly in relation to whether improvements would be lasting and if the intervention would result in broader changes, such as improvements in communicating with novel partners or when out in the community.

Table 7

Use of Prompts During Intervention Phase across Participants

Prompt	Average per session		
	Imran	Lachlan	Nicholai
Request action *OPEN*	2.3	1.8	8
Call *HEY*	3.2	0.8	1.9
Comment *UH OH*	3.6	1	1.8
Total per session	9.1	3.6	11.7

A detailed explanation of the children's responses to the intervention is provided above, including cases in which sessions were ended prematurely based on interpretation of the children's behaviour. These outcomes were not classified as adverse effects on the basis that the children's behaviour was consistent with that displayed throughout similar and unrelated activities throughout the day. As noted in the social validity survey findings, caregivers reported no adverse effects of the intervention on their children or families.

Discussion

The current study provides evidence that the AEMT can be used to develop symbolic communication and for varied pragmatic functions in children with ASD who are minimally verbal. Of the three participants, two, in particular, demonstrated marked responses to the intervention, but all demonstrated improvements in their communication skills. Despite Nicholai's outcomes being statistically nonsignificant according to PAND, clinically, there was evidence of intervention response, evident through visual analysis and comparison of his performance to baseline. In addition, generalisation and maintenance of skills were demonstrated, and methods, procedures, and outcomes were deemed socially valid by caregivers.

Developing Functional Communication Skills

The AEMT represented a relatively time efficient method to develop functional communication skills, with all participants responding to the intervention after only a few sessions. Although a modest finding, its significance can perhaps be best understood in the context of two participants having experienced years without symbolic communication despite access to AAC; yet, with intervention, they demonstrated the ability to use symbols meaningfully. This finding is consistent with previous studies in which EMT has been combined with aided AAC, whereby children previously reliant on pre-symbolic communication modalities have developed symbolic communication skills in response to intervention (e.g., Olive et al., 2007; Ogletree, 2012). For Lachlan, who was new to AAC, the AEMT assisted him to transition quickly into symbolic communication and demonstrate the potential of aided AAC in providing a means for communication, and the tool by which to increase access to a broader range of vocabulary. EMT is typically recommended for individuals with at least 10 spoken words and with a mean length of utterance of 1.0-3.5 (Kaiser & Hampton, 2017). However, by providing access to symbolic language via picture symbols, and teaching use through milieu teaching techniques (Alpert & Kaiser, 1992), the results indicate that EMT could be applied effectively to individuals without these prerequisite skills.

In addition to benefits in terms of increased symbolic communication demonstrated by participants in the short term, the establishment of functional communication skills have potential for longer term language development. As Chevallier et al. (2012) noted, communication development relies on social interactions: when social communication opportunities are reduced, so too are social learning opportunities. It could be predicted, therefore, that developing children's symbolic language skills will foster increased opportunities for adult-child social interactions, and thereby facilitate the transactional process argued to be needed for language development (Hancock & Kaiser, 2006; Warren et al., 2008).

Increasing the Range of Communication Functions

All participants increased the range of purposes for their symbolic communication, beyond that evident during baseline. Encouragingly, all demonstrated at least some spontaneous use of communication for social interaction and joint attention functions as described by Wetherby and Prutting (1984): for example, commenting and calling. Previous studies in which aided AAC has been paired successfully with EMT have often focused only on teaching object request (e.g., Olive et al., 2007; Ogletree et al., 2012) or required pre-requisites in terms of receptive language skills (e.g., Kasari et. al., 2014). In contrast, the current study provides evidence that the AEMT can be used to broaden purposes of communication, including for children with impaired receptive language skills.

The performance of participants in attaining a range of communication functions was consistent with Stone and Caro-Martinez' (1990) proposal that cognitive skill and ASD severity influence the use of functions. Lachlan, who, in comparison with the other children, had lower estimated ASD severity according to the GARS (Gilliam, 2014) and moderately low, rather than low adaptive behaviours on the VABS-II (Sparrow et al., 2005), was the participant most likely to use declaratives (Stone & Caro-Martinez, 1990). Participants' use of communication functions also aligned with previously conceptualised developmental models (Shumway & Wetherby, 2009; Wetherby, 1986). The predominant function for communication expressed by each of the three participants was for behavioural regulation (i.e., request object and action), even though frequent attempts were made to elicit and model other functions. Even Lachlan, who demonstrated the ability to use a symbol to comment in the context of no intervention (baseline) and who commented frequently during intervention, mostly used communication to request an action.

Although participants demonstrated use of vocabulary (and associated functions) that were targeted during the intervention, both Lachlan and Nicholai used non-targeted vocabulary to a greater extent, on average, during intervention. Participants' use of vocabulary was likely influenced by their motivation to express different messages combined with the effectiveness of the AEMT environmental arrangement and interaction strategies in encouraging symbolic communication. For example, Lachlan frequently requested that an adult *COUNT* objects in a book, *HELP* activate a toy, or *LOOK* for hidden objects, while Nicholai tended to request *MORE* of a preferred object. When they were shown how to express these messages with symbols (via the intervention interaction strategies of modelling and expectant waiting) and provided opportunities in which to communicate these messages (via environmental arrangement), spontaneous use occurred. In contrast, as found by Logan et al. (2020a) in their systematic review, the most successful AAC interventions have included contrived situations in order to elicit a target communication behaviour (e.g., saying "thank you" or naming an object in response to a question), and/or limiting the number of symbols (messages) available to children. Although situations requiring these communication behaviours would likely arise in children's lives, the extent to which they reflect the communication children need to interact with their families and within their communities effectively, or what they might choose to say given access to a broader vocabulary are unclear. In the current study, by following the child's lead, interests, and responses during intervention, and providing access to a broader range of symbols, participants were able to communicate messages that reflected their interests, which did not necessarily match the target communication functions/vocabulary.

Differential Responses to Intervention

Although each child was provided with a dosage of AEMT that reflected the dosage recommended in previous research (Kaiser & Hampton, 2017), response to intervention differed across children, resulting in differing effect sizes per child. These differences in response suggest that a number of factors are relevant in how effective an intervention will be for a child with ASD. As highlighted by Logan et al. (2020a, Chapter 3), additional elements that potentially influence intervention outcomes include teaching strategies, reinforcement, and child-specific factors. The variation across children in the current study in their symbolic communication and functions expressed strengthens the argument for identifying the factors that may influence outcomes, as well as specific considerations that could be addressed to tailor intervention to each child. For example, in addition to the differences to the other children in terms of autism severity and adaptive behaviour, Lachlan demonstrated more verbal communication than the others (albeit, only an additional 1-2 words), and a greater range of baseline symbolic communication functions. It is possible that these factors contributed to Lachlan having a greater response to intervention than the other participants. In previous ASD-AAC experimental single-case design research, children participating in multiple-baseline studies have presented with diverse communication skills (Logan et al., 2020a), which may have been a contributing factor to variation in overall effect sizes and the reason that ASD-AAC interventions can be more effective for some children than others (as seen, for example, in the study by Thirumanickham, Raghavendra, McMillan, & van Steenbrugge, 2018, reviewed in Logan et al., 2020a). Age may also be a relevant consideration, as Lachlan was younger than the other participants (i.e., 2 years old). Although a stable baseline was achieved prior to implementing intervention with Lachlan, his likely communication trajectory without intervention remained unknown, unlike Imran and Nicholai, who had demonstrated the minimally verbal criterion over a number of years prior to this intervention.

Intervention-specific factors arising as a result of child presentation and response to intervention may also have contributed to differing outcomes. For example, Imran and

Nicholai each had more difficulty attending to activities than did Lachlan, and as a result withdrew from them more frequently and needed more time to re-engage with tasks. In addition, Nicholai demonstrated challenging behaviours, which meant that time was spent away from intervention to provide sensory breaks. Lachlan tended to be more responsive to environmental strategies, such as sabotage, and, as a consequence, fewer teaching episodes (and prompting sequences) were needed for him to learn a target response. Nicholai sometimes became distressed or withdrew attention when something unexpected happened, subsequently reducing opportunities to engineer specific events to elicit calling and commenting functions, and possibly resulting in an insufficient dosage to consolidate use (Kaiser & Hampton, 2017). Additionally, because all participants had a limited range of activities that were used repeatedly as the basis for intervention for 28 or more sessions, boredom (and reduced motivation) may have been the reason for fewer responses than might have occurred if more activities were available. Nicholai, who generally was motivated by food only (as identified by his caregiver), also experienced illness mid-intervention, which appeared to reduce his tendency to select food as an activity and motivation to communicate about food during intervention sessions; these factors may have decreased his responsiveness to intervention.

Tailoring the intervention to suit individual needs of children, such as employing shorter sessions to allow for attentional constraints, regular reinforcement checks to determine motivators to communicate, tailoring prompting strategies to incorporate error correction to reduce frustration and communication breakdown, and increasing or decreasing the dose of teaching episodes according to child performance, may be used to maximise outcomes matched to individual needs.

Transferability of Skills into Typical Contexts

The finding of generalisation to caregivers not directly involved in the researcher-delivered intervention suggests that having a trained communication partner provide intervention and develop early skills may be a useful means by which to initially develop a child's communication skills. These skills may then be more likely to be found useful with typical communication partners, arguably because teaching was embedded within a familiar environment and naturalistic strategies were used (Kaiser et al., 1992). This transfer of skills has important ramifications for a child's ongoing language development. As children gain social communication skills, they have more opportunities to participate in turn taking interactions and gain further social experience (Chevallier et al., 2012). By establishing symbolic communication skills during intervention, and ensuring these skills generalise to familiar communication partners, children can have ongoing opportunities to continue to develop and practice these skills, well beyond the period of intervention.

In terms of the social validity of the intervention, although the AEMT involved a significant cost in terms of time, namely, commitment to several intervention sessions per week, this was only for a short period. Perhaps knowing that commitment to a high intensity of intervention for a limited period meant that regardless of the time required, caregivers still deemed procedures to be socially valid, or else the potential results of the intervention justified the time involved (Callahan et al., 2017). Consequently, despite the time needed for implementation, the reported overall acceptability of procedures means they may be more likely to engage with the intervention and implement strategies (Callahan et al., 2008; Horner et al., 2005). On the other hand, barriers to implementation were identified. Caregivers noted that the AEMT took practice to implement and possibly required the teaching of too many symbols at one time. These concerns should be taken into consideration, given that the AEMT involved 15 environmental arrangement and interaction strategies, as well as a least-to-most prompting sequence for language targets, and required the person implementing the intervention to be knowledgeable about the symbol content of six communication boards per participant. Modification of the intervention to account for caregiver feedback, which reflects the purpose of social validity research (Schwartz & Baer, 1991), would likely be needed to ensure that typical communication partners were able to implement the AEMT.

Limitations and Research Directions

A well-known limitation of experimental single case design is that results are not generalisable, which represents a limitation in extending findings from the current study to the population of children with ASD who are minimally verbal. In light of costs associated with conducting rigorous randomised controlled studies and difficulties in recruiting sufficient participants to form homogenous groups, confidence in generalising findings require direct and systematic replications of this study (Horner et al., 2005). Another limitation is the use of the researcher as both the intervention agent and coder for the independent and dependent variables, with the potential for bias. Although inter-rater reliability was at or beyond acceptable levels for most sessions, and for most recorded symbolic communication behaviours, the naturalistic design of the intervention presented some challenges with coding. For example, the prompting sequence was such that at times it could not be completed correctly in the face of certain participant behaviours, leading to a drop in the frequency with which it was implemented (79%). Further, as the intervention was child-led, with the researcher responding to all child communication as symbolic, there was some disagreement amongst coders as to whether a child's communication was symbolic. An example would be if a child touched a symbol that matched the communication context (e.g., *LOOK*), but this was not a message he usually communicated. Nicholai, in particular, presented coding difficulties because his behaviours were inconsistent and often difficult to interpret.

The importance of determining clinically significant participant changes in future research was also highlighted. For example, despite Nicholai's results not being statistically significant, clinically, a response to intervention was observed. For Nicholai, despite their inconsistency, slight changes in the frequency of symbolic communication, in addition to an increase in the range of symbolic functions expressed, represented a noticeable change in comparison to baseline. The information provided in the SVAIS further highlighted that a change (i.e., improvement) in his communication skills was recognised by his caregiver.

Feedback provided by caregivers in the SVAIS indicated uncertainty as to whether changes would endure and skills transfer into typical contexts, such as in the community. Consequently, it will be critical in future studies to determine the longevity of outcomes (via extending the maintenance period over the span of several months), as well as incorporate other opportunities for generalisation, whereby a participant's ability to use symbolic communication is evaluated with both typical (e.g., educators, broader family members) and novel interactants (e.g., community members). As a further consideration for social validity, research is needed to determine whether AEMT strategies can be taught to typical communication partners and applied during routine daily activities. Working with families to ensure that the AEMT requirements are achievable and outcomes satisfactory will be critical to the successful use of these strategies (Callahan et al., 2008).

Given the variability in intervention response, a focus on tailoring the intervention to meet the individualised needs of participants would be warranted (Logan et al., 2020a, Chapter 3). For example, future research into the range of communication acts used to express functions prior to intervention would help to determine the functions that require strengthening for an individual child, with those that are present providing a sound basis on which to target symbolic expression. Some children may need access to either fewer or more symbols in order to understand how to express messages with them (thereby reducing frustration and potentially associated challenging behaviours), or to extend their language skills. Further, as behavioural presentations of participants differed, with some able to engage for longer periods, modifying the length of intervention sessions and increasing the number of teaching trials for specific functions within sessions could result in improved responses to intervention.

Clinical Significance

This study provides evidence that when children with ASD who are minimally verbal are given access to AAC, they can benefit from the application of EMT intervention strategies (Hemmeter & Kaiser, 1994). Given children varied in their ability to acquire different pragmatic functions, initial assessment of a child's repertoire of functions and comparison with models of pragmatic development for children with ASD may prove useful in determining developmentally appropriate social targets for intervention. For example, considering the request object function tends to be relatively well developed in children with ASD and was readily used by participants in the current study, expanding requests to encompass actions or social routines would represent progress towards increasing the range of functions used. Further, progress towards acquisition of less developed/more difficult functions may be increased by targeting a single function at a time, while also providing a multitude of experiences and opportunities for use in order to ensure a high dosage of teaching episodes, embedded opportunities for generalisation, and improved social validity. The current study also provides evidence that use of symbolic language reflected the child's interests and needs during activities; consequently, goal setting that reflects what is motivating for the child to communicate about may result in improved language outcomes. Further, there is evidence in the current study that the development of a child's symbolic communication aligns with pragmatic functions that are considered to be strengths for children with ASD (i.e., communication for imperative purposes). In a clinical setting, these functions could possibly be used to bootstrap less frequently used functions (Wetherby, 1986), such as expanding on the request object function to support a child to make a more socially-oriented request (e.g., for a social routine).

Although the home setting was used in the current study, many of the AEMT strategies are readily applicable to other typical environments, such as preschool or school. Strategies, such as following the child's interests, expectant waiting, turn taking, modelling, and prompting are readily transferable to any setting and do not require special resources. Use of the AEMT across settings may allow for more incidental opportunities for teaching moments to be incorporated into typical routines so as to increase the intensity of intervention. For best outcomes, implementation across varied settings requires planning of communication opportunities and goals in order to elicit target language and pragmatic functions.

Conclusion

Many children with ASD do not develop spoken language, and therefore rely on evidence-based AAC instruction to provide them with an effective communication system. Research into AAC interventions simultaneously needs to address the established difficulties that people with ASD have with social interaction through ensuring opportunities to learn these skills. Although teaching symbolic communication for functions other than object request represents a challenge, it cannot be ignored if we are to support children with ASD who are minimally verbal to develop their ability to interact meaningfully with others. The results of this study indicate that children's typical settings and preferred activities can provide the basis from which to teach more diverse communication skills, with the AEMT both increasing symbolic communication and the range of functions expressed by children with ASD. Importantly, the AEMT was considered socially valid by caregivers, with generalisation of outcomes to untrained partners, and maintenance of skills demonstrated.

There remains a need to determine whether the AEMT can be implemented by individuals typical to a child's life, such as parents and teachers, in order to provide a multitude of rich, meaningful, and functional opportunities to develop social communication skills.

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Appendix A - Chapter 5

AEMT Information Flyer

LA TROBE UNIVERSITY

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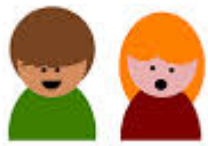
Mildura
Shepparton

Research project: Using pictures to help children with autism spectrum disorder communicate



Autism spectrum disorder (ASD) is associated with a range of communication difficulties. Children with ASD have difficulty learning how to use their communication for different social purposes, such as to ask for things, comment or share news. Some children with ASD have difficulty using speech to communicate their wants and needs.

Kristy Logan, a researcher, speech pathologist and teacher, is currently investigating ways to help children with ASD develop their communication skills, focussing on children who use limited or no speech. This study will form part of her PhD studies, undertaken through La Trobe University. This research is being supervised by Professor Teresa Iacono, La Trobe University, and Dr David Trembath, Griffith University.

Kristy is looking for children with ASD and their families to participate in this study. Children need to be aged under 8 years; have a diagnosis of ASD from their paediatrician; and use less than 10 words. The child's primary caregiver needs to be available for 45 minute home-based therapy sessions 3-5 times each week for 3 to 6 weeks. Caregivers and children in the study will participate in a language intervention that will focus on teaching children how to communicate for different social purposes, with spoken expression supported with pictures.

The NSW DET (SERAP: 2015226) and La Trobe University (UHEC Ethics Approval Number: 15/056) have approved this study. All information about your child will be kept confidential, and you have the right not to participate or withdraw from the study at any time without penalty.

If you are interested in learning more about this study, please contact Kristy Logan on 0435356171. Kristy will talk to you about what the study will involve and if your child may be eligible to participate. A participant information statement with further information and consent form will then be provided.

Participant Information Statement

LA TROBE UNIVERSITY

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Participant Information Statement (PIS)- Caregivers

Project: AIDED ENHANCED MILIEU TEACHING TO DEVELOP COMMUNICATION FUNCTIONS IN MINIMALLY VERBAL CHILDREN WITH AUTISM SPECTRUM DISORDER

What is this study about?

You and your child are being invited to participate in this study about using pictures to help children with autism spectrum disorder (ASD) communicate. This PIS tells you about the research study. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Who is conducting the study?

This doctoral research is being conducted by Kristy Logan, under the supervision of Professor Teresa Iacono, College of Science, Health and Engineering, La Trobe Rural Health School, La Trobe University, Bendigo VIC 3552; Ph: (03) 5448 9110; Email: t.iacono@latrobe.edu.au; and Dr. David Trembath, School of Allied Health Sciences and Menzies Health Institute Queensland, Griffith University, Gold Coast QLD 4222; Ph: (07) 5678 0103; Email: d.trembath@griffith.edu.au.

Why is the study being conducted?

A core difficulty that children with ASD have is learning how to communicate for different social purposes. In this project we will test the effectiveness of using an intervention called *aided enhanced milieu teaching* (AEMT). It was designed to help children with ASD use pictures to communicate for different social purposes, such as asking for things or making comments.

What will being in the study involve?

First, Kristy will meet with you on two occasions to go through necessary background information, complete some assessments of your child, and sight documentation from your child's paediatrician and psychologist that confirm your child's diagnosis of ASD. Both appointments will be at your home and take about 60 minutes. Second, Kristy will visit you before the study starts to complete further assessments of your child – this time focusing on his/her communication skills.

ABN 64 804 735 113
CRICOS Provider 00115M

Third, Kristy will visit you once each week for 45 minute sessions to monitor your child's communication while waiting to start the intervention (children in the study will start this at different times). Fourth, for the intervention, Kristy will visit you at home five times each week (about 45 minutes each) for the period of intervention (4 weeks). During these sessions, Kristy will work with you and your child to help your child express him/herself using pictures through the AEMT therapy. All intervention sessions will be video- recorded so that Kristy can keep track of your child's progress.

The 4-week AEMT intervention involves the following:

- Kristy will set up the room to create opportunities to encourage your child to communicate
- Your child will participate in 3 favourite activities with Kristy, during which he/she will be supported to communicate about the play using pictures and words.
- Kristy will use communication strategies that she will explain to you during the sessions.
- During the last 3 sessions, you will be asked to take Kristy's place and try using the intervention with your child.

The intervention will need to take place in a room at home with as few distractions as possible, so it will need to be in a room away from others in the home. Therefore, other children may need to be occupied by another adult so that your child can concentrate on the therapy.

Immediately after the 4 weeks of intervention, Kristy will ask you to complete a survey about how useful and meaningful the intervention was; it will take about 20 minutes. One month later, Kristy will visit you at home for 2 follow up visits, to see if improvements have maintained or if there has been further development in your child's communication.

The maximum total time commitment will be approximately 20 hours spread over a term.

Who can take part in the study?

To participate in the study your child must be aged under 8 years, have a diagnosis of ASD, and use less than 10 words. You will need to be available for visits from Kristy at home for the duration of the study. It will be necessary that she or he is not receiving any direct picture-based communication intervention during the period of the study.

What are the benefits of participation? What are the risks?

