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VERBAL BEHAVIOUR DEVELOPMENT FOR CHILDREN WITH AUTISM

by

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ABSTRACT

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The utility of functional accounts of language development in establishing the emergence of generalised verbal behaviour in children with autism was evaluated through a programme of research that also investigated ways in which interactions between speaker and listener behaviour can be manipulated to maximise the effectiveness of language-based interventions. Firstly, the Early Behavioural Intervention Curriculum (EBIC) was developed as a comprehensive framework for delivering Early Intensive Behavioural Intervention (EIBI) to children with autism. Secondly, the effectiveness of the EBIC was evaluated through analysis of process data collected during the Southampton Childhood Autism Project (SCAmP). Two subsequent studies provided further controlled investigation of the emergence of naming at the single-word level, the first in vocal children with autism, and the second in non-vocal children with autism who sign. Lastly, research was carried out to evaluate teaching procedures developed to establish complex conditional discriminations in children with autism on the basis of joint control by two types of speaker behaviour. Overall, findings reported indicate that the EBIC provides an effective framework for EIBI in autism, that theoretical accounts of naming and joint control provide a practical basis for developing effective procedures for teaching verbal behaviour to children with autism, and that functional accounts of language development provide effective means of establishing both generalised verbal behaviour and other key life skills in children with autism.

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DECLARATION OF AUTHORSHIP

I, Francesca degli Espinosa, declare that the thesis entitled "Verbal Behaviour Development for Children with Autism", and the work presented therein, are both my own, and have been produced by me as a result of my own, original, research. I confirm that:

- All work was completed wholly while in candidature for a research degree at the University of Southampton.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this has always been clearly indicated and appropriately attributed.
- Where I have quoted from the work of others, sources have always been given, and that, excepting such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done jointly with others, I have made clear exactly what was done by others and what I have contributed myself.
- None of this work has been published before submission.

Signed:

May, 2011

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With the knowledge and agreement of my Supervisor, editorial advice has been sought in the preparation of this thesis. No changes of intellectual content were made as a result of this advice.

1. GENERAL INTRODUCTION

1.1 THESIS STRUCTURE

This thesis is structured around the following chapters:

Chapter 1: General Introduction

Chapter 2: Autism and Applied Behaviour Analysis

Chapter 3: Verbal Behaviour and Language

Chapter 4: Development of the Early Behavioural Intervention Curriculum

Chapter 5: Evaluation of the Early Behavioural Intervention Curriculum

Chapter 6: Teaching Naming to Vocal Children with Autism

Chapter 7: Teaching Naming to Non-Vocal Children with Autism who Sign

Chapter 8: Teaching Generalised Listener Behaviour to Children with Autism

Chapter 9: General Discussion

1.2 THESIS OUTLINE

This thesis will firstly provide a review of the research literature into the effectiveness of behavioural intervention for autism, including an analysis of curricula for remediation of verbal deficits based on both structural and functional models of language acquisition (Chapter 2). Secondly, this thesis will provide an overview of Skinner's (1957) analysis of verbal behaviour and subsequent behavioural models of language development (e.g., Horne & Lowe, 1996; Lowenkron, 1998, 2006) as a theoretical context for understanding relationships between speaker and listener behaviour (Chapter 3). This thesis will thirdly report research carried out to develop and evaluate a structured curriculum integrating principles of verbal behaviour within the wider psychological research literature on child development as a means of teaching generalised language skills to children with autism (Chapters 4 and 5). On the basis of this research, and the literature previously reviewed, this thesis will fourthly report a programme of research carried out to provide controlled investigation of the emergence of naming at the single-word level, both in vocal children with autism and non-vocal children with autism who sign (Chapters 6 and 7). Fifthly, this thesis will report the evaluation of procedures developed to teach complex conditional discriminations to children with autism on the basis of joint control by two types of speaker behaviour (Chapter 8). The research presented will lastly be discussed in relation to the literature reviewed in Chapters 2, 3, and 4, with evaluation provided both of its conceptual implications for the analysis of verbal behaviour and its applied relevance to the design and implementation of curricula for intervention in autism (Chapter 9). Overall, this thesis will address the following questions: Can functional accounts of language development provide an effective means of promoting the emergence of generalised verbal behaviour in children with autism? And in what ways should interactions between speaker and listener behaviour be manipulated to maximise the effectiveness of language interventions for such individuals?

2. AUTISM AND APPLIED BEHAVIOUR ANALYSIS

2.1 AUTISM

The defining characteristics of autism were first described by Kanner (1943, pp. 242-246) in relation to a group of 11 institutionalised children whose behaviour he observed to be marked by "extreme autistic aloneness […], an anxiously obsessive desire for the preservation of sameness […], excellent rote memory […], delayed echolalia […], and limitations in the variety of spontaneous activity". With specific regard to social interaction, Kanner (1949, p. 416) further noted that the individuals with autism whom he observed showed either "profound withdrawal from contact with people" or "mutism or the kind of language that does not seem intended to serve the purpose of interpersonal communication". In recent years, autism has been placed, together with Asperger Syndrome and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), within the broader classification of Autistic Spectrum Disorder (DSM-IV; American Psychiatric Association [APA], 1994). Although people with autism share a range of core symptoms, the severity and the exact nature of symptoms displayed vary widely between individuals. ASD currently affects approximately one in every 116 individuals (Baird et al., 2006) and is therefore the most commonly diagnosed developmental disorder.

Although considerable effort has been made to identify the causes of autism since Kanner's (1943) initial description of the disorder (see Freitag, 2007, for a review), no biological marker or biomedical test is yet available as a diagnostic tool. Diagnosis therefore still currently depends solely upon clinical observation of specific patterns of behaviour common to all individuals with autism. According to the DSM-IV (APA, 1994), a diagnosis of autism can be made when an individual shows qualitative impairments in both social interaction and communication and restricted repetitive and stereotyped patterns of behaviour, interests, and activities. It should be noted that intellectual disabilities are also common among individuals with autism, current estimates indicating that approximately 75% of such individuals show some degree of intellectual impairment (Baird et al., 2006; Fombonne, 2005).

Although all individuals with autism share a range of behavioural characteristics, the extent of individuals' deficits, and the impact these have on their learning, varies greatly. With regard to language and communication, for example, many individuals with autism do not learn to produce spoken language during childhood and fail to compensate through use of alternative modes of communication such as gestures or mime (APA, 1994). It has further been estimated that 50% of individuals with autism never develop spoken language (Bryson, Clark, & Smith, 1988), and that, of those who do, language use is typically characterised by a high frequency of stereotyped and repetitive phrases (i.e., echolalia) and marked impairments in the ability to initiate or sustain conversation with others in a social environment (APA, 1994).

Currently, no cure for autism exists, and educational interventions provide the only means for individuals with the disorder to acquire essential intellectual and social skills (National Research Council [NRC], 2001). A variety of such interventions have been developed as a means of remediating the characteristic deficits of autism. Although these vary widely in terms of underlying philosophy and teaching methods employed, a general consensus exists that intervention should begin in the pre-school years, focus on teaching a range of skills, and take place for a minimum of 25 hrs per week (NRC, 2001).

Recently, three studies (Eikeseth, 2008; Howlin, Magiati & Chairman, 2009; Rogers & Vismare, 2008) have compared the outcomes of a range of the early interventions currently available for autism through comprehensive review of research reporting intervention outcome data. The results of all studies included were based on standardised assessments, all participants were below 6 years of age at intake, and all received comprehensive psycho-educational interventions for a minimum of 12 hrs per week for a minimum of 12 months. On the basis of research evidence reviewed, all three papers independently concluded that interventions based on the principles and techniques of Applied Behaviour Analysis produced the greatest gains in intellectual functioning and skills acquisition in individuals with autism.

2.2 APPLIED BEHAVIOUR ANALYSIS

Applied Behaviour Analysis (ABA) is an applied science that employs principles derived from the Experimental Analysis of Behaviour (EAB) to address human behavioural problems within real-world social contexts. It has therefore been defined as "the science in which procedures derived from the principles of behavior are systematically applied to improve socially significant behavior to a meaningful degree and to demonstrate experimentally that the procedures employed were responsible for the improvement in behavior" (Cooper, Heron, & Heward, 2007, p. 3). It should be noted that, within this definition, "socially significant behaviour" includes all skills necessary for an individual to function effectively in his or her community. These include social, cognitive, academic, self-help, work, and gross and fine motor skills, home and community orientation, and language and communication (Maine

Administrators of Service for Children with Disabilities, 2000). It should be noted that ABA is not a ''therapy for autism'' (Chiesa, 2005, p. 225), but, rather, when employed as a basis for intervention in autism, a set of principles that guides the development of educational activities and techniques aimed at establishing skills central to the needs of an individual within his or her social context.

2.3 BEHAVIOURAL INTERVENTION FOR AUTISM

The first application of behavioural principles to intervention for autism was reported by Wolf, Risley, and Mees (1964), who worked intensively over a period of 18 months with a 3.5 year old boy with autism and challenging behaviour who also had deficits in communication and other core skills. Results indicated that the operant techniques employed were effective both in reducing challenging behaviour and in establishing appropriate adaptive skills, including verbal behaviour (e.g., use of labelling, pronouns, and requests) and self-help skills (e.g., use of cutlery and spectacles). The following year, Lovaas and colleagues published research indicating that self-destructive behaviour could be socially learned through processes of operant conditioning (Lovaas, Freitag, Gold, & Kassorla, 1965), and, subsequently, that behavioural techniques could also be used to remediate such behaviour (Lovaas & Simmons, 1969). Research also indicated that negative reinforcement procedures had been effective in establishing social behaviours in two 5-year old identical twins with autism (Lovaas, Schaeffer, & Simmons, 1965) and that use of shaping procedures had succeeded in teaching imitative speech to two mute children with autism (Lovaas, Berberich, Perloff, & Schaeffer, 1966). Such findings suggested that, contrary to prevailing psychoanalytic interpretations of autism and its associated behaviours, the systematic application of behavioural principles could provide both a coherent conceptual analysis and an effective set of practical techniques for educational intervention in individuals with autism.

2.3.1 The UCLA Model

Building on the preliminary research outlined above, Lovaas and colleagues at the University of California, Los Angeles (UCLA), conducted a further programme of research that led directly to the development of what has subsequently become known as the "UCLA Model" of behavioural intervention for autism (Lovaas, 1987). The principal techniques of this approach are documented in the "Teaching Developmentally Disabled Children: the ME Book" (Lovaas, 1981/2003), which was the first published curriculum manual for teaching children with autism (see Chapter 4). It should be noted that, according to Smith (2001), the UCLA model provides an approach to intervention appropriate for children with autism, without any other major medical condition, whose treatment will commence when they are less than 3.5 years of age. The model provides two approaches to intervention: a clinic-based model involving weekly consultations from a supervisor and other clinical staff, and a parent-directed model composed of monthly workshop-based consultations from a supervisor supported by tutoring staff employed by parents (Smith, 2001). Both approaches use the teaching procedures detailed in "The Me Book" (Lovaas, 1981/2003) as a basis for intervention (Hayward, Eikeseth, Gale, & Morgan, 2009). Both the clinic-based and parent-directed models take place in the child's home and are typically delivered for 40 hrs per week during the first year, with reduction in hours across subsequent years dependent upon the child's level of skills development. The UCLA model uses discrete-trial training (DTT) as a primary instructional method for teaching a wide range of skills including language, academic, play, social, and self-help (Smith, 2001). DTT is a structured teaching method based directly on the three-term contingency (Skinner, 1938) and is composed of successions of "blocks" of individual discrete-trials (see Section 4.3.6).

At present, the UCLA model remains the approach to behavioural intervention for children with autism supported by the largest amount of research evidence, and researchers working within its instructional framework have also conducted the majority of published studies into overall intervention effectiveness (see Section 2.4). In recent years, however, clinicians and researchers have produced a growing body of research into a wider range of behavioural interventions in autism. This has led to the increasingly broad conceptualisation of ABA-based intervention in autism described in the following section.

2.3.2 Early Intensive Behavioural Intervention

Although Lovaas (1987) was the first to suggest a set of characteristics to define behavioural intervention for autism (i.e., that it should be early, intensive, and comprehensive) the term Early Intensive Behavioural Intervention (EIBI) has, in recent years, increasingly come to denote the broader range of behavioural techniques and procedures currently used for educational intervention for autism. Although EIBI necessarily includes the UCLA model, it is not confined solely to research carried out at the UCLA, or its affiliated institutions, or to clinicians who work within that framework of application. Green, Brennan, and Fein (2002), for example, have proposed that EIBI should:

1. Be tailored to children’s individual needs, comprehensively addressing all developmental domains.
2. Use a wide range of behavioural procedures (e.g., differential reinforcement, prompting, discrete-trial teaching, incidental teaching, activity-embedded trials, task analysis) to teach adaptive skills and to reduce challenging behaviour.
3. Be directed by one or more individuals with advanced training in ABA and prior experience of intervention with children with autism.
4. Select intervention objectives based upon typical developmental sequences.
5. Actively involve parents as tutors for their children.
6. Initially deliver one-to-one teaching, gradually moving towards small- and large-group teaching as appropriate for children involved.
7. Initially provide teaching in the home, gradually generalising teaching contexts to include preschool, kindergarten, and school classrooms.
8. Provide intensive, structured intervention throughout the year, composed of 20 to 30 hrs per week of structured teaching sessions, with additional maximal utilisation of natural learning opportunities.
9. Be carried out for a minimum of two years.
10. Commence when children are between 3 and 4 years of age.

According to Green el al. (2002), therefore, EIBI is composed of a set of overarching characteristics that apply across individual programmes of intervention.

It should be noted, however, that EIBI is defined not solely by its techniques and procedures, but also by a research literature that has, from the outset, been central not only to informing methodological development, but also to evaluation of its procedures and outcomes. As Myers, Johnson, and American Academy of Paediatrics (2007, p. 1164) have stated, “the effectiveness of ABA-based intervention in ASD has been well documented through 5 decades of research by using single-subject methodology and in controlled studies of comprehensive early intensive behavioral intervention programs in university and community settings. Children who receive early intensive behavioural treatment have been shown to make substantial, sustained gains in IQ, language, academic performance, and adaptive behavior as well as some measures of social behavior, and their outcomes have been significantly better than those children in control groups". The following section addresses the principal findings of that growing research literature.

2.4 THE EFFECTIVENESS OF BEHAVIOURAL INTERVENTION FOR AUTISM

As described above, two major strands of research into the effectiveness of ABA interventions for autism exist, one centring on the use of single-case designs to evaluate procedures aimed at teaching specific skills (e.g., language, play, self-help, academic, social) or reducing specific challenging behaviour (e.g., self-injury, aggression, stereotypical behaviour) and the other using group design methodologies to evaluate the overall effectiveness of EIBI programmes. Although a review of the former is beyond the scope of the present chapter, a number of papers reviewing the single-case research literature are currently available (e.g., Goldstein, 2002; Hanley, Iwata, & McCord, 2003), and an evaluation of single-case research relating specifically to procedures employed to teach language is presented in Chapters 6 to 8. The following sections provide a review of the existing research literature reporting the use of group design methodologies to evaluate the effectiveness, or "outcome", of EIBI programmes.

2.4.1 Outcome Research

One of the first studies to report the outcome of a comprehensive behavioural intervention for autism was provided by Lovaas, Koegel, Simmons, and Long (1973), who retrospectively evaluated the progress of 19 children with autism who had each received one year of intensive behavioural intervention during the 1960s from UCLA clinicians. Children in an "inpatient" group had received approximately 8 hrs of daily one-to-one behavioural intervention for up to 7 days per week, and were discharged to a California State mental hospital subsequent to intervention. Children in an "outpatient" group had received regular consultations by UCLA clinicians, with intervention delivered on a daily basis by parents who had acted as their children's tutors. All children were reported to have demonstrated varying gains in IQ immediately subsequent to intervention. Follow up assessments, however, conducted 1 and 4 years subsequent to intervention, indicated that the IQ of children in the inpatient group had reverted to pre-intervention levels. Children in the outpatient group, however, who had remained at home with their ABA-trained parents, were found to have maintained IQ or shown further gains.

In what has come to be regarded as a seminal study in the field, Lovaas (1987) reported additional, and more extensive, evaluation of the effectiveness of the UCLA model. On the basis of retrospective examination of the clinical records of children with autism who had received UCLA model intervention between 1970 and 1984, two groups were populated, one composed of children who had received an average of 40 hrs per week of intervention

(Experimental Group, n = 19), and another composed of children who had received 10 hrs per week of intervention (Control Group 1, n = 19). Data from a third group of children who had received standard California State treatment for autism (Control Group 2, n = 21) were also included in the research. Only data from children who were matched for mental and chronological age at intake were included in the analyses. Standardised measures of IQ, taken subsequent to intervention, when children were aged between 6 and 7 years, were compared to baseline measures taken prior to intervention. Because the IQ scores of children in Control Groups 1 and 2 did not differ, these data were treated as those of a single group (Control Group, n = 40) for purposes of analysis. Results indicated that children in the Experimental Group demonstrated significantly higher IQ scores than those of children in the Control Group (mean difference = 30 points), and that, after 2 years of intervention, nine of 19 children in the Experimental group were attending mainstream school without support and also scored within the normal range for IQ. Records indicated that these "recovered" children (Lovaas, 1987, p. 7) had continued to receive 10 hrs per week of intervention during an additional third year, followed by monitoring from UCLA staff during a final fourth year. The remaining 10 children in the Experimental Group had continued to receive intensive one-to-one intervention for a minimum of 40 hrs per week for six or more subsequent years and were eventually placed in "aphasia" classes (n = 8) or specialist autism classes (n = 2), obtaining IQ scores within the "mild to severe" learning difficulties range (Lovaas, 1987). The mental age and IQ of children in the Control Group remained unchanged between intake and follow up, and only one child in that group achieved a normal IQ score and mainstream educational placement.

Lovaas' (1987) research has, however, subsequently been criticised on a range of methodological grounds. It has, for example, been suggested that, because children who received UCLA model intervention were not randomly assigned to groups, selection bias may have occurred (Howlin, 1997; Rogers, 1998; Schopler, Short, & Mesibov, 1989; Shea, 2004), and that, because assessments were carried out by a number of different clinicians at non-standardised time-points, reliability of results may also have been affected (Rogers, 1998). Also, because Lovaas (1987) only analysed data obtained from children whose IQ scores were 35 or above at intake, it has been suggested that a sample of participants may have been selected for whom prognosis was unrepresentatively favourable (Gresham & MacMillan, 1997a; 1997b; 1998). Additional methodological concerns have been raised regarding lack of objective information concerning treatment fidelity, the absence of reporting of exact treatment hours, and the retrospective nature of the research (e.g., Howlin, 1997; Rogers, 1998; Shea, 2004).

Although Lovaas (1989) addressed a number of the above concerns, he also accepted the need for replication of his findings. To this end, a number of research centres were set up across the USA, UK, and Norway under the title of "UCLA multisite—Young Autism Project (YAP)", with the specific aim of conducting research further to evaluate the effectiveness of the UCLA model. The outcomes of such intervention programmes have subsequently been reported by a number of authors (e.g., Cohen, Amerine-Dickens, & Smith, 2006; Luiselli, O'Malley Cannon, Ellis, & Sisson, 2004; Sallows & Graupner, 2005; Smith, Buch, & Gamby, 2000). Beyond this ambitious programme of replication, a range of other researchers have additionally reported the outcomes of EIBI more generally (e.g., Howard et al., 2005; Remington et al., 2007). The principal methodological characteristics (i.e., research design, participant assignment, dependent variables) and findings of all such studies that have used standardised assessments to measure outcomes and met Green et al.'s (2002) definition of EIBI, or that have specifically evaluated the UCLA model, are presented in Table 1. As can be seen, although, overall, studies report that EIBI produces gains in IQ and adaptive skills across a range of participants, contexts, and approaches to intervention, a range of concerns are also evident, relating principally to specific aspects of individual methodologies employed.

2.4.2 Meta-Analyses of Outcome Research

In the last 2 years, four meta-analyses have evaluated various aspects of the results of the outcome studies summarised above, as a means of formally identifying commonalities among the results of the studies reported above. Reichow and Wolery (2009), for example, analysed the data from 13 outcome studies that specifically employed the UCLA model of intervention. [1] Although these authors noted a range of the methodological concerns across studies examined, including lack of random assignment, limited reporting of procedural fidelity, and lack of experimental rigour, a mean change effect size of 0.69 for IQ was

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[1] Anderson, Avery, DiPietro, Edwards, & Christian (1987); Bibby, Martin, Mudford, & Reeves (2002); Birnbrauer & Leach (1993); Boyd & Corley (2001); Cohen, Amerine-Dickens, & Smith (2006); Eikeseth, Smith, Jahr, & Eldevik (2007); Eldevik, Eikeseth, Jahr, & Smith (2006); Lovaas, (1987); Magiati, Charman, & Howlin (2007); Sallows & Graupner (2005); Sheinkopf & Siegel (1998); Smith, Eikeseth, Klevstrand, & Lovaas (1997); Smith, Groen, & Wynn (2000).

Table 1.

Author(s)	Design and group assignment	Mean participant age by group and intake IQ	Intervention Group (IG) intervention(s)	Control Group (CG) intervention(s)	Outcome measures	Results	Strengths	Limitations
Lovaas (1987)	Retrospective comparison Staff availability	IG: 34.6 months, IQ = 62.9 CGs: 40.9 months, IQ = 57.1	UCLA Model, 40 hours p/w for > 2 years and weekly supervision by UCLA clinicians (n = 19)	CG1: UCLA Model, 10 hours p/w for > 2 years (n = 19) CG2: California State intervention (n = 21)	BSID, CIIS, GIDS, SBIS, school placement	IG: mean 30 point greater IQ IG: Significant gains on all other measures IG: 47% of normal range IQ scores and mainstream school placement	High treatment fidelity and integrity Standardised assessments First study of kind	Retrospective inconsistent evaluation points IQ entry threshold “Recovery” not defined by standardised diagnostic measures Lack of CG2 intervention information
Anderson, Avery, DiPietro, Edwards, & Christian (1987)	Prospective pre and post Parental preference	IG: 42.8 months IQ = 55	UCLA Model, 15-25 hours p/w for 1 year (n = 9) or 2 years (n = 5) delivered by tutors and parents	None	BSID, MBOs, PLSSICD, PPVT, SPT, SBIS, VABS,	IG: significant gains across all measures from intake to Year 1, IQ gains = 5.6 points IG: fewer gains between Years 1 to 2	Process data (details of objectives mastered) Parent training	Limited treatment fidelity (curriculum evaluation by parents and tutors) Lack of supervision from EIBI provider No CG
Birnbrauer & Leach (1993)	Prospective comparison Parental preference	IG: 38.1 months, IQ = 45.3 CG: 33.2, IQ = 45	"Me Book”-based EIBI, 18.7 hours p/w of 1:1 for 2 years (n = 9)	No intervention (n = 5)	BSID, Leiter, PIC, PPVT, PSI, REEL, RDLS, SBIS, VABS, WISC, WPPSI	Positive changes in NV-IQ reported	Comprehensive standardised assessments Parental involvement and training Low cost programme (volunteers as tutors)	No statistical analyses Treatment fidelity not reported NV-IQ, not IQ, used as progress indicator
Smith, Eikeseth, Klevstrand, & Lovaas (1997)	Retrospective comparison Staff availability	IG: 36 months, IQ = 27.8 (IQ entry point <35) CG: 38 months, IQ = 27.3	UCLA Model, 30 hours p/w 1:1 > 2 years (n = 11)	UCLA Model 10 hours p/w < 2 years (n = 10)	BSID, RDLS (IG only, n = 3), VABS, parental reports	IG: significantly higher mean IQ (IG = 36, CG = 24) and greater gains in speech development	First evaluation of EIBI among low functioning children with autism	Intervention delivered across UCLA sites (2 in USA, 1 in Norway) Limited treatment integrity Inconsistent evaluation timepoints No report of blind assessments Lack of CG data on VABS and RDLS Retrospective
Sheinkopf & Siegel (1998)	Retrospective comparison Parental preference	IG: 33.8 months, IQ = 62.8 CG: 35.3 months, IQ = 61.7	"Me Book”-based EIBI delivered by parents, tutors, and other State services (e.g., SALT = 7 hours p/w) 19.45 hours p/w of 1:1 < 15 months (n = 11)	Usual treatment (Occupational and SALT, 11 hours p/w; n = 11)	BSID-II, CIIS, MPSD, WPPSI, changes in symptom severity	IG: significantly greater IQ gain (25 points), largely based on NV-IQ		Diagnosis not based on standard criteria. Limited treatment fidelity (multiple interventions) Limited integrity Use of NV-IQ No language assessment No report of blind assessments Retrospective

Table 1. (continued)

Author(s)	Design and group assignment	Mean participant age by group and intake IQ	Intervention Group (IG) intervention(s)	Control Group (CG) intervention(s)	Outcome measures	Results	Strengths	Limitations
Luiselli, O'Malley Cannon, Ellis, & Sisson (2000)	Retrospective pre and post Parental preference	IG: 39 months	UCLA Model, 6-20 hours p/w across 5-22 months (n = 16)	None	DRCs	Overall improvement across developmental domains		Limited treatment fidelity and integrity No standardised assessments No CG Retrospective
Smith, Groen, & Wynn (2000)	RCT	IG: 36.07 months, IQ = 50.53 CG: 35.77 months, IQ = 50.69	UCLA Model, 24.5 hours p/w for 2 years (n = 7 autism, n = 8 PDD)	5 hours p/w parent training with UCLA clinicians and 15 hours Specialist School (n = 7 autism, n = 6 PDD)	BSID-II, ELM, MPSD, RDLS, SBIS, VABS	IG: significant gains in IQ (mean = 15 points) CG: no gains in IQ, language, or on VABS	Comprehensive standardised assessment battery at uniform time points High treatment fidelity and integrity Blind assessment Differential diagnoses of PDD and autism	Baseline assessments within 3 months of starting intervention
Smith, Buch, & Gamby (2000)	Prospective pre and post Parental preference	IG: 36 months, IQ = 50	UCLA Workshop Model (n = 6)	None	BAS, BSID-II, ELM, GMDS, MPSD, RDLS, VABS, WISC-III, WPPSI, WPPSI-R, behavioural ratings, parental satisfaction, school placement, treatment integrity	Only 2 children made measurable gains. Home tutors less effective than clinic-based tutors	Measures of treatment integrity, high parental satisfaction	No CG Retrospective parent report of intensity. Limited treatment fidelity (low-intensity supervision from UCLA staff).
Bibby, Martin, Mudford, & Reeves (2002)	Prospective pre and post Parental preference	IG: 45 months (parental reports)	EIBI Parent-managed, consultation from 25 different providers, varying duration and supervision levels (n = 66)	None			Comprehensive assessment battery Large sample	Baseline data taken up to three years after intervention had started Limited treatment fidelity (supervision) and integrity No CG
Howard, Sparkman, Cohen, Green, & Stanislaw (2005)	Prospective comparison Parental preference	IG: 30.9 months, IQ = 58.5 CG1: 37.4 months, IQ = 53.7 CG2: 34.6 months, IQ = 59.9	EIBI, 25-40 hours p/w, < 14 months (n = 29)	CG1: Eclectic approach, 30 hours p/w of 1:1 or 1:2, < 14 months (n = 16) CG2: ASD specialist small group classes, 15 hours p/w, < 14 months (n = 16)	BSID-II, DP-II, MPSD, RDLS, SBIS, VABS, WPPSI-R	IG: greater gains across all domains except motor IQ gains: IG= 30 points, CGs (combined) = 9 points No difference between CGs	Comprehensive assessment battery High treatment fidelity and integrity	Use of regressive analysis rather than group means No blind assessment
Sallows & Graupner (2005)	RCT	IG: 33.7 months, IQ = 48.8 CG: 30.2 month, IQ = 44.4	UCLA Model clinic-directed 38 hours p/w < 2 years (n = 13)	UCLA Workshop Model (parent-directed), 31.5 hours p/w, < 2 years (n = 10)	BSID-II, CBC, CELF-III, ELM, PIC, RDLS, VABS, WISC-III, WPPSI-R	No difference between groups (both groups's data collated to make pre and post design) Mean gain of 25 IQ points across groups 48% across groups achieved normal IQ Rapid skills acquisition Imitation, language, daily living, and social skills predicted outcome	Comprehensive standardised assessment battery. Individual children's developmental progress Blind assessments Analysis of predictors	Limited fidelity to UCLA model (e.g., PRT, AAC, Social Peer Play used) No alternative intervention CG

Table 1. (continued)

Author(s)	Design and group assignment	Mean participant age by group and intake IQ	Intervention Group (IG) intervention(s)	Control Group (CG) intervention(s)	Outcome measures	Results	Strengths	Limitations
Cohen, Amerine-Dickens, & Smith (2006)	Prospective comparison Parental preference	IG: 34.4 months, IQ = 62 CG: 33.2 months, IQ = 59.4	UCLA Model: 35-40 hours p/w for 3 years (n = 21)	Specialist autism class 10-25 hours p/w, staff-pupil ratios 1:1 and 1:3 (n = 21)	BSID-II, MPSD, RDLS, VABS, WPPSI	Significant VABS and IQ gains: IG gained 25 IQ points (mean IQ post-tx 87), CG gained 14 points (mean IQ post-tx 73) IQ gains mainly in first year. No difference in language	Comprehensive standardised assessment battery High treatment fidelity and integrity Blind assessments	Lack of details of CG intervention
Eldevik, Eikeseth, Jahr, & Smith (2006)	Retrospective comparison Parental preference	IG =53.1 months, IQ = 41 CG = 49 months, IQ = 47.2	UCLA Model in school setting (Norway) 12.5 hours p/w 1:1 for 20 months (n = 13)	Eclectic intervention in school setting (Norway) for 21 months (n = 15)	BSID-II, MPSD, PEP-R, RDLS, SBIS, VABS, WISC-R, WPPSI	Significant difference in IQ language and communication between groups (IG gained 8 IQ points, CG lost 3 points)	First study directly to investigate low intensity EIBI among "older" children	Retrospective At least 35% of assessments not blind (exact percentage not specified)
Eikeseth, Smith, Jahr, & Eldevik (2002, 2007)	Retrospective comparison Staff availability	IG (2002): 5.5 years, IQ = 61.92; CG (2002): 5.5 years, IQ = 65.17	UCLA model, 28 hours p/w of 1:1 for 1 year (n = 13)	Eclectic approach, 29 hours p/w of 1:1 (n = 12)	BSID-II, MPSD, RDLS, VABS, WISC-R, WPPSI	IQ: Significant differences in IQ, language, and VABS Mean IQ gains: IG = 17 and 25 points, CG = 4 and 7 points (2002 & 2007, respectively)	Blind assessment using standardised battery High treatment fidelity and integrity First study involving older children and similar intensity interventions	High entry IQ threshold (50 points) Retrospective
Magiati, Charman, & Howlin (2007)	Prospective comparison Parental preference	IG: 38 months, IQ = 83, Mental Age = 31.4 CG: 42.5, IQ = 65.2, Mental Age = 29.1	Unspecified EIBI provision (UK, USA, Norway, and independent providers), 32 hours p/w, for 2 years (n = 28)	Eclectic provision from 12 different nursery-school for 2 years: 10 ASD-specific, 2 generic special schools for 20 hours p/w 1:3 and 6 hours p/w 1:1 (n = 16)	BSID, BPVS-II, MPSD, SPT, VABS, WPPSI-R	No differences between groups IQ and language best predictors of overall progress across groups.	First UK study comparing EIBI and specialist nursery provision Analysis of outcome predictors	No baseline (first assessments up to 3 months after start of intervention Lack of quality control of ABA provision Lack of treatment fidelity and integrity Assessments not blind Pre-Tx differences between groups
Remington, Hastings, Kovshoff, degli Espinosa, Jahr, Brown, Alsford, Lemaic, & Ward (2007)	Prospective comparison Parental preference	IG: 35.7 months, IQ = 61.4 CG: 38.4, IQ = 62.3	UCLA Model (n = 2), EIBI private practitioners (n = 7), University of Southampton EBIC-based (n = 14), 25.6 hours p/w of 1:1	Eclectic intervention from LEAs (Nursery, Nursery with Support, TEACCH, SALT, PECS, some 1:1; n = 21)	BSID-II, ESCS, SBIS, RDLS, VABS, PSI, HADS, QRS-F	IG: significant differences in IQ IG: IQ gain = 12 points	Comprehensive standardised assessment battery, including measures of Joint Attention, parental stress and depression, and "Best Outcome"	Additional interventions (e.g., diet) and merging of two IG groups Difficult to measure fidelity and integrity for non-University group Limited information on comparison intervention Assessment not blind
Zachor , Ben-Itzchak, Rabinovich, & Lahat (2007)	Prospective comparison Geographical location	IG: 27.7 months, IQ = 76.1 CG: 28.2 months, IQ = 79.6	EIBI centre-based, 35 hours p/w of 1:1 (n = 20)	Eclectic-developmental centre-based, 35 hours p/w (2 hours per day 1:1) (n = 19)	ADOS, SBIS	Both groups improve, but no IQ difference between groups IG: significant diagnostic change	First study directly to measure changes in diagnosis through ADOS Group assignment by geographical area rather than parental preference	Limited assessments (e.g., no language evaluation) Limited information regarding treatment fidelity and integrity