We hope that your child will learn new communication skills through being in the study. Also, you will have the opportunity to develop communication treatment goals for your child, and observe and learn the communication intervention strategies.

There is the potential risk that you may experience emotional distress from talking about your child's communication skills and difficulties. If you do become distressed, it is recommended that you contact your regular service provider, such as your early childhood intervention team, or Lifeline, for telephone crisis support on 13 11 14. There is also the risk that you might be inconvenienced by the time taken to take part in the study. Kristy will negotiate a convenient time for you for home visits to occur.

What will happen to information that is collected during the study?

Results from this study will be included in Kristy's Ph.D. thesis and published in journal articles. They will also be presented at conferences. The results may also be used in future research projects, following approval from the relevant ethics committee. However, no information that could identify you or your child will be included in any articles or presentations. All information provided by you will be confidential, except as required by law. All digital (video) recordings will be stored in a secure, locked filing cabinet at the researcher's home office, and electronic files and data will be stored in password protected files on a computer accessible only by password. You may request a copy of personal data collected during the study. All data will be stored securely at La Trobe University for a period of 5 years upon completion of the research project.

Participating in the study and collection of data

Being in this study is voluntary and your child does not have to take part. No penalties, disadvantages or adverse consequences will be involved if you do not wish to participate.

If you would like to participate in this study, please complete the participant consent form. If you decide to take part in the study, and change your mind later, you are free to withdraw from the study after it has started. You may also request that data arising from your participation are not used in the research project provided that this right is exercised within four weeks of the completion of your participation in the project. You are asked to complete the "Withdrawal of Consent Form" or to notify Kristy by email or telephone that you wish to withdraw your consent for your data to be used in this research project.

Will we be told the results of the study?

You and your child have a right to receive feedback about the overall results of the study. You can tell us that you wish to receive feedback by ticking the relevant box on the consent form. The feedback will be emailed to you after the study finishes, and will be a one page summary of the research. Personalised feedback regarding the results of any testing completed on your child will also be available in the form of a brief one page summary report, and Kristy will allocate time to discuss this with you.

What if we would like further information about the study?

Any questions regarding this project may be directed to Kristy Logan, PhD candidate, (E: k2logan@students.latrobe.edu.au), or Prof. Teresa Iacono (E: t.iacono@latrobe.edu.au, T: 03-5448-9110).

This project has received ethics approval from the College of Science, Health and Engineering, La Trobe University Human Ethics Committee (UHEC Ethics Approval Number: 15-056) and NSW DET (SERAP: 2015226). If you have any complaints or concerns about your participation in the study that the researcher has not been able to answer to your satisfaction, you may contact the Senior Human Ethics Officer, Ethics and Integrity, Research Office, La Trobe University, Victoria, 3086 (P: 03 9479 1443, E: humanethics@latrobe.edu.au). Please quote the application reference number: 15-056.

Participant Consent Form

Mailing address
La Trobe Rural Health School
PO box 199, Bendigo, 3550

T + 61 3 54489110
E t.iacono@latrobe.edu.au
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Bendigo
Albury-Wodonga
Mildura
Shepparton

LA TROBE UNIVERSITY

College of Science, Health and Engineering

Consent Form- Family
AIDED ENHANCED MILIEU TEACHING TO DEVELOP COMMUNICATION FUNCTIONS IN MINIMALLY VERBAL CHILDREN WITH AUTISM SPECTRUM DISORDER

Chief Investigator:

Professor Teresa Iacono, La Trobe Rural Health School, College of Science, Health and Engineering, La Trobe University, Bendigo VIC 3552; Ph: (03) 5448 9110; Email: t.iacono@latrobe.edu.au

Researchers:

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"I (the participant) have read (or, where appropriate, have had read to me) and understood the participant information statement and consent form, and any questions I have asked have been answered to my satisfaction. I agree to participate in the project, realising that I may withdraw at any time. I agree that research data provided by me or with my permission during the project may be included in a thesis, presented at conferences and published in journals on the condition that neither my name nor any other identifying information is used."

I consent to be a participant in this study (please circle) :

Yes **No**

I give consent for my child to be a participant in this study:

Yes **No**

I give consent for video recording of myself and/or my child to be used in this study:

Yes **No**

I give consent for research data provided by me to be preserved for use in future projects by the chief investigator, on the condition that neither my or my child's name nor any identifying information be used:

Yes **No**

I give consent for video footage, collected during the study, to be used by members of the research team for educational purposes (i.e., training students and seminar/conference/workshop presentations):

Yes **No**

I give consent for the intervention used in the study to occur at my home.

Yes **No**

I would like feedback regarding the overall results of the study. If yes, please write your e-mail address below; feedback will be e-mailed after the study finishes.

Yes **No**

E-mail address: ______________________________

Name of Adult Participant (block letters): ______________________________

Signature: ______________________________ Date: ______________

Name of Child Participant (block letters): ______________________________

Name of Authorised Representative (block letters):______________________________

Signature: ______________________________ Date: ______________

Name of Investigator (block letters): ______________________________

Signature: ______________________________ Date: ______________

Appendix D- Chapter 5

Operational definition of symbolic communication and associated functions

1. Is the behaviour symbolic?

Does the child use a recognisable spoken word or select a picture, both of which have an obvious referent?	For pictures, is there evidence of selecting a specific picture – e.g., scanning a picture to locate a specific one, or going directly to a picture without touching one or more others (unless to form a phrase)?

2. Is the behaviour intentionally communicative?

Was the use of the symbol (speech or picture) directed at the adult communication partner, as indicated:
- using eye gaze or movement (e.g., orientation) towards the adult
- and/or the child waiting for the adult's response
- the child not trying to change the adult's actions, but accepting it e.g., by not repeating the behaviour (spoken word, picture selection), or showing rejection of the adult's response through protest, pushing away, or absconding from the activity

3. What function does it serve?

Behavioural regulation	Social interaction	Joint attention
Object request: demanding a physical object Action request: commanding an action to be completed Protest: refusing an undesired object or requesting to cease an undesired action	Social routine request: commanding another to start or continue a social game or routine that involves interaction between the child and communication partner Showing off: purposefully attracting the attention of another to something they are doing with their body or with a prop Greeting: noticing another's presence through looking or orienting towards them Calling: gaining the attention of another person, usually to pre-empt another communication act to follow Acknowledgement: noticing, answering, or responding to another person's communication, requiring a shift or focus of attention on the communication partner and their communication partner's message Permission request: seeking another's permission to complete an action	Comment: directing another's attention to an object or event to inform, label, or describe Information request: using communication to find something out about an object or event Clarification: using communication to further explain what has been said, either solicited or self-initiated

Appendix E - Chapter 5

Fidelity of use of the prompting sequence

PPT: Session: Time:

Symbol or word used: Communication function: Spontaneous (y/n) ____________

If the symbol/word relates to open/hey/uh oh, and is NOT used spontaneously, what level of the prompt hierarchy is required (see below): Level__ (No if not implemented correctly)

Prompting Hierarchy

Level 1: time delay- adult shows child relevant picture and waits 5 seconds

Is Level 1 prompt implemented? **YES/NO** Does child point to relevant picture (open/hey/uh oh)? **YES/NO** (if no, proceed to Level 2 prompt)

Level 2: Mand- adult tells child what they need to do e.g., "you need to ask/call/tell me"

Is Level 2 prompt implemented? **YES/NO** Does child point to relevant picture (open/hey/uh oh)? **YES/NO** (if no, proceed to Level 3 prompt)

Level 3: Mand model- adults tells child what to do e.g., "say open/hey/uh oh" (while tapping picture)

Is Level 3 prompt implemented? **YES/NO** Does child point to relevant picture (open/hey/uh oh)? **YES/NO** (if no, proceed to Level 4 prompt)

Level 4: Physical prompt- adult guides child's hand to the relevant picture, and verbally models language e.g., "uh oh"

Is Level 4 prompt implemented? **YES/NO**

Appendix F - Chapter 5

Procedural Fidelity Checklist: Environmental Arrangement and Interaction Features

Environmental arrangement																				
Does the adult:	M1	M2	M3	M4	M5	M6	M7	M8	M9	M 10	M 11	M 12	M 13	M 14	M 15	M 16	M 17	M 18	M 19	M 20
1. Provide materials of interest to child																				
2. Place objects out of child's reach																				
3. Provide communication activity boards within child's reach																				
4. Give child less portions than needed to complete activity																				
5. Provides child with choices																				
6. Create the need for assistance with activities, sabotage activities, or use the element of surprise																				
7. Take turns of an activity																				
Features of the interaction																				
Does the adult:	M1	M2	M3	M4	M5	M6	M7	M8	M9	M 10	M 11	M 12	M 13	M 14	M 15	M 16	M 17	M 18	M 19	M 20
8. Look expectantly at the child to encourage communication																				
9. Model language using communication activity boards																				
10. Provide language stimulation by verbally modelling language during natural interactions, and providing commentary on what is happening or what the child is doing																				
11. Provide child with opportunities to lead interactions by waiting for them to initiate																				
12. Match own language use with that used by child																				
13. Expand child's language use																				
14. Provide natural consequences to child's communication and behaviour																				
15. Provide child with time to respond																				

<u>Examples</u>

Environmental arrangement

1. Child appears interested and engaged in the activity
2. Adult has control of the object or keeps them visible in a container/box
3. Child can reach the picture boards at all times
4. Adult gives child only a small piece or short turn of an activity
5. Adult offers child options e.g., between activities, sizes, shapes, more/finished etc. The choices should be named.
6. Examples include: adult devises situations where the child will need help to commence or continue with an activity; adult does something to interrupt the continuation or start of an activity; adult does something unexpected during the activity
7. Adult and the child take turns of an activity

Features of the interaction

8. The adult looks at the child, gives them time to communicate e.g., raises their eyebrows to let the child know that the adult is waiting for them to have a turn
9. The adult points to pictures on the board that match what the child is doing or what is happening, while also stating verbally what is happening
10. Examples include: adult uses words that match what the child is doing or what is happening; adult narrates what is happening or what the child is doing. These language models should occur during typical routine or preferred activities for that child
11. The adult waits for the child to initiate play and communication. The adult provides opportunities for the child to communicate by pausing, looking at the child, giving the child many chances to use speech or pictures, and not monopolising the activity with excessive talking
12. The adult uses simple language, at the same level, or slightly above, what the child is saying (verbally or non-verbally). This might also involve imitating the child, and repeating the sounds, words or pictures they use.
13. Does the adult imitate what the child has communicated, and also add extra words/picture symbols to expand the length of the child's message. For example, if the child points to a picture of *MORE* the adult might point to *MORE* + *FOOD*, or *WANT* + *MORE*. If the child doesn't point to any pictures but is communicating a message through their actions (e.g., moving away, pointing), the adult might point to a picture that matches what they appear to be trying to say e.g., "You look like you've *FINISHED*," or "You want *MORE/BLOCKS*." Picture use might also be accompanied by a verbal expansion e.g., If the child points to *WANT*, the adult might verbally expand the message to, "You want it".
14. The adult follows what the child is doing or communicating with their body, sounds, or picture use. For example, if the child yawns, the adult might comment that he/she looks tired; if the child points to the picture for *EAT* the adult will respond accordingly, such as giving the child something to eat; or if the child moves away from an activity, the adult might talk about them being finished with the current activity.
15. The adults pauses after commenting or questioning, waiting for the child to say something verbally or via pictures.

Appendix G - Chapter 5

Social Validity in AAC Intervention Survey

What were the communication goals for your child?

____

____

Please rate to what extent you agree or disagree with each of the following statements.	Strongly disagree	Disagree	Agree	Strongly agree	Unsure
1. The therapy goals were relevant to my child	1	2	3	4	U
2. I was involved in developing communication goals for my child	1	2	3	4	U
3. My child needs to use pictures to communicate	1	2	3	4	U
4. It is important that caregivers learn communication strategies to help their child with ASD	1	2	3	4	U
5. The therapy included activities and materials (e.g., toys) that were relevant or important to my child	1	2	3	4	U
6. It was easy to use the pictures during therapy	1	2	3	4	U
7. My child enjoyed the activities and materials used during therapy	1	2	3	4	U
8. My child enjoyed using the pictures during therapy	1	2	3	4	U
9. I found find the communication therapy easy to do	1	2	3	4	U
10. I enjoyed participating in the communication therapy	1	2	3	4	U
11. I found the therapy to be appropriate for my child's needs	1	2	3	4	U
12. I would continue to use the communication therapy when the study has finished	1	2	3	4	U
13. I will continue using pictures at home to help my child's communication when the study has finished.	1	2	3	4	U
14. I will use pictures in other settings (outside of home) to help my child's communication	1	2	3	4	U
15. Therapy occurred during typical daily routines and activities	1	2	3	4	U
16. It is important that parents use this communication therapy	1	2	3	4	U

	Strongly disagree	Disagree	Agree	Strongly agree	Unsure
17. I found the therapy time consuming	1	2	3	4	U
18. The therapy was costly to implement	1	2	3	4	U
19. The therapy fitted into my family's everyday routines and activities	1	2	3	4	U
20. My child's communication skills improved during therapy	1	2	3	4	U
21. I learned strategies to help my child's communication skills	1	2	3	4	U
22. My child will find it easier to communicate with familiar people after therapy	1	2	3	4	U
23. My child will find it easier to communicate with unfamiliar people after therapy	1	2	3	4	U
24. My child has been able to participate in activities at home more easily after Therapy	1	2	3	4	U
25. My child has been able to participate in activities out in the community more easily after therapy	1	2	3	4	U
26. My child has made lasting improvements in his/her communication as a result of Therapy	1	2	3	4	U
27. My child is able to communicate for reasons other than requesting objects after Therapy	1	2	3	4	U
28. I would recommend this communication therapy to another parent	1	2	3	4	U
29. It is important that people use this communication therapy with children with ASD	1	2	3	4	U
30. Other people have noticed improvements in my child's communication	1	2	3	4	U

Additional comments

What did you like most about the communication therapy?

What did you dislike about the communication therapy?

Please write any other comments you have about the therapy in the space below.

Thank you for taking the time to complete this survey.

Chapter 6: Acquisition of Aided Enhanced Milieu Teaching Intervention Strategies by Parents of Children with Autism

Overview

This chapter presents the second intervention study of this thesis in which a modification of the researcher-administered AEMT was implemented. The study was based on the results of the first in extending the delivery of AEMT from the researcher to parents. In order to evaluate the extent to which parents could learn to implement AEMT, the intervention was simplified to three core strategies. Variables of interest were parent acquisition of teaching strategies in addition to child use of symbolic communication. Dyads differed according to whether they had had previous involvement with AEMT, and if so, their response to AEMT. The study is presented as a manuscript for submission for publication.

Manuscript in Preparation

Logan, K., Iacono, T., & Trembath, D. (2020c). *Acquisition of aided enhanced milieu teaching intervention strategies by parents of children with autism*.

Statement of Contribution

As co-authors of the following manuscript titled "Acquisition of aided enhanced milieu teaching intervention strategies by parents of children with autism," we confirm that Kristy Logan has made the following contribution: The study was designed by the candidate in collaboration with her primary supervisor Professor Teresa Iacono and associate supervisor Associate Professor David Trembath. The candidate was solely responsible for data collection and analysis. Inter-rater agreement and procedural fidelity checks were conducted by Dr Suzanne Stevens. Kristy Logan was responsible for writing the complete first draft of the manuscript, while Professor Teresa Iacono and Associate Professor David Trembath provided critical feedback of each draft prior to thesis inclusion.

Signed: ______________________________ Date: 03/11/2020

Professor Teresa Iacono

Signed: ______________________________ Date: 03/11/2020

Associate Professor David Trembath

Abstract

Augmentative and alternative communication (AAC) interventions have been shown to be effective in increasing functional communication skills for children with autism spectrum disorder (ASD). Most frequently, they have been delivered by highly trained interventionists. A small, but growing, evidence base exists to show that parents can be trained to provide AAC interventions to their child with ASD, with positive child and parent outcomes. The aim of the current study was to investigate parents' learning of aided enhanced milieu teaching (AEMT) strategies, and associated benefits for children's communication. Parent-child dyads participated in a multiple baseline across behaviours design, with systematic variation across the three participating children. Results showed that parents acquired most target AEMT strategies, with some relationship between parent use of strategies and child symbolic communication evident. The results point to the need to individualise parent teaching strategies and desired child communication goals in order to obtain best outcomes for diverse parent-child dyads.

Acquisition of Aided Enhanced Milieu Teaching Intervention Strategies by Parents of Children with Autism

Augmentative and alternative communication (AAC) is often introduced to children who have difficulty using speech to communicate. A significant proportion of children with autism spectrum disorder (ASD) remain minimally verbal (Rose, Trembath, Keen, & Paynter, 2016; Wodka, Mathy, & Kalb, 2013) in that they lack functional speech skills and, consequently, are candidates for AAC. Synthesised evidence from systematic reviews and meta-analyses have demonstrated that AAC interventions are effective in building functional communication skills for children with ASD (e.g., Flippin, Reszka, & Watson, 2010; Ganz et al., 2012; Logan, Iacono, & Trembath, 2017; 2020a; Still; Rehfeldt, Whelan, May, & Dymond, 2014; van der Meer & Rispoli, 2010). However, these interventions have most often been implemented by researchers who have been trained to high levels of accuracy in the approach used (Iacono, Trembath, & Erikson, 2016). Yet to be established is whether typical communication partners, such as parents, can successfully deliver AAC interventions (Ganz, 2015).

Typical Communication Partners as Intervention Agents

Inclusion of typical communication partners in AAC intervention research involving children with ASD is arguably critical for several reasons. First, parents spend more time and interact with children to a far greater extent than educators, therapists, or researchers, and thereby are well-placed to provide increased therapy dosage, which has been linked to improved intervention outcomes (Virués-Ortega, 2010). Second, individuals with ASD have known difficulties with behaviour generalisation, with parental involvement demonstrated to assist transfer of skills into typical contexts through providing learning opportunities in daily routines (Ganz, 2015; Maglione, Gans, Das, Timbie, & Kasari, 2012). Third, provision of parent training may decrease costs of intervention by equipping families with the skills needed to develop their child's communication skills during routine contexts (Zwaigenbaum et al., 2015). Fourth, parental stress may be reduced by empowering parents to implement intervention strategies within the context of existing routines, and through provision of associated coaching and support (Estes et al., 2014; Koegel, Bimbela, & Schreibman, 1996). Finally, parental involvement in therapy may facilitate engagement with, and reduce attrition from, intervention programs (Pickard, Kilgore, & Ingersoll, 2016).

In addition to practical reasons for involving parents, theoretical models of language development also provide a rationale for the involvement of parents in delivering intervention. Developmental social-pragmatic models of language development, such as transactional models (Sameroff, 1975, 2009), posit that language development occurs through a bi-directional process, whereby interactions within the parent-child dyad mutually affect each member's subsequent behaviour. In this way, parent responsiveness reinforces a child's communication attempts, which enables the child to repeat successful communicative behaviour (Yoder & Warren, 2001). Far greater opportunities for parent-child interactions are afforded in typical routines and contexts than are available through participation in a structured intervention program. By supporting parents to utilise intervention strategies that encourage communication skills, children are provided with increased opportunities to demonstrate, practice, and improve these skills, and subsequently be reinforced by parent responses (Barnett, Gustafsson, Deng, Mills-Koonce, & Cox, 2012). It has been argued that if children with communication difficulties can be helped to transition to the use of intentional communication, then changes may occur in parent-child interactions that then facilitate further language growth (Hancock & Kaiser, 2006). Specifically, as children use more communication with parents, parents in turn may interpret, repeat and expand the children's utterances, leading to models of, and further opportunities for, communication growth (Warren et al., 2008).

Research into Parents as AAC Intervention Agents for Children with ASD

Albeit limited, there is a growing evidence base demonstrating the efficacy of parent-mediated AAC interventions in both ASD (e.g., Alsayedhassan, Banda, & Griffin-Shirley, 2016) and AAC literature (e.g., Kent-Walsh, Murza, Malani, & Binger, 2015; Shire & Jones, 2015), reflecting a trend in the ASD field more broadly (e.g., Althoff, Dammann, Hope, & Ausderau, 2019; Kasari, Gulsrud, Paparella, Hellemann, & Berry, 2015; Nevill, Lecavalier, & Stratis, 2018; Stadnick, Stahmer, & Brookeman-Frazee, 2015). Outcomes of parent-mediated interventions have included targeted skill acquisition in children, such as symbolic communicative behaviours (e.g., Nunes & Hanline, 2007; Olive, Lang, & Davis, 2008; Park, Alber-Morgan, & Cannella-Malone, 2011), maintenance and generalisation of targeted skills (e.g., Hong, Neely, Gerow, & Gann, 2018), improvement in parental use of strategies (e.g., Shire et al., 2015), and improvements in parent-child interactions (Oono, Honey, & McConachie, 2013). Given the significant time demands involved in parenting children with disabilities who require AAC, there is a need for further research that applies teaching strategies in meaningful activities that can be incorporated readily into existing routines (Goldbart & Marshall, 2004; Roberts & Kaiser, 2011). Further, given the diversity of families and children with ASD, there is a need for research that includes families who vary with respect to culture and socioeconomic status, and of children who are reflective of the comorbidities associated with ASD, such as intellectual disability and severe language impairment (Trembath et al., 2019).

Naturalistic Communication Interventions

Naturalistic interventions have been suggested as a means to address potential barriers to parents implementing therapy with their child with ASD, such as complexity of procedures and the time for intervention required (Laski, Charlop, & Schreibman, 1988). In naturalistic interventions, activities selected are directed by child routines, interests and motivation, learning is based on natural interactions, and natural and social reinforcement is used in response to child communication (Koegel, O'Dell, & Koegel, 1987). Everyday routines and contexts provide the basis for communication opportunities, allowing therapy to be incorporated into existing family routines (Woods, Kashinath, & Goldstein, 2004).

One example of a naturalistic intervention that has been successfully implemented with children with ASD is enhanced milieu teaching (EMT). In EMT, environmental arrangement creates communication opportunities, responsive interaction strategies are used to model language and encourage interaction, and milieu teaching procedures are applied to teach relevant language in context (Hemmeter & Kaiser, 1994; Kaiser & Hampton, 2017; Kaiser, Hancock, & Nietfeld, 2000). Use of EMT (and milieu teaching variants) has resulted in gains in the communication of children with ASD (e.g., Franco, Davis, & Davis, 2013; Hancock & Kaiser, 2002; Yoder & Stone, 2006), and, critically, typical communication partners have been able to apply this intervention (e.g., Kaiser et al., 2000; Kaiser & Roberts, 2013).

There is evidence that EMT can be used effectively with children with ASD to teach the use of AAC. Logan, Iacono, and Trembath (2020b, Chapter 5) implemented an aided form of EMT (AEMT) with children with autism, incorporating a combination of setting events to create communication opportunities, interaction strategies to model and elicit communication, and least-to-most prompting to teach specific vocabulary and functions represented through picture symbols on activity-specific paper-based communication boards. They noted that, in addition to improvements in the children's use of symbolic communication and range of pragmatic functions, outcomes generalised to familiar partners, and the intervention procedures and outcomes were considered socially valid (i.e., acceptable) by participating parents and caregivers. In other studies, EMT has also been implemented to teach the use of high technology aided AAC devices. For example, Olive et al. (2007) paired EMT with a speech generating device (SGD) containing four picture symbols in a classroom setting. The researchers found that after only 5 min intervention sessions over the course of one month (up to 19 sessions in total), children learned to make requests using the device. In a further example, Kasari and colleagues (2014) investigated improvements in symbolic communication and range of pragmatic functions in response to the application of EMT with a joint attention and symbolic play intervention. Parents were also trained to deliver treatment during the second half of the intervention. Outcomes were significantly enhanced when an SGD was incorporated into the intervention. Combined, these studies indicate that EMT holds promise as an evidence-based intervention for teaching symbolic communication with aided AAC and its potential as a basis for parent delivered strategies.

Considerations in Parent-Mediated Interventions

Involvement of parents in intervention research has allowed for the identification of factors that influence outcomes. Gulsrud, Hellemann, Shire, and Kasari (2016) found that parent-rated buy-in, interventionist-rated parent involvement, and parental use of strategies were all predictors of treatment outcome. The identification of these factors highlights the need for multiple outcome measures that extend beyond child outcomes to include the social validity of interventions (Wolf, 1978). As part of social validity, the acceptability to parents of AAC intervention goals, procedures, and outcomes needs to be considered (Schlosser, 1999). Comprehensive measures of social validity can reveal facilitators and barriers to implementation of therapy, and, thereby, the likelihood of adherence (Wainer & Ingersoll, 2013). As part of social validity, implementation found to be easy is apt to increase likelihood of uptake by parents: therefore, effective strategies that can be easily acquired by parents are needed (Allen & Warzak, 2000).

Relevant to social validity, a further consideration when working with parents to deliver AAC interventions is their preference regarding AAC systems, and how well AAC systems match a child and family's needs and abilities. Moorcroft, Scarinci, and Meyer (2019a) explored parent perceptions of AAC systems, particularly those related to system abandonment. Key themes identified related to uptake of AAC were that AAC implementation represented additional work for families, children did not use the introduced system, and parents did not feel the system introduced to their child matched the needs of the child and family. Parents may demonstrate a preference for working directly to improve a child's speech and, as a result, perceive the adoption of AAC as forfeiting attempts to develop speech (Cress & Marvin, 2003; Donato, Spencer, & Arthur-Kelly, 2018). Findings from the studies by Moorcroft et al. (2019a, 2019b) highlight several considerations when supporting families to use AAC with their children: (a) choosing teaching strategies that can be incorporated easily into extant family routines to minimise additional work, (b) involving parents in the AAC decision-making process, (c) taking into account child characteristics (e.g., motivation, sensory profile), and (d) consideration of family preferences.

In addition to identifying strategies that are effective and easy to use, there is also a need to determine effective methods of teaching parents how to implement them with their children (Wainer & Ingersoll, 2013). In systematic reviews of parent training for children with ASD, a number of strategies applied in parent training have been found effective, including verbal instruction (incorporating explanation, and the opportunity for questions to be answered), provision of written instructions, modelling, and feedback following video review of intervention procedures (Lang, Machalicek, Rispoli, & Regester, 2009; Patterson, Smith, & Mirenda, 2012). Yet to be identified, however, are those strategies that are most effective and efficient in parent-training (Lang et al., 2009). To this end, Kent-Walsh et al. (2015) conducted a meta-analysis of parent training instructional procedures specific to AAC, identifying modelling, practice, role-play, and the provision of descriptive information to be those most frequently used. While moderate to very large effect sizes were associated with all strategies used in parent training, the instructional strategies or combination of instructional strategies that yield the best outcomes for parents remain unknown.

Aims

The aim of this study was to investigate whether parents could learn to implement AEMT, an aided form of EMT (Logan et al., 2020b), with their children with ASD in typical and child-preferred activities at home. This study built on that of Logan et al. (2020b; Chapter 5), in which AEMT was used to teach symbolic communication to children with ASD. The focus of the current study was to determine whether (a) parents could learn to use AEMT with their children, and (b) there would be associated improvements in the children's use of symbolic language if parents were successful. The AEMT was simplified in the current study to include a focus on three core strategies to improve likelihood of parents learning the skills. The three strategies selected reflected the setting events presumably required for generalisation in the form of environmental arrangement (Logan et al., 2020a), and use of symbols through the provision of models and prompts (Logan et al., 2020b). Further aims were to investigate whether changes in behaviour were maintained, if parents considered the intervention goals, procedures, and outcomes to be socially valid, and if previous involvement with the AEMT was associated with improved outcomes. There were two predictions.

1. Parent training would result in acquisition or increased use of the AEMT strategies of environmental arrangement, and provision of models and prompts.
2. Frequency of parental use of AEMT strategies would be associated with increases in symbolic communication by children with ASD.

Method

Ethics Approval

Approval for this study was obtained from the La Trobe University Human Ethics Committee (15-056), the Aspect Research Approvals Committee (1719), and the NSW Department of Education State Education Research Applications Process (2015226).

Design

A multiple baseline across behaviours design was employed (Baer, Wolf, & Risley, 1968), with systematic variation across three participants. Systematic variation was used to determine differential responses according to a dyad's previous involvement in and response to AEMT. The design involved three children who differed according to whether they responded, demonstrated limited response, or were new to the AEMT. The independent variable was the parent-mediated AEMT training. The dependent variable was parent use of the AEMT strategies of environmental arrangement, providing models, and prompting. There were three phases during the study: baseline, intervention (parent training), and post-training. A maintenance data probe was also administered where possible. A secondary dependent variable measured across phases was the frequency of symbolic communication produced by the children, although these data were not used in deciding to implement the next phase of the design.

Participants

Selection criteria. Parents were selected on the basis of being a primary caregiver to a child with ASD who was minimally verbal. Additional selection criteria were that they were willing to participate in parent training, be video-recorded, and implement the AEMT therapy during home-based sessions for the duration of the study.

Children were selected if they met the following criteria: (a) had a diagnosis of ASD based on DSM-IV/TR/5 criteria (American Psychiatric Association, 1994; 2000; 2013), confirmed by psychological or paediatrician written assessment reports and administration of the Gilliam Autism Rating Scales (GARS) (Gilliam, 2014); and (b) were minimally verbal, defined as having fewer than 10 different words identified as “understands and says” on the MacArthur-Bates Communicative Development Inventories (CDI) (CDI; Fenson et al., 2007), and confirmed during observational assessment**.**

Recruitment. Two parents who had previously participated in the study by Logan et al. (2020b) were contacted. Their interest in participating in a follow-up study was initially ascertained by e-mail, in which they were informed about the overall aims of the parent-mediated AEMT study and asked whether they would like to receive further information. A third participant in the Logan et al. (2020b) study was not invited to participate because the child no longer met criteria for being minimally verbal. An additional participant was recruited through information leaflets about the study that had been sent to early childhood intervention centres, developmental paediatricians, autism-specific service providers and parent-interest groups, and special schools in Sydney, Australia (refer to Appendix A- Chapter 6). Interested parents then contacted the researcher, who interviewed them via phone to ascertain their interest in participating in the study based on its requirements, and to obtain consent to proceed to an in-person meeting.

The researcher then met with each of the three parents who had expressed interest to further explain the study, answer questions, and provide a written participant information statement (refer to Appendix B- Chapter 6). All parents signed a consent form for their own participation and that of their child (refer to Appendix C- Chapter 6).

Description. Dyad 1, who had previously participated in the Logan et al. (2020b) study, comprised Abigail, a 35-year-old female, and her son Nicholai. Abigail had a bachelor’s degree, was employed full-time, and lived with her husband and two children. She had observed all AEMT sessions during Nicholai’s participation in Logan et al.’s (2020b) study, and received written and verbal information regarding how to apply strategies during Nicholai's everyday routines at the conclusion of the study. Nicholai was 8 years old and had a diagnosis of ASD - Level 3 (requiring very substantial support), and global developmental delay according to paediatrician report. At the conclusion of Logan et al.'s (2020b) study, Nicholai had demonstrated sporadic, inconsistent use of symbolic communication, using picture symbols, and mainly for the purposes of making requests. He continued to rely on an adult pointing to symbols as a prompt to use aided AAC. At the time of the current study, Nicholai communicated using non-symbolic methods, such as leading, touching, and some challenging behaviours when distressed or frustrated. He was not reported or observed to use any formal means of communication spontaneously or consistently prior to initiation of the study, except for the reported use of one spoken word ("bye"), and inconsistent production of a request for "more" using manual sign or a picture symbol (on an iPad®). Nicholai attended a special school five days per week. Nicholai's family spoke English as their primary language at home, and Abigail also spoke Russian with her husband and extended family. The family resided in an area of Sydney that had an index of relative socio-economic disadvantage score of 1108 (10th decile).

Dyad 2, who had also previously participated in Logan et al.'s (2020b) study, comprised Aara, a 37-year-old female originally from Bangladesh, and her son, Imran. Aara had a Master's degree, was not in paid employment, and lived with her husband and two children, with Imran's younger brother also having a diagnosis of ASD. She had observed all AEMT sessions during Imran's participation in Logan et al.'s (2020b) study and received written and verbal information regarding how to apply strategies during Imran's daily routines at its conclusion. Imran was 8 years old with a diagnosis of autistic disorder and global developmental delay according to paediatrician report. At the conclusion of his participation in the previous study, Imran was using picture symbols to communicate with consistency, but was reliant on strategies to prompt use, such as expectant waiting and withholding objects. At the time of the current study, Imran was observed to communicate using non-symbolic methods, such as leading, vocalising, and reaching towards desired objects. He used one word spontaneously ("password") to request preferred objects, and had recently developed some verbal imitation skills, predominantly single words to request objects that he found highly motivating following a preceding verbal model. Imran attended a special school five days per week. Imran's family spoke English as their primary language at home, and Aara also spoke Bengali with her husband and extended family. They resided in an area of Sydney that had an index of relative socio-economic disadvantage score of 983 (5th decile).

Dyad 3 comprised Dhir, a 37-year-old male originally from India, and his son, Harbeer. Dhir had a Master's degree, was in paid employment part-time, and lived with his wife and two children. Harbeer was 2 years old and had a diagnosis of ASD and a significant global developmental delay, according to paediatrician report. Harbeer communicated mainly by leading another person to what he wanted and handing objects that he needed assistance with to another person. He did not use any words spontaneously at the time of the current study. Harbeer was not enrolled in any educational setting during the time of the study. Harbeer's family spoke both English and Punjabi in the home environment. They resided in an area of Sydney that had an index of relative socio-economic disadvantage score of 950 (3rd decile).

Setting

Sessions were conducted in participants' homes. Locations within the home varied according to child interests and activities selected for intervention. For Nicholai, these comprised the kitchen, loungeroom, and backyard. For Imran, sessions were conducted in the bedroom, loungeroom, backyard, and a playroom. For Harbeer, sessions occurred in the loungeroom and bedroom. During each session, each parent was positioned beside or opposite the child. The researcher was positioned approximately 1m away from the dyad in order to operate a Sony® Digital HD Video Camera Recorder (HDR PJ230) to record sessions and follow participants if locations changed.

Materials

An iPad® was configured as an SGD by installing the Proloquo2go® application (AssistiveWare, 2018) and restricting access to other applications during sessions. Proloquo2go® was configured to remove navigational requirements and contain only a single page of coloured line drawings selected from its picture symbol library. Nine picture symbols were selected to represent vocabulary that could be used across different activities for a range of pragmatic functions and intended meanings. Procedures for selecting vocabulary reflected those described by Goossens, Crain, and Elder (1992). The picture symbols selected represented *I, WANT, THAT, HELP, GO, GOOD, TURN, MORE, FINISH.* Touching a picture symbol resulted in synthetic speech output for the word represented.

Intervention Researcher

The researcher (first author) who administered parent-training intervention procedures had 13 years' experience working as a speech pathologist with children with ASD. Her qualifications included Hanen certification for the It Takes Two To Talk™ program, which is utilized in the responsivity education component of EMT (Fey, Yoder, Warren, & Bredin-Oja, 2013).

Procedures

As parents served as their own controls within each of three respective and independent multiple baseline design across behaviour experiments, participant dyads commenced the study according to their availability. A minimum of three baseline data points were required for documenting use of each strategy by a parent prior to entry into the intervention phase. When a response to intervention was observed in parents, defined as a visible increase in frequency of any technique within the focus AEMT strategy in comparison to the previous phase, evident on a minimum of two data points, the next target AEMT strategy was introduced. Definitions of behaviours required for demonstration of each AEMT strategy (dependent variable) are listed in Table 1. A minimum of three training sessions was provided per strategy.

Baseline. These sessions involved the parent interacting with the child during parent-selected activities that they had observed to be of interest to their child. The iPad® was turned on, the Proloquo2go® application launched, and settings configured so that the display was on the AAC page with the nine selected symbols during the entirety of the session. Parents were asked to stay with their child and engage in a typical manner for that activity. No instruction regarding how to interact with their child or use the iPad® was provided.

Intervention. Each participant dyad received a minimum of nine sessions of the parent-mediated AEMT. Sessions occurred at a minimum of three days per week, over a 3-week period, but there was some variation in how these were scheduled across the week according to parent availability. Nine sessions were selected as the minimum period during which to implement intervention, as all participants in Logan et al.'s (2020b) AEMT researcher-administered intervention study had demonstrated a response to intervention by the third session. Sessions were a minimum of 20 min duration, extending up to approximately 30 min so as not to disrupt an activity if parents and children were engaged. During each AEMT session, parents were free to choose the number and type of activities in which they engaged their child. However, prior to each intervention session, the researcher asked each parent which activities were currently most motivating to the child and, therefore, should be selected. The AEMT was simplified into three main categories to facilitate ease of learning: environmental arrangement, provision of models, and prompting. A written description of teaching strategies is provided in Appendix D - Chapter 6 and summarised in Table 1. Environmental arrangement strategies were adapted from Ostrosky and Kaiser (1991), provision of models from Hancock and Kaiser (2006), and prompting from Alpert and Kaiser (1992), and Hancock and Kaiser (2006).

Strategies used to teach parents the intervention reflected those with an evidence base for ASD and AAC parent instruction: (a) verbal instruction, which included explaining the strategy, answering parent questions, and having parents identify when the strategy could be used; (b) providing a written copy of instructions for parent reference; (c) demonstrating the strategy, providing an opportunity for role-play; and (c) providing feedback while the parent observed video recordings of parent-child interactions during either baseline for the initial intervention session, or the preceding intervention session for all other intervention sessions (Lang et al., 2009; Kent-Walsh et al., 2015).

Table 1

AEMT strategies taught to parents

Strategy	Description
Environmental arrangement	Parents organise the child's environment to provide communication opportunities. Specific strategies constitute using child-preferred activities, providing choices, having preferred objects in sight but out of reach, and utilising sabotage and surprise.
Modelling	Parents provide a spoken model as children participate in activities, while also pointing to relevant picture symbols. Parents say words and point to picture symbols that match what the child is doing or what is happening.
Prompting	Parents elicit their child's use of picture symbols. A least-to-most support prompting sequence is encouraged, with parents taught how to wait, show, and then help their child to use picture symbols. Specifically, before physically helping their child to point to pictures, parents are encouraged to show their child what to communicate by pointing at a relevant picture. Before showing their child a relevant picture, parents are required to wait and look expectantly at their child.

For Dyad 3 (Dhir and Harbeer), one modification was made to training procedures during intervention sessions because Dhir expressed uncertainty during sessions regarding how to proceed if Harbeer engaged in a behaviour that had not been rehearsed during parent training. These questions were associated with the following situations: Harbeer leaving the room or wandering without purpose, Harbeer doing something inappropriate with materials (e.g., making a mess), and Harbeer having difficulty tolerating an adult providing a physical prompt to use the iPad®. Subsequently, on 5 occasions the researcher provided a verbal prompt during the session (e.g., "He might be ready for a different activity") and on one occasion demonstrated a least-to-most prompting sequence directly with Harbeer to attempt to reduce Harbeer's frustration at being physically prompted. These prompts were considered ethically appropriate (and socially valid) to use in situations during which parents (in this instance Dhir) demonstrated marked uncertainty. When these prompts were provided to Dhir, his immediate subsequent demonstration of the target AEMT strategy was not scored. Additionally, during sessions for Dyad 1 (Abigail and Nicholai), occasionally Nicholai became distressed without an obvious cause, sometimes engaging in self-injurious behaviours. These behaviours (distress, self-injurious) were consistent with those displayed throughout the day by Nicholai, irrespective of activity (confirmed through observation by the researcher, and as noted in clinical assessment reports and parent report). During these instances, the researcher discussed with Abigail that she was free to choose whether to persist with intervention, take a break, or implement any strategies that Nicholai may find calming (e.g., a drink of water). Again, these discussions were deemed ethically appropriate to occur during intervention.

Post-training. Following the training for environmental arrangement and modelling, participants entered the post-training phase during which no specific training was provided for these strategies. Anecdotal feedback regarding use of the previous strategies was provided only incidentally during this phase. For example, when modelling was introduced as the focus teaching strategy, no specific instruction was provided for environmental arrangement, and when prompting was introduced, no specific instruction was provided for environmental arrangement and modelling. The purpose of the post-intervention phase was to allow parents to focus on the current target strategy by limiting the amount of information they needed to retain. After completing parent training for the third AEMT teaching strategy (prompting), a 4-week break from intervention occurred.

Maintenance

After the intervention phase (when all strategies had been taught), there was a 4- week break from intervention. During these four weeks, no parent training occurred. After the four weeks, a maintenance probe was conducted. Parents were given the SGD used during intervention and asked to stay with their child and interact as they felt appropriate. Only Dyads 1 and 3 were available for the maintenance probe.

Data Collection and Coding

In keeping with repeated measures time series designs, data collection occurred during baseline, intervention, post-training, and maintenance sessions. All sessions were video-recorded and coded by the researcher. For each session, recording started from the beginning of the parent-child interaction and continued for at least 20 min; all of and only this first 20 min of recording was used for coding, regardless of whether the interactions continued. Information coded from the videos comprised the parent use of AEMT strategies (environmental arrangement, modelling, prompting) (see Table 1 for definitions), and any use of symbolic communication by their child. Child symbolic communication was defined as producing a spoken word or pointing to a picture symbol that appeared meaningful (i.e., was relevant) to the context, was not an imitation of a previous production (speech or symbol use) by the parent, and was intentionally communicative as demonstrated by being directed to the communication partner (refer to Appendix E - Chapter 6 for the operational definition). For target parent behaviours, use was recorded in 30s intervals; if a behaviour was used at least once within that interval, a single tick was recorded. Ticks were tallied to provide the number of intervals during which target parent behaviours were used. For coding of child symbolic communication, information recorded comprised time of use, symbol/s used, and whether use was non-imitative, meaningful to the context and selected with intent, and intentionally communicative by being directed to the parent. Only symbols that were symbolic, non-imitative, meaningful, and intentional were included as instances of symbolic communication; these occurrences were tallied to provide total symbolic behaviours per session. Multiple symbol combinations produced in succession with an apparent linked meaning (e.g., *I WANT THAT; MORE TURN*) were reported as a single occurrence of symbolic communication.