Author(s)	Design and group assignment	Mean participant age by group and intake IQ	Intervention Group (IG) intervention(s)	Control Group (CG) intervention(s)	Outcome measures	Results	Strengths	Limitations
Perry, Cummings, Geier, Freeman, Hughes, LaRose, Managhan, Reitzel, & Williams (2008)	Retrospective pre and post	IG: 53.56 months, IQ = 45.50	EIBI from a variety of home- and centre-based providers, 20 to 40 hours p/w for 18 months (range = 4 to 47 months; n = 332)		BSID-II, CARS, MSEL, SBIS, VABS, WPPSI-III, WPPSI-R	Significant improvement on VABS, fewer autistic symptoms on CARS	Large scale study of State-based EIBI provision Group assignment based by geographical area rather than parental preference	Limited treatment fidelity and integrity Limited information regarding intervention model Assessments not delivered at uniformed time points IQ assessment data available for only 1/3 of participants No CG Retrospective
Hayward, Eikeseth, Gale, & Morgan (2010)	Prospective comparison Parental preference & geographical location	IG = 35.7 months, IQ = 53.5 CG = 34.4 months, IQ = 54.7	UCLA model clinic based, 37.4 hours p/w for 1 year (n = 23)	UCLA model parent-directed, 34.2 hours p/w for 1 year (n = 21)	BSID-II, ELM, MPSD, RDLS, VABS, WPPSI-R	No difference between groups Data from groups collated to make pre and post design Increase in RDLS score and significant gains in adaptive behaviour Positive correlation between NV-IQ and outcome Intake IQ not predictive of IQ changes	Independent blind assessment Comprehensive assessment battery at uniform timepoints Inclusion of multiple baseline for curriculum attainment (ELM) Correlation analysis of variables associated with outcome High treatment fidelity and integrity	No alternative intervention CG

Table 1. Summary of principal methodological characteristics, results, strengths, and limitations of all major EIBI outcome studies, in chronological order of publication. *Note*. Outcome measures: Autism Diagnostic Observation Schedule (ADOS), British Picture Vocabulary Scale (2nd ed.; BPVS-II), Bailey Scale of Infant Development (BSID), Bailey Scale of Infant Development (2nd ed.; BSID-II), Childhood Autism Rating Scale (CARS), Cattell Infant Intelligence Scale (CIIS), Child Behavior Checklist (CBC), Clinical Evaluation of Language Fundamentals (CELF-III), Developmental Profile (2nd ed.; DP-II), Developmental Ratings Checklists (DRCs), Early Learning Measure (ELM), Early Social Communication Scales (ESCS), Gesell Infant Development Scale (GIDS), Griffiths Mental Development Scales (GMDS), Hospital Anxiety and Depression Scale (HADS), Leiter International Performance Scales (Leiter), Mastery of Behavioral Objectives (MBOs), Merrill-Palmer Scales of Development (MPSD), Mullen Scales of Early Learning (MSEL), Psychoeducational Profile (Rev. ed.; PEP-R), Personality Inventory for Children (PIC), Preschool Language Scale Sequenced Inventory of Communication Development (PLSSICD), Peabody Picture Vocabulary Test (PPVT), Parenting Stress Index (PSI), Questionnaire on Resources and Stress–Friedrich (Short Form; QRS-F), Reynell Developmental Language Scales (RDLS), Stanford-Binet Intelligence Scales (SBIS), Symbolic Play Test (SBT), Symbolic Play Test (SPT), Receptive-Expressive Emergent Language Scale (REEL), Vineland Adaptive Behavior Scales (VABS), Wechsler Intelligence Scale for Children (WISC), Wechsler Intelligence Scale for Children (3rd ed.; WISC-III), Wechsler Preschool and Primary Scale of Intelligence (WPPSI), Wechsler Preschool and Primary Scale of Intelligence (3rd ed.; WPPSI-III), Wechsler Preschool and Primary Scale of Intelligence (Rev. ed.; WPPSI-R), Woodcock-Johnson Classroom Placement (W-JCP). Per week (p/w), randomised control trial (RCT).

nevertheless reported across studies, and the conclusion presented that EIBI provides “an effective treatment, on average, for children with autism” (Reichow & Wolery, 2009, p. 23).

Eldevik et al. (2010a) evaluated the data of nine controlled EIBI outcome studies, [2] seven of which, specifically employing UCLA model interventions, had previously been evaluated by Reichow and Wolery (2009). Data from two studies reporting interventions carried out within the broader framework of EIBI were also included. Analyses were conducted upon the individual raw data of 297 children, rather than on the published group mean averages used by Reichow and Wolery (2009). Eldevik et al.’s (2010a) meta-analysis yielded an overall mean difference effect size of 1.1 for IQ and 0.66 for adaptive behaviour. On the basis of these results, the authors concluded that “EIBI produces large to moderate effect sizes for changes in IQ and [Adaptive Behaviour Composite] scores for children with ASD when compared with nonintervention controls and eclectic provision” (Eldevik et al., 2010, p. 449).

Makrygianni and Reed (2010) subsequently analysed the data of 14 studies [3] to investigate not only whether EIBI produces improvements in IQ, language, and adaptive behaviour in children with autism, but also which intake variables may predict such outcomes. It should be noted that these authors also included two outcome studies (Reed, Osborne, & Corness, 2007a, 2007b) that reported interventions that do not satisfy Green et al.’s (2002) definition of EIBI. Effect sizes of 0.95 and 0.91 were reported for IQ in studies that the authors assessed as being of high and low methodological quality, respectively. Effect sizes of 0.99 and 0.89 for language and 0.42 and 0.47 adaptive behaviour, were also reported. Medium to large effect sizes for EIBI were observed across all factors even when compared to eclectic interventions. Because intensity of intervention was found to be positively correlated with effect size for IQ and adaptive behaviour, Makrygianni and Reed (2010, p. 585) suggested that “[…] more intensive programs, in general, have a higher impact on the gain in intellectual and adaptive behavioural abilities of children with ASD. However

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[2] Birnbrauer & Leach (1993); Cohen, Amerine-Dickens, & Smith (2006); Eikeseth, Klevstrand, & Lovaas (1997); Eikeseth, Smith, Jahr, & Eldevik (2007); Eldevik, Eikeseth, Jahr, & Smith (2006); Howard et al. (2005); Lovaas (1987); Remington et al. (2007); Smith, Groen, & Wynn (2000).

[3] Anderson, Avery, DiPietro, Edwards, & Christian (1987); Ben-Itzchak & Zachor (2007) Cohen, Amerine-Dickens, & Smith (2006); Eldevik, Eikeseth, Jahr, & Smith (2006); Howard et al. (2005); Lovaas, (1987); Magiati, Charman, & Howlin (2007); Reed, Osborne, & Corness (2007a); Reed, Osborne, & Corness (2007b) Remington et al. (2007); Sallows & Graupner (2005); Smith, Eikeseth, Klevstrand, & Lovaas (1997); Smith, Groen, & Wynn (2000); Weiss (1999).

the intensity of the behavioural programs does not seem to be correlated with progress on the children's language abilities". Duration of intervention was also found to be correlated with improvement in adaptive behaviour compared to eclectic interventions, but not with the overall effect size for IQ, language, and adaptive behaviour. Heterogeneity of assessment time points was, however, suggested by the authors as potentially having accounted for the absence of significant correlations for this variable. Finally, improvement in language was correlated with adaptive behaviour at intake. Makrygianni and Reed (2010, p. 589) therefore concluded that "the more intensive the behavioural Early Intervention Programs (EIP) are and the longer they last, the more effective they are compared to the control programs".

In a final meta-analysis, Eldevik et al. (2010b) evaluated the data of 15 EIBI outcome studies. [4] Rather than using published group means, individual data from 453 children with autism were examined, using the Reliable Change Index (Jacobson & Truax, 1991) to establish the percentage of children achieving reliable change [5] in IQ and adaptive behaviour subsequent to EIBI. Eldevik et al. (2010b) found that 29.8% of children undergoing EIBI achieved IQ scores that met the criterion for reliable change but that only 2.6% and 8.7% of children in the comparison and control groups, respectively, achieved the same result. With regard to adaptive behaviour, 20.6% of children demonstrated reliable change compared to 5.7% and 5.1% of children in the comparison and control groups, respectively. Regression analyses of potential outcome predictors further indicated that, in accordance with Makrygianni and Reed's (2009) findings, "high intervention intensity was the only variable that independently predicted both IQ and [adaptive behaviour] gain" (Eldevik et al., 2010b, p. 401). Additionally, intake IQ and adaptive behaviour predicted gains in adaptive behaviour, but not in IQ.

Overall, therefore, meta-analyses to date confirm the conclusions of individual EIBI outcome studies, that EIBI produces large to moderate gains in the intellectual functioning

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[4] Anderson, Avery, DiPietro, Edwards, & Christian (1987); Birnbrauer & Leach (1993); Ben-Itzchak & Zachor (2007); Cohen, Amerine-Dickens, & Smith (2006); Eikeseth, Smith, Jahr, & Eldevik (2002); Eldevik, Eikeseth, Jahr, & Smith (2006); Hayward, Eikeseth, Gale, & Morgan (2009); Harris & Handleman (2000); Howard et al. (2005); Lovaas (1987); Remington et al. (2007); Sallows & Graupner (2005); Smith, Eikeseth, Klevstrand, & Lovaas (1997); Smith, Groen, & Wynn (2000); Weiss (1999);

[5] Reliable change refers to "the amount by which an outcome measure has to change before one can be 95% certain that the change cannot be accounted for by the variability of the scores in the sample and/or measurement error" (Jacobson & Truax, 1991, p. 14)

and adaptive behaviour of children with autism in comparison to the outcomes of other approaches to intervention.

2.4.3 Limitations of Outcome Research

Although all outcome studies and related meta-analyses described above have provided broad-ranging evidence that EIBI produces meaningful increases in intellectual functioning in children with autism, as a whole, clinicians reporting the outcomes of EIBI have nevertheless provided "less than comprehensive descriptions of their independent variables" (Lechago & Carr, 2008, p. 491). Specifically, although all EIBI outcome studies have reported use of curriculum manuals (e.g., Lovaas, 1981/2003) as a basis for the interventions employed, none has provided detail regarding the specific teaching procedures, curriculum content and organisation, behavioural objectives, or criteria for skills mastery employed within the interventions reported. In other words, although many studies have reported the outcomes of teaching procedures, none has provided the *process data* regarding intervention that would permit detailed understanding of the pragmatics of implementation, and, hence, replication (see Chapters 4 and 5). In part as a result of this approach to empirical design, it should further be noted that neither "The Me Book" (Lovaas, 1981/2003), nor the two other existing curriculum manuals (Leaf & McEachin, 1999; Taylor & McDonough, 1996), has yet received empirical evaluation of which of the sequences of behavioural objectives they propose are the most effective, of which specific skill areas targeted for intervention are critical, or of the order in which skills can most effectively be established.

2.4.4 Behavioural Intervention and Language

It should lastly be noted that all currently published curricula for EIBI are specifically based on psycholinguistic, rather than behavioural, accounts of language and its development (Leaf & McEachin, 1999; Lovaas, 1981/2003; Taylor & McDonough, 1996). Within these curricula, language is typically categorised as either "receptive" (i.e., responding to the speech of others) or "expressive" (i.e., speaking to others), which two types of interaction, in combination, are regarded as defining "communication" (Sundberg & Michael, 2001). That such structural approaches have been used, either explicitly or implicitly, within EIBI is, in many ways, remarkable, because one of the most powerful aspects of behaviour analysis is provided by its uniquely functional account of verbal behaviour (Skinner, 1957). As Sundberg and Michael (2001, p. 701) have observed, that EIBI does not make use of behavioural analyses of language consistent with its analyses of non-verbal behaviour "seems inconsistent with the stated behavioural focus of many intervention programs". As a basis for exploring the suggestion that many advantages, both conceptual and practical, can be provided by integrating behavioural accounts of language within EIBI, the following chapter provides a review of Skinner's (1957) analysis of verbal behaviour and subsequent theoretical developments of its principles (e.g., Horne & Lowe, 1996; Lowenkron, 1998, 2006). Chapter 4 subsequently integrates these accounts within the EIBI research literature as a context for reporting the development of the Early Behavioural Intervention Curriculum (EBIC), a framework for teaching generalised verbal behaviour and other skills to children with autism.

2.5 SUMMARY

Autism is an increasingly widespread developmental disorder characterised by deficits in language, communication, and social skills. As an applied discipline, ABA uses the principles of the EAB to achieve significant behavioural change in real-world contexts. Initial research in the 1960s indicated that ABA could provide both a systematic analysis and a set of techniques to remediate many key deficits of autism. Building on such research, a growing number of outcome studies have assessed the outcomes both of UCLA model interventions and EIBI programmes more generally, supporting the effectiveness of behavioural interventions for teaching core skills, and reducing challenging behaviour, in children with autism. Although meta-analyses have confirmed these findings, no published outcome research has yet provided process data relating to specific teaching procedures used, or involved interventions based around behavioural conceptualisations of language. Chapter 3 provides an overview of behavioural accounts of language, and Chapter 4 integrates these accounts with the existing EIBI research literature to describe the development of the EBIC as a framework for teaching broad-ranging skills to children with autism.

3. VERBAL BEHAVIOUR AND LANGUAGE

3.1 INTRODUCTION

Chapter 2 reviewed outcome research into EIBI interventions for autism and evidence of the effectiveness of ABA-based educational programmes in teaching adaptive skills to children with autism. In these areas, a key consideration was language acquisition, investigation of which has been, and remains, of central importance to researchers and clinicians who design and implement EIBI programmes for individuals with autism. Although behaviour analysis has already made important contributions to the field of language remediation in such populations (see Goldstein, 2002, for a review), various researchers have suggested that additional gains can be made by further developing Skinner's (1957) conceptual analysis of verbal behaviour (e.g., Sundberg & Michael, 2001). Of particular applied interest with regard to the acquisition of verbal behaviour is investigation of the relationships between speaker and listener behaviour (i.e., "expressive" and "receptive" language, respectively). This chapter has three principal aims: Firstly, to provide an overview of Skinner's (1957) analysis of verbal behaviour, and, secondly, to explore the relevance of that analysis to recent behavioural accounts of language acquisition and development. Finally, this chapter will seek to evaluate the potential contributions of such accounts to the development of behavioural interventions for children with autism.

3.2 THE ROLE OF THE SPEAKER

Skinner (1957) provided a conceptual interpretation of verbal behaviour and its controlling variables that sought to explain, in accordance with the principles of the EAB, the behaviour of the speaker as a result of past history and current circumstances. In this regard, Skinner's (1957) account centres around the three-term contingency (i.e., the functional relations between behaviour, its antecedents, and its consequences) as the basic unit of analysis. For Skinner (1957), language is operant behaviour, acquired and maintained by the same kinds of environmental variables as non-verbal behaviour: It is a function of reinforcement contingencies and can therefore be explained using the same analyses adopted for the prediction and control of non-verbal behaviour. Nevertheless, according to this account, verbal behaviour differs from non-verbal behaviour in one critical way—it is "behaviour reinforced through the mediation of other persons" (Skinner, 1957, p. 2). By this definition, therefore, verbal behaviour may not necessarily conform to more traditional conceptualisations of language as allowing "us to express our thoughts and understand the thoughts of others” (Bloom, 2000, p. 259). For behaviour to be considered verbal, the only necessary and sufficient condition is that the reinforcement for that behaviour is provided by another member of the individual’s verbal community. A key implication of this account is that verbal behaviour can therefore be considered as independent of “any one form, mode or medium” of expression (Skinner, 1957, p. 14).

As an illustration of Skinner’s (1957) approach to verbal behaviour, consider the example of a child who is thirsty and wants a drink from a cup of water that she can see on a table in front of her. The child may either reach for and grasp the cup, or, alternatively, look at her mother and point to the cup, with the consequence that her mother gives her the drink. Although both can be considered instances of operant behaviour in that the behaviour in question is reinforced by its consequences (in both cases, obtaining water), the former behaviour is, by Skinner’s (1957) definition, non-verbal, but the latter verbal. In the first case, the child’s grasping the cup and drinking from it directly produces the reinforcer. In the second case, however, the child’s pointing results in another member of the child’s verbal community (i.e., the mother) providing the reinforcer for the child’s behaviour. In this verbal episode, it should be noted, the child acts as the “speaker” and the mother as the “listener”. For Skinner (1957), these different contingencies provide the crucial distinction between verbal and non-verbal behaviour. Also illustrated by these two examples is Skinner’s (1957) previously mentioned assertion that verbal behaviour need not be limited to vocalisation or by any other specific response topography. Any behaviour—whether vocal, signed, gestural, written, or typed—that is capable of affecting a listener “to reinforce the behaviour of the speaker” can be considered verbal (Skinner, 1957, p. 225).

According to Skinner’s (1957) analysis, the behaviour of the speaker in a verbal episode should be considered verbal but that of the listener non-verbal, because the latter requires no special form of analysis beyond that necessary to explain any other form of operant behaviour—an assertion that has subsequently been disputed (Hayes & Hayes, 1992; Horne & Lowe, 1996; Lowenkron, 1998, 2006; Schlinger, 2008; Skinner, 1989). On the basis of this analysis of the roles of the speaker and listener, Skinner’s (1957) account of verbal behaviour is concerned almost exclusively with the analysis of speaker behaviour in relation to its controlling environmental variables. Although Skinner (1957) primarily addressed the functions of such behaviour, it should be noted that his analysis was not intended as a refutation of taxonomic analyses of the individual structural units (phonemes, words, sentences, etc.) involved in many instances of verbal (especially vocal and textually based) behaviour. Instead, as Catania (1998) has observed, Skinner's (1957) account offers a functional perspective that can be viewed as wholly complementary to traditional structural analyses. As noted, much of Skinner's (1957) account was composed of description of the different "verbal operants" composing speaker behaviour—classes of verbal behaviour defined in terms of functional relations between speaker behaviour and its antecedent and consequential conditions. The following sections provide an overview of those functional classes of verbal behaviour.

3.3 THE VERBAL OPERANTS

Skinner (1957) identified a range of verbal operants that he considered to be independent of one another on the basis of the differing functional relations between the behaviour and controlling variables involved. Consider the following example. A child sits on a chair in the presence of an adult and says "water". Although a structural analysis might indicate that the child has vocally emitted a simple noun, consideration of the context (i.e., the antecedent and consequential conditions) in which the behaviour was emitted could, however, reveal a variety of very different functions served by the same behaviour. For example, the child might have been thirsty and said "water" to request a drink from the adult, as in the example above. Alternatively, the child might have said "water" in direct response to the adult speaking the word "water", or to indicate to the adult that he had been looking at a picture of the sea. He might alternatively have spoken the word in response to the adult's question "what is it that fish swim in?". Each of these environmental analyses would indicate that the child's spoken word "water" belonged to a different operant class on the basis of its individual function. The principal functional classes of verbal behaviour can be defined as follows.

3.3.1 The Mand

According to Skinner (1957), the mand is a verbal operant in which the response specifies its own reinforcer under the control of a relevant state deprivation or aversive stimulation. In simple terms, the first element of this definition requires that the behaviour in question specifies what the listener must do to reinforce the speaker's behaviour. The second element requires that the speaker must also be experiencing a state of deprivation or aversive stimulation as a result of the absence of the stimulus specified by the behaviour. In the first example above, the child specifies to the adult that water will act as a reinforcer, and does so as a result of a current condition of thirst (i.e., water deprivation). Subsequent accounts have conceptualised this latter element of the mand in terms of “establishing operations” (Michael, 1988, 1993) or, more recently, “motivating operations” (MOs; Laraway, Snycerski, Michael, & Poling, 2003; Michael, 2004). Such operations are environmental variables that temporarily alter the reinforcing effectiveness of specific stimuli and thus also change the current frequency of all behaviour that has, in the past, been reinforced by obtaining those stimuli.

3.3.2 The Echoic

An echoic is “verbal behaviour under the control of verbal stimuli in which the response generates a sound-pattern similar to that of the stimulus.” (Skinner, 1957, p. 55). In the second example above, the child’s vocalisation “water” functions as an echoic because it is emitted in direct response to the adult saying “water”. As Skinner (1957) observes, echoic behaviour is frequently used by parents and teachers to evoke novel patterns of responding from children that can then be brought under direct stimulus control. For example, hearing a mother’s spoken word “water” may occasion echoic vocal repetition of the word by her daughter. The mother may then say “that’s right, water!” to reinforce her daughter’s verbal behaviour. As Skinner (1957) has pointed out, echoics also provide a common means of shaping young children’s verbal behaviour. For example, a child may initially produce only approximations of an adult’s vocal stimulus (e.g., “wa” or “wada” in response to “water”). The acquisition of echoic behaviour is therefore typically a lengthy process involving differential reinforcement of initial, imperfect, matches to the target response “to keep the behaviour in strength” (Skinner, 1957, p. 60).

3.3.3 The Tact

A tact is a verbal operant in which a response of a given form is evoked by a particular object or event, or a property of an object or event. In other words, a tact is verbal behaviour occasioned by contact with a non-verbal discriminative stimulus through one of the senses that results in generalised conditioned reinforcement. In the third example above, a child may say “water” as he looks at a picture of the sea, and his mother respond “that’s right, good boy!”. In this example, the picture provides the non-verbal stimulus that sets the occasion for the child’s emission of the word “water” and the mother’s response provides the generalised conditioned reinforcer for that response. As Sundberg (2007) has noted, non-verbal stimuli that evoke tact relations can be either static (i.e., objects nouns such as “water”), or transitory (i.e., verbs such as “drink”), and can thus include relations between properties of objects, and properties of actions.

3.3.4 The Intraverbal

Intraverbals are verbal responses that are occasioned by verbal stimuli, but that need share no point to point correspondence or topographical similarities with the stimuli that occasion them. Illustration of an intraverbal response is provided by the fourth example above, in which the child says “water” in response to the adult’s question “what do fish swim in?”. As Sundberg (2007) has pointed out, children typically acquire early intraverbal responses by singing songs, telling stories, describing activities, explaining problems, or through completing partial sentences (for example, a mother may say “fish swim in…?” and the child respond “water”). A developed repertoire of intraverbal responding is thus a fundamental prerequisite for answering questions, holding conversations, and talking about events and objects that are not physically present (Skinner, 1957).

3.3.5 The Autoclitic

Autoclitic behaviour refers to “verbal behaviour which is based upon or depends upon other verbal behaviour” (Skinner, 1957, p. 315). In other words, the occurrence of an autoclitic depends on the prior or concurrent emission of another verbal operant (e.g., a mand, tact, or intraverbal) and cannot occur on its own. For example, the statement “I see water” includes both a tact and an autoclitic. In this example, a non-verbal discriminative stimulus (for example, a picture of the sea), occasions the tact “water” and the autoclitic “I see” informs other members of the verbal community that the tact is under the control of visual rather than auditory or any other form of sensory stimulation. As Skinner (1957, p. 329) has observed, “an autoclitic affects the listener by indicating either a property of the speaker’s behaviour or the circumstances responsible for the property”. Autoclitics are further subcategorised by Skinner (1957) into descriptive (e.g., “I see”, “I hear”, “I am telling you”), qualifying (e.g., “no”, “not”, “yes”), quantifying (e.g., “all”, “always”, “none”, “some”, “never”), and relational and manipulative (e.g., word order, syntax, and grammar) autoclitics.

3.3.6 Textuals, Transcriptions, and Copying

These three operant classes of verbal behaviour are closely related because they involve responding to or producing verbal behaviour in the form of written text. Textual operants are defined by Skinner (1957) as vocal responses under the control of non-auditory verbal stimuli, as, for example, in reading aloud from a book. Transcriptions refer to non-vocal behaviour controlled by auditory verbal stimuli as, for example, in taking dictation. Copying refers to non-vocal verbal behaviour controlled by non-vocal stimuli, as, for example, in copying a quotation from a book.

3.4 THE ROLE OF THE LISTENER

Although Skinner (1957) acknowledged that his account of verbal behaviour was almost exclusively concerned with providing an analysis of the role of the speaker, he nevertheless defined verbal behaviour as resulting from the actions of the listener, both as a provider of reinforcement to the speaker, and as a discriminative stimulus for the speaker's verbal behaviour. As previously mentioned, the emphasis thus placed on speaker behaviour to the exclusion of an analysis of listener behaviour has subsequently been debated (e.g., Hayes & Hayes, 1989; Horne & Lowe, 1996; 1997; Lowenkron, 1998; Skinner, 1989), as has Skinner's (1957) suggestion that the behaviour of the listener should be regarded as non-verbal.

According to Hayes and Hayes (1989), the latter suggestion implies that the listener is simply responding under simple, non-verbal, stimulus control. Thus, one of the main assumptions of Skinner's (1957) analysis of verbal behaviour is that, at least initially, speaker and listener repertoires are independent of each other. Similar categorisation has been offered by psycholinguistic approaches to language acquisition that assert that language can be classed either as expressive or receptive (e.g., Pinker, 1987). Therefore, a child capable of responding as a listener to an adult's exclamation, "Look at the cat!", by orientating towards or pointing to a cat, would not necessarily be able to say, "cat" unless that behaviour had also been directly taught. This view therefore entails that each word that a child learns will require direct reinforcement in both its speaker and listener forms—something that would appear to be in contrast to the behaviour of typically developing children. For example, Hart and Risley (1996) reported few incidences of direct instruction in language in their longitudinal study of the development of language. McGuinness (2004) also, in reviewing the literature on reading and spelling, observed that children require 55,000 words for normal discourse and 86,000 words to be successful throughout primary education. It would therefore seem unlikely that each of these words would have been learned as a result of direct instruction (Greer & Speckman, 2009). That children appear to acquire language in the absence of direct instruction has led psycholinguists to discount the role of learning in language acquisition and to propose instead that innately driven psychological language processes are responsible for children's rapid acquisition of language (Pinker, 1999).

As Skinner (1989) observed, however, his initial interpretation of the listener's role in the verbal episode (Skinner, 1957) was, for purposes of exposition, intended only to address situations in which the listener functions as an audience—a discriminative stimulus that occasions the speaker's verbal behaviour and/or reinforces it. As Skinner (1957, 1989) has pointed out, the speaker often emits verbal discriminative stimuli that evoke verbal responses in the listener that can be either overt (i.e., spoken) or covert (i.e., silent). Under both circumstances, the listener also behaves as a speaker, and therefore "the speaker and the listener may reside within the same skin: The speaker hears himself and the writer reads what she herself has written. Such self-stimulation often evokes further behaviour—echoic, textual, or intraverbal" (Skinner, 1957, p. 163). Under these circumstances, the speaker can behave verbally even in the absence of direct reinforcement from the verbal community. Although Skinner (1989) acknowledged that a complete account of verbal behaviour must address both the speaker's and the listener's behaviour, and provide separate yet interlocking accounts of their respective repertoires, he remained otherwise silent about the development of interactions between speaker and listener behaviour. Based on the assumption that verbal behaviour should be defined not only by the functions of speaker and listener behaviour as the individual interacts with others, but also by the functions of speaker and listener behaviour within the individual's own skin (Greer & Speckman, 2009), more recent analyses of verbal behaviour have attempted to investigate the development of interactions between these repertoires.

3.5 THE INTERACTION BETWEEN SPEAKER AND LISTENER REPERTOIRES

Understanding "how the speaker and listener functions come to be joined" (Greer & Speckman, 2009, p. 452) is central to a thoroughgoing analysis of verbal behaviour. The speaker's verbal function is, for his or her environment, to be "mediated" by a listener (Skinner, 1957). In turn, the speaker provides reinforcement to the listener by providing an extension of the listener's senses (Skinner 1957, 1989). The listener may benefit when the speaker warns the listener of certain punishing consequences, for example, by saying "it is raining out there," or "that wine is terrible", or "I am not well today", each of which may then set the occasion for the listener to engage in an alternative behaviour. It has also been suggested that reinforcement for engaging in listener behaviour needs to be present if an individual is to have empathy (Reilly-Lawson & Walsh, 2007), a repertoire that children with autism are frequently reported to lack (e.g., Happé, 1994). Analysis of the ways in which children become both speakers and listeners, and listeners in relation to their own speaker behaviour, is potentially therefore of central importance to the development of effective interventions for children with autism, who typically demonstrate specific deficits in the acquisition and generalisation of verbal behaviour (see Chapters 4 to 8).

3.6 NAMING

In a recent major theoretical account, Horne and Lowe (1996, 1997) have extended Skinner's (1957) analysis of verbal behaviour by providing detailed theoretical investigation of the interaction between speaker and listener behaviour within their "conceptualisation of the individual as a speaker-listener within the same skin" (Horne & Lowe, 1996, p. 189). These authors propose the "name relation" as the basic unit of interaction between the speaker and listener repertoires during the early stages of language acquisition. Drawing on a wide range of developmental research, the critical steps the typical child goes through during the first two years of life to achieve naming are described. As defined by Horne and Lowe (1996, p. 190), naming is "a circular relation" that includes seeing an object, saying the name of that object, hearing that self-generated name, and attending to the object again (see Figure 1). In this view, naming incorporates the listener, echoic, and tact repertoires in a relationship that enables the individual, as a listener, to respond to his or her own behaviour as a speaker (Horne & Lowe, 1996).

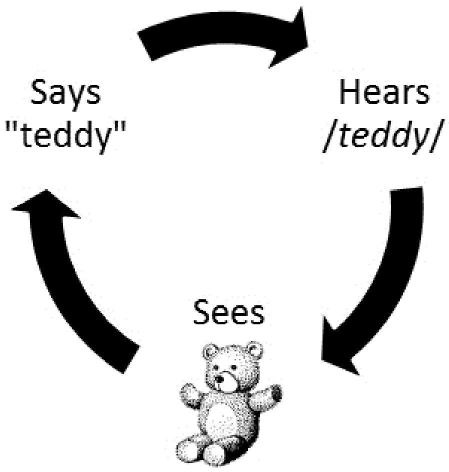

Figure 1. Horne and Lowe's (1996) name relation, illustrating how a child sees a teddy, says "teddy", hears her spoken word /teddy/, and, subsequently, looks at the teddy again.

3.6.1 Development of Listener Behaviour

According to Horne and Lowe (1996), during the first 12 months of life, the typical child develops prerequisites for the subsequent development of listener behaviour such as attending to caregivers' speech, following caregivers' gestural cues, and eventually pointing to objects himself, resulting in caregivers saying the names of those objects. During this period, the child also learns to imitate the caregiver's modelling of differentiated interactions appropriate to specific objects (for example, picking up a cup and drinking from it). Research in developmental psychology (Fenson, Kagan, Kearsley, & Zelazo, 1976; Hutt, 1967) indicates that, between the ages of 12 and 18 months, children cease to explore different objects in similar ways (e.g., grasping, mouthing, transferring from hand to hand), but, rather, begin to respond to objects in differentiated and appropriate ways. Through subsequent processes of prompting, fading, and differential reinforcement, children next become able to select (i.e., display listener behaviour towards) specific items from among other items solely on the basis of a caregiver's verbal instruction. Such developmental sequences are in accordance with Skinner's (1957) suggestion that listener behaviour arises when the verbal community (represented in this case by the caregiver) establishes a correspondence between verbal behaviour produced by the speaker and behaviour evoked in the listener.

3.6.2 Development of Echoic Behaviour

Early vocalisations, in the form of babbling, generally occur from the age of 5 months in typically developing children (Goldstein, Schwade, & Bornstein, 2009). As the child's vocal apparatus matures sufficiently to produce a wider range of sounds, in combination with an increasing history of exposure to differential reinforcement of successive approximations, the child begins to be able to echo caregivers' utterances (Goldstein, 2002; Skinner, 1957). Through repeated reinforcement of echoic responses, the child begins to echo novel sound combinations without having being previously taught to do so, resulting in the emergence of generalised echoic behaviour (Poulson & Kymissis, 1988; Poulson, Kymissis, Reeve, Andreatos, & Reeve, 1991).

Although Skinner (1957) defined the echoic as an instance of verbal behaviour, others have suggested that this operant can be considered verbal only when it is emitted simultaneously with listener behaviour (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001). Although the emergence of vocalisations such as babbling generally precedes listener behaviour, with the development of echoic behaviour, the child begins to behave both as a speaker and as a listener, because he is able to echo caregivers' vocal naming of objects that he has previously been able only to respond to as a listener (by looking, pointing, giving, etc.). At this stage of development, the caregiver may, for example, say to the child "say cup" while pointing at a cup. The child will respond by saying "cup" (or some approximation to that word), typically resulting in generalised conditioned (i.e., social) reinforcement from the caregiver. Although the child's utterance in this example complies with Skinner's (1957) definition of an echoic, Horne and Lowe (1996) have argued that, in fact, two additional behaviours are entailed. Because the child has already developed listener behaviour in relation to a wide range of different objects in his environment, the auditory stimulus produced by the child's echoic also has evoked additional listener behaviour in the child (e.g., orientating towards or pointing at the cup) and further vocal repetitions of the response (i.e., self-echoics).

3.6.3 The Emergence of Tacting

According to Horne and Lowe (1996), the emergence of the echoic as a component of listener behaviour constitutes a fundamental link in the development of the name relation because it enables the child, who, until then, could be no more than a listener, additionally to become a speaker. Tacting (i.e., when, for the child, a non-verbal stimulus evokes a verbal response in the absence of a preceding adult verbal model) thus emerges through repeated experience of seeing objects, hearing the names of those objects, and subsequent repetition of caregivers' utterances of the names of those objects in their presence. In other words, objects begin to assume generalised discriminative properties as stimuli that occasion appropriate verbal responding by the child on the basis of repeated prior exposure to multiple exemplars.

According to Horne and Lowe (1996), the acquisition of tacting also marks the emergence of the name relation as a functional bidirectional unit in which relations between objects and their names, and relations between the names of objects and the objects named, emerge. Because of this bidirectionality, Horne and Lowe (1996) argue that, if, in relation to a novel object, only listener responding is taught, a child will also acquire corresponding speaker behaviour without additional training, and that, when only speaker behaviour is trained, the child will automatically become able to demonstrate the corresponding listener behaviour. As Catania (1998, p. 398) has pointed out, naming can therefore be described as a "higher order class [of responding] that involves arbitrary stimulus classes (things or events with particular names) and corresponding arbitrary verbal topographies (the words that serve as their names) in a bidirectional relationship". Speaker and listener behaviour can thus be said to interact in a way that "the presence of one presupposes the other" (Horne & Lowe, 1996, p. 207). On the basis of this account, Horne and Lowe (1996, p. 227) have further proposed naming to be "stimulus classifying behaviour" that provides the basis for verbal categorisation of environmental objects. In this view, when the child has become a speaker-listener with respect to a particular object, she will then also be able to name the other objects in the same stimulus class to which she has previously only responded as a listener. The name relation can therefore also extend to include novel objects on the basis of common function or structural characteristics shared with a previously named object, thereby establishing the basis for the formation of stimulus classes (e.g., ‘furniture, ‘vehicles’, ‘clothes’, or ‘animals’).

Some important predictions emerge from Horne and Lowe’s (1996) account. Firstly, because of the bidirectional nature of the name relation, when a child has acquired naming as a higher order class of behaviour, acquisition of a response in the speaker repertoire should transfer to the listener repertoire without further training, and vice versa. Secondly, training a response in one repertoire should not engender the corresponding response in the other repertoire unless naming has developed as a higher order class of behaviour. Thirdly, learning to name one member of a class of stimuli previously established in the listener repertoire should generalise to produce naming of all other members of that same class: Conversely, an inability to name will lead to failure in tests of categorisation.

These predictions have already received empirical support (Horne, Hughes, & Lowe, 2006; Horne, Lowe, & Harris, 2007; Horne, Lowe, & Randle, 2004; Lowe, Horne, Harris, & Randle, 2002; Lowe, Horne & Hughes, 2005). In a first study, Lowe et al. (2002) employed vocal tact training procedures to investigate the extent to which acquisition of the tact element of the name relation would result in listener behaviour and generalised categorisation. In this study, nine typically developing children aged between 2 and 4 years were taught a single common vocal tact response for one set of three arbitrary three-dimensional geometric shapes, and a second vocal common tact response for another set of three different three-dimensional geometric shapes. During subsequent match-to-sample testing, participants were shown one member of each of the previously established sets as samples and asked to find the comparison that belonged to the same category. Only four of the children were able to respond accurately in this way. When asked to tact the sample prior to comparison selection, however, all participants selected accurately. Additionally, when, in a second testing phase, the spoken names of sample stimuli were presented as cues, all participants were again able accurately to select comparisons, demonstrating that previously established speaker behaviour had transferred to the listener repertoire.

The evidence offered by Lowe et al. (2002), and partly replicated by Miguel, Petursdottir, Carr, & Michael (2008), thus provides initial support for the suggestion that naming leads to categorisation and that speaker behaviour in the form of tacting leads to the corresponding listener behaviour. With regard to common listener behaviour, however, the name relation would predict a different outcome: that unless naming has been established, listener behaviour alone "will not give rise to categorisation" (Horne, Lowe, & Randle, 2004, p. 270).

In a second study investigating whether listener behaviour produces categorisation, Horne et al. (2004) taught nine children of between 1 and 4 years of age to select three pairs of arbitrary stimuli of different shapes in response to a verbal cue. When asked to categorise the stimuli, none was able to do so correctly, and seven participants also failed the corresponding speaker behaviour test of tacting. The two participants who passed this test were observed frequently to engage in echoic responding during establishment of listener behaviour, thus suggesting that they were not just learning listener behaviour, but also the corresponding tacts. These are the conditions, of emission of echoic behaviour while engaging in listener behaviour, under which, according to Horne and Lowe's (1996) account of naming, "the object stimulus will come to evoke the appropriate tact response" (Horne et al., 2004, p. 282).

Naming has additionally been found to contribute to the emergence of derived stimulus relations (Lowe et al., 2005). In this study, ten typically developing children were taught an individual common vocal tact for each of two sets of three pairs of arbitrary visual stimuli. Participants were then taught to clap in the presence of a member of one stimulus pair and to wave in the presence of a member of the other pair. When responding was tested in relation to the remaining members of each pair, all participants demonstrated accurate differential transfer of clapping and waving responses to those stimuli. In addition, when the experimenter subsequently presented "clap" and "wave" as vocal instructions, all participants were also found to demonstrate appropriate listener behaviour (i.e., clapping and waving, respectively) in response. Findings from this study again support the suggestion that teaching naming may provide an effective means of promoting transfer of function between arbitrary stimuli on the basis of a shared common name.

In a subsequent study, Horne et al. (2006) further demonstrated that 10 of 14 children who had demonstrated transfer to corresponding tacts following teaching of listener responding to the names of arbitrary pictorial stimuli were subsequently successful in passing match-to-sample tests of categorisation involving the previously presented stimuli. The remaining four children, who failed the tact test following listener training, also failed to demonstrate transfer of function and categorisation. In the final study of this series, Horne, Lowe, and Harris (2007) employed a similar design to the one described by Lowe et al. (2002) to investigate the effects of naming established through manual signing. In this study, eight children aged between 2 and 4 years were taught a single common manual sign as a tact for one set of three arbitrary three-dimensional shapes, and a second manual sign tact for another set of three different three-dimensional shapes. During subsequent match-to-sample testing, participants were shown one member of each of the previously established sets of shapes as samples and asked to find the comparison that belonged to the same category. All participants were able to pass this category match-to-sample test.

Overall, the results of all five studies described above are consistent with the hypothesis that naming produces stimulus categorisation, but that listener behaviour alone is insufficient to establish either categorisation or transfer of function. The results also support the suggestion that tacting is not the unidirectional class of behaviour suggested by Skinner (1957), but that it entails the additional bidirectional relations between speaker and listener behaviour proposed within the name relation. In summary, therefore, through investigation of the role of listener behaviour in relation to the verbal operants that Skinner (1957) proposed as a basis for understanding speaker behaviour, Horne and Lowe (1996) have developed naming as an account of the emergence of the bidirectional relations commonly observed between objects and words in the real world, and as a basis for stimulus categorisation. Nevertheless, other researchers (e.g., Lowenkron, 1996b; Michael, 1996) have suggested that listener responding may itself reflect a different interaction between the echoic and the tact. The following section investigates the proposal entailed that a full understanding of the relationships between speaker and listener behaviour may therefore require analyses additional to those proposed within Horne and Lowe's (1996) account of naming.

3.7 JOINT CONTROL

Lowenkron's (1998) concept of joint control seeks to investigate the interaction between speaker and listener behaviour through a molecular analysis of the sources of stimulus control that result in the emergence of listener behaviour as a generalised, or higher order, class of responding (cf. Catania, 1998). As defined by Lowenkron (1998, p. 332), "joint control is a discrete event, a change in stimulus control that occurs when a response topography, evoked by one stimulus and preserved by rehearsal, is emitted under the additional control of a second stimulus". Joint control thus describes the process whereby two verbal operants (the echoic and the tact) exert simultaneous and combined control over a single, common, verbal response topography. The following example (adapted from Lowenkron, 2004) provides an illustration of the operation of joint control. Imagine you are a participant in an experiment in which your task is to select specific six digit target numbers from among arrays of six digit distracters. On one trial, you are asked to locate the number “939173” from among the array presented in Figure 2. Try this now for yourself.

917393	931937
930731	939317
931793	939173
939137	937193

Figure 2. Array of stimuli for visual search illustrating jointly controlled selection responding.

As you responded to this request, you will probably have noticed that you first read the target number and then, as you searched through the array, continued to repeat (i.e., self-echo) “939173” to yourself, either overtly (i.e., aloud) or covertly (i.e., silently), until you became able to select the target number. Because your self-echoic at this moment of selection was functionally related to the presence of the target number, the self-echoic, at that moment, additionally functioned as a tact. This momentary conjunction of contingencies established the joint control of verbal responding that permitted you to select (i.e., display listener behaviour towards) the target number.

It should be noted that the developmental sequence proposed by Lowenkron (1996a, 1996b) to account for the emergence of jointly controlled responding is in accordance with Horne and Lowe’s (1996) description of the development of the name relation in the following ways. Firstly, the typically developing child learns to locate individual objects from among other objects in response to hearing their spoken names (i.e., the child engages in listener behaviour). As described by Lowenkron (1998), the child’s listener behaviour at this stage of development produces “unmediated”, or non-verbal, selection on the basis of a history of differential reinforcement in relation to specific stimulus exemplars. Under these conditions, the spoken name of a target object thus functions as a conditional stimulus in the presence of which the object named serves as a discriminative stimulus for its own selection. Secondly, Horne and Lowe (1996) propose that the typically developing child next learns to echo others’ utterances while engaging in listener behaviour, resulting, finally, in the emergence of the tact relation—the third of the three distinct verbal repertoires (i.e., echoing, listener responding, tacting) that form the prerequisites for naming, and, according to Lowenkron (1998), for joint control.

Michael (1996) has proposed that jointly controlled responding typically originates in environments more complex than the ones in which the component conditional discriminations involved were established—for example when there is a delay between the speaker's emission of the name of an object and the listener's location of the object, or when a multiple stimulus visual array, or a multiple component instruction, is presented (Potter, Huber, & Michael, 1997). To preserve the caregiver's verbal instruction in this complex environment, it has been suggested that the child rehearses the name of the object as a self-echoic while searching for it, with selection of the item indicating the occurrence of joint control (Lowenkron, 1997; Michael, 1996). Correct selection is not the only behaviour to be reinforced in this example, however. The "selection of an object that evokes a tact that enters into joint control with the currently rehearsed self-echoic is [also] adventitiously reinforced" (Lowenkron, 1997, p. 245). Through repeated experience of this process in relation to multiple stimulus exemplars, Lowenkron (1998) has suggested that jointly controlled responding moves beyond its relation to specific exemplars to become a higher order class of generalised responding that can control behaviour in relation to novel objects, and novel features and classes of objects. At this point, jointly controlled responses can be defined as descriptive autoclitics: tacts controlled by the events that control other verbal behaviour (Lowenkron, 1998; Skinner, 1957). Joint control can therefore be regarded as a higher order class of generalised responding that need not be limited by specific stimulus properties or by stimulus complexity (Lowenkron, 1998). As Palmer (2006, p. 210) has observed, "the particular stimuli that jointly control a response are specific to the example at hand [but] the saltation in response strength is general from one example to the next". In other words, this sudden increase in response strength is proposed to provide a discriminable stimulus property that can, itself, serve as a controlling variable for specific topographies of responding within complex environments (e.g., selection in visual search tasks involving multi-element conditional discriminations). This discriminable jump in response strength occurs when two concurrent S^Ds control a response of a common topography. Given a typical history, this event becomes an S^D for a matching or selection response, and, on this basis, jointly controlled responding can also occur in relation to abstract non-verbal stimulus dimensions such as colour, size, shape, or even the structural components of verbal stimuli such as nouns, verbs, and prepositions (Lowenkron, 1998, 2006). The necessary prerequisites, however, remain the same: The listener must simultaneously tact the relevant features of stimuli involved while emitting the appropriate echoic (and, when occasioned by the context, self-echoic) behaviour.

This conceptual analysis resulted from a series of studies during which young children were observed engaging in codic rehearsal of a previously shown sample during a delayed matching task (e.g., Lowenkron, 1984).[6] Using a match-to-sample methodology, Lowenkron (1984) taught five children aged between 3 and 5 years to select visually presented comparison stimuli based on the orientation of pictorial samples. During each trial of an initial training phase, participants were taught to tact the target stimulus presented by rotating an arrow card to match the sample's orientation. The sample was then removed, but the arrow card retained to allow participants to emit codic responses through its observation. During subsequent testing, the arrow card was removed by the experimenter prior to presentation of comparison stimuli, and participants were observed spontaneously to use their fingers to point in the direction of the sample's orientation (i.e., to produce a self-codic response) prior to target stimulus selection. Participants in a control condition were not given arrow cards during the experiment and the accuracy of their selection responding was observed to be significantly lower than that of participants in the experimental condition. In a constructive replication of these findings, Sidener and Michael (2006) prevented participants from orientating their fingers as self-codic responses during experimentation, and also observed low accuracy selection responding. The results of both studies indicate that both components of jointly controlled responding must be concurrently present to produce accurate listener behaviour.

Research involving participants with intellectual disabilities has provided further support for the concept of joint control. Lowenkron (1988), for example, taught four adolescents with severe developmental delays to produce specific hand signs in the presence of individual arbitrary visual stimuli (i.e., to tact the stimuli). Participants were then taught to rehearse the hand signs across a time delay (i.e., to engage in self-mimetic behaviour) during

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[6] The codic describes a response form that is controlled by a verbal stimulus with which it shares point to point correspondence but not formal similarities (Michael, 1982). In other words, the antecedent verbal stimulus and the response are functionally similar but the physical medium through which they occur differs. Textuals, dictation, and speaking and writing from gestures, are examples of codic relations: The first involves a visual verbal antecedent and a vocal response, the second, an auditory verbal antecedent and a written response. Speaking and writing from gestures involve a visual verbal stimulus and a vocal or written response.

match-to-sample trials in which the previously presented stimuli were employed as comparisons. Accurate selection of comparison stimuli was found to be correlated with accurate rehearsal of the previously trained hand signs appropriate to the comparison stimuli presented. Correct performance observed during match-to-sample trials was thus concluded to be dependent upon the momentary conjunction of self-mimetic rehearsal and tacting evoked by the target stimulus. [7]

Only one study has so far investigated the implications of joint control for establishing generalised listener behaviour within an applied context. In the first of two experiments, Tu (2006) presented four arbitrary visual stimuli to children with autism and limited vocal repertoires using a match-to-sample procedure. Participants were firstly taught to tact stimuli presented using experimenter-provided one- or two-syllable names. Secondly, participants were taught to echo those names when spoken by the experimenter in the absence of the visual stimuli. When subsequently tested for listener behaviour to those stimuli (i.e., selection), however, no participant was able accurately to demonstrate corresponding selection responses. In a subsequent training phase, participants were directly taught to select novel arbitrary visual stimuli under the joint control of tact and self-echoic responding: Firstly, participants were taught tacts for the stimuli presented, and, secondly to select comparisons only after they had both overtly echoed and self-echoed the names of sample stimuli. In subsequent tests for generalisation, participants were found to be able correctly to select novel comparisons only when their selection responses were preceded by self echoics. As the author notes, "there was no case of an accurate selection without an accurate self-echoic response" (Tu, 2006, p. 205). Although, in the first phase, participants had learned separate tact and echoic repertoires, it was not until their selection responding came under the joint control (i.e., that they learned to respond to the interaction) of these two repertoires that they were able to demonstrate generalised listener behaviour—an important finding confirming that tact and echoic repertoires separately are insufficient to produce generalised listener behaviour: It is the momentary *conjunction* of these two repertoires that provides the necessary and sufficient precondition for such behaviour.

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[7] It should be noted that, in this study, the mimetic and self-mimetic behaviour observed served the same function as the echoic and self-echoic behaviour reported previously: Verbal behaviour is not constrained by the medium of its emission (Lowenkron, 1998; Skinner, 1957).

In a second experiment, Tu (2006) employed the same training and testing procedures with four different non-vocal children with autism as participants. Rather than vocal responses, these participants were taught to produce hand-signs as both tacts and mimetics in relation to pictorial stimuli presented. Consistent with the previous findings, tact and mimetic training separately were found not to produce generalised listener behaviour. Only after participants had learned to select stimuli under the joint control of these repertoires (i.e., by simultaneously emitting an intraverbal and a self-mimetic) were they able to demonstrate generalised listener behaviour. This study therefore provided initial evidence of the effectiveness of joint control as a means of establishing generalised listener behaviour in children with autism in applied settings, and, in so doing, also provided further support for the theoretical validity of the joint control paradigm.

Overall, therefore, the studies described above provide initial support for Lowenkron's (1998, 2006) proposal that the emergence of generalised listener responding occurs under multiple stimulus control resulting from the momentary conjunction of two speaker repertoires—the echoic and the tact.

3.8 NAMING, JOINT CONTROL, AND LANGUAGE INTERVENTION IN AUTISM

Horne and Lowe (1996) and Lowenkron (1998, 2006) each provide coherent accounts of the phenomena of derived verbal relations in early language development. Although similar in their predictions that name-object relations will lead to object-name generalisation, the accounts nonetheless differ in their descriptions of the emergence of generalised listener responding subsequent to acquisition of tacting. It should additionally be noted that, although both accounts suggest the same antecedent conditions, Lowenkron (1996) has argued that the generalised selection responding demonstrated by children subsequent to acquisition of tacting requires explanation in addition to that provided by Horne and Lowe (1996).

According to Horne and Lowe (1996), by the time the child has learned to tact, listener behaviour (e.g., pointing to, looking at, or selecting an object) will have already become established as a generalised class. In other words, the child is able to respond as a listener to novel objects named by a caregiver even when those responses are not directly reinforced. As a result, for example, the caregiver saying, "look a car, what is it?" while looking at a car, will evoke not only the child's echoic of "car" but also her orientating towards the car, for which the caregiver provides reinforcement (e.g., "good girl!"). Thus, in the above example, and in numerous other real-world situations, although tact training alone is intended, natural contingencies make "it almost impossible to prevent the child from simultaneously learning listener behavior as well" (Horne & Lowe, 1996, p. 318). If tacting entails listener behaviour, therefore, it can plausibly be suggested that listener responding emerges as a direct result of tact training.

Lowenkron (1997) has suggested, however, that it may not be supportable to propose that a new object-name relation can be strengthened while it is being trained, because, during spontaneous name-object pairing, responding to an object under the control of its name is never differentially reinforced. As Lowenkron (1996b, p. 253) has observed, "without a history of differentially reinforced responding to the object under the control of its name, why (excluding primary generalization) should the name ever cause the corresponding object to evoke a selection response? [….] The problem is simply that the name of the object evokes no differential responding to one object vis-a-vis any other". Lowenkron (1996b, p. 255) has further argued that joint control comprises a "fundamental process of the naming relation", in that it describes the process through which generalised name-object relations occur.

Lowenkron (1996b, 1997) has additionally proposed that, subsequent to acquisition of listener, echoic, and tact repertoires, a child will be able to demonstrate generalised listener responding to the name of an object that she has previously learned to tact because "the occurrence of joint control over the child's self-echoic rehearsals of the sample name by the addition of tact control [is] evoked by the object so named" (Lowenkron, 1996b, p. 254). As noted above, in support of this assertion, Tu (2006) has demonstrated that, despite having learned to tact specific samples, children were unable to demonstrate corresponding generalised listener behaviour and only demonstrated such ability after they were taught to select by engaging in self-echoic rehearsal following tacting.

Further support for the role of jointly controlled responding as a key component of the name relation has been provided by Miguel et al. (2008), who, in discussing the outcome of their attempts to replicate Lowe et al.'s (2002) and Horne et al.'s (2004) findings, reported results that appeared inconsistent with Horne and Lowe's (1996) predictions. In this study, participants, who were slightly older than those in Horne et al.'s (2004) research, performed incorrectly on category-sort trials despite having previously demonstrated appropriate tacting and listener responding to stimuli presented. Additionally, during this study, participants categorised stimuli appropriately despite having previously demonstrated incorrect tact and listener responding. The authors suggested, therefore, that "the notion of joint control may serve to explain some of the results that were inconsistent with the naming hypothesis" (Miguel et al., 2008, p. 403). Lowenkron (1998, p. 332) has described joint control as "a change in stimulus control that occurs when a response topography, evoked by one stimulus (e.g., the sample) and preserved by rehearsal, is emitted under the additional (and thus joint) control of a second stimulus (e.g., the comparison)''. On the basis of this analysis, Miguel et al. (2008) further suggested that the children in their research may have failed some of the categorisation trials because they had previously failed to tact the sample stimuli on those trials. Such failure would have prevented them from engaging in jointly controlled responding (in this case echoing their tact while scanning for the comparison), resulting in inaccurate stimulus categorisation.

Although conceptually-driven research into Horne & Lowe's (1996) account of naming has typically investigated the name relation either as an independent variable, or as a process that facilitates higher order responding such as stimulus categorisation (Eikeseth & Smith, 1992; Miguel et al., 2008; Randell & Remington, 1999), the applied implications of speaker-listener bidirectionality have interested behavioural researchers for some time (e.g., Cuvo & Riva, 1980; Guess & Baer; 1973; Wynn & Smith, 2003). Results from such applied research have not, however, been interpreted within the conceptual framework of verbal behaviour, but, typically, with reference to "cross-modal generalisation" or "stimulus equivalence" (e.g., Bush, 1993; Lane, Clow, Innis, & Critchfield, 1998; Sidman & Cresson, 1973, and see Chapters 6 and 7).

Perhaps because of this, little research has yet directly investigated either the emergence of naming as a dependent variable, or the effectiveness of behavioural procedures to induce its emergence (Greer & Speckman, 2009). The implications of such research for the teaching of individuals with autism—who demonstrate core deficits in language learning and generalisation—are important, especially considering that the acquisition of such a repertoire may lead to the emergence of novel listener and speaker responding. If children with autism could be taught to name, it would be expected that responses learned under one type of stimulus control (e.g., listener) would transfer to another (e.g., speaker) in the absence of additional teaching. Until naming is acquired, however, it would be expected that novel speaker and listener responses would have to be taught using time-intensive direct instruction, prompting, and differential reinforcement of approximations to target responses.

No research into either naming or joint control has so far addressed the emergence of generalised listener behaviour in relation to anything beyond simple (i.e., single-element) stimuli. To ensure that children with autism acquire verbal behaviour beyond the single-word verbal relations described in published EIBI curriculum manuals (See Chapter 4), therefore, interventions must be designed to teach individuals both to produce and respond to increasingly complex utterances including combinations of, and abstract relations between, verbal events (i.e., multi-element, or compound, stimuli). By providing a molecular account of the emergence of generalised listener responding, joint control may therefore constitute an important step towards this goal. If children with autism could be taught to respond under the joint control of their tacting and echoing, Lowenkron's (1998, 2006) account predicts that they would become able to respond to increasingly complex multiple-word instructions as listeners, without the need for reinforcement of each constituent combination of words. Although both naming and joint control may therefore constitute important components of language-based teaching, current EIBI curricula appear almost completely to have omitted to utilise, or even acknowledge, such analyses. Further investigation of the extent and ways in which effective procedures can be derived from these two accounts is therefore not only desirable, but essential. Towards this end, the following chapter describes the process of development of an EIBI curriculum based on Skinner's (1957) analysis of verbal behaviour and additionally incorporating accounts of both naming (Horne & Lowe, 1996) and joint control (Lowenkron, 1998, 2006) as bases for developing interventions targeted to produce the emergence of generalised listener and speaker behaviour in children with autism.

3.9 SUMMARY

According to Skinner (1957), language is operant behaviour, acquired and maintained by the same kinds of environmental variables as non-verbal behaviour. Although Skinner (1957) identified a range of verbal operants on the basis of the differing functional relations between the behaviour and controlling variables involved, his analysis nevertheless focused primarily on the role of the speaker in the verbal episode. Subsequent accounts of naming (Horne & Lowe, 1996) and joint control (Lowenkron, 1998, 2006) have sought to provide more complete theoretical descriptions of the development of verbal behaviour through detailed analysis both of listener behaviour and its interactions with speaker behaviour. Although conceptually distinct, both accounts have received a range of empirical support, some of which has suggested that Lowenkron's (1998) account of joint control may provide an analysis of the development of listener behaviour sufficiently molecular to inform understanding of key components of Horne and Lowe's (1996) name relation. Although theoretical debate continues, research into naming and joint control has already highlighted the centrality of speaker-listener behaviour in the emergence of higher order verbal behaviour, deficits in which are a defining characteristic of autism. In addition to increasing theoretical understanding, additional research into the development of speaker-listener behaviour will therefore have important implications for the application of behavioural principles to language remediation. The following chapter describes a programme of curriculum design for children with autism who possessed limited verbal repertoires and no speaker-listener behaviour, the principal aim of which was to integrate current accounts of verbal behaviour to develop a conceptually coherent educational curriculum for EIBI in autism.

4. DEVELOPMENT OF THE EARLY BEHAVIOURAL INTERVENTION CURRICULUM

4.1 INTRODUCTION

As described in Chapter 2, a range of outcome studies have indicated the effectiveness of EIBI in enabling children with autism to acquire important life and language skills (e.g., Anderson et al., 1987; Birnbrauer & Leach, 1993; Cohen et al., 2006; Eikeseth et al., 2002; Howard et al., 2005; Lovaas, 1987; Remington et al., 2007; Sallows & Graupner, 2005; Sheinkopf & Siegel, 1998; Smith et al., 2000). The curricula for intervention that such studies have employed have, however, neither been described in detail nor directly evaluated. In addition, although research reported has typically employed behavioural techniques to teach language skills, neither the rationale for techniques used, nor the curricula within which they have been implemented, have been based on functional analyses of verbal behaviour (e.g., Horne & Lowe, 1996; Lowenkron, 1998, 2006; Skinner, 1957), the potential centrality of which to language intervention for children with autism was discussed in Chapter 3. The current chapter provides a review of published EIBI curricula as context for describing the development of the Early Behavioural Intervention Curriculum (EBIC), which, incorporating both Skinner's (1957) analysis of verbal behaviour and subsequent accounts of naming (Horne & Lowe, 1996) and joint control (Lowenkron, 1998, 2006), was designed as a framework for establishing generalised speaker and listener behaviour in children with autism.

4.2 CURRICULA IN EDUCATION

"Since the real purpose of education is not to have the instructor perform certain activities but to bring about significant changes in the students' pattern of behaviour, it becomes important to recognize that any statement of objectives [...] should be a statement of changes to take place in the students"(Tyler, 1949, p. 44).

In the field of mainstream education, the word "curriculum" is associated predominantly with the organisation of educational content, and can be defined as "all the learning which is planned and guided by [a] school, whether it is carried on in groups or individually, inside or outside the school" (Kelly, 1983, p. 10), a definition that suggests students' learning requires advanced planning and organisation, and a specific environment for delivery. More than 60 years ago, Tyler (1949) provided guidelines for curriculum planning and organisation that remain influential today, through specification of four fundamental questions that must be addressed during development of any educational curriculum to provide optimal organisation of both content and teaching procedures, and evaluation of resultant learning outcomes (Tyler 1949, p. 1). These were as follows:

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?
3. How can these educational experiences be effectively organized?
4. How can we determine whether these purposes are being attained?

Although Tyler's (1949) framework was developed as a guide for curriculum development in mainstream education, the behavioural orientation of his model and its clear definition of requisite components suggest that it may also be applicable to the design and evaluation of EIBI curricula. To this end, Tyler's (1949) four questions can be expressed, in behavioural terms, within the following four requirements:

1. Clear definition of learning objectives.
2. Descriptions of teaching procedures for acquisition and generalisation.
3. Sequential organisation of learning objectives within and across curricular domains.
4. Data-based evaluation of mastery and generalisation of learning outcomes.

This reformulation of Tyler's (1949) questions will be used throughout Section 4.4, below, as a basis for reviewing all currently published EIBI curricula for intervention in autism.

4.3 DEFINITION OF TERMS

A number of specific terms are used within the EIBI research literature and its curriculum manuals, but authors differ in the ways that these terms are used. For example, different terms may be used synonymously to refer to the same behaviours and contingencies, and identical terms may be used to refer to different behaviours and contingencies. For consistency and clarity of exposition, a definitional summary of commonly used terms is provided below.

4.3.1 Curricula and Curricular Domains

Although no commonality of terminology exists across published curricula, each is nevertheless organised around a three-part hierarchy. At the most general level is a book or manual (i.e., the "curriculum"), which is divided into subordinate categories that will subsequently be referred to as "curricular domains". Each curricular domain is composed of specific, individual, "programmes".

4.3.2 Programmes

A "programme" (Leaf & McEachin, 1999; Lovaas, 2003; Taylor & McDonough, 1996; also referred to as a "task" by Partington & Sundberg, 1998) is a term used to describe different behaviours, or sets of behaviours, within a curriculum that a learner is expected to acquire during the course of EIBI. Operationally, these terms describe the S^Ds, materials, prompts, and teaching procedures employed by a teacher in specific teaching situations, in combination with the expected responses produced by a learner in those situations. For example, to teach a learner to imitate the actions of a model, the teacher might introduce a "Non-verbal Imitation" programme (Lovaas, 1981/2003), or, to teach visual-visual match-to-sample, an "Identical Matching" programme might be used (Taylor & McDonough, 1996).

4.3.3 Items

An "item" (Leaf & McEachin, 1999; also referred to as a "S^D" by Lovaas, 2003) is a specific behaviour to be established within a programme. For example, items in an "Object Manipulation" programme might include "ringing bell", "shaking tambourine", and "pulling lever" (Leaf & McEachin, 1999), and items in a "Receptive Colours" programme might include appropriate selection of a blue, green, or black swatches in response to a teacher's individual verbal S^Ds (Partington & Sundberg, 1998).

4.3.4 Learning Objectives and Outcomes

Although not used in any published curricula, the terms "learning objective" and "learning outcome" will be used during this chapter to describe the changes in a learner's behaviour that individual programmes are put in place to achieve, and the changes in a learner's behaviour resulting from implementation of those programmes, respectively. For example, the learning objective for an "Object Imitation" programme would be that a child imitates a specified number of actions relating to specific objects modelled by an adult, with the learning outcome that the child masters the generalised skill of imitating actions involving objects.