Fidelity of parent-training procedures. Fidelity checks occurred for 50% (*n*=9) of randomly selected intervention sessions. Fidelity of the researcher's use of the parent training procedures was assessed during intervention by an independent clinical researcher (a PhD-qualified clinical psychologist) using a checklist (see Appendix F - Chapter 6). Fidelity of implementation was 100%.

Inter-rater agreement for the dependent variable. The researcher initially coded all sessions. The same independent clinical researcher who had completed fidelity checks, then coded parent and child behaviours for 37% (*n*=14) of sessions randomly selected from across baseline, intervention, post-training, and maintenance sessions (refer to Appendix G - Chapter 6 for coding specifications). Inter-rater agreement was subsequently calculated to determine the degree of agreement for coding of parent behaviours (use of environmental arrangement, modelling, and prompting), and child behaviours (symbolic communication). Inter-rater agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements, multiplied by 100. The average inter-observer agreement for parent's use of AEMT strategies was 91% (range 89-92%), and for child symbolic communication was 91% (range 89-100%).

Analysis

Visual analysis was used to evaluate the effectiveness of the parent-mediated intervention, reflecting convention for single case experimental design studies. Graphed data were inspected to determine intervention effectiveness (with a focus on performance, immediacy of effect, trend, variability, and overlap) (Kratochwill et al., 2010). Statistical analysis, such as percentage of all non-overlapping data, was not performed due to lack of the requisite minimum data points within each parent-child dyad.

Social Validity

A social validity survey, as developed and described in Chapter 4, was administered to ascertain the social validity associated with the parent-mediated AEMT (refer to Appendix H - Chapter 6). This survey included 30 questions requiring parents to rate intervention goals, methods, and outcomes on a 4-point scale from strongly disagree to strongly agree (including an option for unsure; with score reversals for some items), as well as three open-ended questions inviting parents to state what was liked and disliked about the intervention and provide any other feedback. Scored responses to survey questions were tallied, and an average calculated, with higher scores representing higher social validity). Content grouping was also used to summarise responses to open ended questions.

Results

Figures 1-6 display the results for the three parent-child dyads across baseline, intervention, and maintenance.

Dyad 1

Activities that Nicholai participated in during baseline and intervention involved food snacks, vibrating toys, water beads, a hammock, a spinning chair, and a trampoline. One intervention session was of only 18 min duration because Nicholai lost interest in activities presented and became distressed (demonstrated through crying and some self-injurious behaviours).

During baseline, Abigail was observed to spontaneously use 4 of the 6 environmental arrangement strategy forms with high frequency (in 114-126 out of a possible 240 intervals of 30 s). Given these high baseline rates, it was decided to record data on the two environmental arrangement forms (doing something unexpected, and forgetting to return an object), which would provide the clearest demonstration of intervention effects, although training was still provided on all six forms in order to allow for demonstration of strategies in novel contexts (i.e., during new activities or to provide alternate ideas within an activity). Similarly, within the strategies of modelling and prompting, verbal modelling was frequently provided (38-40 uses out of a possible 40 intervals), as was prompting (19-30 uses out of a possible 40 intervals). Subsequently, during parent training, although training was provided for all types of modelling and prompting, the specific focus for Abigail was on picture symbol modelling (within the modelling strategy) and application of a least-to-most prompting sequence (within the prompting strategy).

As evident in Figure 1, during baseline, Abigail did not use the target environmental arrangement forms. During intervention (parent training), her use increased, with maximum use occurring in the third session of environmental arrangement parent training (15 intervals). She continued to use environmental arrangement forms post-training and during the maintenance probe at a higher level than for baseline. During the intervention for modelling, Abigail's use of this strategy increased from a maximum of 15 intervals during which

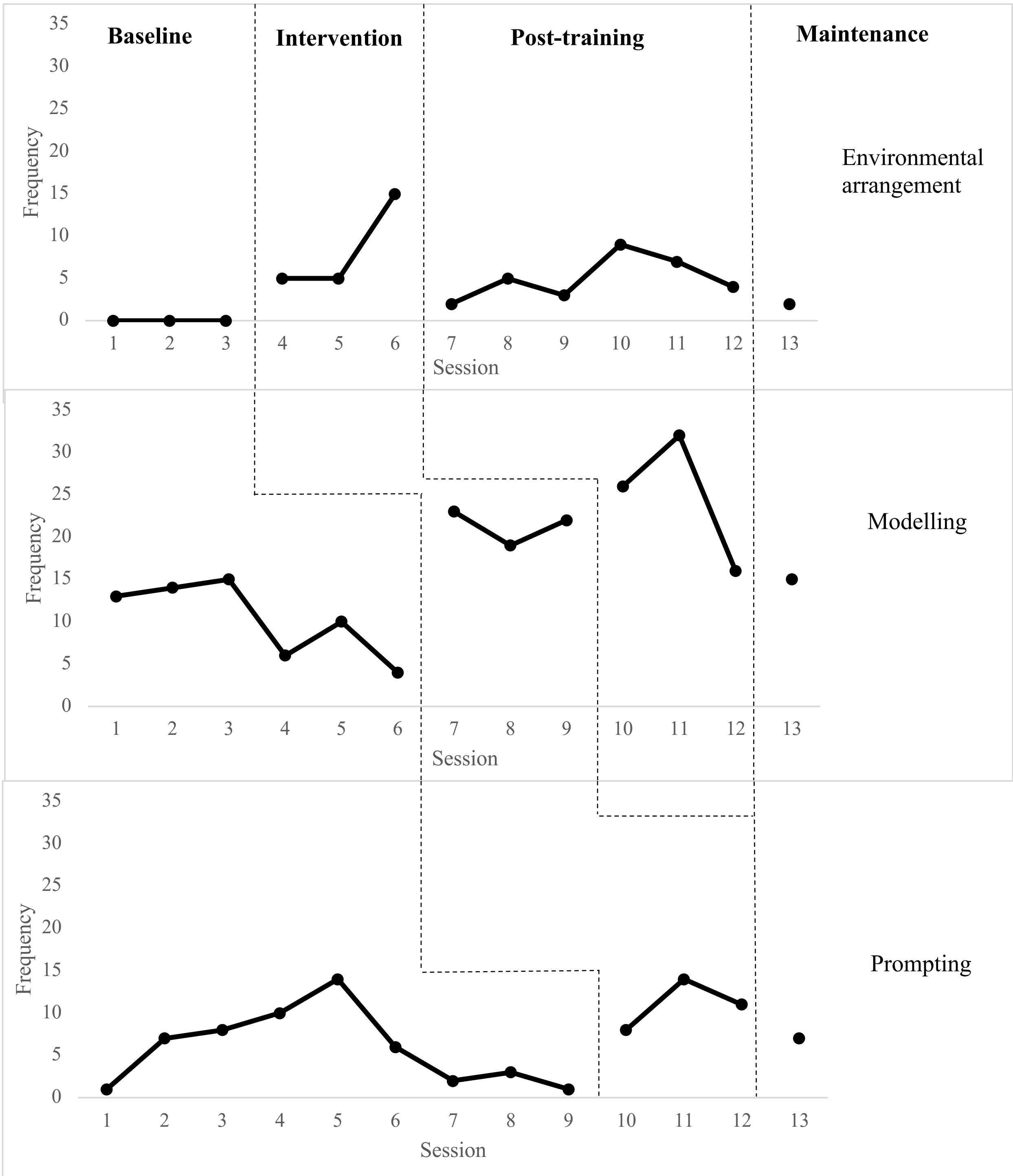

Figure 1. Abigail's use of AEMT strategies.

modelling was observed to a maximum of 32 intervals during parent-training. Abigail maintained a higher frequency of modelling during intervention and post training, but during the maintenance probe it had returned to baseline. When parent training was initiated for prompting, Abigail's use increased to the maximum recorded during baseline (14 intervals), but did not exceed baseline during this phase or the maintenance probe.

Inspection of Figure 1 indicates that there appeared to be some association between parent training (and parent's subsequent use of target AEMT strategies) on other AEMT parent behaviours. For example, when parent training occurred for environmental arrangement, Abigail's modelling declined (from occurring in a maximum of 15 intervals to 5), and during the intervention phase for modelling, her prompting also declined (decreasing in observed use from a maximum of 14 to 1 interval). Further, an increase in prompting during baseline was noted to occur during the environmental arrangement intervention phase, but declined during modelling.

Nicholai's use of symbolic communication is depicted in Figure 2. Although variable, an increase in his symbolic communication was noted in conjunction with each parent training intervention phase, from a maximum of 11 instances observed during baseline, to 48 during parent training for prompting. This increase occurred across phases, despite parent prompting occurring at similar rates to baseline during intervention for this strategy. During the maintenance probe, Nicholai's use of symbolic communication had decreased in comparison to the previous intervention phase (prompting), but was still above baseline levels (*n*= 16). The form of Nicholai's symbolic communication was always picture symbols (selected via pointing) on the iPad®.

Dyad 2

Activities Imran participated in during baseline and intervention involved playdough, kinetic sand, cars, and a swing set and trampoline. During baseline, Aara most frequently used the environmental arrangement strategy forms of using materials of interest (used in 31-38 of 40 intervals), placing objects in sight but out of reach (used in 10-20 of 40

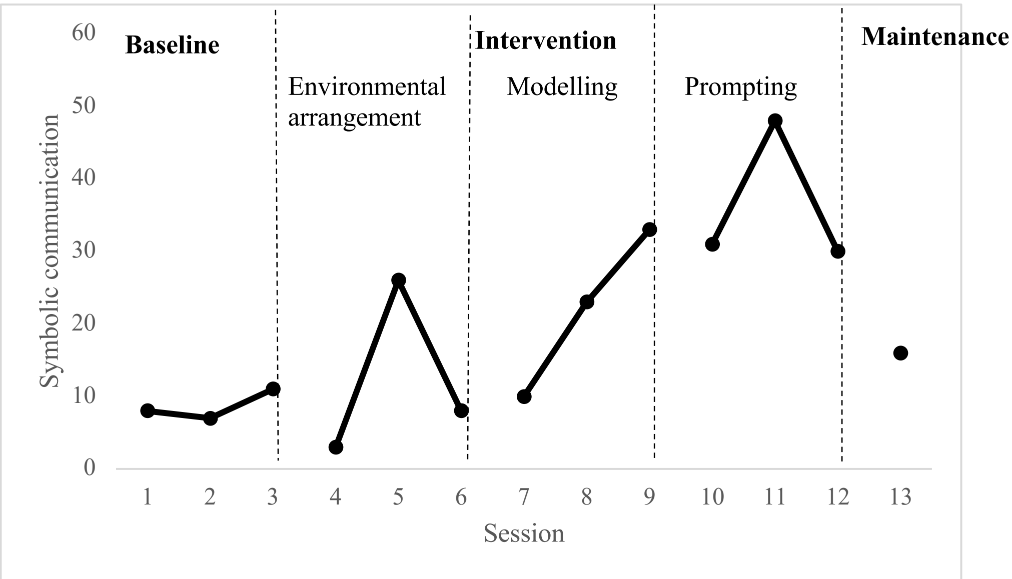

Figure 2. Nicholai's use of symbolic communication

intervals), and providing short turns (used in 8-15 of 40 intervals). During training, these three forms were also used most frequently though at a higher rate, however, her use of all types of environmental arrangement increased. With respect to the provision of modelling and prompting, during baseline, Aara most frequently provided verbal (used in 34-38 of 40 intervals), rather than picture symbol models (used in 0-1 of 40 intervals), and rarely used any type of prompting to elicit use of picture symbols.

As illustrated in Figure 3, during baseline, Aara used at least any one of the 6 environmental arrangement forms in 56-68 intervals. Her use increased during parent training to occur in a maximum of 90 intervals. During post-training, when the modelling strategy was introduced, her use of environmental arrangement declined, but increased again during the prompting parent training phase to a frequency similar to the direct training phase. Aara's use of modelling increased from occurring in 35-38 intervals during baseline, to 46-58 intervals during parent training (reflecting an increase in both verbal and picture symbol modelling). Her use during the post-training phase remained at a higher level than baseline (40-44 intervals). When Aara was taught to use prompting to elicit symbolic communication,

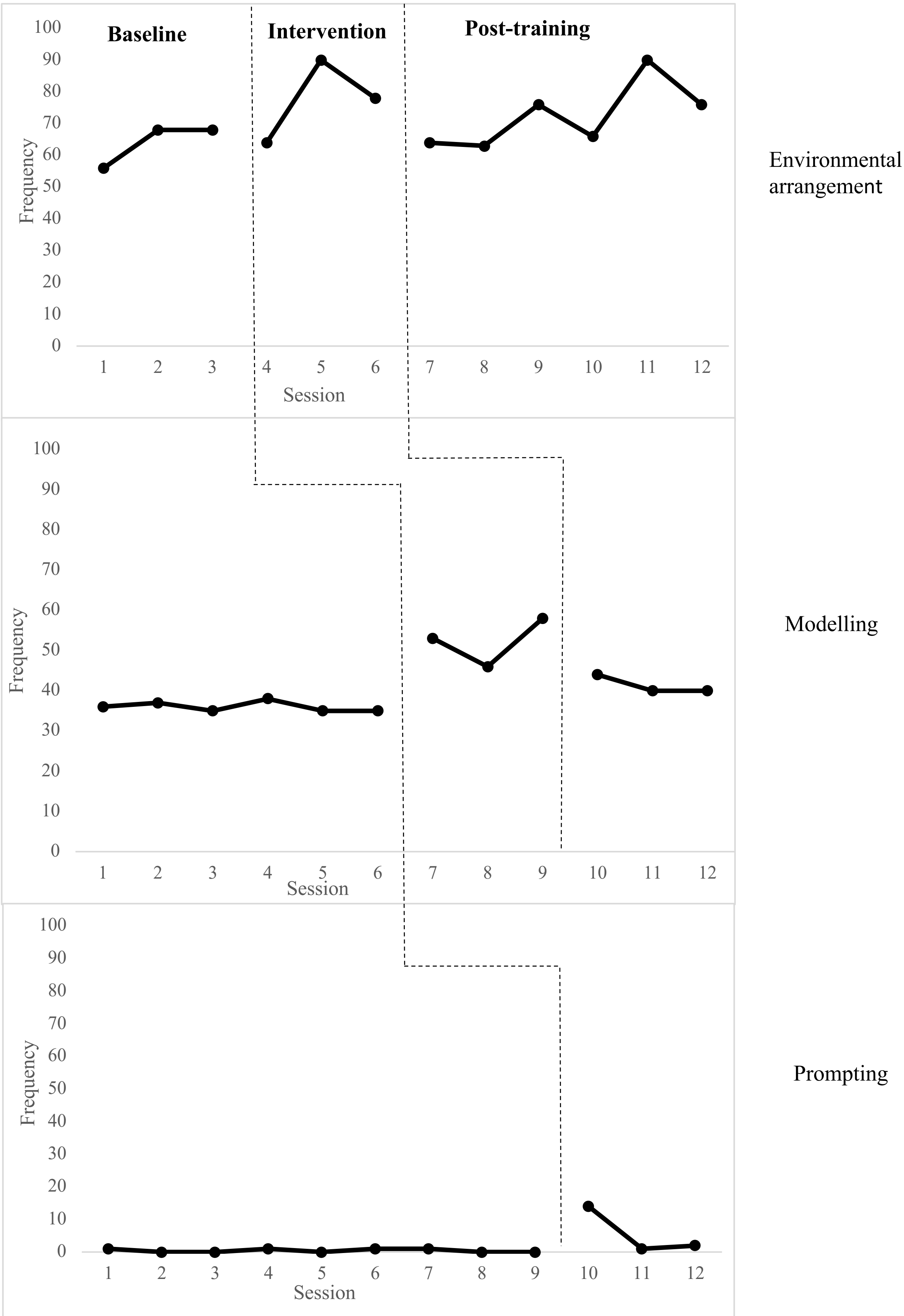

Figure 3. Aara's use of AEMT strategies.

an increase from 0 to 14 was observed, but then decreased to baseline levels in the next session, followed by a slight increase. However, during all phases, she frequently used expectant waiting as a stand-alone strategy to elicit specific speech targets (rather than elicit use of picture symbols).

Imran's use of symbolic communication is depicted in Figure 4. His use was variable (0-6 instances during baseline, 1-10 during environmental arrangement, 1-4 during modelling, and 5-30 during the prompting phase). The highest frequency (*n*=10 and *n*=30) of his symbolic communication occurred on the two occasions when his mother demonstrated environmental arrangement in 90 intervals during the session. The form of Imran's symbolic communication comprised both use of picture symbols and speech.

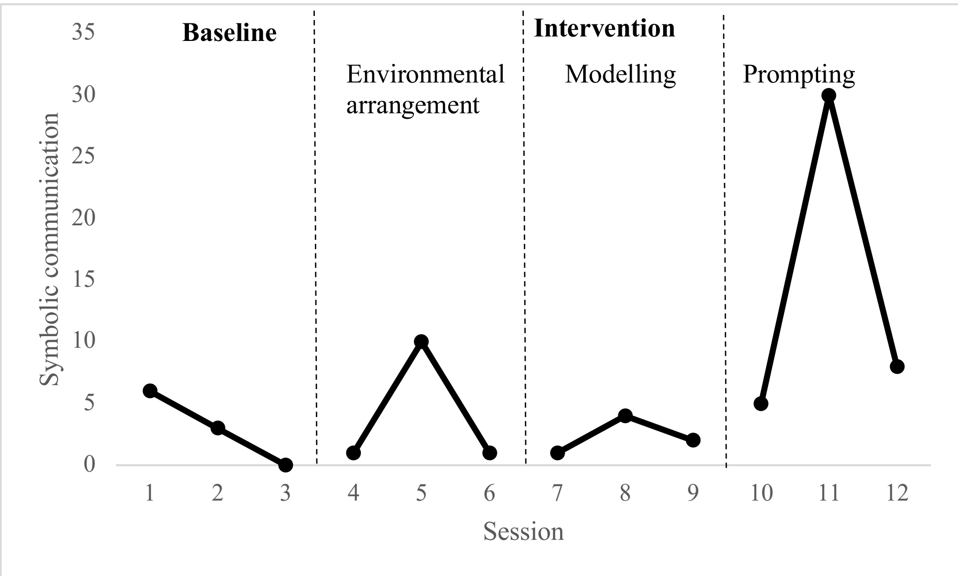

Figure 4. Imran's use of symbolic communication

Dyad 3

Activities selected for intervention comprised cars, water play, flour play, bubbles, wind-up toys, jumping, and blocks. As can be seen in Figure 5, during baseline, the environmental arrangement forms most often used by Dhir comprised using materials of interest (used in 13-35 of 40 intervals), and doing something unexpected (used in 2-16 of 40 intervals), with all forms demonstrated at least once with the exception of taking turns with an object and not returning it. Within the modelling strategy, he used verbal modelling most frequently (9-20 of 40 intervals, in comparison to 0-1 of 40 intervals for picture symbol modelling). No forms of prompting for picture symbol use occurred during baseline.

Dhir's use of AEMT strategies is depicted in Figure 5. As can be seen, an increase did not occur in Dhir's overall use of the environmental arrangement strategy following training or across phases, with his use of environmental arrangement forms remaining consistent over each phase. The decision was made to progress to the next phase in order to have sufficient time to complete data collection for all three AEMT strategies, due to constraints on the family's availability following emergence of personal commitments. A notable increase in use of modelling occurred during parent training (from a range of 9-20 to a range of 32-52) and post intervention (range 26-31), and remained higher than baseline during the maintenance probe (n=23). Dhir's use of prompting to elicit picture symbols also increased from none during baseline to a range of 2-5 instances during parent training. Most prompting by Dhir involved most-to-least, rather than the least-to-most sequence, with least-to-most observed on one occasion only - during the maintenance probe.

As indicated in Figure 6, Harbeer was not observed to use symbolic communication during baseline, nor across any of the study phases. Although Harbeer did not produce any symbolic communication during the maintenance probe, he was observed to spontaneously point to picture symbols on the iPad® for the first time, although without apparent meaning.