4.3.5 Mastery and Mastery Criteria

A "mastery criterion" is a threshold that determines the point at which a learner has become able to demonstrate a given behaviour, or set of behaviours, at a specified level of accuracy (i.e., when a behaviour, or set of behaviours, has been "mastered"). Within EIBI interventions, mastery criteria can apply to individual items, or to programmes. In practical terms, therefore, an "item mastery criterion" serves to answer the teacher's question, "When can I tell that a specific behaviour has been reliably established?” and a “programme mastery criterion” serves to answer the teacher’s question, “When is it appropriate to terminate a specific programme?”.

4.3.6 Discrete-trial Training

Discrete-trial training (DTT) provides a primary instructional method across all published curricula described in Section 4.4, below, and has been shown to be effective in establishing a range of adaptive behaviours in children with autism, including those involved in verbal behaviour, academic, social, motor, self-help, and play (e.g., Eikeseth, 2008; Smith, 2001). DTT is a highly-structured method of teaching based directly on the three-term contingency (Skinner, 1938) and is composed of “blocks” (i.e., sequences) of individual discrete-trials. Each discrete-trial is, itself, composed of five parts (Koegel et al., 1977), ordered as follows:

1. *Discriminative stimulus (S^D).* The teacher presents a brief, clear instruction or question to the child (e.g., "do this" or "what is it?").
2. *Prompt.* Simultaneously with, or immediately following the S^D, the teacher carries out one of a number of actions (e.g., moving the child's hand, or modelling the response) to guide the child’s response. As the child’s accuracy of responding increases, prompts will be faded until the child is able to respond appropriately to the S^D without prompting.
3. *Response.* The child engages in behaviour consequent to the teacher’s S^D.
4. *Consequence.* If the child’s response is appropriate to the given S^D, the teacher immediately provides reinforcement (e.g., praise, hugs, small bites of food, access to toys). If the child’s response is not appropriate, the teacher seeks to extinguish that response (e.g., by saying "No", looking away, and removing teaching materials).
5. *Inter-trial interval.* Subsequent to the consequence, the teacher pauses for between 1- and 5-s prior to presenting the S^D for the next discrete-trial in the block.

The organisation and content of DTT blocks are determined by learners’ abilities and their learning objectives within specific programmes. Three specific DTT teaching procedures are commonly used within EIBI to teach novel behaviours, as follows.

4.3.6.1 Massed-trialling.

Massed-trialling is a technique developed by Lovaas (1981) for use as a first stage in teaching a novel item using DTT. Massed-trialling involves the repeated presentation of the same S^D for a specific item within a given DTT block and is terminated when a learner demonstrates accurate independent responding on 9 of 10 trials (Lovaas, 2003). It should be noted, however, that some models of EIBI do not include use of massed-trialling at any point (e.g., Sundberg & Partington, 1998).

4.3.6.2 Discrimination Training.

Discrimination training refers to a specific set of teaching procedures that involve the gradual interspersal of two or more previously massed-trialled S^Ds within a given DTT block (Lovaas, 1981/2003). Discrimination training is commonly used across EIBI interventions as a means of assisting learners to achieve reliable conditional discriminations.

4.3.6.3 Random Rotation.

Random rotation (Lovaas, 1981/2003) is typically employed subsequent to discrimination training, and provides the final stage of DTT. It can be used both in establishing maintenance of items previously learned during massed-trialling and discrimination training, and for testing their mastery. During random rotation, a number of previously taught items are presented in random order, ensuring that the learner does not learn artefactual patterns of responding. Thus, random rotation can be “considered a safety check and a strengthening measure that ensures the student has acquired correct discrimination through the employment of differential reinforcement procedures” (Lovaas, 2003, p. 131).

4.3.7 Natural Environment Training

Natural Environment Training (NET; Sundberg & Partington, 1998) provides an alternative, less structured, and more naturalistic, approach to teaching verbal behaviour than DTT. Although NET derives from the Natural Language Paradigm (NLP; Koegel, O’Dell, & Koegel, 1987), NLP utilises a psycho-linguistic conceptual framework whereas NET is based upon the analysis of verbal behaviour (Skinner, 1957). According to Sundberg and Partington (1998), Natural Environment Training (NET) should be used as a teaching technique within EIBI for autism, in addition to DTT. NET seeks to enable children with autism spontaneously to emit and to generalise verbal behaviour in the context of motivating activities (LeBlanc, Esch, Sidener, & Firth, 2006; Sundberg & Partington, 1998). During the initial stages of NET, the teacher focuses on mand training through manipulation of a learner’s MOs (Michael, 2004; Sundberg & Partington, 1998). The main focus of NET in the early stages of a curriculum is to teach manding and to establish the teacher as a perceived source of reinforcement, although, gradually, additional demands related to ongoing motivating activities will be introduced (e.g., a learner may be asked to tact or point to the parts of the toy he is playing with). Depending on the learner's skills and learning objectives in place, NET is planned around activities and objects that motivate the learner's behaviour (i.e., through manipulation of MOs).

NET differs from DTT in a number of fundamental ways (Koegel, Koegel, & Surratt, 1992; Sundberg & Partington, 1999). Firstly, during NET, the learning activity is chosen by the learner, whereas in DTT, stimuli are chosen, and learning processes directed, by the teacher. Secondly, NET initially centres on establishing manding, whereas DTT focuses mainly on teaching all other classes of verbal behaviour. Thirdly, during NET, natural contingencies of reinforcement operate (e.g., opportunities to play with desired items provide both the learning activity itself and intrinsic sources of reinforcement for engaging in that activity) whereas, in DTT, extrinsic reinforcers that are not directly related to individual responses are provided by the teacher (e.g., social praise or tangible reinforcers may be presented within, for example, a block of visual match-to-sample trials). Lastly, less rigorous mastery criteria are employed in NET than in DTT. For example, during NET, any attempt to respond verbally may be reinforced, whereas, during DTT, only appropriate responses, or successive approximations to those responses, will be reinforced. Research has shown that although both NET and DTT are effective in establishing verbal repertoires in children with autism, NET alone may be effective in establishing spontaneous verbal behaviour and its generalisation (Delprato, 2001; Elliot, Hall, & Soper, 1991; Koegel, et al., 1992).

4.4 REVIEW OF PUBLISHED EIBI CURRICULA

As a result of increasing demand for EIBI for children with autism, four published curriculum manuals (including Partington & Sundberg, 1998; see Section 4.4.4) are currently commercially available that detail teaching techniques and procedures, and learning objectives to be used as bases for intervention. These are reviewed in Sections 4.4.1 to 4.4.4, below, within the behavioural reformulation of Tyler's (1949) taxonomy for curriculum development presented in Section 4.2, above.

4.4.1 "Teaching Developmentally Disabled Children: the ME Book"

"Teaching Developmentally Disabled Children: the ME Book" ("The Me Book"; Lovaas, 1981) originated as a framework for curriculum content development within the UCLA-YAP (Lovaas, 1987). Derived from work carried out during the 1960s and 1970s, "The Me Book" was the first published manual to describe procedures for teaching children with autism. A subsequent, revised and expanded, edition (Lovaas, 2003) maintained the general structure and content of Lovaas (1981) with the addition of further language objectives, and two additional chapters that discuss the use of visual alternative and augmentative communication (AAC) systems, reflecting recent advances in teaching communication. Lovaas (2003) will form the basis for review below.

4.4.1.1 Definition of learning objectives and descriptions of teaching procedures for acquisition and generalisation.

Although learning objectives are not defined operationally in "The Me Book", clear explanations of phases of acquisition are provided for specific programmes, which are subdivided into individual items. All items are taught using DTT through massed-trialling, discrimination training, and random rotation. Suggestions for establishing generalisation of some skills are also included. For example, when a learner has become able to label 25 objects expressively, Lovaas (2003) recommends that she should be taught to label other exemplars of the same items.

4.4.1.2 Sequential organisation of objectives within and across curricular domains.

A total of 60 programmes are listed within nine curricular domains of "Matching", "Motor and Object Imitation", "Verbal Imitation", "Receptive Language", "Expressive Language", "Abstract Language", "Play skills", "Academic", and "Self-help". Although Lovaas (2003) presents no information regarding the sequential organisation of programmes within these domains, or across "The Me Book" curriculum overall, Lovaas and Smith (2003, p. 331) have subsequently suggested such an order through use of five "treatment stages", each composed of various "Me Book" programmes. In order, these authors suggest "Establishing a Teaching Relationship" through use of the "following one-step directions" programme. Next, implementation of "Teaching Foundational Skills", including programmes of "discrimination between one-step directions", "imitating gross motor actions", "matching", and "receptively identifying objects" should take place. Thirdly, "Beginning Communication" should commence, including programmes of "imitating speech sounds", "expressively labelling objects", and "receptively identifying actions and pictures". Fourthly, the authors suggest that "Expanding Communication, Beginning Peer Interaction" should be put in place, including programmes of "labelling colors and shapes" and "beginning language concepts such as big/little and yes/no". Lastly, the stage of "Advanced Communication, Adjusting to School", should be implemented, including programmes of "prepositions", "pronouns", "describing objects and events", and "conversing with others". Although Lovaas and Smith (2003) acknowledge that learners will progress through these stages at different rates, a minimum timescale for intervention of approximately 2 years and 11 months is proposed. The authors further suggest that learners who cannot achieve verbal imitation should be taught to use forms of visual AAC such as the Picture Exchange Communication System (PECS; Bondy & Frost, 1994, 2001) for requesting, and the "Reading and Writing Program" (Watthen-Lovaas & Eikeseth, 2003) for all expressive programmes. It should be noted that, for Lovaas (2003), DTT provides the principal method of teaching across all programmes.

4.4.1.3 Data-based evaluation of mastery and generalisation of learning outcomes.

Lovaas (2003) specifies a mastery criterion of 90% appropriate responding during random rotation for individual items within a programme, but does not specify a criterion for programme mastery. According to Lovaas (2003), learning outcomes can be considered to have generalised when a learner demonstrates mastery of individual items across instructors, locations, verbal instructions, and materials.

4.4.2 "Behavioural Intervention for Young Children with Autism"

"Behavioural Intervention for Young Children with Autism" (Maurice, Green, & Luce, 1996) consists of 21 chapters, including "Early Intervention for Autism: What does Research Tell Us?" (a review of research into EIBI and other interventions for autism), "Teaching New Skills to Young Children with Autism" (recommendations to carers as to how to begin EIBI), "Identifying Qualified Professionals in Behaviour Analysis" (guidance to carers on selection of EIBI professionals), and, perhaps most importantly, a chapter entitled "Selecting Teaching Programs" (Taylor & McDonough, 1996) in which the latter authors describe their own curriculum for EIBI in autism.

4.4.2.1 Definition of learning objectives and descriptions of teaching procedures for acquisition and generalisation.

Every programme in Taylor and McDonough's (1996) curriculum is presented on an individual page, and, in many cases, programme titles provide clear operational definitions of the learning objectives and outcomes to be established during those programmes (e.g., "Answers General Knowledge Questions", "Requests Desired Items Verbally", "Imitates Block Patterns"). For every programme, teaching procedures are clearly outlined, with examples of teacher's instructions, learner's expected responses, prompts, materials, and prerequisite skills specified. In addition, every programme provides a list of component teaching items.

4.4.2.2 Sequential organisation of objectives within and across curricular domains.

Taylor and McDonough's (1996) curriculum presents 200 programmes, organised within three "Curriculum Guides" ("Beginner", "Intermediate", and "Advanced"). Each Curriculum Guide is subdivided into the domains of "attending skills", "imitation", "receptive language", "expressive language", "pre-academic", and "self-help skills", although the Advanced Curriculum Guide contains four additional domains of "abstract language", "academic", "social skills", and "school readiness". The number of individual programmes in each domain ranges between two and 31, and, within each domain, order of programme presentation is clearly specified. Taylor and McDonough's (1996) curriculum does not, however, attempt to indicate dependencies of programme introduction across domains, although such dependencies are implied by indication of programmes that are considered "suggested prerequisites" for introduction of other programmes (e.g., suggested prerequisites for "Imitates Block Patterns" are "Follows One-Step Instructions" and "Imitates Actions with Objects" and suggested prerequisites for "Function of Body Parts" are "Identifies and Labels Body Parts and "Labels Objects by Function").

4.4.2.3 Data-based evaluation of mastery and generalisation of learning outcomes.

Although Taylor and McDonough (1996) indicate no mastery criteria for either items or programmes, they nevertheless specify a list of items for each programme in their curriculum, suggesting that programme mastery depends upon mastery of all items listed for that programme. For example, the programme "Pronouns" provides a list of the three items "My", "Your", and "Randomise My and Your", and the programme "Gender (Receptive and Expressive)" lists the five items "Boy", "Girl", "Man", "Woman", and "Lady".

4.4.3 "A Work in Progress"

The authors of "A Work in Progress" (Leaf & McEachin, 1999) gained experience of ABA while working on the UCLA-YAP project and later founded the "Autism Partnership" as an independent ABA service delivery agency. As well as providing a manual for behavioural intervention in autism, Leaf and McEachin (1999) provide both background information regarding EIBI and a description of behavioural techniques, including DTT and prompting.

4.4.3.1 Definition of learning objectives and descriptions of teaching procedures for acquisition and generalisation.

Similarly to Lovaas (2003), Leaf and McEachin (1999) do not provide operational definitions of learning objectives within their curriculum. Learning objectives are likewise suggested by programme titles, and operational definitions of learners' behaviour indicating programme mastery are not specified. For example, learning objectives for the programme "Receptive Instructions" are simply listed as "increase understanding of language", "establish compliance", "establish instructional control which can be used to decrease disruptive behaviour", "extend therapy from chair into natural environment", "develop attending and awareness", "increase duration of on-task behaviour", and "increase memory and develop independence" (Leaf & McEachin, 1999, p. 189). Procedures for teaching items are clearly described throughout the manual, however, and are similar to those described by Lovaas (2003) with regard to predominant use of DTT.

4.4.3.2 Sequential organisation of objectives within and across curricular domains.

Leaf and McEachin (1999) provide a total of 400 programmes within their curriculum, categorised within 49 curricular domains including "Non-verbal Imitation", "Drawing", "Emotions", "Pronouns", "Attributes", and "Functions". Curricular domains are presented in ascending order of learning difficulty, and within each domain, programmes are likewise organised sequentially from least to most difficult for the learner to acquire. Across the curriculum as a whole, however, dependencies of programme introduction across domains are not made explicit, but implied through a loose system of sections (titled "cross-refer"), one for each domain, indicating other domains related to that domain. Whether or not other domains specified within this system are dependent upon, or prerequisites for, other domains is not, however, specified.

4.4.3.3 Data-based evaluation of mastery and generalisation of learning outcomes.

Again, similarly to Lovaas (2003), mastery of individual items is determined by a criterion of 80% to 90% appropriate responding on trials involving those items. Likewise, learning outcomes are considered to have become generalised when a learner demonstrates mastery of individual items across instructors, locations, verbal instructions, and materials.

4.4.4 "The Assessment of Basic Language and Learning Skills"

The "Assessment of Basic Language and Learning Skills" (ABLLS; Partington & Sundberg, 1998) differs from all three intervention curricula described above in two principal ways. Firstly, its authors describe it as an assessment tool rather than a curriculum for intervention, and, secondly, its programmes are subcategorised into curricular domains on the basis of Skinner's (1957) analysis of verbal behaviour, rather than within a psycho-linguistic theoretical framework. Although, as noted, the ABLLS (Partington & Sundberg, 1998) is presented as an assessment tool, a number of clinicians who utilise functional analyses of language as a basis for intervention have reported adopting the ABLLS as their main curriculum guide (e.g., Carbone, 2004; McGreevy, 2010). For this reason, the ABLLS is considered within the current review as a curriculum for EIBI in autism.

4.4.4.1 Definition of learning objectives.

In contrast to all previously reviewed curricula, each programme within the ABLLS has a clear and descriptive name, an operationally defined learning objective, a guiding question that the teacher can use to evaluate the learner's response, and an example of a correct/appropriate learner response. For example, the programme "Locate Objects from Parts of Objects in Larger Complex Picture" (Partington & Sundberg, 1998, p. 15) includes the objective that "the student will be able to locate objects when only shown parts of the objects within a larger, complex picture", the guiding question, "Can the student locate pictures of objects when only parts of the objects are shown within a complex picture?", and the example response that the learner will "find all the fish when only part of each fish may be visible (e.g., the head or the tail) in an underwater scene". Likewise, the programme "Request Others to Perform an Action" (Partington & Sundberg, 1998, p. 23) includes the objective that "the student will be able to ask others to perform specified actions", the guiding question, "Does the student ask others to perform specified actions?", and the example response that the learner will "ask others to 'come' with them, 'stand up', 'sing', 'open', 'push', [etc.]".

4.4.4.2 Descriptions of teaching procedures for acquisition and generalisation.

A companion manual entitled "Teaching Language to Children with Autism or Other Developmental Disabilities" (Sundberg & Partington, 1998) specifies a range of teaching procedures to be used in conjunction with the ABLLS (Partington & Sundberg, 1998). Because the authors argue that children with autism show most profound deficits in speaker, rather than listener behaviour, the manual is concerned almost exclusively with establishing the former class of behaviour. Based on the proposal that speaker operants are functionally independent of each other (Skinner, 1957), Sundberg and Partington (1998) further emphasise that the establishment of verbal behaviour should centre on the establishment of core vocabulary across speaker operants using the following ordered sequence of "transfer of stimulus control procedures" aimed at teaching the learner to emit identical verbal topographies (i.e., words) across differing sources of stimulus control.

1. *Learner's existing echoics form the basis for establishing manding.* The learner should be taught individual mands by presenting a range of individual non-verbal stimuli (e.g., a book), prompting echoic responses to those stimuli (e.g., teacher says "book"), and then systematically fading prompts for those stimuli until the learner is able to mand stimuli unprompted. Subsequent to the establishment of 50 mands using this procedure, Step 2 should be introduced.
2. Learner's existing echoics form the basis for establishing tacting. The learner should be taught individual tacts by presenting a range of individual non-verbal stimuli (e.g., a book), prompting echoic responses to those stimuli (i.e., teacher says the word "book" which the learner repeats), and then systematically fading prompts for those stimuli until the learner is able to tact stimuli unprompted. Subsequent to the establishment of 50 tacts using this procedure, Step 3 should be introduced.
3. *Learner's established tacts form the basis for establishing intraverbals.* The learner should be taught individual intraverbal responses by presenting individual non-verbal stimuli (e.g., a book) that he previously learned to tact, the teacher asking "what is it?", to which the learner should respond by stating the name of that object (e.g., "book"). Subsequently, the teacher will ask the learner a question about the function of that object (e.g., "what do you read?"), to which the learner should respond with the name of the object (e.g., "book"). At this point, the teacher will remove the object and repeat the previously presented question regarding the function of the object. According to Sundberg and Partington (1998), this final element of the procedure sets the occasion for the learner's expected intraverbal response of stating the name of the object (i.e., "book"). In this way, the authors suggest that intraverbal repertoires can be established through presentation of multiple exemplars.

For learners who do not develop echoic responding, Sundberg and Partington (1998) recommend that sign language should be taught as a form of AAC, using procedures identical to those described above, but in which motor imitation (i.e., mimetic responding) replaces echoic responding.

4.4.4.3 Sequential organisation of objectives within and across curricular domains.

The ABLLS presents a total of 478 programmes categorised within 25 curricular domains, including "Imitation", "Requests", "Labelling", "Intraverbals", "Receptive Language", "Spontaneous Vocalisations", "Syntax and Grammar", "Visual Performance", and "Motor Imitation". Within each domain, programmes are organised sequentially, starting with those that are least difficult for the learner to acquire, and progressing to those that are most difficult. Across the curriculum, no description is provided regarding relationships or interdependencies between individual programmes across domains. In a preface to the manual, however, a "Skills Tracking System" (Sundberg & Partington, 1998) is presented as a visual guide to chart learners' progress through the ABLLS' teaching programmes. Sundberg and Partington (1998) also suggest teaching within their curriculum should involve both DTT and NET, with the proportion of time spent in type of teaching dependent upon the individual learner's specific learning objectives. The authors further suggest five phases of intervention for verbal behaviour.

1. Principal focus on NET to establish manding, teachers as conditioned reinforcers, and compliance.
2. Equal focus on NET and DTT to establish more complex mands, tacting, receptive language, imitation, echoics, and intraverbals.
3. Principal focus on DTT to establish early academic skills and more complex language (e.g., use of prepositions and adjectives).
4. Principal focus on NET to establish social interaction with peers.
5. Principal focus on DTT to develop academic skills to align the learner with the requirements of mainstream primary education.

The authors lastly state that the order of phase presentation is flexible, so as to provide clinicians with a framework for EIBI that can be adapted to the needs of individual learners.

4.4.4.4 Data-based evaluation of mastery and generalisation of learning outcomes.

Because the ABLLS (Partington & Sundberg, 1998) was designed as an assessment tool, the criteria indicated for its component programmes are targeted at evaluating learners' abilities, and it is therefore unclear whether the same criteria can be used to establish the point at which an item or programme has been mastered. Nevertheless, the ABLLS is the first manual to provide a criterion for evaluation of the generalisation of established behaviours by overtly differentiating between those that have been directly taught within programmes and those that have emerged without such direct and specific prior teaching.

4.5 COMPARISON OF PUBLISHED EIBI CURRICULA

Section 4.4 reviewed all four published curricula for EIBI. Although a range of differences was evident, similarities were also apparent. Firstly, and despite differences in terminology used within individual curricula, each is organised within three levels, forming a hierarchy from general to specific (i.e., “curriculum”, “curricular domains”, and “programmes”, respectively). All curricula also specify procedures to teach items within individual programmes. In addition, although all curricula indicate, with varying degrees of specificity, sequences for introduction of programmes within curricular domains, none indicates specific relationships or interdependencies between programmes across those domains.

Although all curricula share use of DTT as a key teaching method in EIBI, it should be noted that Sundberg and Partington (1998) additionally emphasise the importance of NET. Most significantly, however, the ABLLS (Partington & Sundberg, 1998) differs from other curricula with regard to the behavioural (i.e., functional) rather than psycholinguistic (i.e., structural) conceptualisation of language it adopts as a basis for intervention. Specifically, Lovaas (2003), Taylor and McDonough (1996), and Leaf and McEachin (1999) each organise learning objectives for language establishment within a structural framework of receptive and expressive language, and, within the curricular domain of expressive language, none of these curricula clearly specifies the sources of stimulus control necessary to achieve learning outcomes specified. These considerations result in crucial distinctions between the former curricula and the ABLLS, with regard both to overall curriculum organisation and teaching procedures employed. For example, the establishment of manding (a fundamental repertoire in which children with autism show profound deficits), receives no special emphasis in the former curricula, but, for example, is simply classified as a programme within the curricular domain of “Expressive Language” (Lovaas, 2003). Furthermore, in these three curricula, the mand, because consideration of the role of MOs (Laraway et al., 2003; Michael, 2004) is absent, is conceptualised in essentially the same way as the tact—an approach to language teaching that is in direct contrast to the findings of research into the establishment and development of verbal behaviour (e.g., Lamarre & Holland, 1985; Twyman, 1995). Although each of these three curricula indicates the use of behavioural techniques to teach language, the rationale by which such techniques are chosen is necessarily based neither upon theoretical analysis of, nor empirical research into, verbal behaviour. Three further related—and crucially important—considerations are relevant to all four curricula reviewed above, as follows:

1. No published curriculum attempts to distinguish or differentiate between *finite* classes of behaviour, composed solely of individual behaviours that have been directly taught, and *generalised* classes of behaviour, composed of potentially unlimited

numbers of behaviours that emerge from a finite subset of taught behaviours (cf. Catania, 1998; Horne & Lowe, 1996; Lowenkron, 1998, 2006; Sidman, 1994).

2. All published curricula are organised and presented so that clinicians choose programmes with the aim of establishing behaviours. Although learners exposed to teaching within these curricula may acquire generalised classes of behaviour as a result of procedures employed, no curriculum explicitly attempts to describe, teach, or otherwise establish generalised classes of behaviour, verbal, or otherwise.
3. No curriculum, or the domains and programmes of which it is composed, specifically proposes any data-based means of evaluating the establishment of generalised classes of behaviour.

Finally, and, perhaps, of equal importance, it should be noted that, although the underlying techniques of all four curricula are based on empirically validated principles of the EAB, none of the four curricula has, itself, been subjected to empirical validation beyond research reporting group analyses of overall intervention outcomes (see Chapter 2). Crucially, no outcome studies have reported process data detailing the specifics, and hence allowing replication, of the individual interventions underlying their findings (cf. Lechago & Carr, 2008). Because of the absence of such data, evaluation of the relative effectiveness of the component elements of published curricula, and the arrangement of those components within interventions, is also, currently, not possible.

4.6 THE EARLY BEHAVIOURAL INTERVENTION CURRICULUM

Children with autism, unlike children with other developmental disabilities, show impairments not only in some aspects of their development, but in every developmental domain. With regard to this, a fundamental goal of EIBI must be to provide programmes of instruction that can meaningfully enhance the development of children with autism across developmental domains, and to move their developmental trajectories towards those of typically developing children. Although it is generally agreed that intervention for autism should be delivered early (i.e., commencing in the preschool years), for no fewer than 25 hrs per week, and for a minimum duration of one year (NRC, 2001), little research has yet directly investigated which sequences of curriculum programmes and which teaching procedures are most effective and efficient in promoting rapid and lasting skills acquisition (Green, Brennan, & Fein, 2002; Weiss 1999; Weiss & Delmolino, 2006). Although applied data are limited, research into the establishment of generalised classes of behaviour (e.g., Horne & Lowe, 1996, 1997; Lowenkron, 1998, 2006; Sidman, 1994) may potentially provide a key conceptual basis for designing and implementing maximally effective and efficient training protocols.

As soon as research into the emergence of generalised behaviour classes is accepted as relevant to EIBI, curriculum design can no longer remain solely concerned with the nature and structure of curriculum content. Instead, the focus necessarily changes to consideration of the design and arrangement of teaching procedures that will ensure that the greatest gains in novel, untaught, skills can be obtained from the minimum amount of direct teaching. In other words, the focus of curriculum design shifts from programmes that establish finite numbers of directly taught individual behaviours to teaching procedures that are designed to establish generalised classes of behaviour on the basis of finite subsets of specifically taught behaviours. For the rest of this thesis, for clarity of exposition, the former limited, or finite, classes of behaviour, that are established solely through direct teaching of specific individual behaviours, will be referred to as *finite skills*, and the latter, generalised classes of behaviour, that are composed of potentially unlimited numbers of related behaviours and established through strictly limited amounts of direct teaching, will be referred to as *generalised skills*.

This key conceptual shift in curriculum design was central both to the development and implementation of the EBIC, which was designed to meet the educational needs of 20 children with autism receiving University-led EIBI during SCAmP. This research programme provided the first major investigation of EIBI effectiveness for children with autism in the UK, and was a collaborative enterprise between 11 South of England Local Education Authorities (LEAs) and the School of Psychology at the University of Southampton (see Remington et al., 2007 and Chapter 2 for outcomes). SCAmP was conducted by two teams of personnel, one composed of experienced ABA practitioners, and another, composed of independent clinicians, that was responsible for carrying out psychometric assessments of all participating children. The present author was Senior Supervisor for all University-led EIBI during SCAmP, and thus was responsible for planning, organising, and delivering intervention to six children participating in the pilot programme, and 14 of 23 children participating in the main outcome study (see Remington et al., 2007). [8]

The research carried out during SCAmP had two primary aims: firstly, through comparison of the outcomes of EIBI with those of standard LEA provision for children with

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[8] The other nine SCAmP children received parent-commissioned intervention from recognised private ABA providers.

autism, to provide the first controlled evaluation of the effectiveness of EIBI in a UK context, and, secondly, in so doing, to develop a UK-based model of EIBI that would incorporate the latest research-validated ABA procedures, techniques, and approaches to curriculum design. To achieve these aims, therefore, the author's first task was to create a curriculum for EIBI that would form the basis for intervention delivery to all children receiving University-led SCAmP intervention. The resulting EBIC was designed around the following principles, being:

1. Specific to the needs of children with autism.
2. Sequenced by ascending difficulty of skill acquisition.
3. Constructed to differentiate between finite and generalised skills.
4. Targeted to teach and evaluate generalised skills.
5. Based on behavioural accounts of verbal and non-verbal behaviour.
6. Delivered using research-validated behavioural teaching techniques.

Overall, therefore, the EBIC potentially marked a substantial departure from all previous curricula through its incorporation, both in theory and application, of behavioural accounts of verbal behaviour, and through differentiation between finite and generalised classes of behaviour. As will be described in Section 4.6.1, below, the EBIC also provided a major change of emphasis, from a fundamentally structural, programmatic, approach to EIBI to a functional one (cf. Baer, Wolf, & Risley, 1968, 1987), being organised around the goal of teaching both finite and generalised skills, rather than around the goal of teaching finite skills in anticipation of generalised skills emerging. Lastly, the funding of the SCAmP intervention provided the opportunity to develop and deliver the EBIC over a 3 year period, and thus to monitor and empirically evaluate its effectiveness as a curriculum for intervention for autism (see Chapter 5).

4.6.1 Definition of Learning Objectives

Whereas, as noted in Section 4.6 above, learning objectives in all published curricula are suggested or implied by the programmes of which they are composed, the organisation of the EBIC centred on learning objectives composed of 190 finite and generalised skills, with the role of programmes subordinated as a means to teach those skills. To inform development of this structure, the programmes of which all published curricula reviewed in Section 4.4 were composed were first reviewed and categorised as potential means of establishing either finite or generalised skills. Programmes to establish finite skills were defined as those including teaching procedures during which at least one teaching trial would be required to establish any novel response within the programme. These principally related to vocabulary acquisition (e.g., "acquisition of common nouns as listener behaviour"), because, for a learner to select a given object, the teacher must say the name of an object in the presence of that object at least once for the learner to select it and for that selection to be reinforced and to become part of the learner's listener repertoire. Programmes to establish generalised skills (e.g., "imitation" or "two-word descriptions") were defined as including teaching procedures during which more than one novel response could be established as a result of teaching individual responses. For example, within the "Imitation" programme, skill generalisation could be assessed as having been established if, subsequent to direct teaching of a given number of imitative responses (e.g., "clapping hands", "stamping feet", "waving"), a child was able to demonstrate novel responses (e.g., "putting arms up", "rolling arms", "touching head"), on probe trials, in the absence of prompting. A complete list of finite and generalised skills taught within the EBIC is provided in Appendix A. It should be noted, that, although this first stage of the EBIC's development centred on programme categorisation, the overall aim was to produce a curriculum the principal emphasis of which was not, as in previous curricula, on programmes as a basis for teaching behaviour, but on creating a cumulatively sequenced framework of finite and generalised skills, the establishment of which would be attained through delivery of a range of programmes specific to teaching those skills.

4.6.2 Descriptions of Teaching Procedures for Acquisition and Generalisation

As noted in Section 4.6.1, above, a "programme" within the EBIC describes a set of teaching procedures selected to teach finite or generalised skills. For every skill, therefore, one or more programmes were created. Similarly to Taylor and McDonough's (1996) approach, each programme in the EBIC was presented on an individual "Programme Sheet" (i.e., a single curriculum page) with a clear title describing its intended learning outcome (i.e., the finite or generalised skill it was designed to establish). Unlike any other curriculum, however, every Programme Sheet presented all the following information:

1. Programme title.
2. Learning objectives.
3. Item Mastery criteria.
4. Skills mastery criteria.
5. S^Ds and responses.
6. Teaching procedures.

7. Prerequisite skills.
8. Skills to teach subsequently.
9. Generalisation procedures.
10. Generalisation evaluation criteria.

For each Programme Sheet, an accompanying “Item List” (i.e., list of items to be taught) was attached (see Appendices B and C, for an example Programme Sheet and Item List for “Object Imitation”, respectively). The EBIC also indicated guidelines for teaching finite and generalised skills through specification of appropriate combinations of DTT and NET.

4.6.3 Sequential Organisation of Objectives within and across Curricular domains

As noted in Section 4.6.1, above, 190 finite and generalised skills were proposed within the EBIC. These were organised into 12 curricular domains, each defined on the basis of categories suggested by research in developmental psychology (e.g., Schlinger, 1995; Sparrow, Balla, & Cicchetti, 1984), classifications previously used in published EIBI curricula, and the outcomes of theoretical and applied research into verbal behaviour. The latter were specifically organised around sources of stimulus control identified by Skinner (1957). The EBIC’s 12 domains are presented below, each with a summary of the skills of which they were composed.

- *Visuo-spatial.* Visual-visual match-to-sample skills (e.g., identity matching and sorting).
- *Motor Imitation.* Object-based gross and fine motor imitation skills (e.g., copying movement of another person).
- *Play.* All skills involved in conventionally appropriate interaction with play-objects.
- *Echoic.* Echoic skills (e.g., vocal imitation of sounds or combinations of sounds emitted by another person).
- *Mand.* Manding skills (e.g., requesting the delivery or removal of a stimulus).
- *Listener.* Listener (or “receptive language”) skills (i.e., responding appropriately to another person’s verbal behaviour).
- *Tact.* Tacting skills (e.g., all skills involving verbal descriptive responses to visually presented stimuli).
- *Listener by Feature/Function and Class.* Skills defined by Sundberg and Partington (1998) and Partington and Sundberg (1998), including listener responding involving selection of specific objects consequent to description of those objects within another

person's verbal instruction. (e.g., upon hearing "find the one with wings" the learner should select the picture of a bird from an array of pictures of other animals or objects).

- *Intraverbal.* Intraverbals skills (e.g., all skills involving verbal behaviour emitted solely in response to verbal antecedents).
- *Academic.* All skills required for integration with Reception-level UK schooling, (e.g., drawing, colouring, early reading and writing)
- *Social.* All skills, excluding manding, for which maintenance of interaction with another person (i.e., social attention) was the reinforcer.
- *Abstract Reasoning.* All skills involving complex verbal behaviour such as problem solving, perspective taking, and inferencing (i.e., "higher cognitive skills").

Within these domains, skills were organised in ascending level of difficulty of learner acquisition, so that each skill formed a prerequisite for the following skill. For example, within the "Echoic" domain, the first skill to be taught was "vocal play", followed by "imitates single sounds", "imitates sound combinations", "imitates single words", "imitates sentences", "variations in volume", "variations in pitch", and "variations in tone". In the "Mand" domain, the first skill to be taught was "point to desired items", followed by "mands visible items", "mands actions", "mands non-visible items", "mands for help", "mands to stop an activity", "mands with colours", "mands action and object", "mands for missing items", "mands using simple sentences", "mands with adjectives", "mands for attention", "answers Yes/No to visual choices", "answers "Yes/No to verbal choices", "mands using prepositions", "mands from conditional verbal choices", "mands with complex sentences", "mands for information based on direct MO", and "mands for information based on verbal MO". With regard to organisation of skills across the curriculum, the EBIC was divided into three levels ("Beginner", "Intermediate", and "Advanced"), each of which focused on the establishment of different key repertoires of skills, as follows:

- *Beginner (59 Skills).* Teach elementary motor and visual skills and establish basic vocabulary across different classes of verbal responding (i.e., mand, tact, echoic). Teach finite skills including manding for visible reinforcers, listener responding to and tacting of common nouns, actions, and colours. Teach generalised skills of motor imitation, match-to-sample, echoics for single words, eye-contact, and naming.

- *Intermediate (76 Skills).* Teach basic social and play skills and abstract vocabulary (e.g., adjectives, prepositions) across more complex levels of verbal conditional discrimination. Teach finite skills including listener responding to, and manding and tacting of, adjectives and prepositions. Teach generalised skills including accurate responding to different questions about the same stimulus (i.e., tact-based conditional discrimination), categorisation, providing syntactically correct multiple-word descriptions, engaging in jointly controlled responding to multiple-component verbal instructions, manding using sentences, using “yes” and “no”, symbolic play, and reciprocating comments.
- *Advanced (55 Skills).* Establish complex generalised multiply controlled verbal behaviour, abstract reasoning, and peer-mediated social and play skills. Within these domains, teach key generalised skills including sequencing events in temporal order, providing complex descriptions of complex visual stimuli, recalling past events, manding for information, engaging in conversation, generating inferences and predictions, understanding emotions and perspective taking, role-play, and co-operative play.

A principal aim of the EBIC was not to teach skills in hierarchical fashion (cf. Lovaas, 2003; Partington & Sundberg, 1998) but to achieve a developmentally appropriate balance of skills across all curricular domains within the three levels of the curriculum. Although some flexibility in this regard was allowed within the EBIC, it was recommended that, as a general approach, all skills and programmes within each level should be mastered before teaching of skills within the next level commenced. This aspect of the EBIC was central to avoiding the development of “skewed” skills profiles in individual learners (i.e., mastery of skills in some domains but low levels of skills acquisition in others), a learning characteristic typical of children with autism, who, for example, can show relatively advanced non-verbal skills compared to verbal skills (Howlin, 1997; Lord, Risi, & Pickles, 2004). Crucially, therefore, the organisation of skills within the EBIC formed a matrix of interconnected skills both *within* curricular domains (sequenced by order of difficulty of learner acquisition) and *across* different levels of adaptive and intellectual functioning. Figure 3 shows a complete map of the EBIC indicating 190 finite and generalised skills and their interrelationships within curricular domains and across curricular levels.

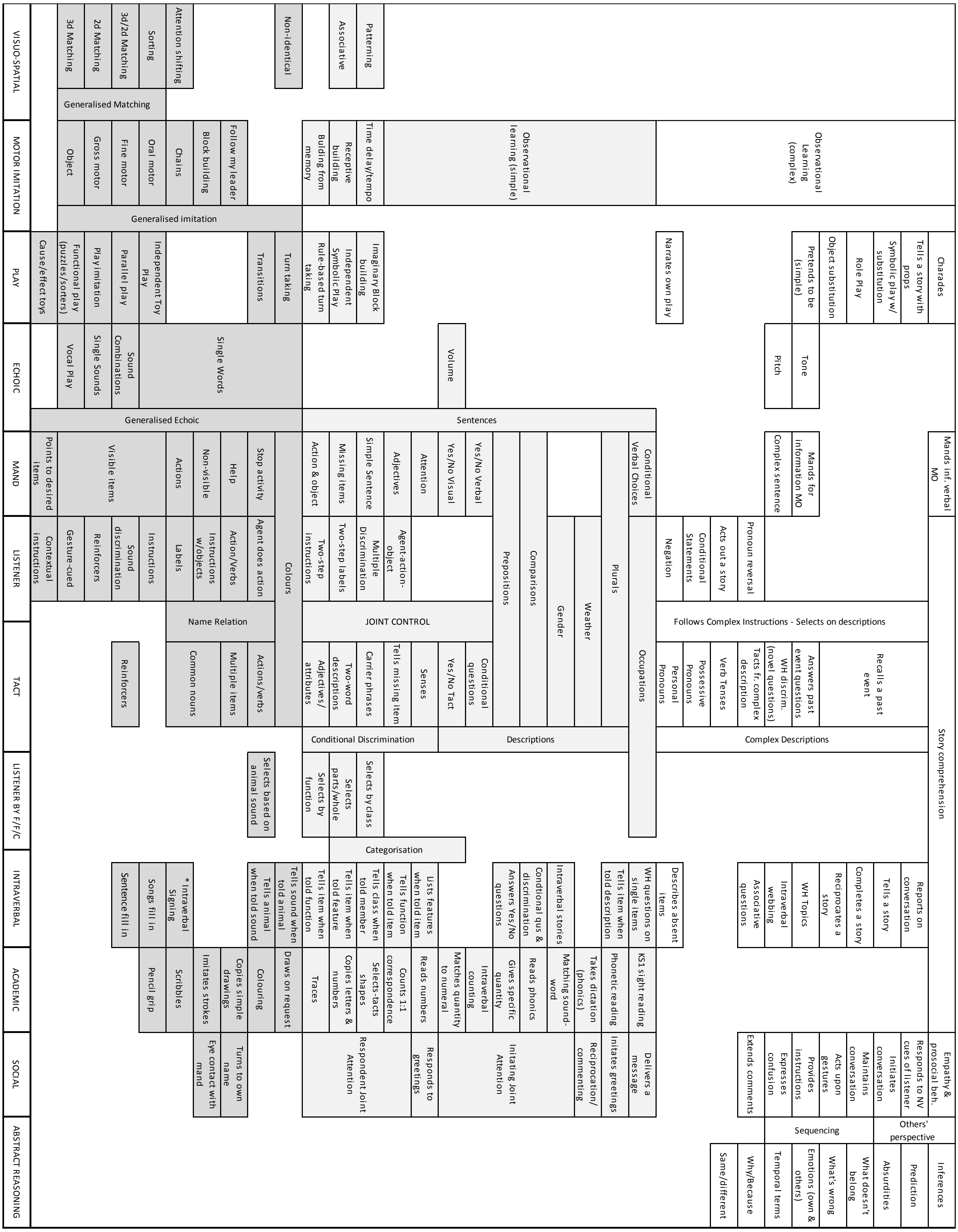

Figure 3. Complete map of the EBIC, indicating 190 finite and generalised skills organised within curricular domains (bottom row) and across curricular levels (cell shadings). *Note.* Dark grey cells contain “Beginner” skills, middle grey cells contain “Intermediate” skills, and light grey cells contain “Advanced” skills.

4.6.4 Data-based Evaluation of Mastery and Generalisation of Learning Outcomes

Distinct but consistent mastery criteria were specified within the EBIC, both for items and for finite and generalised skills. Mastery criterion for any individual item was specified as accurate responding on initial presentation of that item during random rotation across three consecutive teaching sessions. This rigorous criterion was adopted because it eliminated the possibility inherent in the use of a 90% accuracy criterion (cf. Leaf & McEachin, 1999; Lovaas, 2003) that an item could be considered mastered even though prompting had taken place on one trial of a 10-trial block. Because some finite skills (e.g., “possessive pronouns”, “prepositions”) are composed of a limited number of items, and others (e.g., “listener responding to common nouns”, “tacting common nouns”) are composed of an unlimited number of items, two mastery criteria for finite skills were employed. For finite skills composed of a limited number of items, mastery was determined by satisfaction of the individual mastery criterion for all items specified within that skill. For finite skills composed of an unlimited number of items, mastery could not be determined by the number of individual items mastered. Instead, and in accordance with the response-evaluation criterion suggested by Sundberg and Partington (1998), mastery was determined by the speed at which accurate responding to new items within that skill was demonstrated by the learner (i.e., 100% accurate responding consequent to no more than three prompted trials). The mastery criterion for generalised skills was defined as 100% accurate responding across 20 consecutive novel items within that generalised skill (see Section 5.2.1.3.5 for description of how skills were scored within the EBIC).

4.7 SUMMARY

Curricula form an essential means of organising teaching content and delivery within both mainstream education and behavioural interventions for autism. In recent years, four major EIBI curricula have been published, each structured around subcategories of curricular domains and programmes, within which individual items are taught. Although all curricula suggest sequences for programme introduction within domains, none indicates specific dependencies between programmes across domains. All curricula are also structured to prioritise programmatic rather than skills-based approaches to intervention, but differ with regard to the detail with which they specify teaching procedures. The EBIC was designed as a framework for intervention that would differ from all previous curricula in its prioritisation of skills over programmes, its differentiation between finite and generalised skills, its specification of relationships between skills both within and across curriculum areas, its emphasis on the establishment and evaluation of generalised skills, and its theoretical grounding in the analysis of verbal behaviour (Horne & Lowe, 1996; Lowenkron, 1998, 2006; Skinner, 1957). The following Chapter presents a programme of research that was carried out to evaluate the effectiveness of the EBIC as a basis for EIBI among children with autism.

5. EVALUATION OF THE EARLY BEHAVIOURAL INTERVENTION CURRICULUM

5.1 INTRODUCTION

As described in Chapters 2 and 4, a large number of outcome studies have evaluated the effectiveness of EIBI as a means of teaching life skills to children with autism (e.g., Anderson et al., 1987; Birnbrauer & Leach, 1993; Cohen et al., 2006; Eikeseth et al., 2002; Howard et al., 2005; Lovaas, 1987; Remington et al., 2007; Sallows & Graupner, 2005; Sheinkopf & Siegel, 1998; Smith et al., 2000). Although all such research has reported the effectiveness of EIBI for children with autism, none has provided specific information regarding, or evaluation of, the individual curricular targets, teaching procedures, or criteria for skills mastery (i.e., process data) that have formed the basis for intervention underlying outcomes reported, rendering analysis of the effects of specific independent variables and replication of reported interventions difficult (Lechago & Carr, 2008).

Currently, only three published studies have attempted to report process data relating to EIBI (Green et al., 2002; Weiss 1999; Weiss & Delmolino, 2006). Of these, Green et al. (2002) reported curricular targets and behavioural procedures employed during an intervention put in place for a young girl described as being “at high risk for autism”. In addition, these authors clearly illustrated their participant’s rate of skills acquisition to achieve mastery of primary curricular objectives during the first year of intervention, thus providing “an excellent example of sufficiently described independent variables in the behavioral treatment literature” (Lechago & Carr, 2008, p. 492). It should be noted, however, that this study reported data from only one participant, and it therefore necessarily remains “unclear whether this model would adequately apply to larger outcome studies with more participants” (Lechago & Carr, 2008, p.492). Utilising a similar approach, Weiss (1999) sought to investigate predictors of EIBI outcome by evaluating the progress of 20 children with autism across early curricular targets during intervention. Results indicated that participating children’s initial learning rates were correlated with later learning, higher levels of adaptive skills, and improved autism symptomatology, and also that those children who initially learned quickly continued to demonstrate rapid skills acquisition across all curricular domains. In particular, early acquisition of identity match-to-sample, echoics, receptive language, and tacting were found to be strongly correlated with adaptive behaviour acquisition. These findings were subsequently replicated by Weiss and Delmolino (2006). Because research has indicated that initial IQ may also be predictive of outcome (e.g., Sallows & Graupner, 2005), however, and such data were not included in Weiss's (1999) and Weiss and Delmolino's (2006) analyses, it should be noted that conclusions drawn from these authors' data necessarily remain inconclusive. Nevertheless, the research reported in these studies strongly suggests that participants' progress during the initial months of intervention may provide a potential indicator of outcome, supporting the findings of other researchers who have reported that acquisition of verbal skills in the first few months of EIBI may be predictive of subsequent learning attainment (Lovaas & Smith, 1988; Smith et al., 2000).

Although a small number of studies have therefore reported process data relating to EIBI, owing to limitations in both methodology and scope, individual predictors and processes underlying EIBI effectiveness remain largely unclear. As a means of increasing understanding of such factors through collection and analysis of detailed EIBI process data, and, thereby, of evaluating the EBIC as a framework for intervention in autism, the programme of research reported in the present chapter was carried out. All data reported were collected during the course of SCAmP (Remington et al., 2007).

5.2 STUDY 1

As described in Chapter 4, the EBIC was designed to provide a comprehensive framework for intervention for children with autism who received University-led EIBI during SCAmP. Although derived from principles of behaviour analysis and verbal behaviour (Horne & Lowe, 1996; Lowenkron, 1998, 2006; Skinner, 1957) and other published EIBI curricula (Leaf & McEachin, 1999; Lovaas, 1981/2003; Partington & Sundberg, 1998; Taylor & McDonough, 1996; see Chapters 2 to 4) the EBIC had not, itself, been previously subjected to empirical evaluation. For these reasons, and to identify potential practical considerations relating to implementation and evaluation of the EBIC that might require revision prior to the latter phases of SCAmP, pilot research was carried out involving the first six children to receive University-led EIBI during the initial six months of SCAmP. All participating children received additional SCAmP intervention beyond the period during which pilot data were collected and resultant changes to the EBIC and its implementation made. Because these children had, however, in some respects initially received a materially different intervention from those children who participated subsequently in SCAmP, complete data from the former children's 24 months of intervention are reported in the present study and not during Study 2.

5.2.1 Method

5.2.1.1 Participants.

Six boys with autism (M_{age} = 39.6 months, age range: 30-48 months) participated in the present research. Each child had been referred by his LEA to take part in SCAmP and had previously received an independent diagnosis of autism from a specialist paediatrician or clinical psychologist, in addition to a LEA Statement of Special Educational Needs. No psychometric assessment data were available for any children. Prior to intervention, each child's level of skills in every domain of the EBIC was evaluated (see Table 2).

Domain	David	Leo	Giles	Corey	Callum	Reece
Motor Imitation	20 Imitations	10 Imitations	18 Imitations	24 Imitations	-	-
Visual Performance	2D and 3D Identity Matching	2D and 3D Identity Matching	2D and 3D Identity Matching	2D and 3D Identity Matching	-	-
Listener	> 50 items and 20 instructions	> 50 items and 18 instructions	-	> 50 items	-	-
Echoic	Single words	Single words	5 sounds	-	-	-
Mand	20 items	Pointing	Pointing	5 PECS pictures	-	-
Tact	30 items	30 items	-	-	-	-
Intraverbal	3 songs	3 animal sounds	-	-	-	-
Play	9-piece puzzles and imitation	20-piece puzzles	12-piece puzzles	12-piece puzzles	-	-
Social	Eye-contact with mands	-	-	-	-	-

Table 2. All children's skills in every EBIC domain prior to intervention. *Note.* Dashes indicate absence of domain-specific skills.

5.2.1.2 Materials.

All materials were provided by children's parents or by LEAs consequent to advice from the SCAmP clinical team. Because each child's intervention was individually targeted to establish and develop a comprehensive range of skills, a wide variety of materials was used throughout the research, including toys, household objects, and flashcards. Individual materials required to teach specific skills were detailed in every Programme Sheet and Item List used during intervention.

5.2.1.3 Procedure.

The present research was carried out over an intervention period of 26 months, during which each child received a maximum duration of 24 months intervention. Figure 4 shows the intervention month of introduction and duration of each child's intervention within the overall period of University-led SCAmP EIBI delivery, during the first six months of which data were collected as a basis for subsequent alterations to be made, as required, both to the organisation of the EBIC and to the practicalities of its implementation and evaluation. Each child's scores on the EBIC were recorded both prior and subsequent to the intervention period. Hours of intervention delivered by tutors and by parents were separately recorded throughout each child's intervention. The following sections detail practical considerations specific to implementation and evaluation of the EBIC.

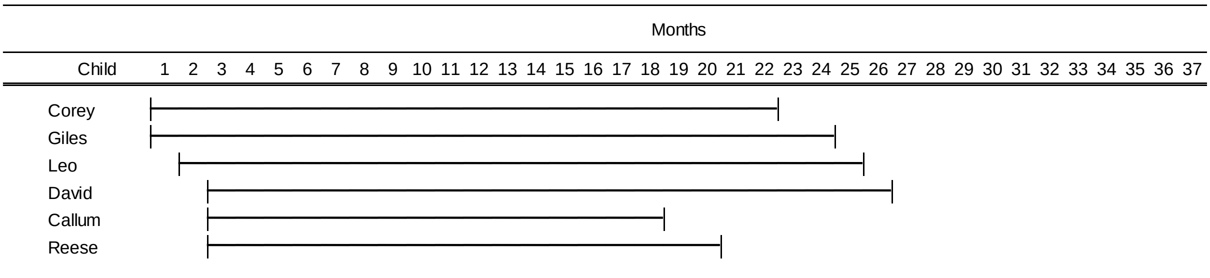

Figure 4. Intervention month of introduction and duration of each child's intervention within the overall period of University-led SCAmP EIBI delivery.

5.2.1.3.1 Intensity.

Each participating LEA signed a contract with the University of Southampton to deliver 30 hrs of EIBI per week, for 50 weeks per year, for a period of 2 years, for each child referred by them to receive intervention during SCAmP. The parents of each participating child also agreed personally to deliver an additional 10 hrs of EIBI to their child each week. Together, therefore, a total of 40 hrs EIBI per week was determined for every child participating in the research. For the first 12 months, each child's intervention was delivered in his own home. For the second 12 months, however, all children attended either Nursery, or Primary School, if they were of statutory school age. Although each child was supported by an ABA tutor during the latter period to ensure participation in educational activities, no EIBI was delivered in those environments.

5.2.1.3.2 Treatment fidelity.

On the basis of geographical location, each child was allocated an individual SCAmP Supervisor, and a team of three or four tutors recruited by his LEA. Although LEAs were responsible for line-management of tutors, the SCAmP clinical team was responsible for training both tutors and parents in the principles and techniques of ABA and for overall programme delivery. To ensure that all tutors and parents were able to provide EIBI delivery, each tutor and participating parent attended a 3-day workshop conducted by the SCAmP clinical team. In addition, prior to intervention, all parents and tutors received a 2-day home-based initial workshop run by the present author accompanied by the parents' allocated Supervisor. During this workshop, each child's level of skills in all EBIC domains was evaluated and initial curricular targets within the EBIC assessed. To ensure treatment fidelity, tutors' implementation of key EIBI techniques (i.e., DTT, NET, prompting, and fading) was assessed after 10 sessions (approximately 30 hrs of intervention delivery) using the SCAmP Tutor Assessment Tool (STAT; see Appendix D). Subsequent to assessment, Supervisors provided tutors with additional training, if required.

5.2.1.3.3 Frequency of supervision.

To evaluate children's progress within the EBIC, and to update curricular targets, each Supervisor conducted a fortnightly 3-hr team meeting for each of their assigned children individually, each of which was attended by all that child's tutors and one or both participating parents. Each Supervisor additionally provided between 6 and 9 hrs of direct training in EIBI delivery to tutors and parents every month. To assess each child's progress, and to provide clinical advice to Supervisors, the present author oversaw all children's programmes and additionally attended each child's team meeting every 6 weeks.

5.2.1.3.4 Teaching procedures.

Each child's intervention was individually tailored to meet his specific ongoing learning needs, and, for each child, teaching procedures involved use of both DTT and NET, dependent on the nature of individual skills taught (see Sections 4.3.6 and 4.3.7).

5.2.1.3.5 Scoring the EBIC.

The EBIC consists of 190 finite and generalised skills, for each of which a unique mastery criterion was specified, determined by whether the skill was generalised or finite, and whether it related to a limited or unlimited number of items (see Section 4.6.4). For purposes of determining children's levels of skills within the EBIC, one of three scores ("2", "1", or "0") was assigned for each skill, depending on each child's demonstration of those skills, defined as follows:

- Score of “2”. Skill mastered (i.e., mastery criterion met).
- Score of “1”. Skill present (i.e., child can respond appropriately to five items in random rotation; cf. Weiss & Delmolino, 1999).
- Score of “0”. Skill absent (i.e., neither present nor mastered).

The maximum score that can be achieved on the EBIC is therefore 380 (i.e., mastery of 190 skills).

5.2.2 Results

Of the six children who participated in the research, three (David, Leo, Giles) received 24 months intervention. Intervention for the three other children (Corey, Callum, Reece) was terminated at 22, 16, and 18 months, respectively, because these children left SCAmP to attend full-time specialist schools. Table 3 shows all children’s EBIC scores before and subsequent to intervention.

EBIC score	David	Leo	Giles	Corey (22 months)	Callum (16 months)	Reece (18 months)
Pre-intervention	12	8	5	5	0	0
Post-intervention	298	302	112	98	128	42

Table 3. All children’s EBIC scores before (Pre) and subsequent to (Post) intervention. *Note*. Figures for months indicated in parentheses indicate duration of intervention for children who did not complete the full 24 month intervention.

Table 4 shows intervention week of introduction and teaching duration for major skills (cf. Green et al., 2002; Lechago & Carr, 2008) for all children across curricular levels within the EBIC. Only two children (David and Leo) progressed sufficiently to learn advanced skills within the EBIC. Although these children had not mastered all advanced skills by the end of intervention, all skills at this level were present and progressing towards mastery. David and Leo both mastered all beginner skills within the first four months of intervention, and both of these children achieved mastery of the majority of intermediate skills during the first year of intervention, by the end of which a range of advanced skills were also mastered or present. Both of these children had been able to produce vocal verbal behaviour (i.e., tacting, echoics, basic listener and intraverbal responding) prior to intervention. Giles, however, was not able to produce verbal behaviour prior to intervention and spent the first 18 months of his intervention learning to mand and tact using sign language and to produce vocal verbal behaviour, while learning other beginner skills. Subsequent to mastering naming, Giles was able to progress to learning intermediate skills,

	David		Leo		Giles		Corey		Callum		Reece	
Curriculum Level & Skill	Int	Dur	Int	Dur	Int	Dur	Int	Dur	Int	Dur	Int	Dur
Advanced												
Others' perspectives	90	*8*	82	*16*	-	-	-	-	-	-	-	-
Inferences and predictions	90	8	76	*22*	-	-	-	-	-	-	-	-
Initiates conversation	54	12	90	*8*	-	-	-	-	-	-	-	-
Role play	72	20	90	*8*	-	-	-	-	-	-	-	-
Co-operative play	60	*38*	94	*4*	-	-	-	-	-	-	-	-
Emotions, own and others	44	16	76	8	-	-	-	-	-	-	-	-
Maintains conversation	64	22	74	*24*	-	-	-	-	-	-	-	-
Answers "why/because" questions	86	*12*	40	20	-	-	-	-	-	-	-	-
Recalls past events	88	*0*	68	18	-	-	-	-	-	-	-	-
Self-narrates play	34	8	66	32	-	-	-	-	-	-	-	-
Mands for information	22	24	42	16	-	-	-	-	-	-	-	-
Makes a story	82	*16*	70	*28*	-	-	-	-	-	-	-	-
Object substitution	36	2	36	10	-	-	-	-	-	-	-	-
Intraverbal descriptions	70	*28*	40	46	-	-	-	-	-	-	-	-
WH topics	72	*26*	68	24	-	-	-	-	-	-	-	-
Pronouns	68	24	40	32	-	-	-	-	-	-	-	-
Sequencing	78	12	44	36	-	-	-	-	-	-	-	-
Negation	44	4	32	4	-	-	-	-	-	-	-	-
Complex descriptions	48	*40*	42	24	-	-	-	-	-	-	-	-
Intermediate												
Initating Joint Attention	12	4	32	4	-	-	-	-	-	-	-	-
Multiple discrimination	16	6	18	8	-	-	-	-	-	-	-	-
Joint Control	16	2	22	2	-	-	-	-	-	-	-	-
Simple descriptions	24	36	16	8	-	-	-	-	-	-	-	-
Yes/No, tact and mand	12	8	24	10	52	*44*	-	-	-	-	-	-
Intraverbal feature, function, class	18	30	18	20	56	*40*	-	-	-	-	-	-
Categorisation	16	27	16	12	56	*40*	-	-	-	-	-	-
Receptive & tact parts	14	24	24	8	54	*42*	-	-	-	-	-	-
Receptive & tact functions	12	22	24	8	72	*24*	-	-	-	-	-	-
Conditional discrimination tact	24	12	24	7	-	-	-	-	-	-	-	-
Prepositions	16	40	18	8	-	-	-	-	-	-	-	-
Adjectives	10	8	16	6	-	-	-	-	-	-	-	-
Reciprocation	10	6	26	8	-	-	-	-	-	-	-	-
Mand for missing items	8	4	12	4	56	38	48	32	38	*26*	-	-
Beginner												
Naming	2	2	10	2	58	8	80	8	58	4	-	-
Colours	8	8	10	6	84	*12*	-	-	60	*4*	-	-
Two-step instructions	8	10	12	12	-	-	-	-	44	*20*	-	-
Tacts actions	4	3	6	4	46	20	82	*6*	56	8	-	-
Receptive actions	2	3	4	3	40	24	48	20	34	28	-	-
Animal sounds	2	4	2	2	30	8	-	-	40	8	-	-
Tacts common nouns	1	16	1	8	24	*72*	20	*68*	32	*32*	-	-
Echoes words	1	40	1	8	36	*60*	-	-	32	*32*	46	*26*
Echoes sounds	1	4	1	4	1	48	20	*68*	14	28	44	*28*
Two-step receptive labels	8	12	12	7	-	-	-	-	52	*16*	-	-
Receptive labels	1	4	1	8	16	48	1	*87*	16	46	28	*44*
Receptive instructions	1	4	1	4	1	36	6	30	12	36	18	*54*
Respondent Joint Attention	6	7	6	10	18	16	6	16	20	28	-	-
Play Imitation	4	12	8	12	20	24	8	28	24	24	22	*50*
Motor Imitation	1	2	1	3	1	30	1	12	8	32	1	16
Object Imitation	1	2	1	2	1	28	1	2	1	28	1	20
Identical match-to-sample	1	2	1	1	1	2	1	1	1	12	1	36
Eye-contact with mand	1	8	1	16	16	32	1	36	18	24	12	32
Manding visible SR	1	2	1	6	1	64	1	58	12	48	1	*72*
Pointing to choose	1	1	1	1	1	4	1	8	1	16	1	8

Table 4. Intervention week of introduction (Int) and teaching duration in weeks (Dur) for major EBIC skills in all curricular levels for all children who achieved learning of advanced skills within the EBIC. *Note*. Dashes indicate that a skill was not introduced. Duration figures in italics indicate that a skill was present but not mastered at the end of intervention.

but continued to learn beginner skills of echoing words, and tacting common nouns and colours, until the end of intervention. Callum, Corey, and Reece each finished intervention early, after 16, 22, and 18 months, respectively. None of these children had been able to produce vocal verbal behaviour prior to intervention, although Corey possessed basic receptive labelling and limited use of PECS. Within the first year of intervention, Callum mastered echoing sounds and a range of other beginner skills including naming, tacting actions, motor imitation, and manding visible reinforcers. At this point, Callum had been ready to start learning intermediate skills but was withdrawn from SCAmP before being able to do so. Although Corey began intervention with more advanced receptive skills than either Giles or Callum, he was not able to achieve mastery of echoics and finished intervention with a lower EBIC score than either of those two children. Although, by the end of the first year intervention, Reece demonstrated the presence of echoing sounds and words and limited manding, listener behaviour and tacting remained absent despite intensive teaching. Reece achieved the lowest level of skills gains of any child in the present research.

Table 5 shows all children's mean weekly intervention hours delivered by tutors and parents throughout intervention. No child received 40 hrs weekly intervention as determined prior to SCAmP. The highest mean total hours received by any child was 29 (*SD* = 4.7; (Giles) and the lowest was 18 (*SD* = 6; Reece). Overall, children received a mean of 23.9 hrs of intervention (*SD* = 4.22).

Mean intervention hours	David	Leo	Giles	Corey (22 months)	Callum (16 months)	Reece (18 months)
Tutors	19.1	18.5	21.2	22.2	19.2	17.1
Parents	3.4	7.5	8	5	1.3	1.1

Table 5. Mean weekly intervention hours delivered by tutors and parents throughout intervention for all children. *Note*. Months indicated in parentheses indicate duration of intervention for children who did not complete the full intervention.

5.2.3 Discussion

The present research was conducted to address three principal aims. Firstly, to obtain initial process data for children receiving University-led EIBI during SCAmP, and, secondly, by doing so, to provide pilot evaluation of the EBIC's effectiveness as a framework for EIBI. Thirdly, the present research sought to identify potential practical considerations relating to the implementation and evaluation of the EBIC to be addressed prior to full-scale implementation during the latter phases of SCAmP.

Regarding the first aim, detailed process data for intervention were obtained through description and recording of children's curricular targets, acquisition rates of a range of skills across curricular levels, teaching techniques employed, and hours of intervention delivered (cf. Lechago & Carr, 2008). Regarding the second aim, the EBIC scores of five of six children indicated wide-ranging skills gains, thereby provided strong initial support for the EBIC as an effective framework for organising and delivering EIBI. Overall, data indicated that five of six children progressed sufficiently to learn skills beyond the beginner level, although variability in outcomes and rates of skills acquisition was observed across children. Importantly, however, results observed suggested that children who had acquired vocal verbal behaviour rapidly during the early stages of intervention also mastered subsequent skills more rapidly, and in greater number, than those who had acquired vocal verbal behaviour less rapidly (cf. Weiss, 1999; Weiss & Delmolino, 2006). It should be noted, however, that, owing to absence of psychometric assessment data, formal analyses could not be carried out to evaluate whether rate of acquisition of vocal verbal behaviour was associated with observed gains in intellectual functioning.