Social Validity

Dyad 1. Abigail scored the social validity of the intervention with an average of 3.8 (range 2-4). In the open-ended questions, Abigail reported that after intervention, Nicholai "attempts to communicate more with Proloquo2go® or uses signs and vocalisation to request. Before therapy, he would just hit himself." In response to the question asking what was liked

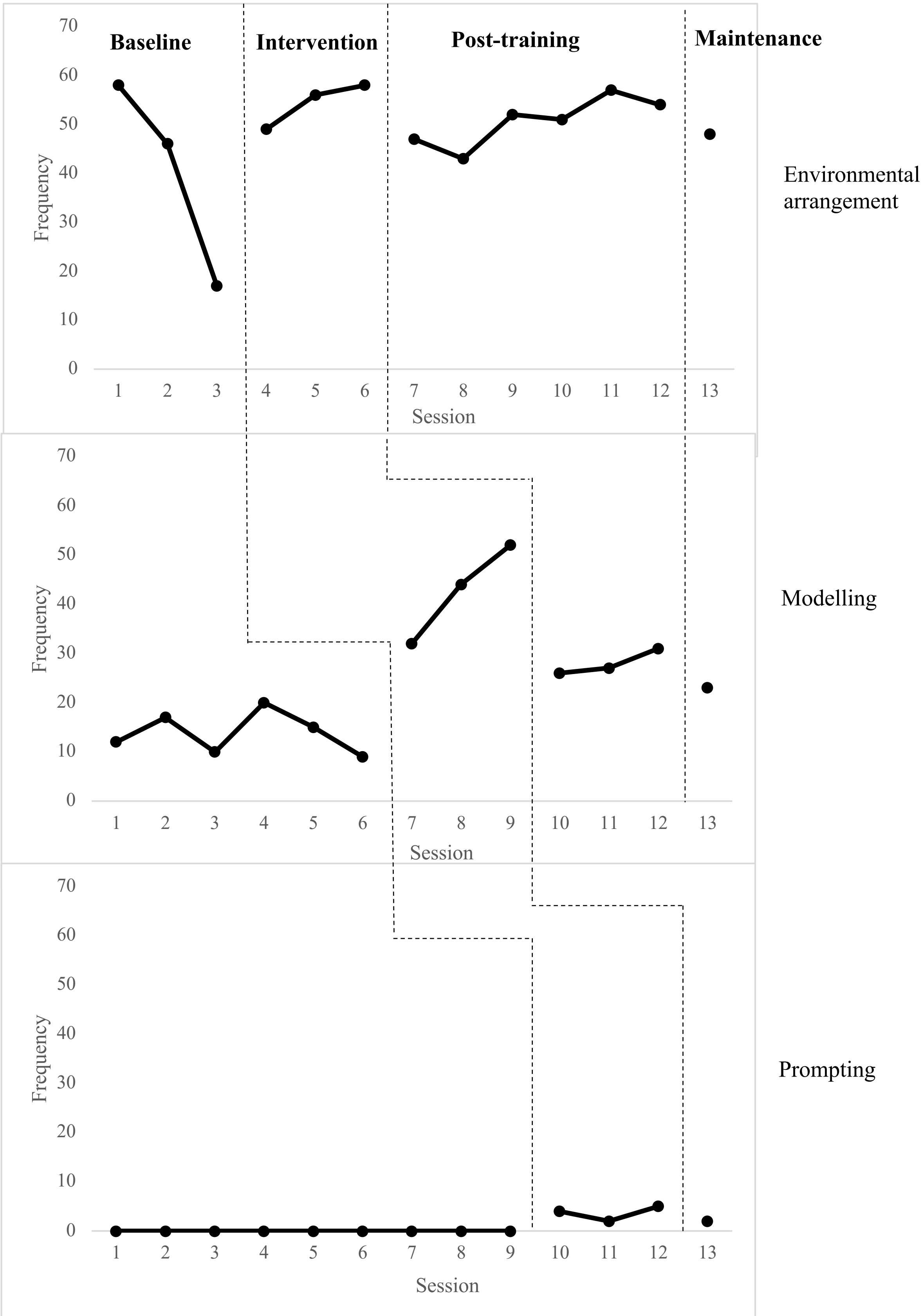

Figure 5. Dhir's use of AEMT strategies

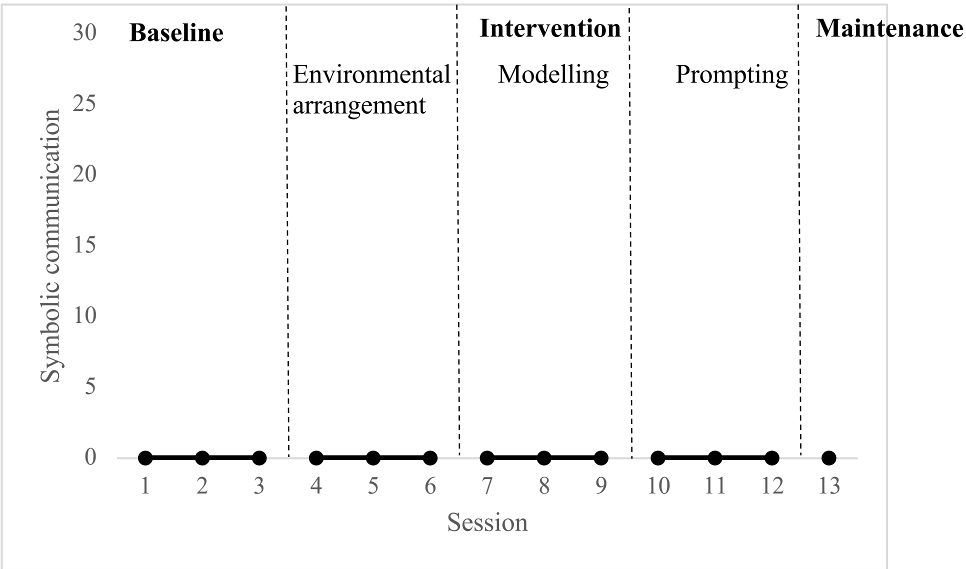

Figure 6. Harbeer's use of symbolic communication

about the intervention, Abigail reported that it was "easy to follow and help (Nicholai)" and that there was "flexibility with pictures." Abigail did not provide a response to the question asking what was disliked about therapy. She did indicate uncertainty, however, in response to items on the survey about the potential for therapy strategies and outcomes to be transferred to other settings, and disagreed that therapy had occurred during typical daily routines and activities, or that Nicholai could communicate for reasons other than making object requests after intervention.

Dyad 2. Aara rated the social validity of AEMT with an average of 2.9 (range 2-4). In response to the open-ended questions, Aara reported that although the intervention did not provide the results she was looking for (speech), she "learned techniques to communicate effectively" with Imran, and found the videos provided "the clue to improve my actions." Additionally, she reported it matched Imran's "skills at the moment and gave him an extra dimension to communicate." Aara responded with "nothing" to the question asking what was disliked about the intervention, though she did provide an additional comment that involvement of both parents would have been more beneficial. Items on the survey in which Aara disagreed were that Imran would be able to participate out in the community more effectively after intervention, that results would be lasting, and that Imran was able to communicate for reasons other than making object requests. Aara also responded with "unsure" as to whether Imran would be able to communicate with unfamiliar people following intervention.

Dyad 3. Dhir rated the social validity of the intervention with an average of 4 (range 3-4). In response to the open-ended questions, Dhir reported that in response to the therapy, Harbeer "started improving and getting along with his daily activity," and that he was able to develop his requesting skills during everyday activities. Anecdotally, both parents also reported that he started saying a few words and engaging more in other tasks. No negative aspects of the AEMT were reported in the survey.

Parents reported no adverse effects either relating to their own participation in the study or their child's response to intervention procedures. Although challenging behaviours were observed in Nicholai during intervention, these behaviours did not differ to behaviours observed during preferred, similar, or unrelated activities, and as a result, were not classified as adverse effects.

Discussion

The overall findings from the study provide evidence that parents can learn to implement strategies from the AEMT. All parents developed their skills in at least two of the three target strategies in a maximum of three sessions per strategy, and largely rated the intervention as socially valid. Of the three child participants, two demonstrated changes in their communication skills that aligned with parent use of AEMT strategies. Together, these findings demonstrate the positive outcomes that can be associated with parent-mediated interventions. However, given that not all AEMT strategies increased in comparison to baseline, and not all children improved symbolic communication, there is need to consider individual differences and tailor intervention goals and strategies accordingly.

Implications for Changes in Parent Communication Behaviours

The finding that parents can be effective agents of intervention is consistent with previous research. In other studies in which AAC intervention strategies have been taught to parents of children with ASD, it has been found that parents have demonstrated both skill acquisition (Shire et al., 2015) and high fidelity of intervention procedures (e.g., Olive et al., 2008; Park et al., 2011). The outcomes of the current and previous research are relevant in terms of parents' potential to provide an increased dosage of therapy (Zwaigenbaum et al., 2015), with associated cost benefits (Oono et al., 2015). The outcomes also provide additional support for research indicating that participation in parent training allows parents to increase their knowledge and skills, possibly decreasing parental stress and facilitating more enjoyable parent-child interactions (Estes et al., 2014). More engaged and interested parents may, thereby, be more responsive to their child's communicative and potentially communicative behaviours during interactions (Koegel et al., 1996). Consistent with the transactional theory, responsive and engaged parents are more able to provide the bidirectional exchanges needed for language development (McDuffie & Yoder, 2010).

Aligned with the transactional model of language development (Sameroff, 1975, 2009) was the finding of an apparent association between parent use of strategies and child symbolic communication for two of the three children. Imran, for instance, demonstrated peaks in his symbolic communication, which appeared to be in response to his mother's maximum use of environmental arrangement; her actions within the dyad's interactions thereby appeared to serve to shape his responses. Nicholai, who gradually increased his symbolic communication in line with each new parent strategy, was consistently using symbolic communication by the time prompting was introduced. It is possible that as a consequence, Abigail prompted less frequently, but increased her use of modelling (see Figure 1), accordingly, providing additional opportunities for language growth (Warren et al., 2008). Previous research in which naturalistic interventions have been implemented has also provided support for a transactional relationship between adult-child interactions. For example, Nunes and Hanline (2007) found that as a child used more communication, changes to the adult's actions occurred (e.g., reduced prompting). Although Harbeer did not use any symbolic communication during the intervention, anecdotally (and as conveyed on the social validity survey), his parents observed changes to his communication over the course of intervention. These perceived changes could possibly be attributable to changes within the dyad's interactions (i.e., his father's increased use of AEMT strategies), although response bias may also have been a factor given that his parents knew the intervention was designed to improve communication skills (Paulhus, 1991).

Factors Potentially Impacting Parent Response

Although parents learned some of the target AEMT strategies, others were not used above baseline levels. Both Abigail and Dhir did not increase their use of one of the three AEMT strategies (prompting and environmental arrangement, respectively) even following direct instruction. One reason may relate to a failure to set a benchmark with regard to an acceptable minimum use of a target strategy. In contrast, in their study in which parents successfully learnt all intervention strategies associated with the picture exchange communication system, Park et al. (2011) required that parents meet a criterion of 90% accuracy (with the researcher serving as the communication partner) across three trials prior to implementation with their child. Setting a benchmark for demonstration of target strategies as part of parent training would help parents learn to use strategies consistently, as well as ensure that the dose of intervention provided is that needed for child skill acquisition. Although research that establishes the ideal number of teaching episodes in AAC is still in a relative early stage (Logan et al., 2020a), some guidance can be found in the EMT literature. Kaiser and Hampton (2017), for example, suggested that 6-10 milieu prompts for language should be the aim per 20 min session. Further, in other studies in which parents have been taught EMT strategies, parents have received training over the course of many more sessions than those provided in the current study (e.g., 36 sessions by Kaiser & Roberts, 2013), providing a substantially longer period over which intervention dosage was provided to children. It is possible that training over a longer period with more sessions may also have supported parents to increase frequency of all target strategies.

One unanticipated complication in interpretation of parent outcomes was that over the course of intervention, target behaviours did not demonstrate functional independence. For example, when environmental arrangement was introduced for Abigail, she concurrently increased prompting even though this strategy had not been taught or encouraged. On the other hand, attention to a particular strategy sometimes caused parents to shift their attention to it and reduce their use of others. When Abigail and Aara were focused on providing models, for example, their respective prompting and environmental arrangements decreased. Nunes and Hanline (2007) similarly found that when multiple EMT strategies were taught, parents tended to focus on one strategy within sessions. In other multiple baseline design studies in which parents have received training for EMT, individual strategies have not served as the dependant variable (e.g., Kaiser et al., 2000), precluding the potential to determine relationships across strategies. It is possible that providing training on grouped AEMT strategies and measuring progress across parents, rather than AEMT behaviours, may have yielded different results.

Another factor that may have influenced outcomes was the selection of strategies used to teach parents. Those selected for the current study (e.g., role play, discussion, video-based feedback) have been frequently identified as successful within the ASD-AAC literature (e.g., Kent-Walsh et al., 2015; Lang et al., 2009). Others include guided practice, whereby the instructor provides in-vivo feedback to parents (Kent-Walsh et al., 2015; Lang et al., 2009), guided problem solving whereby the instructor works with parents to identify opportunities for communication and barriers to implementation of AAC (Alsayedhassan et al., 2016), and instructor modelling with children, whereby the instructor shows parents how to use the intervention with their child (Lang et al., 2009). Although the best combination of parent-teaching strategies is currently unknown (Kent-Walsh et al., 2015), it is possible that the incorporation of additional or different methods to teach parents may have facilitated improved outcomes.

Differences Across Parents

Related to the selection of training strategies was that parent teaching procedures may need to be refined or individualised to particular parents. Dyads 1 and 2 involved parents who had previously participated in the AEMT, and because of this, had watched the researcher implement it during 20 previous sessions. As a consequence, they had prior experience with instructor modelling (Lang et al., 2009) for AEMT. Given that parents in Dyads 1 and 2 demonstrated the selected AEMT strategies at a higher frequency than Dyad 3, it is possible that Dyad 3's outcomes may have been enhanced with prior modelling by the researcher. Such modelling may have allayed the uncertainty Dhir expressed during the intervention regarding what to do if something that had not been specifically rehearsed occurred. Incorporating in-vivo feedback (Kent-Walsh et al., 2015; Lang et al., 2009) as a core part of his training, particularly as he had no prior exposure to AEMT, may have provided him with more support and facilitated acquisition and use of strategies.

Parents were diverse with respect to background, culture, socio-economic status, access to resources, previous exposure to therapy, and goals for their child. Importantly the study did not exclude parents on the basis of language proficiency, or willingness to adhere to or previous exposure to the intervention, unlike many other studies involving parent-mediated interventions (Trembath et al., 2019). However, there is likely a need to individualise parent training methods and strategies accordingly. For example, despite having indicated her willingness to participate in the study and for Imran to learn to use AAC as the primary goal of the study, Aara stated on the social validity survey that her goal was for Imran to talk. Considering Aara's social validity ratings were the lowest of the three parents, the need for parent intervention buy-in was highlighted (Gulsrud et al., 2016; Moorcroft et al., 2019a). Aara may have benefited from extended discussions (beyond that provided to all parents prior to and during intervention) about how and why aided AAC could support Imran's speech and language growth, and how the strategies used within the intervention were also those that would support speech development alongside AAC use (Cress & Marvin, 2003). As part of social validity, a parent's existing skills and interaction style with their child also need to be taken into account. As observed with Abigail, parents may enter an intervention demonstrating natural use of some intervention strategies (Lang et al., 2009), and for them, a focus on additional strategies may be needed. Further, although not a focus of the current study, any differences between the interaction styles of mothers and fathers may need to be considered when determining relevant AEMT strategies to teach, and which parent teaching strategies to employ. Finally, the setting of intervention may also need to reflect a family's access to resources. Dhir reported that one of Harbeer's highly preferred activities was outside play, but, unlike Nicholai and Imran's homes, the family did not have access to an outside play area. Potentially, more communication opportunities may have arisen for Harbeer within this environment.

Child Use of Symbolic Communication

The increased use of symbolic communication over the course of parent training by two of the children suggests that parental use of AEMT strategies was associated with language growth. Harbeer was an exception, quite likely because he differed from the other children in several ways. He was the youngest (at 2 years of age), but also the only child who had not previously participated in the AEMT. He also did not demonstrate imitation skills during intervention and became frustrated during prompting, unlike Nicholai and Imran, who both imitated adult actions and were responsive to prompts for AAC use. For all child participants, individualising teaching strategies and goals according to a detailed appraisal of their skills at baseline may facilitate improvements (Logan et al., 2020a). For Harbeer, this might have meant a focus on developing imitation skills, joint attention, and intentional communication acts, and selecting AEMT teaching strategies relevant to enhancing pre-symbolic communication, as described by Logan et al (2020b).

Limitations and Areas for Further Research

Despite the evidence that parents could be taught to use AEMT strategies, there was an apparent relationship between the behaviours measured (parent implementation of the strategies), which did not appear to be independent. Consequently, the current results must be interpreted with caution. There is a need to research parent acquisition of strategies using variations in the current research design, such as a multiple baseline across participants or activities, rather than across AEMT strategies, which may not be independent of each other. Measuring response to parent training across participants or activities will allow for parents to demonstrate acquisition of strategies as the dependent variable, without any relationship between AEMT strategies affecting outcomes. Further, in the current study, maintenance probes were completed for only two participants and then on a single occasion for each; as a consequence, the longevity of intervention outcomes is unknown. The fact that Abigail had decreased her target behaviours to baseline levels points to the need for ongoing measures of maintenance, and possibly a longer duration of intervention or introduction of generalisation strategies or situations to embed learnt skills.

Given that AEMT was developed to target a range of communication functions (Logan et al., 2020b), what is not yet clear is whether parents are able to use AEMT to elicit them. In the current study, parents were free to use the AEMT strategies to help their child communicate any messages they felt matched the situation. In future research, it would be useful to explore whether particular AEMT strategies lend themselves to teaching certain functions, and ultimately, how to support parents teach their child to communicate for a range of pragmatic purposes.

In consideration of social validity, more research is required to ensure that parent-mediated interventions represent the best fit for a family. Analysis of a dyad's interactions prior to intervention, and individualising parent intervention strategies and child communication goals based on this information would likely support improved outcomes. For example, some parents may be able to learn multiple strategies at once, while others may need to focus on specific elements to consolidate use before moving to the next. Working with parents to establish their own learning goals could offer the potential to enhance their engagement in the intervention. Similarly, individualisation of child goals will also need to be considered, which may include a focus on developing or strengthening intentional communication acts, or increasing or reducing the cognitive demands of the aided AAC system (for example modifying the number of symbols available). The social validity of outcomes in terms of a child's generalisation of skills to other people and settings will also need to be established in future research. Further, it will be important to ascertain whether parents perceive interactions with their child with ASD as more enjoyable following the AEMT, and whether they identify reductions in parental stress. In future research, these elements could be added to social validity evaluations of the intervention.

Clinical Implications

Findings from the study have several implications for therapists and educators working with families of children with ASD. Firstly, there is evidence that by systematically employing teaching strategies during parent training, such as verbal and written instruction, role play, and video feedback, as included in the current study, parents can learn to deliver AEMT strategies. However, depending on parent responses to training, they may benefit from additional teaching strategies, such as instructor modelling or in-vivo training as an adjunct to parent-mediated sessions. Secondly, the study findings highlighted the individual nature of parent-child interactions, with substantial variation across the strategies parents used when interacting with their child. When working with parents, therapists and educators will need to tailor intervention strategies to ensure they reflect what will be helpful to that parent-child dyad to enrich interactions and support language development. Thirdly, collaborative goal setting and education regarding communication development, the function of AAC, and intervention strategies may support parents to engage with an intervention, and ensure that interventions are socially valid for families. This goal setting would entail working with parents to select intervention strategies that match their preferences and their child's needs. Finally, goal setting for children may need to incorporate both symbolic communication and development of the communication acts that precede symbolic communication.

Conclusion

Involvement of parents in AAC interventions for children with ASD is critical for a multitude of reasons, but particularly because of their role in facilitating language growth during interactions. The results of this study indicate that parents can be taught to implement key AEMT strategies, but these strategies are not necessarily independent, and indeed, may be complementary (e.g., the relationship between environmental arrangement and prompting). The use of AEMT by parents appeared to be associated with development of a child's communication skills, with two of the three children responding to their parent's use of AEMT by increasing use of symbolic communication. In future research, individualising the AEMT and goals according to a dyad's typical interactions will be needed, in particular, exploring how parents can use AEMT to increase their child's range of communication functions.

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Appendix A - Chapter 6

AEMT Information Flyer

College of Science, Health and Engineering

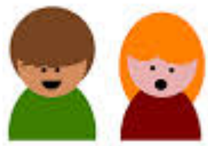
Mailing address
La Trobe Rural Health School
PO box 199, Bendigo, 3550

T + 61 3 54489110
E t.iacono@latrobe.edu.au
latrobe.edu.au/school-allied-health/research/living-with-a-disability

MELBOURNE CAMPUSES
Bundoora
Collins Street CBD
Franklin Street CBD

REGIONAL CAMPUSES
Bendigo
Albury-Wodonga
Mildura
Shepparton

Research project: Using pictures to help children with autism spectrum disorder communicate



Autism spectrum disorder (ASD) is associated with a range of communication difficulties. Children with ASD have difficulty learning how to use their communication for different social purposes, such as to ask for things, comment or share news. Some children with ASD have difficulty using speech to communicate their wants and needs.

Kristy Logan, a researcher, speech pathologist and teacher, is currently investigating ways to help children with ASD develop their communication skills, focussing on children who use limited or no speech. This study will form part of her PhD studies, undertaken through La Trobe University. This research is being supervised by Professor Teresa Iacono, La Trobe University, and Dr David Trembath, Griffith University.

Kristy is looking for children with ASD and their families to participate in this study. Children need to be aged under 8 years; have a diagnosis of ASD from their paediatrician; and use less than 10 words. The child's primary caregiver needs to be available for 45 minute home-based therapy sessions 3-5 times each week for 3 to 6 weeks. Caregivers and children in the study will participate in a language intervention that will focus on teaching children how to communicate for different social purposes, with spoken expression supported with pictures.

The NSW DET (SERAP: 2015226) and La Trobe University (UHEC Ethics Approval Number: 15/056) have approved this study. All information about your child will be kept confidential, and you have the right not to participate or withdraw from the study at any time without penalty.

If you are interested in learning more about this study, please contact Kristy Logan on 0435356171. Kristy will talk to you about what the study will involve and if your child may be eligible to participate. A participant information statement with further information and consent form will then be provided.

Participant Information Statement

Mailing address
La Trobe Rural Health School
PO box 199, Bendigo, 3550

T + 61 3 54489110
E t.iacono@latrobe.edu.au
latrobe.edu.au/school-allied-health/research/living-with-a-disability

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Shepparton

College of Science, Health and Engineering

Participant Information Statement (PIS)- Caregivers

Project: AIDED ENHANCED MILIEU TEACHING TO DEVELOP COMMUNICATION FUNCTIONS IN MINIMALLY VERBAL CHILDREN WITH AUTISM SPECTRUM DISORDER

What is this study about?

You and your child are being invited to participate in this study about using pictures to help children with autism spectrum disorder (ASD) communicate. This PIS tells you about the research study. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Who is conducting the study?

This doctoral research is being conducted by Kristy Logan, under the supervision of Professor Teresa Iacono, College of Science, Health and Engineering, La Trobe Rural Health School, La Trobe University, Bendigo VIC 3552; Ph: (03) 5448 9110; Email: t.iacono@latrobe.edu.au; and Dr. David Trembath, School of Allied Health Sciences and Menzies Health Institute Queensland, Griffith University, Gold Coast QLD 4222; Ph: (07) 5678 0103; Email: d.trembath@griffith.edu.au.

Why is the study being conducted?

A core difficulty that children with ASD have is learning how to communicate for different purposes. In a previous study, children were taught to use pictures to communicate different messages through an intervention called *aided enhanced milieu teaching* (AEMT). In this project, we will be testing whether caregivers can be taught to use the intervention strategies associated with this therapy with their child with ASD.

What will being in the study involve?

First, Kristy will meet with you on one occasion to discuss your child's current communication system and activity preferences. This appointment will occur at your home and will take approximately 60 minutes. If needed, Kristy will make up some communication picture boards that relate to your child's interests following this appointment. Then, over the course of one week, Kristy will visit you three times for 30 minute sessions to monitor how you and your child communicate during your child's favourite activities. Third, during the intervention, Kristy will visit you at home three times each week (about 45-75 minutes each) for the period of intervention (3 weeks). During these sessions, you will be trained by Kristy to use AEMT with your child. All intervention sessions will be video recorded so that Kristy can keep track of you and your child's progress.

The 3-week AEMT intervention involves the following:

- Kristy will help you to set up the room to create opportunities to encourage your child to communicate.
- Your child will participate in their favourite activities with you, during which he/she will be supported to communicate about the play using pictures and words.
  Kristy will teach you a series of prompts such as waiting, showing, telling, and physically helping your child use the pictures to communicate.

The intervention will need to take place in a room at home with as few distractions as possible, so it will need to be in a room away from others in the home. Therefore, other children may need to be occupied by another adult so that your child can concentrate on the therapy.

Immediately after the 3 weeks of intervention, Kristy will ask you to complete a survey about how useful and meaningful the intervention was; it will take about 20 minutes. One month later, Kristy will visit you at home for 2 follow up visits, to see how you communicate with your child and to see how your child's communication is developing.

The maximum total time commitment will be approximately 15 hours spread over two months.

Who can take part in the study?

To participate in the study your child must have a diagnosis of ASD, and use less than 10 words spontaneously (without repeating). You will need to be available for visits from Kristy at home for the duration of the study.

What are the benefits of participation? What are the risks?

We hope that you will learn the communication intervention strategies used in AEMT, your child will learn new communication skills through being in the study.

There is the potential risk that you may experience emotional distress from talking about your child's communication skills and difficulties, and while receiving feedback on your use of communication strategies with your child. If you do become distressed, it is recommended that you contact your regular service provider, such as your early childhood intervention team, or Lifeline, for telephone crisis support on 13 11 14. There is also the risk that you might be inconvenienced by the time taken to take part in the study. Kristy will negotiate a convenient time for you for home visits to occur.

What will happen to information that is collected during the study?

Results from this study will be included in Kristy's Ph.D. thesis and published in journal articles. They will also be presented at conferences. The results from this study may also be used in future research projects, following approval from the relevant ethics committee. However, no information that could identify you or your child will be included in any articles or presentations. All information provided by you will be confidential, except as required by law. All digital (video) recordings will be stored in a secure, locked filing cabinet at the researcher's home office, and electronic files and data will be stored in password protected files on a computer accessible only by password. You may request a copy of personal data collected during the study. All data will be stored securely at La Trobe University for a period of 5 years upon completion of the research project.

Participating in the study and collection of data

Being in this study is voluntary and your child does not have to take part. No penalties, disadvantages or adverse consequences will be involved if you do not wish to participate.

If you would like to participate in this study, please complete the participant consent form. If you decide to take part in the study, and change your mind later, you are free to withdraw from the study after it has started. You may also request that data arising from your participation are not used in the research project provided that this right is exercised within four weeks of the completion of your participation in the project. You are asked to complete the "Withdrawal of Consent Form" or to notify Kristy by email or telephone that you wish to withdraw your consent for your data to be used in this research project.

Will we be told the results of the study?

You and your child have a right to receive feedback about the overall results of the study. You can tell us that you wish to receive feedback by ticking the relevant box on the consent form. The feedback will be emailed to you after the study finishes, and will be a one page summary of the research. Personalised feedback regarding the results of any testing completed on your child will also be available in the form of a brief one page summary report, and the researcher will allocate time to discuss this with you.

What if we would like further information about the study?

Any questions regarding this project may be directed to Kristy Logan, PhD candidate, La Trobe Rural Health School, at k2logan@students.latrobe.edu.au, or Prof. Teresa Iacono (E: t.iacono@latrobe.edu.au, T: 03-5448-9110).

This project has received ethics approval from the College of Science, Health and Engineering, La Trobe University Human Ethics Committee (UHEC Ethics Approval Number: 15-056) and NSW DET (SERAP: 2015226). If you have any complaints or concerns about your participation in the study that the researcher has not been able to answer to your satisfaction, you may contact the Senior Human Ethics Officer, Ethics and Integrity, Research Office, La Trobe University, Victoria, 3086 (P: 03 9479 1443, E: humanethics@latrobe.edu.au). Please quote the application reference number: 15-056.

Participant Consent Form

College of Science, Health and Engineering

Mailing address
La Trobe Rural Health School
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T + 61 3 54489110
E t.iacono@latrobe.edu.au
latrobe.edu.au/school-allied-health/research/living-with-a-disability

MELBOURNE CAMPUSES
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Collins Street CBD
Franklin Street CBD

REGIONAL CAMPUSES
Bendigo
Albury-Wodonga
Mildura
Shepparton

Consent Form- Family

AIDED ENHANCED MILIEU TEACHING TO DEVELOP COMMUNICATION FUNCTIONS IN MINIMALLY VERBAL CHILDREN WITH AUTISM SPECTRUM DISORDER

Chief Investigator:
Professor Teresa Iacono, La Trobe Rural Health School, College of Science, Health and Engineering, La Trobe University, Bendigo VIC 3552; Ph: (03) 5448 9110; Email: t.iacono@latrobe.edu.au

Researchers:

Kristy Logan, PhD Candidate, La Trobe Rural Health School, College of Science, Health and Engineering, La Trobe Rural Health School, La Trobe University; Email: k2logan@students.latrobe.edu.au; and Dr. David Trembath, School of Allied Health Sciences and Menzies Health Institute Queensland, Griffith University, Gold Coast QLD 4222; Ph: (07) 5678 0103; Email: d.trembath@griffith.edu.au.

"I (the participant) have read (or, where appropriate, have had read to me) and understood the participant information statement and consent form, and any questions I have asked have been answered to my satisfaction. I agree to participate in the project, realising that I may withdraw at any time. I agree that research data provided by me or with my permission during the project may be included in a thesis, presented at conferences and published in journals on the condition that neither my name nor any other identifying information is used."

I consent to be a participant in this study (please circle):

Yes **No**

I give consent for my child to be a participant in this study:

Yes **No**

I give consent for video recording of myself and/or my child to be used in this study:

Yes **No**

I give consent for research data provided by me to be preserved for use in future projects by the chief investigator, on the condition that neither my or my child's name nor any identifying information be used:

Yes **No**

I give consent for video footage, collected during the study, to be used by members of the research team for educational purposes (i.e., training students and seminar/conference/workshop presentations):

Yes **No**

I give consent for the intervention used in the study to occur at my home.

Yes **No**

I would like feedback regarding the overall results of the study. If yes, please write your e-mail address below; feedback will be e-mailed after the study finishes.

Yes **No**

E-mail address: ______________________________

Name of Adult Participant (block letters): ______________________________

Signature: ______________________________ Date: ______________

Name of Child Participant (block letters): ______________________________

Name of Authorised Representative (block letters):______________________________

Signature: ______________________________ Date: ______________

Name of Investigator (block letters): ______________________________

Signature: ______________________________ Date: ______________

Appendix D - Chapter 6

Parent-mediated AEMT teaching strategies

Teaching Strategy One: Environmental Arrangement

Environmental arrangement involves setting up your child's surrounds, so that they are motivated to communicate, and provided with opportunities to communicate.

There are four key ways to do this:

1. Use activities that your child loves when working on communication. If they don't seem interested, offer them something different. Signs that your child is interested include watching you and/or the materials, reaching for the materials, smiling, and staying with you and the materials.

2. Give you child choices where possible. You might offer two different activities (one your child likes, one they don't, or two they like), or give choices while your child is at an activity (e.g., do you want: lots or a little bit; big or small; red or green etc). Try to show them visually what the choices are (e.g., showing a big biscuit or a tiny piece).

3. Have preferred objects in sight, but out of reach. This means your child needs to show you what they want or have help to get what they want. You could try placing objects up high and out of reach, having objects in clear containers where the lid is too tight, or holding onto objects firmly when first getting them out.

4. Sabotage your child's access to favourite objects, but in a playful (non-distressing) way. You might only give a small amount of something at a time (e.g., one puzzle piece, one piece of food), or only a short turn of materials at a time. You can also 'borrow' what your child is using and 'forget' to give it back, give something unexpected to your child when they ask for something, or do something silly with an object (e.g., drop it, break it- if appropriate, or place it somewhere unexpected). Sabotage events should be positive, and quickly and successfully resolved to avoid frustration (with your help). They should also only happen occasionally so that they are unexpected, and do not interrupt the flow of the activity.

Teaching Strategy Two: Modelling

- Modelling involves showing children how to do something.
- In the AEMT intervention, adults model language as children participate in activities. This modelling occurs by saying words that match what the child is doing or what is happening, and pointing to and showing relevant pictures that would express an appropriate message (to match what is happening).
- During activities, comment, describe and interpret what your child is doing, as they are doing it. Point to relevant pictures on the communication board at the same time.
- For example, if your child reaches for food, you could point to *WANT*, and say, "You want food." If they seem to be enjoying their food, you could say "Mmm, it's good" while pointing to the picture for *GOOD*. If they get up, you could say "You've finished," while showing the picture that means *FINISHED*.
- Modelling needs to occur at the same time as the action/event happens, so it is meaningful.
- Modelling how to use pictures shows your child what to do and how to communicate, much like how a first or second language is learnt.

Teaching Strategy Three: Prompting

Prompting actively helps your child to use pictures (or words) to communicate a message. When prompting, we only give the smallest amount of help needed, so a child is as independent as possible.

The prompting sequence we use in Aided Enhanced Milieu Teaching involves three steps, from least to most helpful:

1. **Waiting + looking expectantly-** when it would be appropriate for your child to say something (e.g., to ask for something), look at them and wait a few seconds. This gives them time to realise that a response is required, plus time to plan how they will communicate
2. **Showing your child what to do-** if your child doesn't say anything or point to any pictures, show them what they can do to communicate. Point to the relevant picture, and say the target word or message.
3. **Helping them communicate-** if your child doesn't point to a picture or say a word after you have showed them what to do, help them point to the correct picture.

Appendix E - Chapter 6

Operational definition of instances of symbolic communication with coding form

1. Does the child use a symbol?

Does the child use a readily recognisable spoken word or point to/pick up a picture? Pointing to a picture, but with insufficient force to activate the speech generating component is acceptable.

2. Is use of the symbol non-imitative?

Did the child communicate without directly imitating what the adult said or pointed to immediately prior? To mark as yes, the child must not say a word in direct imitation of the adult, or point to a picture symbol in direct imitation of the adult pointing to the same picture/s (i.e., immediately following). It is acceptable if the adult provides a general reference to the iPad (e.g., points towards the iPad in a situation where communication is expected), however the adult must not appear to point to specific pictures directly before the child uses them. Count as correct the child's initial non-imitative use of a symbol, and record (but don't score as correct) subsequent symbols that are imitated (e.g., the parent attempts to extend what the child has communicated by having them imitate additional, different symbols).

3. Is the symbol used meaningful and relevant to the context?

For spoken words or pictures, is the referent for the symbol evident in the context (i.e., the picture or word used matches what is happening, or reflect what words or messages might be expected in that situation)?

4. For use of pictures, does the child show evidence of selecting a specific picture?

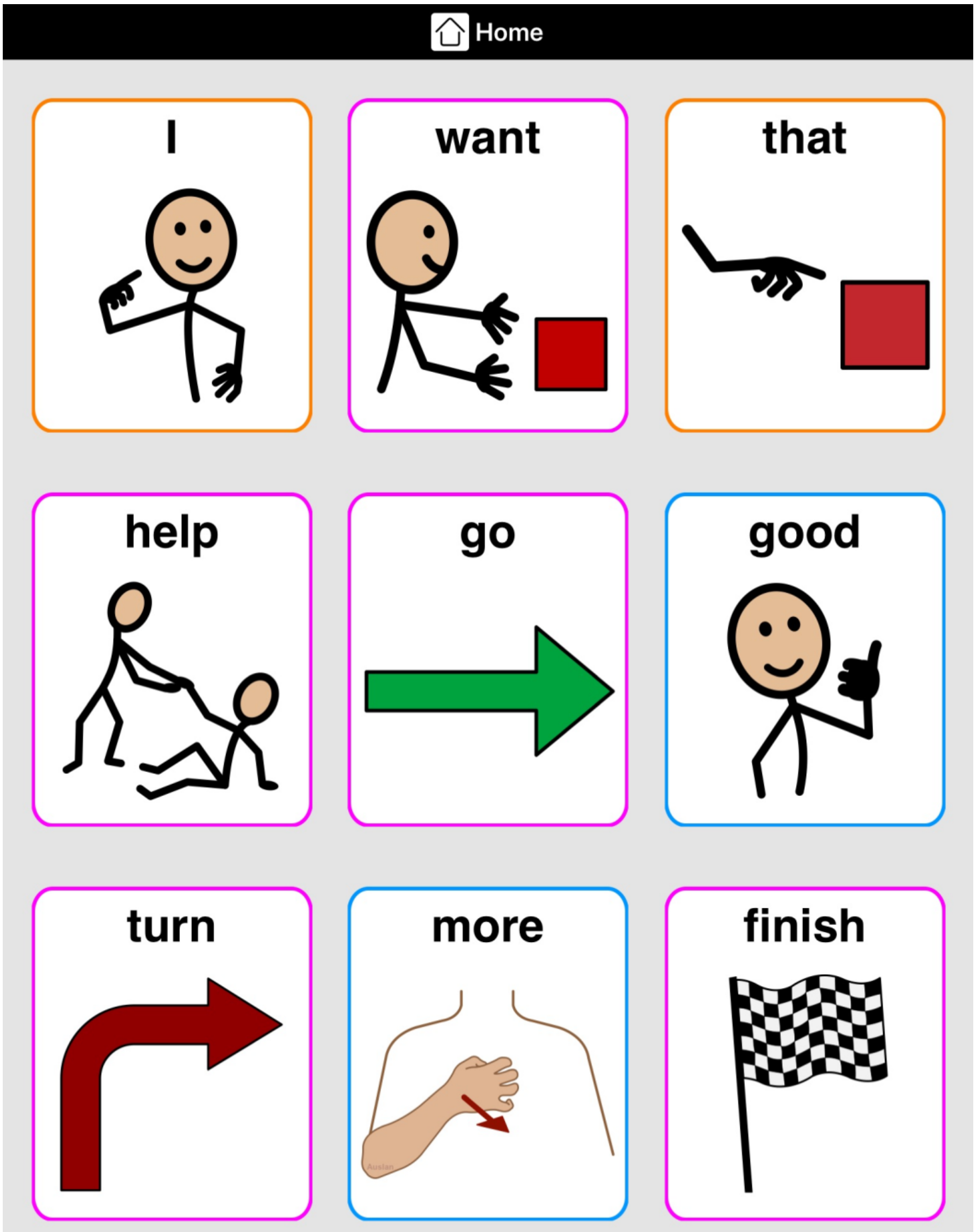
For example, did the child scan pictures to locate a specific one, or go directly to a picture without touching or pointing to others (unless to meaningfully link words in a phrase)?

5. Is the behaviour intentionally communicative?

Was the use of the symbol (spoken word/s or picture/s) directed to the adult communication partner, as indicated:
- using eye gaze or movement (e.g., orientation) towards the adult
- **and/or** the child waiting for the adult's response
- **and** the child not trying to change the adult's subsequent response, but accepts it. For example, the child does not repeat the behaviour (spoken word, picture selection) unless to make an additional request, reiterate, or clarify a message, and does not show rejection of the adult's response through protest, pushing away, or absconding from the activity

Symbolic, spontaneous, intentional communication requires yes to all of the above

Vocabulary arrangement on device:



Example messages involving iPad symbols:
Want- I want to ask for something
That- that is the one that I want
Help- I need you to assist me
Go- let's start/move; let's go out; it's my go
Good- this is good; these taste good; I like this
Turn- I want to have a go; it's my turn now
More- I want this to continue; I need some more of what you have
Finish- I don't want to do this anymore; I want to stop

Coding form:

Child:		Session:	Date:			Yes to 2-5? √
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	
Time:	1.Symbol/s used:	2. Non-imitative? Y/N	3.Meaningful content? Y/N	4.Meaningful selection? Y/N	5.Intentionally communicative? Y/N	

Appendix F - Chapter 6

Parent Teaching Procedure

Parent Training Procedure

1. The researcher provided the caregiver with an information sheet regarding the teaching strategy (in initial training session only)

Yes No

2. The researcher defined the teaching strategy to the caregiver by providing a summary of the features of the strategy-

Environmental arrangement: providing materials of interest to the child, giving the child choices, having preferred objects in sight by out of reach, giving a small amount or short turn of an activity at a time, taking an object and 'forgetting' to return, doing something unexpected
Modelling: saying words that match what the child is doing or what is happening, pointing to pictures that would express an appropriate message that matches what is happening
Prompting: sequence of least to most prompting-waiting and looking expectantly, showing the child what to do, helping the child to communicate

Yes No

3. The researcher discussed the training strategy with the caregiver

Yes No

4. The researcher accurately modelled an example of the teaching strategy by identifying one of the child's preferred activities, and discussing how each of the 3 levels of prompting would be differentially applied.

Yes No

5. The researcher asked the parent to generate an example of when the strategy could be applied

Yes No

6. The researcher provided accurate feedback in response to the parent example

Yes No

7. The researcher practiced the strategy with the caregiver via role play, with the researcher acting as the child participant

Yes No

8. The researcher provided accurate feedback to the caregiver during training

Yes No

9. The researcher watched a video of the caregiver performing therapy and provided accurate feedback

Yes No

Appendix G - Chapter 6

Coding for parent-mediated AEMT and descriptions

Strategy		**0-0.30**	**0.30-1**	**1-1.30**	**1.30-2**	**2-2.30**	**2.30-3**	**3-3.30**	**3.30-4**	**4-4.30**	**4.30-5**	**5-5.30**	**5.30-6**	**6-6.30**	**6.30-7**	**7-7.30**	**7.30-8**	**8-8.30**	**8.30-9**	**9-9.30**	**9.30-10**
EA	Uses material of interest with child																				
	Gives choice																				
	Places object in sight but out of reach of child																				
	Provides small turn/small piece																				
	Takes turn, 'forgets' to give object back																				
	Does something unexpected																				
Mo	Says words that match what the child is doing or what is happening																				
	Points to pictures on iPad that match what is happening																				
Pr	1. Least to most picture prompting is used																				
	2. Parent prompts use of iPad in a different sequence to above																				

Strategy		**10-10.3**	**10.3-11**	**11-11.3**	**11.3-12**	**12-12.3**	**12.3-13**	**13-13.3**	**13.3-14**	**14-14.3**	**14.3-15**	**15-15.3**	**15.3-16**	**16-16.3**	**16.3-17**	**17-17.3**	**17.3-18**	**18-18.3**	**18.3-19**	**19-19.3**	**19.3-20**
EA	Uses material of interest with child																				
	Gives choice																				
	Places object in sight but out of reach of child																				
	Provides small turn/small piece																				
	Takes turn, 'forgets' to give object back																				
	Does something unexpected																				
Mo	Says words that match what the child is doing or what is happening																				
	Points to pictures on iPad that match what is happening																				
Pr	1. Least to most picture prompting is used																				
	2. Parent prompts use of iPad in a different sequence to above																				

Environmental arrangement

1. *Uses material of interest.* Parent and child are engaged in the same activity, whether parent introduces or responds to the child's interest. Child shows interest in the activity (e.g., watching, reaching for materials, smiling, staying with adult and materials)
2. *Choices.* Parent offers the child a choice between activities, objects, or options. They may directly state names of choices, or show the options, and ask "Which one would you like?"
3. *Preferred objects in sight but out of reach.* Objects are out of reach of the child by the adult holding onto objects, placing them in containers that the child will have difficulty opening, or otherwise placing where child cannot reach to access. This includes impeding child's access to turns of an object (e.g., preventing the child's turn of an object such as swinging). The child may still have a piece of the object, but the adult maintains control of the whole activity/object, or limits how much is given/available. The child must maintain interest in the activity for each segment that this behaviour is recorded for.
4. *Provides small turn/small piece.* Adult gives a small amount at a time (e.g., one item), or takes turns with the object
5. *Takes turn, forgets to give the object back.* Adult takes a turn or control of the object, but does not immediately return the object to the child
6. *Does something unexpected*. Adult does something unexpected or silly with an object (e.g., drop, break, place somewhere unexpected). Adult does something designed to elicit a response- may include introducing something different. Adult does something that you wouldn't routinely do with that object or in that situation.