Regarding the organisation of the EBIC, data suggested refinement prior to full-scale implementation. Because previous curricula (Leaf & McEachin, 1999; Lovaas, 1981/2003; Taylor & McDonough, 1998) had classified "Two-step Labelling" and "Two-step Instructions" as "Receptive" skills to be taught subsequent to mastery of "One-step Receptive Labelling" and "Single-step Instructions", this order had been maintained within the initial structure of the EBIC. Data indicated, however, that non-vocal children were unable to learn the former skills within this framework. In addition, it was observed that vocal children were able to master these skills only after they had mastered "Joint Control" within the EBIC. For these reasons, it was decided to place the former skills subsequent to the latter within the organisation of the EBIC.

Regarding practical considerations of implementation and evaluation, parents reported that familial demands had made it difficult to provide their child with the teaching hours agreed prior to intervention (the parents of Corey and Giles had even privately employed tutors to increase teaching hours delivered to their children). The present research also indicated serious practical concerns regarding tutor turnover and training. At the start of intervention, 20 tutors had been trained, but, because of turnover, by the end of 24 months, an additional 16 tutors had had to be recruited and trained. Because of the demands thus placed on SCAmP clinical staff, and the increased number of children that would subsequently be participating in University-led EIBI during SCAmP, an additional part-time member of staff was recruited specifically to provide training for new tutors. It was also evident that no LEA was able to provide the number of teaching hours agreed prior to intervention. Unfortunately, no action was possible to rectify this situation during SCAmP.

5.3 STUDY 2

Study 1 provided pilot process data using the EBIC and thereby provided initial support for the utility of the curriculum as a basis for EIBI for children with autism. Results of this research also suggested minor revision to the EBIC's organisation, and further indicated a number of practical concerns regarding tutor turnover and training, and weekly hours of intervention delivery. Subsequent to Study 1, and following implementation of available remedial action, the present research was carried out throughout the final 30 months of SCAmP. As described in Section 5.1, the present research had three principal aims: Firstly, to provide process data for children receiving EIBI based on the EBIC as a framework for intervention, and, secondly, to evaluate the EBIC in relation to standardised measures of intellectual functioning. The final aim was to identify whether learning of any specific individual skills within the EBIC was associated with subsequent gains in skills and intellectual functioning.

5.3.1 Method

5.3.1.1 Participants.

Thirteen boys and one girl with autism (M_{age} = 37.2 months, age range: 31-42 months) participated in the present research. Each child had been referred to SCAmP by his or her LEA to receive University-led EIBI. Prior to intervention, each child completed a battery of standardised assessments carried out by the SCAmP research team (see Remington et al., 2007 for details). Prior to referral to SCAmP, each child had received an independent diagnosis of autism from a specialist paediatrician or clinical psychologist, which was confirmed by the SCAmP research team using the ADI-R. Each child also had a LEA Statement of Special Educational Needs. Prior to intervention, each child's level of skills in every domain of the EBIC was evaluated. Table 6 shows participating children's skills in every EBIC domain prior to intervention.

Domain	Ray	Anthony	Archie	Byron	Nate	Andy	Harry	Jay	Johnny	Dean
Motor Imitation	5 Imitations	5 Imitations	5 Imitations	10 Imitations	5 Imitations	5 Imitations	5 Imitations	-		5 Imitations
Visual Performance	2D and 3D Identity Matching	2D and 3D Identity Matching	2D and 3D Identity Matching	2D and 3D Identity Matching	2D and 3D Identity Matching	2D and 3D Identity Matching	-	Matches 5 identical objects	Matches 5 identical objects	-
Listener	30 nouns	40 nouns	-	5 contextual instructions	>50 nouns	-	-	-	-	-
Echoic	-	20 sounds and CVC words	20 sounds and CVC words	10 sounds	3 sounds	-	-	-	-	-
Mand	-	3 mands	-	-	-	-	-	-	-	-
Tact	-	18 nouns	5 nouns	-	-	-	-	-	-	-
Intraverbal	-	-	-	-	-	-	-	-	-	-
Play	12 piece puzzles and shape sorters	12 piece puzzles	12 piece puzzles	Insert puzzles	18 piece puzzles and shape sorters	12 piece puzzles and shape sorters	4 piece puzzle	6 piece puzzle	6 piece puzzle	-
Social	Eye-contact when offered reinforcer	-	-	-	-	-	-	-	-	-

Table 6. Participating children's skills in every EBIC domain prior to intervention. *Note.* Dashes indicate absence of domain-specific skills. Timmy, Alice, and Robbie's data are not included because these children were not able to demonstrate any skills in any domain.

5.3.1.2 Materials and procedure.

Identical to Study 1, except Supervisors provided a maximum of 3 hrs direct training monthly to each child's team of tutors. Figure 5 shows intervention month of introduction and duration of each child's intervention within the overall period of University-led SCAmP EIBI delivery.

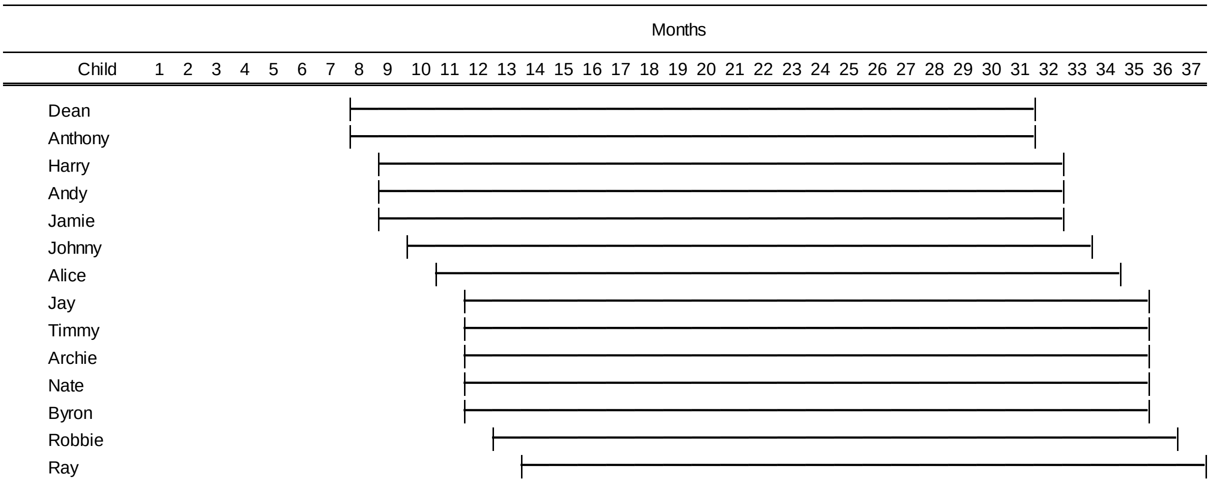

Figure 5. Intervention month of introduction and duration of each child's intervention within the overall period of University-led SCAmP EIBI delivery.

5.3.2 Results

All participating children received 24 months of EBIC-based EIBI.

5.3.2.1 Recording and reliability.

Throughout the period of intervention, each child's team of tutors recorded that child's responding to all individual items to allow evaluation of the absence, presence, or mastery of each skill (see Chapter 4). During each child's fortnightly team meetings, Supervisors additionally tested each item previously evaluated by tutors to provide confirmatory assessment of skills. Supervisors' assessments were subsequently independently evaluated by the present author during team meetings every six weeks. If Supervisors' evaluation of mastery of any skill was not confirmed by this evaluation, teaching of that skill continued until the Supervisors' evaluation was confirmed by the present author. Analysis of a sample of 50% of all children's data, carried out by an independent clinician subsequent to data collection, indicated 97% agreement with the present author's evaluation of all children's item mastery across skills.

5.3.2.2 EBIC skills progression.

Table 7 shows the intervention week of introduction and teaching duration for major skills across curricular levels for all four children (Ray, Anthony, Harry, Nate) who progressed sufficiently to learn advanced skills within the EBIC. These children mastered all beginner skills within 5, 4, 8, and 9 months, respectively, of starting intervention. By the end of intervention, Ray had mastered 99% and 69% of all intermediate and advanced skills, respectively, Anthony had mastered 97% and 53% of all intermediate and advanced skills, respectively, Harry had mastered 96% and 35% of all intermediate and advanced skills, and Nate had mastered 91% and 15% of all intermediate and advanced skills. Although only one of these children (Anthony) had been able to produce any vocal verbal behaviour (echoics and tacts) prior to intervention, within the first 3 months of the intervention, all four children demonstrated presence of the four basic verbal skills (echoing sounds, echoing words, tacts, mands) and also receptive labelling.

Table 8 shows the intervention week of introduction and teaching duration for major skills across curricular levels for all six children (Byron, Johnny, Archie, Dean, Jay, Andy) who progressed sufficiently to learn intermediate skills within the EBIC. By the end of intervention, Byron had mastered 97% and 36% of beginner and intermediate skills, respectively, Johnny had mastered 93% and 22% of beginner and intermediate skills, respectively, Archie 85% and 23% of beginner and intermediate skills, respectively, Dean had mastered 85% and 16% of beginner and intermediate skills, respectively, Jay had mastered 78% and 17% of beginner and intermediate skills, respectively, and Andy had

Curriculum Level & Skill	Ray		Harry		Anthony		Nate	
	Int	Dur	Int	Dur	Int	Dur	Int	Dur
Advanced								
Others' perspectives	96	*4*	-	-	-	-	-	-
Inferences and predictions	88	*12*	68	*32*	-	-	-	-
Initiates conversation	88	*12*	96	*4*	-	-	-	-
Role play	88	4	72	*28*	72	*28*	-	-
Co-operative play	88	2	60	*40*	76	*24*	-	-
Emotions, own and others	88	4	56	20	72	*28*	-	-
Maintains conversation	84	12	60	28	72	*28*	-	-
Answers "why/because" questions	84	8	52	8	60	8	-	-
Recalls past events	80	16	40	8	60	16	-	-
Self-narrates play	72	4	44	14	70	*30*	84	*16*
Mands for information	40	8	52	12	56	8	68	*32*
Makes a story	76	*24*	88	*12*	70	*30*	84	*16*
Object substitution	72	3	48	4	56	8	88	8
Intraverbal descriptions	68	8	36	8	56	*44*	82	*18*
WH topics	68	*32*	32	42	56	*44*	80	*20*
Pronouns	64	16	52	18	52	*48*	40	44
Sequencing	64	16	56	32	64	16	74	*26*
Negation	64	4	44	8	52	8	48	12
Complex descriptions	48	20	56	*44*	36	12	30	*70*
Intermediate								
Prepositions	44	6	12	4	24	4	16	60
Reciprocation	16	40	44	20	52	12	16	36
Intraverbal feature, function, class	40	8	32	12	28	4	16	40
Yes/No, tact, and mand	40	4	20	3	60	4	12	12
Conditional discrimination tact	34	12	24	8	60	4	16	28
Initating Joint Attention	20	36	40	4	52	4	24	40
Multiple discrimination	32	1	20	4	20	2	16	2
Two-step instructions and labels	32	1	20	4	16	2	16	2
Joint Control	32	1	16	4	16	2	16	2
Simple descriptions	30	4	20	8	12	12	28	20
Adjectives	28	12	16	8	20	4	8	4
Categorisation	28	13	36	8	20	12	20	12
Receptive & tact parts	28	13	24	8	16	10	16	12
Receptive & tact functions	24	12	20	4	20	12	16	12
Respondent Joint Attention	12	4	44	4	16	2	20	12
Mand for missing items	14	1	24	8	8	8	12	28
Beginner								
Naming	12	1	12	4	8	2	14	1
Colours	20	2	24	8	14	4	4	12
Tacts actions	20	4	16	4	12	8	16	4
Animal sounds	12	8	8	8	14	2	4	12
Receptive actions	12	12	4	12	14	8	4	4
Eye-contact with mand	8	4	20	8	14	8	16	14
Play Imitation	8	2	12	8	14	4	8	28
Tacts common nouns	6	8	12	12	4	8	12	4
Echoes words	4	12	12	20	1	4	12	16
Echoes sounds	1	4	4	8	1	4	1	16
Receptive labels	1	8	1	8	1	8	1	12
Receptive instructions	1	8	1	8	1	12	1	12
Motor Imitation	1	1	1	16	1	4	1	4
Object Imitation	1	2	1	16	1	3	1	4
Identical match-to-sample	1	0	1	3	1	8	1	1
Manding visible SR	1	8	8	16	1	8	1	16
Pointing to choose	4	1	1	3	1	4	20	4

Table 7. Intervention week of introduction (Int) and teaching duration in weeks (Dur) for major EBIC skills in all curricular levels for all children who achieved learning of advanced skills within the EBIC. *Note*. Dashes indicate that a skill was not introduced. Duration figures in italics indicate that a skill was present but not mastered at the end of intervention.

mastered 72% and 7% of beginner and intermediate skills respectively. Of these children, only Archie had been able to produce any vocal verbal behaviour (echoing words and tacts) prior to intervention. The remaining five children all began intervention by learning verbal behaviour through sign language, and, subsequent to mastery of echoing words, three of these children (Byron, Johnny, Jay) became able to demonstrate presence of vocal verbal behaviour. The remaining two children (Dean, Andy) continued to use sign language.

	Byron		Johnny		Archie		Dean		Andy		Jay	
Curriculum Level & Skill	Int	Dur	Int	Dur	Int	Dur	Int	Dur	Int	Dur	Int	Dur
Intermediate												
Prepositions	52	24	-	-	-	-	-	-	-	-	-	-
Reciprocation	48	24	-	-	-	-	-	-	-	-	-	-
Intraverbal feature, function, class	40	12	76	12	-	-	-	-	-	-	-	-
Yes/No, tact, and mand	36	*64*	-	-	-	-	-	-	-	-	-	-
Conditional discrimination tact	36	48	88	*14*	70	*30*	-	-	-	-	-	-
Initating Joint Attention	28	24	88	4	44	*56*	-	-	-	-	92	20
Multiple discrimination	76	8	60	12	64	4	-	-	-	-	-	-
Two-step instructions and labels	76	8	56	20	56	2	92	4	-	-	20	16
Joint Control	72	4	52	12	56	4	88	4	-	-	28	22
Simple descriptions	40	28	86	*16*	66	*34*	72	*30*	64	*36*	-	-
Adjectives	24	10	92	*12*	80	*20*	-	-	-	-	-	-
Categorisation	28	12	52	16	44	28	70	*32*	92	*8*	-	-
Receptive & tact parts	36	12	52	16	92	*8*	56	28	64	*36*	-	-
Receptive & tact functions	32	20	60	16	88	*12*	60	*42*	60	*40*	72	*28*
Respondent Joint Attention	28	6	48	3	32	4	76	4	52	4	28	42
Mand for missing items	36	56	44	28	20	48	24	12	52	12	44	8
Beginner												
Naming	28	3	44	4	36	8	24	8	48	4	32	20
Colours	36	10	48	12	36	28	54	*48*	52	12	60	*40*
Tacts actions	28	12	44	24	36	28	16	52	40	24	52	8
Animal sounds	20	12	40	12	24	12	60	20	72	*28*	36	40
Receptive actions	24	7	44	28	28	12	24	12	40	24	24	36
Eye-contact with mand	8	8	20	24	24	12	16	8	40	10	40	50
Play Imitation	8	22	28	16	32	8	4	12	16	12	8	12
Tacts common nouns	20	12	24	52	8	36	32	32	40	56	26	*64*
Echoes words	12	10	32	12	44	1	66	*36*	32	*68*	40	*60*
Echoes sounds	12	12	20	16	28	1	46	*56*	32	*68*	8	32
Receptive labels	4	28	12	40	8	28	8	26	8	42	4	48
Receptive instructions	8	20	8	56	28	3	4	12	1	12	4	44
Motor Imitation	2	28	4	8	4	20	1	8	4	14	1	18
Object Imitation	1	12	1	24	1	8	1	8	1	12	1	8
Identical match-to-sample	1	5	1	16	1	7	1	6	1	8	1	12
Manding visible SR	1	20	1	6	1	24	1	24	1	40	1	*100*
Pointing to choose	1	6	1	33	1	2	1	8	1	6	1	4

Table 8. Intervention week of introduction (Int) and teaching duration in weeks (Dur) for major EBIC skills for all children who achieved learning of intermediate skills within the EBIC. *Note*. Dashes indicate that a skill was not introduced. Duration figures in italics indicate that teaching of a skill was in progress at the end of intervention.

Table 9 shows intervention week of introduction and teaching duration for major curricular skills for all four children (Robbie, Jamie, Timmy, Alice) whose skills remained at the beginner EBIC level for the duration of their intervention. By the end of the intervention, these four children had mastered 57%, 42%, 35% and 25% of beginner skills, respectively. Of these children, only Robbie and Jamie became able to demonstrate presence of vocal verbal behaviour (at 14 and 19 months, respectively). Alice and Timmy did not acquire any vocal verbal behaviour despite intensive teaching throughout their interventions. These two children achieved the lowest EBIC and IQ scores of any children in the present research.

	Robbie		Jamie		Timmy		Alice	
Curriculum Level & Skill	Int	Dur	Int	Dur	Int	Dur	Int	Dur
Beginner								
Naming	88	4	96	4	-	-	-	-
Colours	-	-	-	-	-	-	-	-
Tacts actions	-	-	-	-	-	-	-	-
Animal sounds	76	16	-	-	-	-	-	-
Receptive actions	-	-	-	-	-	-	-	-
Eye-contact with mand	72	*30*	-	-	-	-	-	-
Play Imitation	20	72	-	-	-	-	-	-
Tacts common nouns	68	*28*	64	28	28	*76*	28	*74*
Echoes words	60	*42*	80	*20*	-	-	-	-
Echoes sounds	20	40	64	*36*	36	*68*	-	-
Receptive labels	20	*82*	36	56	20	*84*	56	*46*
Receptive instructions	12	*90*	8	88	40	*64*	-	-
Motor Imitation	1	26	8	60	6	*98*	4	48
Object Imitation	1	26	1	48	1	32	1	52
Identical match-to-sample	1	13	1	14	1	8	1	50
Manding visible SR	2	*100*	1	66	1	*104*	1	*102*
Pointing to choose	1	16	1	16	4	12	4	*98*

Table 9. Intervention week of introduction (Int) and teaching duration in weeks (Dur) for major EBIC skills for all children who learned only beginner skills within the EBIC. *Note*. Dashes indicate that a skill was not introduced. Duration figures in italics indicate that teaching of a skill was in progress at the end of intervention.

5.3.2.3 Hours of intervention.

Table 10 shows all children's mean weekly intervention hours delivered by tutors and parents throughout intervention. No child received 40 hrs weekly intervention as agreed prior to SCAmP. The highest mean total hours per week received by any child was 23.3 (*SD* = 6.1; Nate) and the lowest was 17.5 (*SD* = 4.5; Anthony). Overall, children received a mean of

21.9 hrs (*SD* = 3.17) of EIBI per week during the period of the research. A total of 125 tutors delivered intervention across children during the period of the research.

	Ray	Anthony	Archie	Byron	Nate	Andy	Harry	Jay	Johnny	Dean	Timmy	Alice	Robbie	Jamie
Tutors	19.8	14.5	20.5	18	22.3	21.5	18.8	20.5	22	20.5	20.5	18	20.8	18.5
Parents	0.5	3	1	1	1	10	4	0	1	2.8	0.5	3	0.5	2.8

Table 10. Mean weekly intervention hours delivered by tutors and parents throughout intervention for each child.

5.3.2.4 IQ and EBIC scores.

	IQ Score		EBIC Score	
Child	Pre	Post	Pre	Post
Nate	87	100	5	258
Ray	81	120	10	298
Andy	63	47	5	79
Archie	63	64	8	120
Robbie	63	62	0	39
Anthony	61	103	16	267
Harry	61	93	2	238
Jay	59	52	1	74
Dean	55	60	1	86
Byron	53	72	8	154
Timmy	41	38	0	37
Jamie	38	33	0	34
Alice	35	31	0	22
Johnny	30	70	3	136

Table 11. All children's IQ and EBIC scores before (Pre) and subsequent to (Post) intervention.

Table 11 shows all children's IQ and EBIC scores before and subsequent to intervention. Mean IQ for all children was 56.4 (*SD* = 16.3) before intervention and 67.5 (*SD* = 27.6) subsequent to intervention. Repeated measures t-tests revealed that gains in EBIC scores observed were significant (t = -.5.8, $p < 0.001$) and that gains in IQ scores approached significance (t = -2.1, $p < 0.06$). Of fourteen children, two (Nate, Ray) started intervention with IQ scores within the normal range, eight (Andy, Archie, Robbie, Anthony, Harry, Jay, Dean, Byron) with IQ scores within the mild intellectual disability range, three (Timmy, Jamie, Alice) with IQ scores within the moderate intellectual disability range, and one (Johnny) with an IQ score within the severe intellectual disability range. At the end of 24 months intervention, one of the two children with normal pre-intervention IQ (Ray) had moved to the superior range of intellectual functioning and the other (Nate) maintained normal intellectual functioning. Of the eight children who started intervention with IQ within the mild intellectual disability range, two (Harry, Anthony) achieved normal intellectual functioning. One (Byron) achieved borderline intellectual functioning, four (Dean, Archie, Robbie, Jay) remained within the mild intellectual disability classification, and one (Andy) achieved functioning in the moderate intellectual disability range. All three children (Timmy, Jamie, Alice) who began intervention with moderate intellectual disability retained that classification subsequent to intervention. The only child (Johnny) who began intervention with IQ in the severe intellectual disability range, however, achieved borderline intellectual disability subsequent to intervention.

		IQ Pre	IQ Post	IQ Change	EBIC Pre	EBIC Post	EBIC Change	Acquis-ition	Imitat-ion	Echoing Sounds	Echoing Words	Listener	Tact	Mand	Visual
IQ Pre	CC	–	.56*	.1	.46	.5	.39	-.31	-.63*	-.18	-.29	-.69**	-.53	-.25	-.48
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
IQ Post	CC	.56*	–	.85**	.96**	.79**	.91**	-.78**	-.71**	-.75**	-.8**	-.72**	-.76**	-.71**	-.66*
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
IQ Change	CC	.1	.85**	–	.83**	.61*	.81**	-.64*	-.5	-.62*	-.67*	-.43	-.63*	-.72**	-.38
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
EBIC Pre	CC	.46	.96**	.83**	–	.83**	.98**	-.86**	-.71**	-.77**	-.8**	-.79**	-.81**	-.81**	-.7**
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
EBIC Post	CC	.5	.79**	.61*	.83**	–	.72**	-.82**	-.68**	-.74**	-.73**	-.82**	-.83**	-.84**	-.85**
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
EBIC Change	CC	.39	.91**	.81**	.98**	.72**	–	-.73**	-.64*	-.61*	-.65*	-.72**	-.71**	-.76**	-.63*
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
Acquisition	CC	-.31	-.78**	-.64*	-.86**	-.82**	-.73**	–	.71*	.93**	.95**	.77**	.91**	.78**	.6*
	N	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Imitation	CC	-.63*	-.71**	-.5	-.71**	-.68**	-.64*	.71*	–	.65*	.66*	.75**	.83**	.7**	.54*
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
Echoing Sounds	CC	-.18	-.75**	-.62*	-.77**	-.74**	-.61*	.93**	.65*	–	.95**	.6*	.78**	.64*	.53
	N	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Echoing Words	CC	-.29	-.8**	-.67*	-.8**	-.73**	-.65*	.95**	.66*	.95**	–	.64*	.84**	.71**	.49
	N	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Listener	CC	-.69**	-.72**	-.43	-.8**	-.82**	-.72**	.77**	.75**	.6*	.64*	–	.84**	.66*	.73**
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
Tact	CC	-.53	-.76**	-.63*	-.81**	-.83**	-.71**	.91**	.83**	.78**	.84**	.84**	–	.81**	.53*
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
Mand	CC	-.25	-.71**	-.72**	-.81**	-.84**	-.76**	.78**	.7**	.64*	.71**	.66*	.81**	–	.64*
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14
Visual	CC	-.48	-.66*	-.38	-.7**	-.85**	-.63*	.6*	.54*	.53	.49	.73**	.53*	.64*	–
	N	14	14	14	14	14	14	12	14	12	12	14	14	14	14

Table 12. Correlation matrix showing correlation coefficients (CC) for all children's IQ and EBIC scores before (Pre) and subsequent to (Post) intervention, change in IQ and EBIC scores, mean weeks required to master each of the first five items of EBIC beginner skills (Imitation, Echoing Sounds, Echoing Words, Listener, Tact, Mand, Visual), and overall acquisition rate (Acquisition) for all beginner skills combined.

Table 12 shows the Spearman's correlation matrix for all children's IQ and EBIC scores before and subsequent to intervention, change in IQ and EBIC scores, mean weeks required to master each of the first five items (cf. Weiss & Delmolino, 2006) of the seven EBIC beginner skills (“Manding for visible reinforcers”, “Imitating movements”, “Identical match-to-sample”, “Receptive labelling”, “Echoing sounds”, “Echoing words”, “Tacting common nouns”) across six EBIC domains (“Mand”, “Imitation”, “Visuo-spatial”, “Listener”, “Echoic”, “Tact”), and overall acquisition rate for all six domains combined. Partial correlations were carried out to investigate which aspects of intervention were correlated with post-intervention IQ and EBIC score, after controlling for pre-intervention IQ. Regarding IQ scores, results indicated that time taken to master the first five items of echoing sounds (r = -.65, p <.05), echoing words (r = -.76, p <.01), tact (r = -.62, p <.05), and mand (r = -.61, p <.05), were all significantly correlated with post-intervention IQ, but not with the time taken to master the first five items of imitation, visual, and listener skills. Regarding EBIC scores, results indicated that the time taken to master the first five items of echoing sounds (r = -.68, p <.05), echoing words (r = -.76, p <.01), tact (r = -.71, p <.05), and mand (r = -.71, p <.05), were all significantly correlated with post-intervention EBIC score,

Regarding the first aim, the present research provided comprehensive process data detailing intervention targets, acquisition and mastery rates of skills within each curricular level, teaching techniques employed, and hours of intervention (cf. Lechago & Carr, 2008), for each participating child who received University-led EIBI during SCAmP. Regarding the second aim, the strong correlations observed between post-intervention IQ and EBIC scores, and between changes in IQ and EBIC scores, indicated that progression through the EBIC was associated with gains in intellectual functioning among participating children. In addition, the correlations observed between pre-intervention EBIC scores and changes in IQ and EBIC scores, and between pre-intervention EBIC scores and post-intervention IQ and EBIC scores, also highlighted the potential effectiveness of the EBIC as a framework for evaluating children’s skills prior to intervention. The significant correlation observed between pre-intervention EBIC score and post-intervention IQ was stronger than that with pre-intervention IQ. Considered in relation to the absence of significant correlation between pre-intervention IQ and post-intervention EBIC scores, this finding suggested that, for participating children, directly assessing levels of pre-intervention skills across EBIC domains would have provided a more effective indicator of future gains in skills and intellectual functioning than did standardised measures of IQ.

Regarding the final aim, the strong correlation observed between post-intervention IQ and EBIC scores was evident even after pre-intervention IQ had been controlled for, suggesting that pre-intervention IQ alone had not accounted for skills gains observed. Although pre- and post-intervention IQ scores were found to be significantly correlated, the extent to which IQ and EBIC scores changed during intervention also could not be accounted for by pre-intervention IQ scores, indicating that factors other than pre-intervention IQ had been associated with changes in intellectual functioning and skills levels. The strong negative correlation observed between time required to demonstrate presence of echoing sounds and words, tacts, and mands, and gains in intellectual functioning and skills further supported this conclusion, and also indicated that development of vocal verbal behaviour had provided a necessary precondition for gains in intellectual functioning and skills attainment observed. Four children progressed sufficiently to learn advanced level skills within the EBIC. These children were the only ones to achieve intellectual functioning within the normal or superior range. Each of these children had mastered vocal verbal behaviour within the first three months of intervention.

5.4 GENERAL DISCUSSION

The present research was carried out to evaluate the EBIC as a basis for intervention in autism. Because the EBIC had never previously been subjected to empirical evaluation, Study 1 sought to provide initial assessment of the practical effectiveness of the EBIC as a basis for EIBI, and to identify potential considerations relating to its implementation and evaluation. Results of this research supported the utility of the EBIC as a framework for delivering EIBI, but also indicated minor revision to the curriculum’s structure and identified practical limitations regarding tutor turnover and training, and hours of intervention delivery. Subsequent to this research, Study 2 sought to obtain detailed process data regarding EBIC-based intervention, to assess the EBIC as a framework for EIBI in relation to standardised measures of intellectual functioning, and to identify whether learning of any specific individual skills within the EBIC was associated with subsequent gains in skills and intellectual functioning.

As Lechago and Carr (2008) have observed, to enable full understanding of the functional components of intervention, and to enable replication of findings reported, any research reporting outcomes of EIBI should provide process data regarding intervention targets, number of items achieved within each major curricular skill, teaching techniques employed, hours of intervention, and levels of tutor training. As noted above, only three studies have previously attempted to report such data (Green, et al., 2002; Weiss 1999; Weiss

& Delmolino, 2006), and each has suffered from limitations in either methodology or scope. The present research therefore provided not only the first comprehensive process data relating to the EBIC as a basis for EIBI, but for behavioural intervention generally. All types of data identified by Lechago and Carr (2008) were collected during both Study 1 and 2, and therefore allowed detailed reporting of the exact content, nature, structure, and delivery of EBIC-based intervention during SCAmP. On this basis, it was possible to evaluate how each individual child progressed within the curriculum, in addition to commonalities and differences in both teaching methods and outcomes across children. It should be noted, however, that, in contrast to Lechago and Carr's (2008) suggestions for evaluating skill items, the number of items mastered within each major curricular skill was not reported in the present research on the grounds that a large number of taught items does not, as Lechago and Carr (2008) suggest, necessarily indicate skill mastery. Indeed, such information may actually indicate that teaching of every single item within a skill has been required, and that, therefore, generalisation of the skill in question has not occurred. These authors based their suggestion on the structure of Leaf and McEachin's (1999) curriculum in which no distinction is made between generalised and finite skills (see Chapter 4). Within the EBIC, however, a specific distinction is made between these two types of skill, and it can be therefore suggested that reporting time required to master a skill, or whether a skill is present but not mastered, may provide a more effective way of presenting and understanding process data underlying intervention outcomes.

As noted above, the EBIC had not been subjected to empirical evaluation prior to its implementation as a basis for University-led EIBI during SCAmP. Although Study 1 provided the initial context for implementation of the EBIC as a framework for EIBI and identified intervention hours and tutor training as limitations, owing to absence of standardised assessments of IQ for participating children, it was not possible to relate children's progress within the EBIC directly to gains in intellectual functioning observed. The significant correlations observed in Study 2 between post-intervention IQ and post-intervention EBIC score, and between changes in IQ and EBIC scores, demonstrated a direct relationship between the number of acquisition of skills within the EBIC and intellectual functioning. It should be noted that this relationship was strongly evident even after controlling for pre-intervention IQ, thus lending further support to effectiveness of the EBIC as a framework for delivering EIBI.

Taken together, the results of Study 2 suggested a direct relationship between both the number of skills children acquired during EIBI and gains in IQ. Results further indicated that pre-intervention intellectual functioning was not a mediating factor in this relationship, a finding consistent with those of recent meta-analyses that have reported that pre-intervention IQ does not predict changes in IQ resulting from EIBI (Eldevik et al., 2009; Makrygianni & Reed, 2010). What appears to mediate gains in intellectual functioning and skills in children with autism receiving EIBI is not pre-intervention IQ, therefore, but how rapidly children acquire skills *during* EIBI (e.g., Lovaas & Smith, 1988; Smith, Groen, & Wynn, 2000)—a variable that itself appears unrelated to pre-intervention IQ. More specifically, results indicated that early acquisition of vocal verbal behaviour (echoing, tacting, manding), but not the early acquisition of visual match-to-sample, motor imitation, or listener skills, was associated with higher levels of gains in skills and intellectual functioning subsequent to 24 months of EIBI.

It should be noted that the present research contained both methodological and practical limitations. With regard to the former, sample size did not permit use of regression analyses, and, therefore, although strong correlations were observed between acquisition rates, EBIC scores, and post-intervention IQ scores, whether the early acquisition of such skills was actually predictive of children's outcome remains to be confirmed by future research. With regard to the latter, process data indicated that tutor turnover remained a major concern throughout both Studies 1 and 2. To provide an average of 20 hrs of tutor intervention for the 20 children who received University-led EIBI during SCAmP, a total of 161 tutors were trained, of whom only 30 had 5 or more months' experience of ABA. It can be concluded, therefore, that all children necessarily received intervention from tutors with limited ABA experience during the period of the research—a factor already confirmed to be detrimental to EIBI outcomes (Bibby et al., 2002; Smith et al., 2000). Additional concerns were related to the limited time parents were able to spend in teaching their children, and, that, although parents participated in team meetings, they rarely agreed to demonstrate the skills they were targeting and also rarely recorded data regarding their children's responding, thus making it difficult to ascertain whether the intervention they did provide was delivered effectively.

Despite such limitations, however, relations observed between participants' verbal behaviour, intellectual attainment, and skills acquisition within the EBIC provided strong support for the application of techniques derived from functionally-based accounts of verbal behaviour (e.g., Horne & Lowe, 1996, 1997; Lowenkron, 1998, 2006; Skinner, 1957, 1989; Sundberg & Michael, 2001) as a means of promoting language acquisition among individuals with autism. Although compelling, the latter results were nevertheless observed within an applied context. To provide further, controlled, investigation of the findings obtained, a programme of research will be reported in Chapters 6, 7, and 8 that sought not only to investigate specific relations between speaker and listener at a theoretical level, but, thereby, to provide converging evidence of the utility of functional analyses of verbal behaviour as a basis for EIBI among children with autism.

6. TEACHING NAMING TO VOCAL CHILDREN WITH AUTISM

6.1 INTRODUCTION

The research presented in Chapter 5 both supported the practical utility of the EBIC as a framework for EIBI, and, in confirmation of existing findings (e.g., Weiss 1999; Weiss & Delmolino, 2006), indicated that children with autism who, early during intervention, had demonstrated rapid acquisition of vocal verbal behaviour (i.e., echoics and tacts) achieved the greatest gains in skills and intellectual functioning. As noted in Chapter 4, although existing curricula for EIBI are based primarily upon structural accounts of language and its development, teaching programmes aimed at remediating language deficits have played a central role in EIBI for children with autism, and typically target establishment of basic listener and speaker behaviour as initial objectives for intervention (e.g., Smith & Lovaas, 1997). It should be noted, however, that the most effective order in which to teach such skills remains unclear (cf. Miguel & Petursdottir, 2009). For example, Sundberg and Partington (1998) have suggested teaching tacting of stimuli whether or not corresponding listener behaviour to those stimuli has been previously established, but others (Leaf & McEachin, 1999; Lovaas, 1981/2003; Taylor & McDonough, 1996) specifically recommend teaching tacting of stimuli only after listener and echoic behaviour towards those stimuli has been established.

Although research indicates that typically developing children learn to respond to the verbal behaviour of others before they learn to produce such behaviour themselves (e.g., Fraser, Bellugi, & Brown, 1963), evidence also indicates that, before the end of the second year of life, typically developing children will have become, without specific teaching, able both to respond as listeners to the speech of others and to produce spoken responses learned through responding as listeners to the speech of others (e.g., Brown, 1973). As described in Chapter 3, Horne and Lowe (1996) conceptualise such generalised bidirectional responding within the “name relation”, a functional unit of behaviour in which relations between objects and their names, and the names of objects and the objects named, become fully reversible, or symmetric. In practical terms, therefore, if a child can name, she will be able to respond as a listener to stimuli to which she has previously only responded as a speaker, and to respond as a speaker to stimuli to which she has previously only responded as a listener.

Although a small number of studies have investigated the emergence of naming in children with intellectual disabilities and/or autism, most have discussed the bidirectionality of speaker and listener behaviour described above in terms of “cross-modal generalisation” (e.g., Guess & Baer, 1973) or "stimulus equivalence" (e.g., Wynn & Smith, 2003), and none has utilised naming as a basis for development of intervention procedures. Nevertheless, Wynn and Smith (2003) have reported that establishment of tacting was more effective than establishment of selection responding as a means of generating both tact and listener skills in children with autism, a finding that has also been reported in both children with language and developmental delay (Miller, Cuvo, & Borrakove, 1977) and in typically developing children (Connell & McReynolds, 1981). Guess and Baer (1973) further reported that, for children with severe intellectual disabilities, selection responding emerged as a result of the establishment of tacting, but only subsequent to presentation of intermixed tact and listener trials in relation to the same set of stimuli. Similarly, Miller et al. (1977) reported that less teaching was required to master tacting than to master selection responding, and that establishment of selection responding did not subsequently produce more rapid acquisition of tacting. Cuvo and Riva (1980) have, however, shown that selection responding facilitated acquisition of tacting and that their participants with developmental delay had demonstrated bidirectional responding not only as a result of tact training, but also as a result of selection responding alone. Taken overall, therefore, with the exception of Cuvo and Riva (1980), existing research suggests that, although establishment of tacting may result in the emergence of corresponding listener behaviour, establishment of selection responding alone is not sufficient to produce tacting.

A small number of more recent studies have directly referred to Horne and Lowe's (1996) account of naming in their investigation of the effectiveness of procedures to establish bidirectional responding in children with developmental and/or language delay or autism. Greer, Stolfi, Chavez-Brown, and Rivera-Valdes (2004), for example, have demonstrated the effectiveness of a Multiple Exemplar Instruction (MEI) procedure in establishing naming in participants with developmental and/or language delay. This intervention was composed of rapid presentation of successive teaching trials involving identity matching with verbal instruction (e.g., "match the Labrador"), selection responding (e.g., "point to the Labrador"), and tacting (e.g., saying "Labrador" upon hearing "what is it?" in the presence of a picture of a Labrador) in relation to one set of pictorial stimuli. Subsequent to MEI, participants demonstrated both selection and tacting of stimuli to which they had previously only responded on identity matching with verbal instruction trials. No participant, however, was able both to select and to tact all stimuli to which they were exposed. In another study, Fiorile and Greer (2007) taught four young children with autism, who had only limited echoic repertoires and no listener behaviour, to tact three-dimensional objects using single-syllable approximations of stimulus names. Although participants demonstrated tacting subsequent to this procedure, none was able accurately to demonstrate corresponding listener behaviour. Subsequent to MEI (Greer et al., 2004), however, participants were taught to tact other stimuli using single-syllable approximations and subsequently demonstrated the ability to select both those stimuli and the stimuli that they had learned to tact prior to exposure to MEI.

Findings suggest, therefore, that procedures such as MEI, that involve establishment of responding to intermixed instructions to match with verbal instruction, select, and tact the same stimuli, may result in the emergence of naming. Whether such procedures overall, or specific components of those procedures, are actually functional in promoting the emergence of naming remains uncertain, however, because no authors have reported whether, during identity matching with verbal instruction or listener trials, participants have echoed the names of items spoken by the experimenter. The implications of this omission are far-reaching, because, as Horne and Lowe (1996) observe, in typically developing children, tacting emerges from a history of differential reinforcement of combined listener and echoic (listener-echoic) responding, and that, after tacting has been established, such children demonstrate generalised corresponding listener behaviour, thus completing the name relation. Within Fiorile and Greer's (2007) procedure, for example, it is unclear whether naming emerged as a direct result of MEI itself, or as a result of adventitious reinforcement of listener-echoic responding. Participants in this research, it should be noted, did not initially possess the listener repertoires fundamental to the emergence of naming, but acquired such repertoires only when it was directly taught during MEI. It also remains unclear whether, during this research, initial identity matching was a prerequisite for the emergence of naming, or whether establishment of tact responses that resulted from differential reinforcement of listener-echoic responding had been sufficient for its establishment. Indeed, it could be argued that the latter procedure would more closely resemble the contingencies specified by Horne and Lowe (1996) as prerequisites for the emergence of naming.

The present research was carried out to provide further investigation, among children with autism, of the findings reported above, and controlled investigation of the effectiveness of a verbally-based procedure to establish naming developed during the course of the research reported in Chapter 5. In so doing, it was sought to investigate whether implementation of techniques derived directly from the analysis of verbal behaviour (Skinner,

1957) would provide a means of establishing generalised speaker and listener responding. To achieve this, the present research firstly evaluated whether participants would demonstrate the definitional bidirectional responding of naming subsequent to independent establishment of tact and selection responding, and, secondly, whether, among participants who had not demonstrated naming as a result of the procedures previously employed, such behaviour could be established by teaching participants to produce tacts as a result of their own combined listener-echoic responding. Overall, therefore, the present research sought to evaluate the effectiveness of a procedure that was designed to replicate the contingencies that Horne and Lowe (1996) specify for the emergence of naming, and, in so doing, to investigate the potentially functional role of echoic responding in the establishment of naming in children with autism.

6.2 METHOD

6.2.1 Participants

Seven boys and one girl with autism (M_{age} = 7.9 years, age range: 6-9 years) participated in the present research. All attended an ABA school and had vocal verbal behaviour to a minimum criterion of single-word echoic, tact, and selection responding. Examination of school records regarding rates of skills acquisition and mastery showed that all participants had mastered all beginner level EBIC skills except “Naming”. All participants were able to sit at a table and respond to instructions for a minimum of 15 min consecutively. Ethical Approval from the University of Southampton and Informed Consent for all participating children from parents was obtained prior to the research (see Appendix E for an Informed Consent form template).

6.2.2 Setting

All teaching sessions were conducted in each participant’s classroom as a part of his or her daily academic activities. All testing sessions were conducted in a quiet part of the school. During all teaching and testing sessions, the experimenter and participant sat opposite each other across a small table.

6.2.3 Materials

All stimuli presented during the research were composed of individual colour photographs, each displayed on an individual laminated card (10cm x 8cm). During Stage 1, two sets of three stimuli (“selection” and “tact” stimuli, respectively) were presented. Every stimulus in both sets depicted an unfamiliar object (e.g., a peeler), musical instrument (e.g., a cello), or animal (e.g., a newt). Each set was composed of one stimulus from each of the above categories. Figure 6 shows stimuli presented to all participants during Stage 1.

Figure 6. Stimuli presented to all participants during Stage 1.

During Stage 2, six sets of stimuli were presented. Five of these sets (Sets 1 to 5), presented during Phases 5 and 7, were composed of three novel stimuli, each of which depicted an unfamiliar object (e.g., a stem), musical instrument (e.g., a harp), or animal (e.g., a bison). The sixth set of stimuli (Set 6), presented during Phase 6 intervention, was composed of six novel pictorial stimuli, two from each of the above categories. Table 13 shows all stimuli presented to all participants during Stage 2 intervention (Phases 5 and 7).

Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	
Camel	Bison	Stork	Sloth	Peacock	Racoon	Woodlouse
Tuba	Cymbals	Harp	Bagpipe	Sax	Flute	Xylophone
Bulb	Stem	Sieve	Cork	Crane	Chain	Engine

Table 13. All stimuli presented to all participants during Stage 2 intervention (Phases 5 and 7).

6.2.4 Design

The study consisted of two stages. Stage 1 (Phases 1 to 3) was designed to assess whether independent establishment of tacting and selection responding would produce naming (i.e., whether establishment of selection responding would result in the emergence of corresponding tacting and whether establishment of tacting would result in the emergence of corresponding listener behaviour), and, on the basis of this assessment, to identify participants who would subsequently require intervention procedures to demonstrate naming. Stage 2 (Phases 4 to 7) provided intervention procedures for participants who did not demonstrate naming during Stage 1. During this stage, a multiple-probe multiple-baseline across-participants design (cf. Horner & Baer, 1978) was employed to evaluate whether teaching participants to produce tacts as a result of their own combined echoic and selection responding would result in the emergence of naming. During Phase 5 baseline, selection responding to one set of novel stimuli was established and corresponding tacting subsequently tested. During Phase 6 intervention, participants were exposed to a procedure designed to establish tacting as a result of listener-echoic responding to novel stimuli. During Phase 7 post-intervention testing, selection of other novel stimuli was established and tacting of those stimuli tested. Table 14 shows presentation order of all stimuli for all participants during Stage 2.

	Block				
Participants	1	2	3	4	5
Sarah	1	2, 1	3, 2, 1	4, 3, 2, 1	5, 4, 3, 2, 1
Yuri	1	2, 1	3, 2, 1	4, 3, 2, 1	5, 4, 3, 2, 1
Charlie	1	2	3, 2	4, 3, 2	5, 4, 3, 2
Oscar	1	2	3,2	4, 3, 2	5, 4, 3, 2
Tommy	1	2	3	4, 3	5, 4, 3
John	1	2	3	4, 3	5, 4, 3
Dan	1	2	3	4	5, 4
Chad	1	2	3	4	5,4

Table 14. Presentation order of all stimuli (Sets 1, 2, 3, 4, 5) for all participants during Stage 2. *Note.* Phase line denotes point of intervention (Phase 6).

6.2.5 Procedure

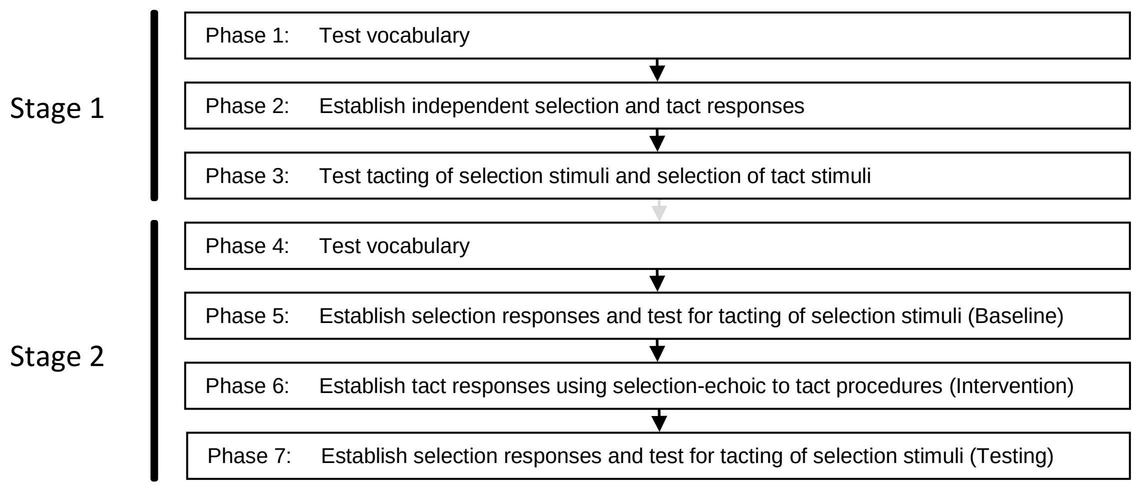

Figure 7. Overview of procedure (Phases 1 to 7) for all participants. *Note.* Black arrows denote progression between phases, grey arrow denotes performance-contingent progression between stages.

All phases were presented during consecutive sessions, each on a different day, with a maximum interval of 9 days between sessions (see Figure 7). All tutors involved in the present research had a minimum of 2 years' experience of applying the principles and techniques ABA.

6.2.5.1 Phase 1: Test vocabulary.

The aim of this phase was to ensure that no participant could either tact or select any of the stimuli to be presented during Phases 2 and 3. Every stimulus was presented four times to each participant, twice to evaluate tacting and twice to evaluate selection responding. If a participant correctly tacted or selected any stimulus on any trial, an alternative stimulus from the same category as that stimulus was presented until two stimuli from each category had been identified for subsequent presentation to that participant.

6.2.5.2 Phase 2: Establish independent selection and tact responses.

The aim of this phase was to establish selection of "selection" stimuli and tacting of "tact" stimuli. Order of establishment of tact and selection responding was counterbalanced across participants. Response accuracy and level of prompting required by participants was recorded immediately subsequent to each teaching trial. The number of participants' echoed responses during establishment of selection responding was also recorded (i.e., if, on any trial, the participant echoed the name of the stimulus subsequent to the experimenter's instruction to "find [stimulus name]" (e.g., "find clippers"), echoic responding was recorded as present on that trial).

6.2.5.2.1 Sub-phase 2a. Establish selection responses.

During this sub-phase, an auditory-visual match-to-sample task was used to establish selection of all selection stimuli in response to the names of those stimuli, spoken by the experimenter. On every trial, one selection stimulus was presented as sample and two other selection stimuli were presented as comparisons (one correct, or "target stimulus", and one incorrect). Each trial began with the experimenter placing three stimuli on the table, followed by the instruction "find [target stimulus]" (e.g., "find clippers"). To establish correct selection of each selection stimulus, an errorless learning procedure was employed that involved the experimenter prompting correct responding by pointing to the target stimulus immediately subsequent to delivering the verbal instruction. This prompt was faded across trials until the participant was able to point to the target stimulus without prompting. Positions of comparison stimuli were varied in pseudo-random order on every subsequent trial involving that stimulus. When correct performance had been demonstrated across three consecutive trials, a stimulus rotation procedure (Lovaas, 2003) was employed, which involved a different stimulus being introduced as target on subsequent trials, with the stimulus that had served immediately previously as target stimulus being presented as an incorrect comparison. Responding to each remaining selection stimulus was subsequently established in the same way. Mastery criterion for this phase was 100% correct selection of each selection stimulus across five consecutive trials, with a response latency of less than 3-s, across two consecutive sessions, using stimulus rotation.

6.2.5.2.2 Sub-phase 2b. Establish tact responses using echoic-tact procedures.

On every trial during this sub-phase, the experimenter presented an individual tact stimulus, said “what is it?”, and immediately spoke the name of the stimulus (e.g., “cello”). If the participant correctly echoed the stimulus’ spoken name, the experimenter provided a verbal or tangible reinforcer. If the participant echoed incorrectly or did not echo, the experimenter spoke the name of the stimulus again to prompt the participant to echo the stimulus’ name (e.g., “cello”). Prompts were faded over subsequent trials until the participant was able to speak the name of the stimulus (i.e., produce an unprompted tact) in response to the pictorial stimulus and the instruction “what is it?”. When correct tacting of a single stimulus had been established, this procedure was repeated in relation to another stimulus. When correct tacting of both stimuli had been established, a stimulus rotation procedure (e.g., Carr, Binkoff, Kologinsky, & Eddy, 1978) was employed, that involved alternating the presentation of the two stimuli in the same block of trials, intermixed with mastered imitation and receptive instructions trials to ensure discrimination between the two newly learned tacts. Correct tacting was established in this way in relation to the other tact stimulus in the set until tacting of all three tact stimuli had been established. Mastery criterion for this phase was 100% correct tacting of each tact stimulus across five consecutive trials, with a response latency of less than 3-s across two consecutive sessions using stimulus rotation.

When criteria for tact and selection responding had been met, Phase 3 commenced.

6.2.5.3 Phase 3: Test tacting of selection stimuli and selection of tact stimuli.

The aim of this phase was to evaluate participants’ selection of tact stimuli and tacting of selection stimuli. Order of testing of tact and selection responding was counterbalanced across participants and order of target stimulus presentation and stimulus locations was varied pseudo-randomly across trials. No reinforcement was provided by the experimenter on any trial, but, to maintain compliance, reinforcement was provided contingent on task-appropriate sitting and correct responding to previously mastered motor imitation or receptive instructions. If a participant correctly tacted or selected any target stimulus on two or more trials on which it was presented, the experiment ended for that participant. If any participant did not meet this criterion, Stage 2 vocabulary testing commenced (Phase 4).

6.2.5.3.1 Sub-phase 3a. Test selection of tact stimuli.

Six testing trials were presented during each of two consecutive sessions. Each tact stimulus was presented twice as target during each session. On every trial, the experimenter presented all three tact stimuli followed by a verbal instruction to select the target stimulus (e.g., "point to cello") using auditory-visual match-to-sample.

6.2.5.3.2 Sub-phase 3b. Test tacting of selection stimuli.

Six trials were presented during each of two consecutive sessions. Each selection stimulus was presented twice as target during each session. On every trial, the experimenter presented an individual selection stimulus followed by the verbal instruction "what is it?".

6.2.5.4 Phase 4: Test vocabulary.

The aim of this phase, the procedure of which was identical to that of Phase 1, was to ensure that no participant could either tact or select any of the stimuli to be presented during Phases 5, 6 and 7.

6.2.5.5 Phase 5: Establish selection responses and test for tacting of selection stimuli (Baseline).

The aim of this phase was, for all participants, firstly to establish selection of novel stimuli (Sub-phase 5a), and, subsequently, to assess participants' ability to tact those stimuli (Sub-phase 5b) prior to intervention (Phase 6).

6.2.5.5.1 Sub-phase 5a: Establish selection responses.

In each block, selection of three stimuli was established using a selection responding procedure identical to that employed in Sub-phase 2a.

6.2.5.5.2 Sub-phase 5b: test tacting of selection stimuli.

Subsequent to meeting criterion for Sub-phase 5a, testing of the corresponding tact responses was carried out using a procedure identical to that employed in Sub-phase 3b.

6.2.5.6 Phase 6: Establish tact responses using selection-echoic to tact procedures (Intervention).

The aim of this phase, which was composed of three sub-phases (6a to 6c) presented in the same order to all participants, was to establish combined selection and echoic responding, transfer to tacting, and subsequent maintenance of tacting, in relation to all six Set 6 stimuli.

6.2.5.6.1 Sub-phase 6a: Establish selection-echoic to tact transfer.

Initially, selection-echoic responding (i.e., simultaneously emitted selection and echoic responding) was established using an auditory-visual match-to-sample procedure. At the beginning of each trial, the experimenter placed three intervention stimuli on the table followed by a verbal instruction to select one target stimulus from among those stimuli (e.g., "engine"). On every trial, appropriate selection was established errorlessly using a pointing prompt, as required. If the participant did not echo the name of the target stimulus while selecting it, the experimenter delivered the verbal prompt "say [target stimulus' name]" (e.g., "say engine") immediately subsequent to stimulus selection. Immediately after the participant echoed, reinforcement was delivered by the experimenter. Level of prompting was faded across trials. If the participant echoed the name of the target stimulus while selecting it, a tact transfer trial was presented, that involved presenting a tact trial immediately consequent to correct selection-echoic responding to the target stimulus. Immediately after the participant had correctly emitted a selection-echoic response to the target stimulus, the experimenter represented the target stimulus (e.g., picture of an engine) and gave the verbal instruction "what is it?". If the participant demonstrated appropriate tacting of the target stimulus (e.g., speaking the word "engine") on the first trial, the expanded tact trials procedure was presented for that stimulus (Sub-phase 6b). If the participant did not demonstrate appropriate tacting of the target stimulus, however, selection-echoic to tact transfer was repeated. If the participant demonstrated appropriate tacting of the target stimulus on this second tact transfer trial, the expanded tact trials procedure commenced for that stimulus. If the participant again did not demonstrate appropriate tacting of the target stimulus, selection-echoic and tact transfer trials were repeated until appropriate tacting was demonstrated on a single tact transfer trial. On no trial was tacting of a target stimulus prompted by the experimenter.

6.2.5.6.2 Sub-phase 6b: Expanded tact trials.

The aim of this sub-phase was to maintain accurate tacting of target stimuli over gradually increasing periods of time. Immediately subsequent to meeting the above criterion, a single distracter trial was presented, during which the participant was engaged in a simple non-verbal task (e.g., gross motor imitation). Subsequent to this trial, another tacting trial was presented using the previously employed target stimulus (e.g., a picture of engine). If appropriate tacting was not demonstrated on that trial, selection-echoic and tact transfer trials (Sub-phase 6a) were repeated until criterion for those trials had again been met, at which point, expanded tact trials recommenced. If, however, appropriate tacting was maintained subsequent to one distracter trial, the number of distracter trials presented prior to the next tact trial was increased, firstly to two, then to five, then to 10, and lastly to 20 trials between tact trial presentations. When the participant had demonstrated correct responding subsequent to three distracter trials involving non-verbal tasks, distracter trials involving mastered tacts taken from children' school records were interspersed with non-verbal distracter trials. If appropriate tacting of the target stimulus was not demonstrated on any tact trial during this process, selection-echoic and tact transfer trials were repeated until criterion for those trials had again been met. When all criteria had been met for a single stimulus, selection-echoic, tact transfer, and expanded tact trials were repeated, as above, for each remaining stimulus individually.

6.2.5.6.3 Sub-phase 6c: Probe maintenance of tacting.

The aim of this sub-phase was to evaluate maintenance of tacting of stimuli presented during Phases 6a and 6b. At the beginning of every session subsequent to that in which the criterion for expanded tact trials had been met for any stimulus, maintenance of tacting of that stimulus was tested, using the procedures employed during Sub-phase 3b, prior to establishment of selection-echoic to tact responding for any new stimulus. When maintenance of tacting of all intervention stimuli had been demonstrated on two trials across two consecutive sessions using the stimulus rotation employed during Sub-phase 2a, Phase 7 testing trials recommenced.

6.2.5.7 Phase 7: Establish selection responses and test for tacting of selection stimuli (Testing).

The aim of this phase was to assess whether Phase 6 intervention had resulted in participants being able to tact novel stimuli for which only selection responding had previously been directly taught. Four sub-phases were presented to each participant in the following order.

6.2.5.7.1 Sub-phase 7a: Establish selection responses.

Identical to Sub-phase 2a.

6.2.5.7.2 Sub-phase 7b: Re-establish selection responses to mastered selection stimuli.

The aim of this sub-phase was to re-establish selection of stimuli presented during Phase 5 using procedures identical to those employed during Sub-phase 2a.

6.2.5.7.3 Sub-phase 7c: Test tacting of selection stimuli.

Identical to Phase 3a, except that stimuli from Sub-phases 7a and 7b were presented.

6.2.5.7.4 Sub-phase 7d: Test maintenance of previous tacts.

The aim of this phase was to test for maintenance of previously tested tacts, using a procedure identical to that of Sub-phase 3a. Maintenance of tacting was tested for all participants as follows:

– Sarah and Yuri: Sets 1 and 2 (Block 2), Sets 1 to 3 (Block 3), Sets 1 to 4 (Block 4), Set 1 to 5 (Block 5).
– Charlie and Oscar: Sets 2 and 3 (Block 3), Sets 2 to 4 (Block 4), Sets 2 to 5 (Block 5).
– Tommy and John: Sets 3 and 4 (Block 4), Sets 3 to 5 (Block 5).
– Dan and Chad: Sets 4 and 5 (Block 5 only).

6.2.5.8 Data recording and reliability

Table 15 shows mode of delivery and recording of all trials during each phase of the research, and percentage of trials on which inter-observer agreement (IOA) was calculated.

		Trials	
Phase/Sub-phase	Delivered by	Recorded by	IOA calculated on (%)
1	Experimenter	Video	100
2	Experimenter or Tutor	Video or Observer	50
3	Experimenter	Video	100
4	Experimenter	Video	100
5a	Experimenter or Tutor	Video or Observer	30
5b	Experimenter	Video	100
6	Experimenter	Video	30
7a	Experimenter or Tutor	Video or Observer	30
7b	Experimenter or Tutor	Video or Observer	30
7c	Experimenter	Video	100
7d	Experimenter	Video	100

Table 15. Mode of delivery and recording of all trials during each phase of the research, and percentage of trials on which IOA was calculated.

6.3 RESULTS

All participants completed all phases of the study.

6.3.1 Inter-Observer Agreement

Percentage IOA on participants' responding was calculated by dividing the total number of agreements between the experimenter's and tutor's or observer's recording of participants' responses by the total number of agreements and disagreements between those ratings, multiplied by 100. All video-recorded trials were scored by the experimenter and an independent ABA clinician. 100% IOA was obtained for all phases of the research except Phases 2 and Sub-phases 7a and 7b (combined), for which it was 96% and 97%, respectively.

6.3.2 Phase 2: Establish Independent Selection and Tact Responses

Figure 8 shows total trials required by each participant to achieve mastery of tact and selection responding, and total selection trials during which echoic responding was present. Participants required a significantly greater number of trials to master tact than selection responding (t = -5.8, p < .001).

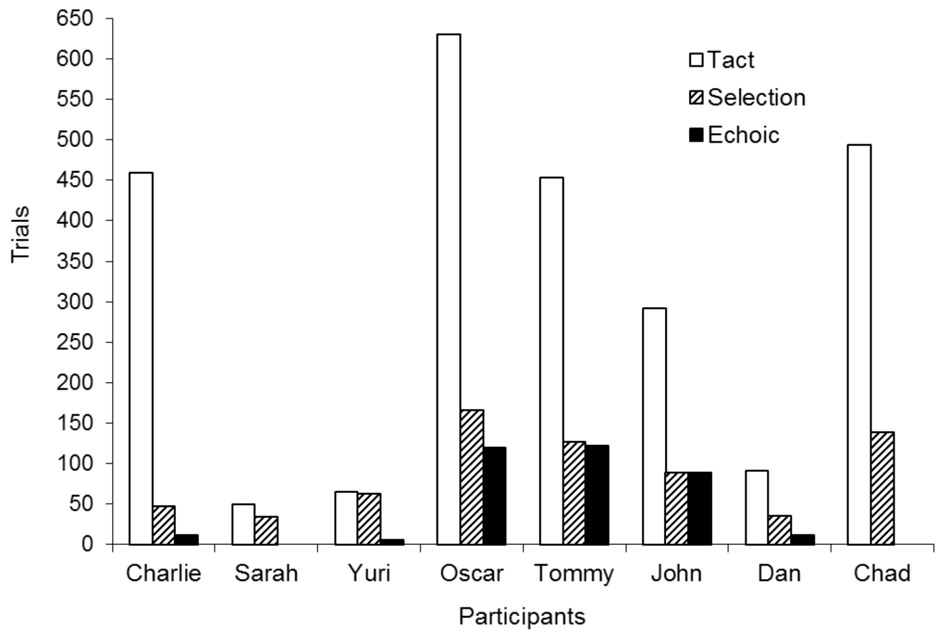

Figure 8. Total trials required by each participant to achieve mastery of tact and selection responding, and total selection trials during which echoic responding was present.

6.3.3 Phase 3: Test Tacting of Selection Stimuli and Selection of Tact Stimuli

Table 16 shows all participants' total correct tacting of selection stimuli and correct selection of tacting stimuli. Charlie, Sarah, Yuri, and Dan correctly selected all tact stimuli on every trial. Oscar, Tommy, John, and Chad correctly selected two tact stimuli on every trial on which they were presented, but selected one individual tact stimulus incorrectly on at least two of the trials on which it was presented. No participant correctly tacted any selection stimulus, except Yuri, who correctly tacted a single stimulus once.

Participants	Tacting of selection stimuli			Selection of tact stimuli		
	S1	S2	S3	T1	T2	T3
Sarah	0	0	0	4	4	3
Yuri	1	0	0	4	4	4
Charlie	0	0	0	4	4	4
Oscar	0	0	0	4	4	2
Tommy	0	0	0	4	4	1
John	0	0	0	4	2	4
Dan	0	0	0	4	4	4
Chad	0	0	0	2	4	4

Table 16. All participants' total correct tacting of selection stimuli (S1, S2, S3) and selections of tact stimuli (T1, T2, T3) during Phase 3.

6.3.4 Phases 2 and 6: Establish Tact Responses using Echoic-tact Procedures and Establish Tact Responses using Selection-echoic to Tact Procedures

Figure 9 shows total trials required by all participants to establish three tact responses using echoic-tact procedures (Sub-phase 2b) and to establish the first three of six tact responses using selection-echoic to tact procedures (Phase 6). Participants required a mean of 316.8 trials using the former procedure (*SD* = 225) and a mean of 228.7 trials using the latter procedure (*SD* = 142.6). The number of trials required by participants using echoic-tact procedures was significantly greater than that required using selection-echoic to tact procedures ($t = -5.8$, $p < .01$).

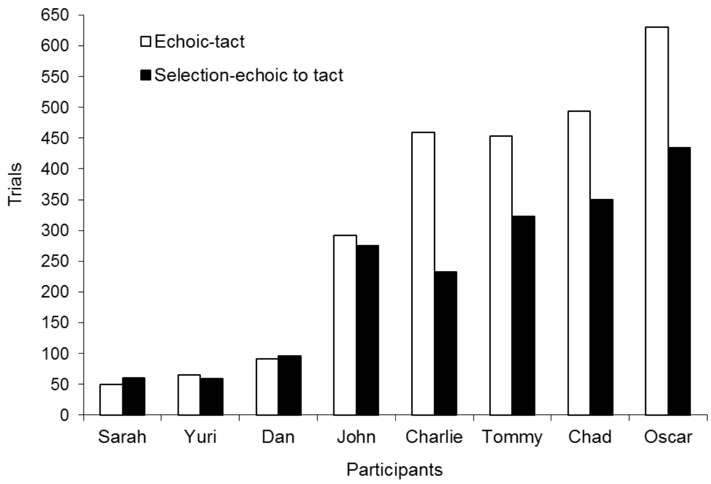

Figure 9. Total trials required by all participants to establish three tacts using echoic-tact procedures (Sub-phase 2b) and selection-echoic to tact procedures (Phase 6).