Modelling

1. Parent *says words* that match what is happening during an activity e.g., commenting, describing, naming, and verbally interpreting what the child might be thinking. Modelling does not include telling the child or giving instructions about what to do in terms of behaviour e.g., You need to sit down").
2. Parent *points to pictures* on the iPad that match what is happening e.g., commenting, describing, naming, and verbally interpreting what the child might be thinking, without the expectation that the child will copy

Prompting

1. Least to most prompting: Adult uses the following sequence of actions to prompt their child's use of the iPad communication device: After briefly waiting when it would be a time appropriate for the child to "say" something,

   (a) adult points to the relevant picture and states the target word or message. If the child doesn't then point to a picture or say the word, or points to the wrong picture/says the wrong word, the adult then proceeds to
   (b) physically help the child to point to the relevant picture

Note: (a) and then (if needed) (b) must be applied to score as least to most prompting i.e., before physically helping, the adult shows the relevant picture and waits.

2. Adult helps the child to touch the picture symbol, but without following the above sequence.

Note: For prompting to be scored, needs to be associated with showing picture symbols (not speech)

Appendix H - Chapter 6

Social Validity in AAC Intervention Survey

What were the communication goals for your child?

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Please rate to what extent you agree or disagree with each of the following statements.	Strongly disagree	Disagree	Agree	Strongly agree	Unsure
1. The therapy goals were relevant to my child	1	2	3	4	U
2. I was involved in developing communication goals for my child	1	2	3	4	U
3. My child needs to use pictures to communicate	1	2	3	4	U
4. It is important that caregivers learn communication strategies to help their child with ASD	1	2	3	4	U
5. The therapy included activities and materials (e.g., toys) that were relevant or important to my child	1	2	3	4	U
6. It was easy to use the pictures during therapy	1	2	3	4	U
7. My child enjoyed the activities and materials used during therapy	1	2	3	4	U
8. My child enjoyed using the pictures during therapy	1	2	3	4	U
9. I found find the communication therapy easy to do	1	2	3	4	U
10. I enjoyed participating in the communication therapy	1	2	3	4	U
11. I found the therapy to be appropriate for my child's needs	1	2	3	4	U
12. I would continue to use the communication therapy when the study has finished	1	2	3	4	U
13. I will continue using pictures at home to help my child's communication when the study has finished.	1	2	3	4	U
14. I will use pictures in other settings (outside of home) to help my child's communication	1	2	3	4	U
15. Therapy occurred during typical daily routines and activities	1	2	3	4	U
16. It is important that parents use this communication therapy	1	2	3	4	U

	Strongly disagree	Disagree	Agree	Strongly agree	Unsure
17. I found the therapy time consuming	1	2	3	4	U
18. The therapy was costly to implement	1	2	3	4	U
19. The therapy fitted into my family's everyday routines and activities	1	2	3	4	U
20. My child's communication skills improved during therapy	1	2	3	4	U
21. I learned strategies to help my child's communication skills	1	2	3	4	U
22. My child will find it easier to communicate with familiar people after therapy	1	2	3	4	U
23. My child will find it easier to communicate with unfamiliar people after therapy	1	2	3	4	U
24. My child has been able to participate in activities at home more easily after Therapy	1	2	3	4	U
25. My child has been able to participate in activities out in the community more easily after therapy	1	2	3	4	U
26. My child has made lasting improvements in his/her communication as a result of Therapy	1	2	3	4	U
27. My child is able to communicate for reasons other than requesting objects after Therapy	1	2	3	4	U
28. I would recommend this communication therapy to another parent	1	2	3	4	U
29. It is important that people use this communication therapy with children with ASD	1	2	3	4	U
30. Other people have noticed improvements in my child's communication	1	2	3	4	U

Additional comments

What did you like most about the communication therapy?

What did you dislike about the communication therapy?

Please write any other comments you have about the therapy in the space below.

Thank you for taking the time to complete this survey.

CHAPTER 7: GENERAL DISCUSSION AND CONCLUSIONS

Overview

The overarching aim of this thesis was to develop an evidence-based aided AAC intervention for children with ASD to facilitate their use of symbolic communication for a range of pragmatic functions. The thesis comprised three studies. First, the existing literature on developing social communication functions was synthesised and critically appraised initially in terms of the effectiveness of aided AAC interventions in teaching varied pragmatic functions to children with ASD, and then in terms of the effectiveness of intervention strategies and dosage in teaching communication functions other than object requesting. Second, a hybrid aided AAC intervention was developed to incorporate elements found to characterise effective interventions, which was then empirically tested for effectiveness in improving use of symbolic communication, communication functions beyond object requests, and for social validity using a measure developed to address the acceptability of intervention goals, procedures, and outcomes. Third, the extent to which parents could learn key elements of the intervention and deliver them to their children was evaluated, including for effects on their child's communication and for social validity. This chapter provides a discussion of the findings in relation to each research question within the context of previous research and culminates in contribution to knowledge, implications, clinical relevance, and future research directions.

Context of the Thesis

During the candidate's early career as a speech pathologist working with children with ASD who used AAC, it was observed that children often readily learned to use symbols to make object requests, but had difficulty using symbols for other social purposes. This thesis subsequently grew out of a clinical interest in developing the ability of children with ASD to use aided AAC to reflect the use of communication in typical contexts and for a range of meaningful purposes, such as to share thoughts and feelings, and develop social relationships. Hence, it addressed the particular difficulties children with ASD have in social communication, including use of language to share, initiate, and respond to others (APA, 2013). The extent to which children with ASD had been taught to use aided AAC for purposes other than object requests was initially investigated through literature review. The findings of the two systematic reviews, demonstrating a lack of evidence for how to support children to develop symbolic communication for a range of pragmatic purposes, informed design of the subsequent intervention studies.

Can Diverse Communication Functions Be Taught to Children with ASD Who Use Aided AAC, and How?

Research Questions 1-3 related to the current state of the ASD-AAC literature regarding the use of aided AAC interventions to develop communication functions other than for the purpose of making object requests. As noted in Chapters 2 and 3, the purposes of the associated two systematic literature reviews were to identify whether aided AAC interventions had previously been found effective in increasing a range of communication functions for children with ASD, determine whether outcomes relevant to generalisation, maintenance, and social validity were addressed within studies, and ascertain whether there was evidence of varied outcomes according to strategies used to elicit different functions.

Contribution to the knowledge base of the systematic reviews (Chapters 2, 3). In previous ASD-AAC research literature, the focus on developing the object request function had been acknowledged, with the need for research and evaluation of strategies used to teach a range of communication functions highlighted (e.g., Ganz, 2015; Ganz, Earles-Vollrath et al., 2012; van der Meer & Rispoli, 2010). Therefore, the first aim of the thesis (Research Question 1) was to extend previous research into ASD-AAC interventions by reviewing evidence of successfully teaching communication functions other than object requests.

Further, in contrast to many published systematic reviews and meta-analyses of ASD-AAC intervention research (e.g., Ganz et al., 2011; Still, Rehfeldt, Whelan, May, & Dymond, 2014), the review presented in Chapter 2 was of research into the functionality and contextual relevance of skills taught.

The finding that aided AAC interventions can be effective in developing a range of communication functions is critical for practitioners working with children with ASD who are minimally verbal. Practitioners have previously been able to have confidence in approaches to increase functional communication skills, such as communication for the purpose of making object requests, supported by a relative abundance of evidence for associated intervention strategies. However, evidence (albeit limited) was provided in the systematic review of ASD-AAC interventions (Chapter 2) that other communication functions can also be taught, including those that children with ASD find more problematic. Nonetheless, not identified in this review were those teaching strategies that may be most successful in extending intervention goals beyond object requests, necessitating a second systematic review (detailed in Chapter 3).

For an intervention to be effective, it must result in the acquisition and generalisation of skills in such a way that is meaningful to all relevant stakeholders, particularly the individual with ASD. With this requirement in mind, Research Question 2 addressed the extent to which aided AAC interventions had been evaluated with respect to maintenance, generalisation, and social validity. The focus of the associated systematic review took several forms: (a) analysis of the type of communication behaviours that were taught; (b) review of measures of social validity applied as per those facets described by Schlosser (1999); and (c) inclusion of outcome believability (Odom et al., 2003), which related to potential real life translation of outcomes with respect to generalisation and maintenance of skills.

As noted in Chapter 2 (addressing Research Question 2), measurement of maintenance, generalisation, and social validity in aided AAC research was reported in 50% or fewer studies. Accordingly, important information about the outcomes of these interventions, as well as factors that may influence their uptake by families not involved in these studies, remains unknown, thereby increasing the potential for interventions to be abandoned despite evidence of their short-term efficacy. The systematic review findings detailed in Chapter 2, therefore, highlighted the need for AAC interventions to not only demonstrate an intervention effect, but also longevity, transferability (i.e., to different partners and contexts), and acceptability to stakeholders.

Although previous research had indicated that ASD-AAC interventions can be effective in developing functional communication skills (e.g., Ganz, 2012), and within the current thesis, could be used to teach diverse pragmatic functions (Chapter 2), the intervention components necessary to teach communication for varied purposes remained unclear. Therefore, to address Research Question 3, detailed appraisal and evaluation of the components of interventions found effective in ASD-AAC research in developing communication functions other than object requests was undertaken via a further systematic review (Chapter 3). Extending from the systematic review of ASD-AAC interventions in Chapter 2, an additional systematic review was undertaken - reported in Chapter 3 - to analyse five elements relevant to methods and outcomes, comprising intervention antecedents (setting events and teaching strategies), target behaviours, consequences (reinforcement), dosage, and effect size in an effort to identify the best combination to maximise success. In addressing Research Question 3, a range of intervention strategies were identified, with time delay and prompting being most frequently applied across studies. In light of commonalities in intervention components implemented across studies, but with varying effectiveness, it was not possible to determine the best combination. Highlighted was the range of additional factors that require consideration and the need to individualise interventions according to factors pertaining to the child and the child's response to intervention.

Practitioners working with children with ASD must know not only than an intervention works, but also how it should be applied and for children with which characteristics. In addressing Research Question 3, previous research indicating the efficacy of aided AAC interventions was extended, providing information of relevance to practitioners about how pragmatic functions other than object requests have been successfully taught to children with ASD. Although firm conclusions could not be drawn, nor clear recommendations made regarding requisite intervention components, the findings of this review indicated that interventions that occur in typical environments during predictable communication routines, particularly using the teaching strategies of time delay and prompting, can maximise success in teaching diverse communication functions.

Is Aided Enhanced Milieu Teaching Effective in Teaching Varied Communication Functions and Can Parents Implement Key Elements?

Research Questions 4 and 5 related to the effectiveness of a naturalistic intervention to increase symbolic communication in children with ASD: specifically, aided enhanced milieu teaching (AEMT) when delivered by a practitioner and then by parents. Although evidence as to the effectiveness of the AEMT was sought by way of experimental single case study design, the need to consider measurement of caregiver perceptions of the intervention was acknowledged in order to enhance the social validity of the intervention. The Social Validity of Aided AAC Intervention Survey (SVAIS) was therefore developed prior to the AEMT studies in order to enable the acceptability of intervention goals, procedures, and outcomes to caregivers to be evaluated (Chapter 4). It was developed following the focused review of previous AAC-ASD intervention research (Chapter 2), and contributed to the methodological design of the two intervention studies. Creation of the SVAIS met an immediate research need, allowing for measurement of the social validity of goals, procedures, and outcomes relating to the AEMT. The SVAIS requires further research and development, such as through large sample testing, to determine its validity and reliability, and hence utility for further research and clinical situations.

To address Research Question 4 (Chapter 5), the AEMT was implemented and subsequently tested for effectiveness in terms of increased symbolic communication, use of symbolic communication for a variety of pragmatic functions, and whether effects generalised to another person and were maintained. To address Research Question 5 (Chapter 6), parents received training to implement a simplified version of AEMT, with their ability to be taught AEMT strategies tested. In conjunction, improvements in children's symbolic communication in response to parental use of AEMT strategies were assessed. The SVAIS provided further (subjective) data regarding the acceptability of the intervention and its outcomes for caregivers.

Contribution of the intervention studies (Chapters 5, 6). The development of the AEMT was informed by the evidence review with the aim of systematically teaching communication functions. The AEMT components reflected the best evidence. A naturalistic teaching approach (Schreibman et al., 2015) provided a context for intervention likely to encourage communication (e.g., use of a typical setting, preferred activities, following the child's lead and interests, modelling language based on what the child was communicating), with a structured teaching sequence applied to provide as little assistance as necessary (least to most prompting) to facilitate use of symbolic communication for varied purposes. To address a weakness of previous interventions (Chapter 3), there was explicit recording of the number of teaching trials for target functions, as well as the candidate's use of teaching prompts and application of teaching strategies in order to enable dose to be determined. The AEMT, thereby, provided an operationalised method of teaching symbolic communication for varied pragmatic purposes, with its evaluation extending previous research. Although other naturalistic ASD-AAC interventions for children with ASD have been described in the research literature, the AEMT was novel in that it was designed for children with ASD who were minimally verbal for the specific purpose of targeting a range of pragmatic functions.

The researcher-mediated intervention study (Chapter 5) provided evidence that AEMT can be used to teach diverse communication functions, including those that are particularly challenging for children with ASD, using naturalistic methods (Research Question 4). As noted previously within the thesis, although a small body of intervention studies have demonstrated that communication functions other than object requests have been taught to children with ASD, intervention often involved teaching communication in a practiced routine, with children having access to only a limited number of symbols from which to make communication selections (see Chapter 3). In contrast, the AEMT included 9-16 symbols available per activity, which were used to model and elicit a broad range of vocabulary and pragmatic targets. The results obtained from the researcher-administered AEMT study (Chapter 5) addressed Research Question 4, indicating that the three children included as participants made some gains in symbolic communication and pragmatic function diversity (although for one participant these gains were clinically evident, rather than evident through visual analysis of the data or statistical analysis). Given the relative dearth of research into developing social communication functions in children with ASD through AAC interventions, the findings of the researcher-administered AEMT study provide preliminary evidence that the AEMT can be used to develop diverse communication skills, although replication of findings is needed. Furthermore, the findings have clinical implications in terms of pointing to developmentally appropriate targets for intervention, based on Wetherby's (1986) model of pragmatic development, as well as considerations for possible modifications according to child progress and characteristics.

Given that the AEMT was naturalistic and designed to be implemented in typical settings, the logical progression was to determine whether communication partners in typical settings could implement it (Research Question 5). However, the AEMT was simplified for the parent-mediated study for reasons primarily relating to social validity: social validity feedback had indicated that caregivers in the AEMT study held concerns that it took practice to implement and involved a large number of pictures, with extant research also indicating that parents are more likely to implement AAC if it represents minimal additional work (Moorcroft, Scarinci, & Meyer, 2019). A focus, therefore, was placed on simplifying the number of AEMT strategies, identifying effective parent-teaching methods, and providing explicit parent training on each AEMT strategy using evidence-based parent-teaching methods prior to parent-mediated sessions. Results from the parent-mediated AEMT study (Chapter 6) that addressed Research Question 5 indicated that parents gained skills in delivering at least two of three target AEMT strategies, with two of the three child participants also demonstrating gains in symbolic communication. Research findings relating to Research Question 5 add to the relatively limited evidence-base regarding parental ability to learn how to implement aided forms of EMT with their child with ASD. The extant research on parent-training practices was also extended by providing information on the success of common teaching strategies used to develop parent skill with three children with ASD who were minimally verbal.

Theoretical Implications

Acquisition of varied communication functions. As noted in Chapter 1, research into the pragmatic development of children with ASD has indicated that communication for the purposes of behavioural regulation is a strength, typically emerging prior to communication for other, more social functions (Shumway & Wetherby, 2009; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby, 1986; Wetherby & Prutting, 1984). It was somewhat surprising to find in the systematic review of AAC interventions (Chapter 2) that functions beyond making object requests had been addressed comparatively infrequently, although arguably having greater priority for the development of communication competence. Despite identifying a range of teaching strategies in the systematic review of intervention components (Chapter 3) that had been used successfully to teach a broader range of communication functions, and focusing on explicit teaching of varied functions, the children in the researcher-led AEMT study (Chapter 5) each used functions for behavioural regulation to a greater degree than for social interaction or joint attention, even with the focus on teaching these other functions. The findings of the researcher-led AEMT study, therefore, provided support for extant research into the development of pragmatic functions in children with ASD who were minimally verbal: that is, that functions for social interaction and joint attention represent a greater challenge in acquisition than do those related to behavioural regulation.

Although children in the researcher-led AEMT study generally acquired symbolic/pragmatic targets in response to environmental arrangement, and structured prompting and elicitation, they also developed symbolic communication for the purposes that were most salient to their interests and needs. Their response to this naturalistic intervention was consistent with strengths associated with designing interventions based on developmental social-pragmatic (rather than solely operant) models. For example, approaching intervention from a developmental social-pragmatic model allows for goal setting that incorporates natural, flexible, and spontaneous language, in comparison to the discrete-skill approach applied in interventions arising from operant theories (Wetherby, Prizant, & Schuler, 2000). In this way, although children in the researcher-led AEMT study could learn specific intervention targets (e.g., to request the action *OPEN* or comment *UH OH* in response to something unexpected), they also simultaneously learnt symbolic communication that was based on the individual needs of the child and reflective of the natural communication context (Prizant & Wetherby, 1998). For example, Lachlan frequently requested that an adult *COUNT* objects, as this reflected his preferred action associated with preferred activities, while Nicholai most often requested *MORE* of an object, as he demonstrated most interest in continuing with or obtaining more of preferred objects.

Incorporating a developmental social-pragmatic model into intervention design may enhance acquisition of a range of communication skills relevant to a child's needs and reflect models of language acquisition. Bloom (1993), for example, argued that an important principle in early word learning is that of relevance, whereby children learn words according to what captures their attention and information that the child wants to share. For children with ASD, selecting language goals (semantic and pragmatic) according to a developmental framework should, therefore, result in targets that align with communication opportunities and expectations within typical contexts, as well as correspond with the messages that they desire to communicate. Nonetheless, it is important to note that the teaching strategies based on ABA, but applied in a naturalistic manner, were those that were used successfully to develop children's skills in the AEMT studies, and demonstrate effectiveness in the wider AAC intervention literature to date (e.g., as detailed in Chapter 3). Therefore, it is likely that contemporary ABA (or naturalistic) interventions, which can marry developmental social-pragmatic and ABA models, hold promise as a useful means to develop symbolic communication for a range of pragmatic purposes.

Factors affecting AAC outcomes. In undertaking the systematic review of intervention components (Chapter 3), it was theorised that factors that would influence acquisition of target skills would relate to teaching strategies selected, reinforcement provided, and dosage of delivery. The findings of this review, however, indicated only a small relationship between dosage and outcome. Further, many of the same instructional strategies were used across both highly and less effective interventions. Outcomes also varied within studies. For example, in several studies, at least one child of a two or more did not respond to intervention (e.g., Nigam et al., 2006; Thirumanickham et al., 2018), or needed procedures to be modified (e.g., Waddington et al., 2014). As a result, it was evident that other factors play a role in AAC intervention outcomes. Explanation for the varied outcomes for children found from the systematic reviews can potentially be accounted for by findings from research into predictors of AAC outcomes, which implicate cognitive skills, ASD severity, and language comprehension and use (Sievers, Trembath, & Westerveld, 2018). Although these predictors were not documented consistently in the studies appraised within the systematic review of intervention components (thus, could not definitively be linked to outcomes), they were specified for participants within the AEMT studies. Similar to the findings of studies included in the systematic review of intervention components (Chapter 3), in the researcher-led AEMT study (Chapter 5), outcomes differed despite the same intervention being applied consistently to children who met the same inclusion criteria, with individual differences appearing to affect outcomes. For example, Lachlan, one of the child participants in the researcher-led AEMT study, demonstrated the greatest response in terms of frequency and variety of symbol use. Developmental assessment information indicated that he presented with less severe needs and adaptive behaviours associated with his ASD on both the GARS (Gilliam, 2014) and VABS-II (Sparrow & Balla, 2005), as well as more verbal communication than the others (albeit, only an additional 1-2 words), and a greater range of baseline symbolic communication functions. These differences align with Sievers et al.'s (2018) potential predictors. They are also consistent with previous research in which it has been recognised that children with ASD represent a heterogenous group with individual differences impacting on the outcomes of AAC interventions, necessitating detailed information regarding participant characteristics (Iacono et al., 2016).

The application of knowledge regarding developmental social-pragmatic theory and individual child characteristics will help account for differences in responsiveness to intervention and inform a child's individual trajectory of language learning. A framework for describing progress based on developmental social-pragmatics (i.e., aligned with child language acquisition theories and models of pragmatic development) can help identify individual goals and strategies according to a child's strengths and needs (Prizant et al., 2000). Specific assessment that incorporates finely grained measures of communication development can be used to set and track goals, monitor progress, and determine the need for amendments to interventions (e.g., dosage parameters or antecedent events/teaching strategies, identified in Chapter 3).

Differential outcomes may also relate to the complexity of intervention goals and the AAC system used to acquire them. There has been little research into the characteristics of AAC devices that are likely to engender successful outcomes, other than device type, such as being aided or unaided, or paper-based or electronic (speech-generating) (e.g., Ganz et al., 2011; Ganz, Rispoli, Mason, & Hong, 2013). Consistent with Wetherby's (1986) ontogeny of pragmatics, it can be surmised that AAC outcomes may also be affected by the relative difficulty of the pragmatic function targeted and complexity of the behaviour required to express that function. The systematic review of intervention components (Chapter 3) indicated substantial diversity in type of communication skill targeted or number of symbols being taught consecutively during AAC interventions (with little or no rationale provided for number of symbols provided). For example, the type of communicative behaviour classified within functions varied (e.g., a comment might be naming an object upon seeing it in a book, or making a generative utterance to share information during a preferred activity), as did the number of symbols from which a child could select to express him/herself (e.g., 1-30).

Findings from the AEMT studies suggest two key contributors to complexity: (a) targeting pragmatic functions that occur later according to Wetherby's (1986) ontogeny, and (b) requiring children to choose from too many options provided on a display. In relation to the complexity of the pragmatic targets, although children did learn the more developmentally advanced functions, those that occur earlier in typical development (i.e., communication for behavioural regulation) were produced more frequently. Regarding the complexity of the AAC display, in the parent-mediated AEMT study, the number and variety of symbols on communication boards were reduced to reflect social validity feedback: from 16 symbols per board (totalling 41 different symbols) to nine different symbols in total across activities. It was evident that Nicholai experienced difficulty in learning how to use specific symbols when presented in the 16 symbol display in the researcher-administered AEMT study, but when changed to a nine symbol display, he quickly learned to use many symbols meaningfully. This improved performance for Nicholai when provided fewer symbols in a display point to the potential for the number of symbol options to impact outcomes. Applying this possibility to Harbeer, the nine symbol display provided in the parent-mediated AEMT may have been too complex to support his learning, but there was no opportunity to trial a display with fewer options. The findings across these two children are also indicative of the need to tailor AAC features to suit individual differences. Hence, attention to the complexity of both the target behaviour, as well as the number of symbols in a display from which the child can select to demonstrate the target behaviour appears warranted.

It is also possible that the type of AAC device incorporated into intervention plays a role in a child's responsiveness to intervention, as suggested by the findings of Ganz et al. (2011) of larger effects for speech-generating devices in comparison to picture-based systems. Findings from the researcher-mediated AEMT study (Chapter 5) provide some supportive evidence. In this study, Nicholai engaged in some behaviours that interfered with the intervention when the paper-based board was present: for example, chewing on the laminated symbols or repeatedly removing and affixing symbols on their Velcro® base. Having the symbols presented on a fixed screen, rather than on a detachable Velcro® base, appeared to enable him to better focus on the symbol, rather than on the sensation provided by removing and re-attaching symbols to the Velcro® repetitively, which he appeared to seek on the paper-based communication boards.

Determining the relevance and acceptability of ASD-AAC interventions to stakeholders. Although development of discrete skills is necessary to establish communication, a focus needs to be placed on participation in typical contexts and development of a range of socially valid communication goals, such as those that help a child learn and make friends (Light & McNaughton, 2015). The AAC research field has evolved substantially over the past 50 years, with growing emphasis on skills that allow for participation and those that allow the user to develop a range of critical competencies, such as linguistic and social (Light & Drager, 2007). From the two systematic reviews (Chapters 2, 3), the lack of development of the skills required for communication competency were highlighted, most particularly, through a lack of interventions that targeted social communication skills, a focus on a specific (limited) range of vocabulary and pragmatic functions, and inconsistent inclusion of naturalistic elements. There were several attempts to redress these limitations in subsequent studies within the thesis: These included designing the AEMT (Chapters 5, 6) to occur in natural settings during typical and preferred activities, with adaptation for use by typical communication partners. Further extending the goals meant that a number of functions were given equal focus, rather than relying on only those that are easiest to teach children with ASD whose strengths align with communication for the purposes of behavioural regulation.

The extent to which interventions reflect contextually-relevant communication needs and their design, goals, and outcomes are considered socially valid by stakeholders is likely to be predictive of real-word translation of newly learned skills. The need for AAC interventions to demonstrate social validity has long been identified in the literature (e.g., Schlosser, 1999). As noted in the systematic review of interventions (Chapter 2), despite measures of social validity being included in some studies, frequently they were limited in scope, focusing on outcomes or intervention procedures rather than goals. Inspection of intervention goals within the systematic review of intervention components (Chapter 3) indicated that these varied with respect to social relevance. Some targets were highly contrived in terms of an expected response to a *wh-* question (e.g., Kagohara et al., 2012; Lorah et al., 2014), some focused on development of vocabulary or syntax (e.g., Finke et al., 2017), while in other studies, targets were selected according to personal characteristics of or about the child (e.g., Lorah, Karnes, & Speight, 2015; Thirumanickham, Raghavendra, McMillan, & van Steenbrugge, 2018), or language dependent on the social context (e.g., Therrien & Light, 2018). Although, within each study, researchers provided a theoretical and clinical rationale for including targets within the intervention, without social validity information it is unclear whether stakeholders (especially the child with ASD and their families) would consider them relevant to their lives or important within daily routines and interactions.

Despite intervention goals being selected according to how well they could be incorporated into a child's preferred activities and reflect commonly used symbols (and associated messages), social validity findings in the AEMT studies highlighted the importance of actively involving stakeholders in goal selection. For example, in the parent-mediated AEMT study (Chapter 6), Aara reported that the intervention did not provide the results she was looking for (i.e., for Imran to use spoken communication). This disappointment was reflected in the lowest social validity ratings amongst the participating parents, despite the gains made by her son in terms of symbolic communication. Involvement of parents in intervention goal setting will likely ensure that goals are relevant to a family's needs, and as a result, demonstrate social validity.

Of relevance to social validity, concern for children's ability to generalise and maintain skills was noted in response to the SVAIS across both AEMT studies, even though measures were implemented to ascertain their ability to do so (i.e., the inclusion of a maintenance phase/probe). Although most AAC intervention studies typically incorporate measures to assess generalisation and maintenance in the form of intervention phases/probes, Schlosser and Lee (2000) argued that strategies for promoting generalisation and maintenance must be built into AAC intervention design, rather than simply assessed following intervention. It is likely that children with ASD have an even greater need for embedded generalisation, given generalisation of skills across contexts can be an area of difficulty (Prizant et al., 2000). Although attempts were made in the AEMT studies to foster generalisation of skills (e.g., consistent symbols across activities), parental concern at their child's ability to generalise highlights the need to work with parents to determine what generalisation looks like from an intervention perspective, as well as from their own. Failure to adequately address whether skills maintain and generalise to other people, settings, and behaviours reduces confidence in the long-term benefits of interventions and the impact these have on a child's functional communication.

Challenges in intervention design. The more closely aligned to typical communication scenarios that an intervention is (i.e., naturalistic), the more difficult it can be to measure progress because of difficulties in identifying and controlling potential confounds (Prizant & Wetherby, 1998). The need to explicitly measure progress may account for the predominant selection of discrete targets in ASD-AAC intervention found in the systematic reviews (see Chapter 3). Many studies included in the systematic review of intervention components (Chapter 3) were reliant on very structured contexts and communication behaviours (e.g., answering *wh-* questions; Kagohara et al., 2012; Strasberger & Ferreri, 2014), and not on the unfolding of a natural, transactional, communication event, which may have provided opportunities for more diverse communication functions to be expressed. It is understandable that in most high-quality research studies identified a highly prescribed teaching structure was followed, with a focus on teaching discrete and objectively defined behaviours, given that these allow for rigorous design and measurement. In contrast, the AEMT studies evaluated in the current thesis were based on naturalistic strategies creating communication opportunities during activities selected by the child. However, aligning intervention with naturalistic communication opportunities meant that there were differences in the frequency with which strategies were implemented, particularly by parents. Taking the need for rigour into consideration, it is critical to develop the spontaneous, flexible communication required for typical communication interactions and transactions. There is a need, therefore, for a range of methods to be incorporated into research in order to capture change and outcomes (Prizant et al., 2000).

The influence of operant theory on intervention design was evident in the systematic reviews (Chapters 2, 3), with highly discrete skills commonly targeted within interventions, such as use of a tact to elicit the name of an animal (Lorah & Parnell, 2017). The challenge with the application of operant theory to interventions targeting communication development with children with ASD is not that it is ineffective: historically, intervention based on a traditional behavioural approach has resulted in gains in discrete communication skills (e.g., Lovaas, 1987). However, generalisation of the skills learned to typical interactions across settings and interactants has been difficult to achieve (Prizant et al., 2000). An argument against a wholly behavioural approach to communication interventions is its prescriptiveness, which does not align with the transactional nature of communication, and may, in fact, limit pragmatic development (Wetherby, 1986).

Supporting parents to deliver ASD-AAC interventions. Many arguments have been made for involving parents and caregivers in the delivery of AAC interventions, not least of which is their ability to facilitate language growth within parent-child interactions in typical routines and contexts (Yoder & Warren, 2001). Although not a specific focus, the findings of the systematic review of AAC interventions (Chapter 2) indicated that parents were infrequently involved in ASD-AAC interventions that targeted a range of pragmatic functions, despite the potential benefits with respect to skill acquisition and generalisation (Maglione, Gans, Das, Timbie, & Kasari, 2012), engagement in therapy (Pickard, Kilgore, & Ingersoll, 2016), and facilitation of the transactional process needed for language development (Warren & Brady, 2007). Given the benefits of parent involvement in AAC interventions, it was considered critical within the current thesis to ensure that the AEMT developed could be implemented by parents, who also considered it acceptable (as indicated using social validity measures).

Despite the demonstration that parents could be taught to implement key components of the AEMT, with concomitant increases in their children's symbolic communication (Chapter 6), again, the relevance of individual differences was evident. However, given that parents who entered the intervention differed in their previous exposures to ASD interventions, the need to refine selection of parent training strategies according to their response to intervention was apparent from the outcomes. An example can be found with respect to the use of in-vivo feedback (Kent-Walsh, Murza, Malani, & Binger, 2015; Lang et al., 2009). This strategy was not included initially for parent training, but was indicated for one of the parents, Dhir, in showing how he could support Harbeer when he did not respond to trained strategies. In these instances, it was considered both ethical and socially valid to provide some in-vivo guidance, at least in one instance. Neither of these teaching strategies had been employed with the other participating parents as they were not deemed necessary, thereby demonstrating the need to keep instruction dynamic and responsive to parent-child dyad needs.

Clinical Implications

Promisingly, the body of work arising from the research aims and questions has a number of direct clinical and practical applications. Firstly, practitioners have empirical evidence from the systematic literature review that it is possible to teach children with ASD who use AAC to communicate for purposes other than for making object requests. Previously, despite acknowledgement that functions for declarative purposes are challenging for children with ASD (Wetherby & Prutting, 1984), research specifically focusing on use of varied communication functions within interventions and their effectiveness was insufficient to guide practice (e.g., Ganz et al., 2012; van der Meer & Rispoli, 2010). Further, practitioners have access to comprehensive information regarding AAC intervention components that have been used in high quality studies to teach children with ASD to express diverse communication functions. The outcomes of the reviews provide support for practitioners to make informed, evidence-based decisions regarding implementation of environmental adjustments to promote communication in routine contexts, as well as to select (and combine use of) teaching strategies shown to be effective. Intervention characteristics that may require adaptation to increase intervention response (such as systematic manipulation of dosage), and to increase likelihood of generalisation (e.g., incorporation of typical settings and activities) have also been specified through this research.

Although preliminary, the research documented in this thesis indicates the potential of the AEMT in developing symbolic communication for a range of social purposes. The findings of both AEMT studies provide some evidence that it can be used to teach symbolic communication to children with ASD. The AEMT can be used to teach pragmatic and symbolic targets that align with developmental social-pragmatic theories of language acquisition (e.g., Wetherby, 1986), and thus progress within the intervention can be mapped against individualised goals. A strength of the AEMT is the detail in which it is specified (allowing for clinical replication), in particular, of elements most likely to facilitate generalisation, reflect a child's interests, and incorporate systematic teaching strategies to develop symbolic language. The teaching strategies used within the AEMT are also readily transferable across settings and do not require specific resources other than access to aided AAC (thus, it is a relatively low-cost, portable intervention). In addition, the findings of the simplified version of the AEMT used with parents provide direction on supporting key caregivers to promote communication skills during interactions with their child. Instructional approaches that can be used to teach parents and caregivers to implement AEMT have also been detailed through this research, such as use of video feedback and parent education, with additional types of instruction dependent on parent response to intervention (e.g., in-vivo feedback).

Finally, the SVAIS (Chapter 4) provides a potential resource for practitioners and guidance regarding the multitude of factors that need to be considered when evaluating the social validity of AAC interventions. Following further work, which could lead to publication of the SVAIS, practitioners could use the tool to support measurement of the social validity of goals, procedures, and outcomes with stakeholders with whom they are working. Working collaboratively with stakeholders to ensure that AAC interventions are acceptable may support them to engage with an intervention and persist with the use of AAC (i.e., support maintenance and generalisation). Further, measures of social validity are critical to practitioners to support them in discussing information regarding the functional impact of

AAC interventions, and increase awareness of factors that may preclude positive outcomes, such as differences between practitioner and child and family intervention preferences.

Limitations and Directions for Future Research

The body of work within this thesis reflects a changing focus for ASD-AAC intervention research from supporting children to request objects to communicating for other purposes. Nonetheless, the findings need to be considered in light of several limitations. First, research with children with ASD who are minimally verbal involves selecting participants from a heterogenous, low incidence population, which informed the choice of research design. The use of SCED allowed for a trial of the intervention in terms of cost/benefit, while also providing information about dosage and effects to inform future research into the AEMT. Confidence in the associated findings will be increased with systematic replications (Horner et al., 2005) and, over time, systematic analyses of combined data (Schlosser, 2003). Consideration of progressing this research through a randomised control trial is warranted to test the effectiveness of the AEMT through a more rigorous design considered higher on the hierarchy of evidence (Kendall, 2003). Second, the research design selected to ascertain parent ability to implement the AEMT proved problematic, because it did not account for an apparent relationship between AEMT strategies. Hence, there was evidence that parent behaviours were not independent of one another, thereby detracting from confidence in the results obtained. In future research, variations in research designs for the investigation of parent-mediated AEMT will be needed, such as multiple baseline across participants or activities, rather than strategies.

Despite the AEMT being designed to foster generalisation (e.g., occurring in a typical setting, using a range of child-preferred activities), caregivers in both intervention studies expressed uncertainty regarding whether improvements would transfer into other settings, such as within the community. The need for AAC interventions to actively embed systematic generalisation strategies has been highlighted in the literature (Schlosser & Braun, 1994), and relevant to the social validity findings here. Future research into application of the AEMT in a variety of contexts, such as education and community-based settings will be important. There is also the need to determine the longevity of outcomes of the intervention, both when administered by a trained practitioner, and by typical caregivers. Notably, in the parent-mediated AEMT study, Abigail had reduced use of target behaviours to baseline levels following absence from the intervention for a month. This failure to demonstrate maintenance reinforces the need for further research into intervention factors necessary to promote maintenance (e.g., systematic dosage manipulation, such as gradual withdrawal of researcher support over a period of time, rather than immediate cessation of training after conclusion of the intervention).

Given that some children did not respond consistently with symbolic language in response to the AEMT or whose use of varied functions was relatively infrequent, there is a need for further research that incorporates more refined measures of progress. More comprehensive developmental communication assessments prior to intervention may provide the finely grained information needed to identify the strategies and goals suitable for particular child characteristics, as well as to measure progress in children for whom symbolic communication remains difficult. Such assessment may include children's use of prelinguistic skills, such as intentional communication acts (Thiemann et al., 2019). The SVAIS findings also reinforce the need for more detailed assessment measures given that even for the children for whom a significant intervention effect was not evident, parents reported improvements in communication skills. It is possible that the measures used in the AEMT studies were not sensitive enough to capture these changes, particularly as symbolic language, not prelinguistic skills, were the focus.

The lack of social validity information from previous studies was addressed in the thesis, but the strategy of designing a survey and obtaining feedback post-intervention may not have been adequate to best engage parents in the AEMT and reflect consideration of their needs and preferences. As noted by Schwarz and Baer (1991), measurement of social validity should occur for the purpose of informing and ultimately changing practice. The need for implementing change in response to social validity findings was highlighted in the AEMT studies in this thesis (Chapters 5, 6). For example, although caregivers rated the researcher-administered AEMT as socially valid overall, there were still some areas in which they had concerns in terms of intervention design and outcomes. If the goal of determining social validity was merely to show that it was well-rated by stakeholders, then practitioners could be confident in implementing the AEMT as designed. However, individual responses to survey questions reflected caregiver concerns with the complexity of the intervention, and the longevity and generalisation of acquired skills. Obtaining positive social validity ratings after an intervention has been designed and provided should not be the sole focus of social validity measures; rather, in future studies, incorporating social validity information (particularly stakeholder criticisms) within intervention design is recommended. Further, given the potential influence of response bias reflecting social desirability when participants complete survey tools (Paulhus, 1991), measures such as pre-post performance and social comparison (Schlosser, 1999) may help to counter or support information obtained from surveys, such as the SVAIS.

Finally, research into instructional strategies used to develop diverse communication functions in children with ASD who use AAC is still in its relative infancy. Although the systematic reviews reported in this thesis provide some initial exploration and appraisal of the range of factors that affect outcomes, both child-specific and intervention-related, further specification of these is required through research. The AEMT was designed to increase use of a range of communication functions, but caregivers nonetheless noted in their feedback the predominance of requesting in their child's communication repertoire. Developing diverse communication functions in children with ASD represents a challenge that will require ongoing research. Future research into variability in outcomes will continue to inform clinical practice in developing the range of symbolic language and pragmatic functions needed for communication competence.

Summary and Conclusion

ASD is prevalent in Australia and globally and is associated with significant communication difficulties. The cost of ASD can be high, both with respect to reduced ability to access activities of daily living due to communication impairment, as well as the financial burden of access to effective interventions. Many children with ASD experience substantial communication challenges, often failing to develop the ability to use speech as their main communication modality. A growing evidence base demonstrates that children with ASD can successfully use aided AAC, with this research historically matched to the development of their existing strengths, such as the use of aided AAC to make object requests. Although acknowledged as needed, there has been less focus on methods to improve communication for a range of pragmatic functions. Accordingly, the overarching purpose of this thesis was to determine the characteristics of effective aided AAC interventions in developing varied communication functions, and to apply these findings within an intervention that targeted multiple functions for children with ASD who were minimally verbal. Subsequently, each chapter within this thesis represents the journey of development and application of this aided AAC intervention. Two systematic reviews were required in order to determine where the research focus had been in aided AAC interventions, and then delineate characteristics of effective interventions. This information was applied to create the AEMT, which was successful in developing symbolic and social communication skills for its participants. Given the importance of parent involvement in communication development and ASD-AAC interventions, parents were then taught to implement AEMT, with modest success. The AEMT showed promise in terms of social validity, informed by the results of a caregiver-completed survey, developed for the purposes of this thesis.

The cumulative findings of studies comprising this thesis demonstrate that children with ASD can be taught to use AAC to communicate for purposes beyond object requests, which have dominated previous ASD-AAC intervention research. These other functions include those that enhance social connectedness, and, hence, are required for the formation of friendships and meaningful societal participation. Continued research into supporting the development of flexible communication skills across a range of contexts and with varied communication partners will be essential to build the evidence base regarding how best to achieve this outcome. Furthermore, parents are well-placed to support their children's communication development, but will need to be actively involved in ASD-AAC intervention design, goal setting, and implementation in order to best engage in therapy, and to facilitate meaningful and personalised change for both the child and family. Although a preference for using AAC to communicate for the purposes of behavioural regulation was indicated for all participants and was consistent with previous research, following intervention, children with ASD demonstrated a considerably wider array of messages to communicate beyond those related to object requests, even though this function continued to dominate. It is the responsibility of researchers and practitioners to facilitate their ability to do so.

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