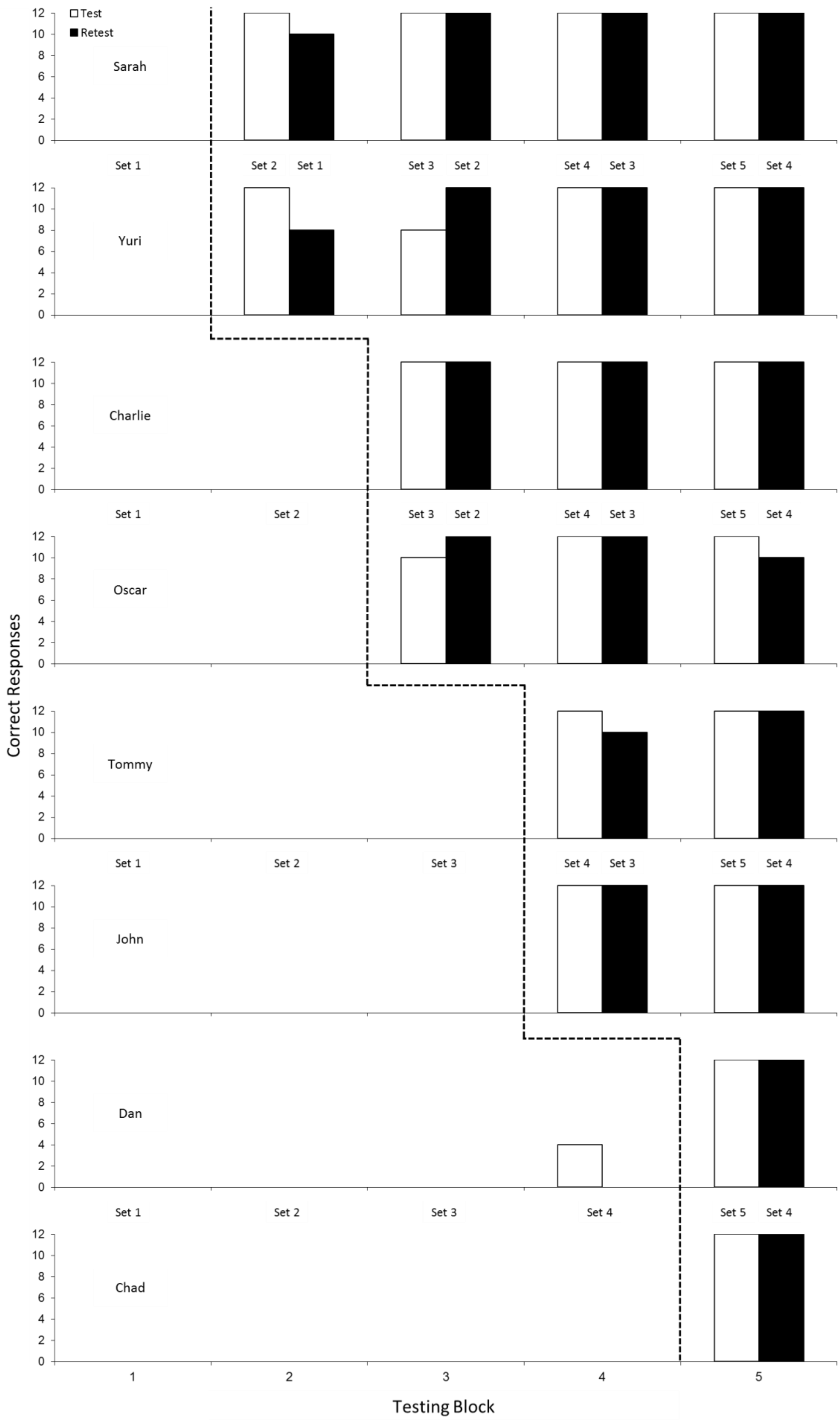

Figure 10. Total correct tact responses for all participants during each Phase 4 testing block prior and subsequent to intervention (Phase 6 intervention).

6.3.5 Phases 5, 6, and 7: Establish Selection Responses and Test for Tacting, Establish Tact Responses using Selection-Echoic to Tact Procedures, and Establish Selection Responses and Test for Tacting

Figure 10 shows total correct tact responses for all participants during all testing blocks before and subsequent to intervention (Phases 5 and 7, respectively). No participant demonstrated correct tacting during Phase 5 except Dan, who correctly tacted a single stimulus during Block 4. Four of eight participants (Charlie, John, Dan, Chad) tacted each target stimulus correctly on every trial subsequent to intervention, and three others (Sarah, Yuri, Oscar, Tommy) made four errors of fewer. For all participants, errors were always made on trials involving one specific target stimulus only, and never across stimuli.

	Stimulus Sets				
Participants	1	2	3	4	5
Sarah	0	100	100	89	88
Yuri	10	86	98	100	100
Charlie	15	12	100	100	100
Oscar	76	69	100	86	92
Tommy	84	76	89	100	100
John	65	71	67	92	100
Dan	54	51	72	96	100
Chad	0	0	0	0	100

Table 17. Percentage of trials for all participants during establishment of selection responding on which echoic responding was present (Phases 5 and 7). *Note*. Phase line denotes point of intervention (Phase 6).

Table 17 shows percentage of trials during which echoic responding was present for all participants during establishment of selection responding (Phases 5 and 7). Prior to intervention, no participant responded echoically on all selection trials, and Sarah and Chad did not echo on any trials. The remaining children demonstrated echoic responding on between 10% and 96% of trials. Subsequent to intervention, however, four participants (Charlie, Tommy, Dan, Chad) demonstrated echoic responding on all trials, and three participants (Sarah, Yuri, John) demonstrated echoic responding on all trials involving two sets of stimuli. No participant demonstrated echoic responding on less than 86% of trials involving stimuli from any individual stimulus set.

Regarding tacting, Sarah, John, Dan, and Chad maintained 100% correct responding to all stimuli across blocks, and Yuri and Charlie, and Oscar and Tommy, maintained 96% and 94% correct responding, respectively.

6.4 DISCUSSION

The present research was carried out to provide controlled investigation of the effectiveness of a verbally-based procedure to establish naming developed during the course of the applied research reported in Chapter 5. In so doing, the utility of principles of verbal behaviour as a basis for establishing naming in children with autism was also evaluated. The aim of Stage 1 (Phases 1 to 3) was to assess whether participants would demonstrate the definitional bidirectional responding of naming subsequent to independent establishment of tact and selection responding. Stage 2 (Phases 4 to 7) was designed to investigate whether, if the procedures employed during Stage 1 had not resulted in the emergence of naming, such bidirectional responding would emerge as a result of participants' tacting established consequent to teaching to selection-echoic responding.

The results of Stage 1 indicated that participants required a significantly greater number of trials to establish tact responses than to establish selection responses (Phase 2). Although this finding was in contrast with those of Miller et al. (1977), it should be noted that Miller et al. (1997) employed older participants than those in the present research, and that participants in that research had developmental delay rather than autism. It should also be noted that the results of this phase were commensurate with the known learning histories of participants in the present research. Analysis of school records showed that, prior to participation, participants had received more extensive teaching in listener skills (e.g., selection of nouns, actions, animals, and people) than in speaker skills, and had therefore already mastered a greater number of the former skills. The results of Phase 3 further showed that, although all participants were able to select stimuli subsequent to learning to tact those stimuli, establishment of selection responding was insufficient to establish corresponding tacting. This result was consistent with previous findings (e.g., Wynn & Smith, 2003) and also offers support for the suggestion that establishing tacting prior to selection responding provides the most effective teaching sequence during EIBI for children with autism (cf. Miguel & Petursdottir, 2009).

Although establishment of tacting may result in the emergence of generalised selection responding, as it did for participants in the present study, for naming to occur, children must also demonstrate tacting as a result of selection responding alone (Horne & Lowe, 1996). Despite possessing all three prerequisite repertoires of the name relation (i.e., echoing, tacting, and listener responding), however, participants in the present study were able to demonstrate responding in only one component of the name relation, and, therefore, the definitional bidirectional responding of naming was not present. Although such a pattern of behaviour might have been expected among children who did not echo during selection responding, its demonstration by children who consistently echoed stimulus names during teaching of such responding was unexpected. Analysis of video-recorded sessions, however, revealed that participants had predominantly spoken stimulus names immediately subsequent to the experimenter's verbal instruction, and not while attending to or selecting stimuli themselves, thereby suggesting that participants had been engaging in echolalia (i.e., non-verbal vocal behaviour) rather than functional echoing during selection trials prior to the intervention. Although this consideration remains speculative, the increase in echoic responding and accurate tacting observed only subsequent to Phase 6 intervention would again appear indicative of a functional difference between participants' vocal repetition of the instructor's spoken stimulus name prior and subsequent to intervention.

Although the results of Stage 1 showed that no participant had named stimuli presented, the results of Stage 2 indicated that establishing tacting using a selection-echoic to tact intervention procedure resulted in the emergence of naming among all participants. It had been anticipated that the procedures employed during Stage 2 might produce this result, because the verbal contingencies put in place were identical to those described by Horne and Lowe (1996) as prerequisite for the emergence of naming (i.e., that, for naming to occur, tacting must emerge from listening to one's own verbal behaviour) and therefore did not involve the direct prompting employed during Sub-phase 2a.

Stage 2 also provided a demonstration of the functional role of the echoic in the emergence of naming (cf. Horne & Lowe, 1996). As noted above, prior to Phase 6 intervention, participants had either engaged in echolalia subsequent to, or otherwise failed to echo, the experimenter's verbal instruction during selection-responding trials, and subsequently failed to tact stimuli that they had previously learned to select. Following intervention, however, emission of functional echoics during selection responding increased across participants, and all participants also demonstrated high levels of accurate tacting. It can be argued, therefore, that, although the aim of Phase 7 had been solely to establish selection responding, tacting had also adventitiously been reinforced as a result of participants' simultaneous and combined echoic and selection responding, and that, because of this, participants were not simply acquiring *receptive* skills, as selection responding is typically defined within published EIBI curricula (e.g., Leaf & McEachin, 1999; Lovaas, 1981/2003; Taylor & McDonough, 1996), but also speaker skills. They had, in other words, become speakers and listeners within the same skin (Horne & Lowe, 1996; Skinner, 1957), being able to speak the name of stimuli presented under one source of stimulus control (i.e., tacting) as a result of hearing themselves say the name of stimuli presented under another source of stimulus control (i.e., selection). Given the deficits in generalisation characteristic of individuals with autism, it is unlikely that naming can emerge without specific intervention. Published EIBI curricula, however, are typically structured to establish tacting and listener behaviour separately (e.g., Leaf & McEachin, 1999; Lovaas, 1981/2003; Taylor & McDonough, 1996), and therefore effectively establish functionally unrelated speaker and listener repertoires. On the basis of the results observed during Stage 2, however, it can be suggested that the teaching procedures employed during the present research offer an efficient and effective means of integrating these repertoires, establishing the prerequisite verbal relations of naming, and, thereby, establishing naming itself, among children with autism.

Overall, therefore, the present research demonstrated the effectiveness of a verbally-based procedure to establish naming in children with autism. Because the procedures employed relied primarily on participants being able to engage in generalised echoic responding, however, participants who do not possess such a repertoire would not be able to benefit from this kind of intervention. As discussed in Chapter 5, despite intensive teaching, many children with autism do not develop echoic responding during EIBI, and, for these children, acquisition of verbal behaviour is dependent upon forms of AAC such as sign language. The following chapter therefore reports research carried out to investigate the utility of procedures designed to establish the emergent bidirectional responding of naming in non-vocal children with autism who sign.

7. TEACHING NAMING TO NON-VOCAL CHILDREN WITH AUTISM WHO SIGN

7.1 INTRODUCTION

The research reported in Chapter 6 suggested that acquisition of naming may be central to the development of verbal behaviour in children with autism. Results also indicated that, although listener behaviour emerged as a result of tact training, the establishment of listener behaviour alone did not result in the emergence of tacting. Results further indicated that, subsequent to being taught to echo vocal instructions while selecting stimuli during match-to-sample responding, participants became able to tact stimuli to which they had previously responded only as listeners. Overall, therefore, results suggested that bringing listener responding under the control of both visual stimuli and echoic responding may provide an effective means of establishing tacting in children with autism, but, also, that generalised echoic responding may be a prerequisite for such tacting to emerge.

Unfortunately, many children with autism remain unable to demonstrate generalised echoic responding despite extensive direct teaching to do so (e.g., Lord et al., 2004). For such children, however, research has shown that use of AAC systems can provide a means of establishing verbal behaviour (e.g., Bondy & Frost, 1994/2001; Carr & Kologinsky, 1983; Remington, 1994). AAC refers to "an area of clinical practice that attempts to compensate (either temporarily or permanently) for the impairment and disability patterns of individuals with severe expressive communication disorders (i.e., the severe speech-language and writing impaired)" (American Speech-Language-Hearing Association [ASHA], 1989, p. 107). In clinical practice, AAC is composed either of aided communication systems such as the Picture Exchange Communication System (PECS), or unaided approaches involving the use of manual signs. Although both types of AAC have been, and continue to be, used extensively to allow children with autism to compensate for temporary or permanent absence of vocal speech (Mirenda, 2003), only a small amount of research has evaluated the effectiveness of sign language as a means of establishing basic speaker repertoires in non-vocal children with autism and/or severe language delay (see Mirenda, 2001, 2003 for reviews). Although some researchers have investigated whether children with autism can learn manual signs (e.g., Bonvillian, Nelson, & Rhyne, 1981) the majority have focused on the establishment of tacting (e.g., Carr et al, 1978).

Another strand of investigation has, however, sought directly to address the potential relationships between signed tacting and listener responding using Simultaneous

Communication Training (SCT) procedures (e.g., Konstantareas, Oxman, & Webster, 1977), during which a teacher simultaneously signs and speaks the name of a picture or object to establish sign-based verbal repertoires. Typically, in research investigating such procedures, tests are subsequently carried out to investigate whether participants' signed responses are under the control of the visual stimuli, or the spoken words, presented during training. Additional testing can also be conducted to establish whether listener responding has emerged as a result of tact training during SCT. Using this approach, Carr and Dores (1981) demonstrated that, although all participants acquired signed tacts, only those participants who had echoic repertoires were able to demonstrate untrained listener responding to stimuli previously presented during SCT.

Remington and Clarke (1983) carried out further research in this area by teaching two children with autism (one of whom demonstrated an echoic repertoire and one of whom did not) to emit signs in response to pictures of objects either during SCT or "sign only" training. Both children's emission of taught signs was then tested under the following sources of stimulus control: "visual" (i.e., only pictures presented), "vocal" (i.e., only spoken names of pictures presented), or "lip" (i.e., silently moving lips as though speaking the names of pictures). Participants' listener responding (i.e., selection of a picture in response to that picture's spoken name) was also assessed. Results indicated that, although the participant with an echoic repertoire signed correctly during vocal, visual, and listener testing, the participant without an echoic repertoire only responded correctly during visual testing.

Using participants with non-specific learning difficulties and some existing echoic behaviour, Clarke, Remington, and Light (1986) subsequently conducted research to evaluate, firstly, the extent to which SCT facilitates acquisition of listener responding, and, secondly, the extent to which acquisition of listener responding towards specific stimuli facilitates the acquisition of signed tacting of those stimuli. Results indicated that acquisition of signs during SCT was enhanced when participants were already able to respond to target stimuli as listeners. In a vocal condition, participants also responded correctly to stimuli that were already in their listener repertoires. Importantly, this research showed that, when sign training alone was employed, the facilitatory effects of existing listener repertoires were no longer present.

The above findings raise important practical and theoretical questions regarding the source, or sources, of stimulus control operating during SCT, none of which has been addressed in previous research. Firstly, because, during SCT, individuals learn to emit a signed response to simultaneous presentation of a pictorial and a vocal stimulus, the signed response may function as an intraverbal (i.e., signing in response to the speech of others) and/or as a tact (Skinner, 1957): in effect both verbal relations may be trained and established simultaneously. As a result of this analysis, it is possible to suggest that intraverbal responding may be functional in the acquisition of listener and tact responding in non-vocal children with autism who sign. Unlike deaf children, for whom listener responding is only controlled by a speaker's signs, signing children with autism learn sign language as speakers, but are encouraged to respond to vocal speech as listeners (Partington & Sundberg, 1998). In practice, therefore, signing may be used initially during selection (i.e., listener responding) tasks as a prompt, but with the aim that it should be faded so that selection responding can eventually come to be controlled solely by the speaker's mand. On the other hand, when teaching a tact response, the procedure described within SCT is generally employed (i.e., the teacher both signs and speaks the name of the picture presented), but the spoken word is faded over subsequent teaching trials so that the child's verbal behaviour (i.e., tacting) becomes solely controlled by seeing the pictorial stimulus or object. As a result of this training, an untrained intraverbal relation can emerge, and it may be that that particular response has produced the untrained listener responding reported in the studies reviewed above (Carr & Dores, 1981; Clarke et al., 1986, Remington & Clarke 1983).

Initial support for the functionality of the intraverbal in the emergence of untrained listener behaviour in children with autism who sign has been provided by recent research into joint control (Tu, 2006). In this study, two children with autism were taught to produce manual signs in response to pictorial stimuli. Depending on the training conditions employed during the study, these signs functioned either as tacts, mimetics, or, simultaneously, as both tacts and mimetics. Results indicated that training tacts and mimetics separately did not produce generalised listener behaviour: Only after participants had learned to select stimuli under the joint control of both tacting and intraverbal/self-intraverbal rehearsal were they able to demonstrate generalised listener responding. On the basis of these findings, Tu (2006) proposed that establishment of jointly controlled responding (Lowenkron, 1998, 2006) can allow participants to demonstrate listener behaviour to stimuli that they had previously only been able to tact.

The present research had two main aims, relating to the above suggestions. Firstly, it was sought to investigate whether intraverbal responding fulfils a role in the emergence of naming among non-vocal signing children that is similarly functional to the role that echoic responding serves for vocal children, and secondly, whether it may, therefore, promote the emergence of naming in children with autism who sign. To achieve this, the present research firstly assessed whether participants would demonstrate intraverbal signing, and the definitional bidirectional responding of naming, subsequent to independent establishment of tact and selection responding. Secondly, the present research investigated whether, among participants who had not demonstrated naming on this basis, tacting would emerge as a result of an intervention that established intraverbal-selection to tact responding (i.e., intraverbally signing a stimulus' name prior to its selection). The rationale for the present research was therefore similar to that of the research reported in Chapter 6, but centred on signed, rather than vocal verbal, responding.

7.2 METHOD

7.2.1 Participants

Six boys with autism (M_{age} = 6.9 years, age range: 6-8 years) participated in the present research. Each had previously received a diagnosis of autism and used sign language as his primary form of communication. Prior to experimentation, participants' verbal behaviour was assessed using the British Picture Vocabulary Test – Third Edition (BPVT-III; Dunn & Dunn, 1997), the echoic subscale of the VB-MAPP (Sundberg, 2008), and by examination of school records regarding rates of skills acquisition and mastery. Although no participant demonstrated an echoic repertoire as assessed on the echoic subscale of the VB-MAPP, all demonstrated generalised mimetics. All participants also performed below the 24-month old level on the BPVT-III and were able to sit at a table and respond to adult instructions for a minimum of 15 min consecutively. Ethical Approval from the University of Southampton and Informed Consent for all participating children from parents was obtained prior to the research. Table 18 shows total mastered responses across verbal operants recorded in each participant's school records.

Participants	Receptive instructions	Selection responses	Tacts	Intraverbal signs	Echoic sounds
Chris	28	80	50	40	2
David	22	92	61	42	0
Josh	21	60	45	38	0
Ryan	26	96	32	22	0
Mike	5	30	25	15	0
Harry	10	12	12	12	0

Table 18. All participants' total mastered responses across verbal operants recorded in school records.

7.2.2 Setting

All teaching sessions were conducted in each participant's classroom as part of their daily academic activities. All testing sessions were conducted in a quiet part of the school. During all teaching and testing sessions, the experimenter and participant sat opposite each other across a small table.

7.2.3 Materials

All stimuli presented during the research were composed of individual colour photographs, each displayed on an individual laminated card (10cm x 8cm). Two sets ("selection" and "tact" stimuli respectively) of five stimuli were presented during Stage 1. Three stimuli in each set depicted unfamiliar common objects (e.g., bucket, plaster, feather), one depicted an animal (e.g., zebra), and one depicted a food item (e.g., carrots). Figure 11 shows all stimuli presented to all participants during Stage 1.

Figure 11. Stimuli presented to all participants during Stage 1. *Note*. One set of stimuli is presented in each row.

During Stage 2, five sets of novel stimuli were presented. Four of these sets (Sets 1 to 4), presented during Phases 8 and 10, were each composed of five stimuli, three depicting an unfamiliar object (e.g., a tractor), one depicting an unfamiliar animal (e.g., a tortoise), and one depicting an unfamiliar food (e.g., spaghetti). The fifth set of stimuli (Set 5), presented during Phase 9 intervention only, was composed of three stimuli depicting unfamiliar objects, one depicting an unfamiliar food, and an unfamiliar animal. Table 19 shows the names of all selection stimuli presented to participants during Stage 2.

Stimulus Sets				
1	2	3	4	5
Tomato	Peas	Spaghetti	Pizza	Grapes
Piano	Violin	Helicopter	Hammer	Sponge
Tractor	Wheel	Clock	Beads	Paintbrush
Bell	Pencil	Spade	Tissue	Handbag
Giraffe	Monkey	Worm	Owl	Rhino

Table 19. Names of all stimuli presented to participants during Stage 2.

7.2.4 Design

The study consisted of two stages. Stage 1 (Phases 1 to 6) was designed to assess whether independent establishment of tacting and selection responding would produce naming (i.e., whether establishment of selection responding would result in the emergence of corresponding tacting and whether establishment of tacting would result in the emergence of corresponding listener behaviour), and, on the basis of this assessment, to identify participants who would subsequently require intervention procedures to demonstrate tacting as a result of establishing listener behaviour. Stage 2 (Phases 7 to 10) implemented intervention procedures for participants who did not demonstrate naming during Stage 1. During this stage, a multiple-probe multiple-baseline across-participants design was employed to evaluate whether teaching participants to produce tacts as a result of their own simultaneous and combined intraverbal and selection (i.e., intraverbal-selection) responding would result in the emergence of tacting of stimuli to which participants had previously only been taught to respond to as listeners. During Phase 8 baseline, selection responding to one set of novel stimuli was established and corresponding tacting subsequently tested. During Phase 9 intervention, participants received a procedure designed to establish tacting as a result of intraverbal-selection responding to novel stimuli. During Phase 10 post-intervention testing, selection of other novel stimuli was established and tacting of such selection stimuli tested. Table 20 shows order of presentation of all sets of stimuli, before and subsequent to intervention, for all participants who were exposed to Stage 2 procedures.

	Block			
Participants	1	2	3	4
Ryan	1	2	3	4
Mike	1	2	3	4
Harry	1	2	3	4

Table 20. Presentation order of Set 1, 2, 3, and 4 stimuli, showing, for each participant who was exposed to Stage 2 procedures, which sets of stimuli were presented before and subsequent to intervention. *Note.* Phase line denotes point of intervention (Phase 9).

7.2.5 Procedure

All phases were presented during consecutive sessions, each on a different day, with a maximum interval of 9 days between sessions (see Figure 12). All tutors involved in the present research had a minimum of 2 years' experience of applying the principles and techniques of ABA. All tutors and the experimenter were also proficient in using Makaton and SignAlong AAC systems. Throughout Phases 4, 5, and 6, and Sub-phases 8c, 8d, 8e, 10c, 10d, and 10e, no reinforcement was provided to any participant on any testing trial. Instead, to maintain compliance, reinforcement was provided contingent on task-appropriate sitting and correct responding to previously mastered motor imitation or receptive instructions.

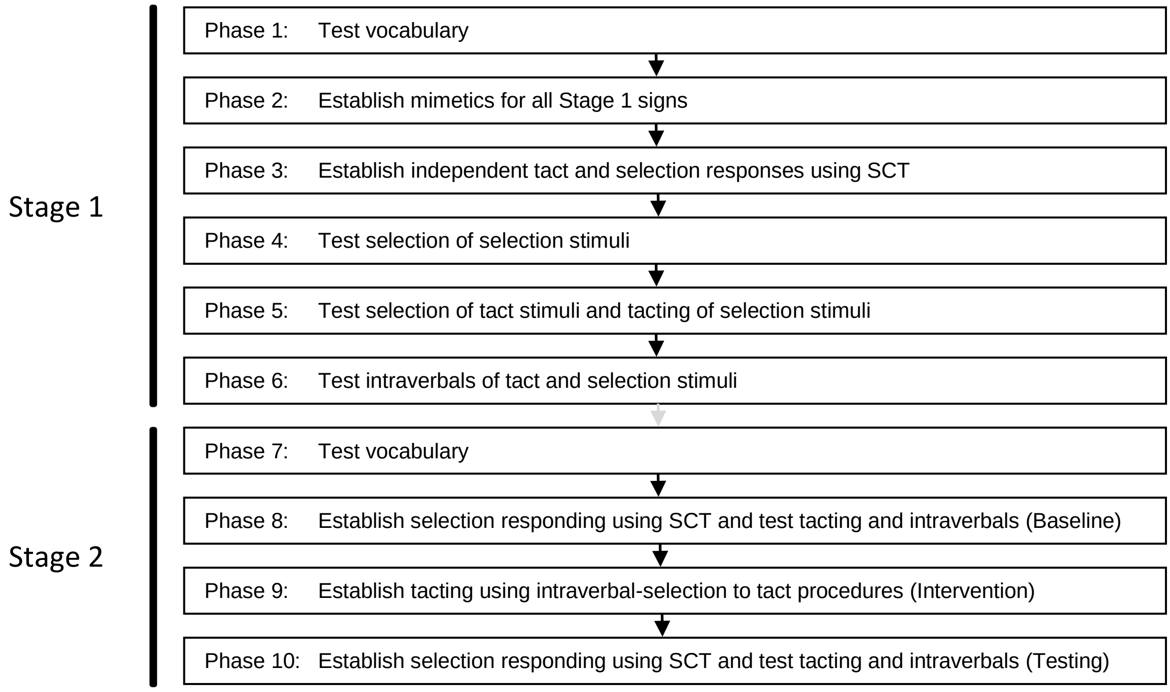

Figure 12. Overview of experimental procedure (Phases 1 to 10). *Note.* Black arrows denote progression between phases, grey arrow denotes performance-contingent progression between stages.

7.2.5.1 Phase 1: Test vocabulary.

The aim of this phase was to ensure that no participant could tact, select, or respond intraverbally to any of the stimuli to be presented during Phase 3. Every stimulus was presented six times to each participant, twice to evaluate tacting, twice to evaluate selection, and twice to evaluate intraverbal signing. If a participant responded correctly to any stimulus on any trial, an alternative stimulus from the same category was presented until two stimuli from each category had been identified for subsequent presentation to that participant.

7.2.5.2 Phase 2: Establish mimetics for all Stage 1 signs.

The aim of this phase was to ensure that each participant was able correctly to respond mimetically to (i.e., imitate manual signs for the names of) all tact and selection stimuli. During this phase, the experimenter presented the spoken instruction "do this" while modelling the sign for one of the stimuli in the set. If the participant imitated the sign correctly, the experimenter provided social reinforcement (e.g., "well done!") and a tangible reinforcer. If, however, the participant signed incorrectly, or made only an approximation to the correct sign, the experimenter provided hand over hand prompting to allow the participant to produce the correct sign. Prompts were faded over subsequent trials until the correct mimetic was achieved. Mastery criterion for each mimetic was 100% correct responding on five consecutive trials across two consecutive sessions. When the mimetic for one stimulus had been established, the mimetic for a second stimulus was established in identical fashion. This procedure was repeated until correct mimetics had been established for all stimuli.

7.2.5.3 Phase 3: Establish independent tact and selection responses using SCT.

The aim of this phase was to establish selection of selection stimuli and tacting of tact stimuli. Order of establishment of tact and selection responding was counterbalanced across participants. Response accuracy and level of prompting required by participants was recorded by the experimenter immediately subsequent to each trial. The number of participants' mimetic responses during establishment of selection responding trials was also recorded (i.e., if, on any trial, the participant imitated the experimenter's sign subsequent to the experimenter's instruction to "find [stimulus name]" (e.g., "find strawberry"), mimetic responding was recorded as present on that trial).

7.2.5.3.1 Sub-phase 3a: Establish tact responses.

On every trial during this sub-phase, the experimenter placed an individual tact stimulus on the table, said "what is it?", and immediately both modelled the sign for and spoke the name of the stimulus (e.g., "strawberry"). As during the previous phase, if the participant imitated the sign correctly, the experimenter provided reinforcement. If the participant responded incorrectly or gave an approximation to the correct sign, however, the experimenter, while once repeating aloud the name of the stimulus (e.g., "strawberry"), provided hand over hand prompting to allow the participant to produce the correct sign. Prompts were faded over subsequent trials until the participant was able to produce the sign unprompted in response to the pictorial stimulus and the instruction "what is it?" When correct signing had been established in response to one stimulus, the procedure was repeated in relation to another stimulus. When correct signing had been established for those first two stimuli, a stimulus rotation procedure (Carr et al., 1978) was employed, which involved alternating the presentation of the two stimuli in the same block of trials, intermixed with mastered imitation and receptive instructions trials, to ensure discrimination between the two newly learned tacts. Correct signing was established in this way in relation to all five tact stimuli. Mastery criterion for this sub-phase was 100% correct tacting of each tact stimulus on five consecutive trials with a response latency of less than 3-s across two consecutive sessions, using stimulus rotation.

7.2.5.3.2 Sub-phase 3b: Establish selection responses using SCT.

On every trial during this sub-phase, an auditory-visual match-to-sample task was presented to establish listener responding (i.e., selection by pointing or giving) to each individual selection stimulus in response to each stimulus' name, both spoken aloud and signed by the experimenter. On every trial, one selection stimulus was presented as sample and two other selection stimuli were presented as comparisons (one correct, or "target stimulus", and two incorrect). Each trial began with the experimenter placing three stimuli on the table, followed by the instruction "find [target stimulus]" (e.g., "find curtain"), spoken while signing the target stimulus' name. To establish correct responding to each selection stimulus, an errorless learning procedure was employed that involved the experimenter pointing to the target stimulus immediately subsequent to delivering spoken and signed instructions. This prompt was faded across trials until the participant was able to point to the target stimulus without prompting. Positions of comparison stimuli were then varied in pseudo-random order across all subsequent trials involving that stimulus. When correct performance had been demonstrated across three consecutive trials, stimulus rotation (Lovaas, 2003) was employed, and a different selection stimulus introduced as target stimulus, with the stimulus that had immediately previously served as target stimulus being presented as incorrect comparison. Responding to each remaining selection stimulus was established subsequently in the same way. Mastery criterion for this phase was 100% correct selection of each selection stimulus with a response latency of less than 3 s, across five consecutive trials, during two consecutive sessions, using stimulus rotation.

7.2.5.4 Phase 4: Test selection of selection stimuli.

The aim of this phase was to identify the source of stimulus control for the selection of selection stimuli established during Sub-phase 3b. Two types of assessment were carried out: "spoken instruction" and "signed instruction" (Sub-phases 4a and 4b, respectively). Order of assessments was counterbalanced across participants and order of target stimulus presentation and stimulus locations was varied pseudo-randomly across trials. Each assessment consisted of 10 trials (two trials per stimulus) presented during each of two consecutive sessions.

7.2.5.4.1 Sub-phase 4a: Spoken instruction.

On every trial during this sub-phase, the experimenter presented three selection stimuli on the table and gave, without signing, the spoken instruction: "find [target stimulus name]" (e.g., "find curtain").

7.2.5.4.2 Sub-phase 4b: Signed instruction.

On every trial during this sub-phase, the experimenter presented three selection stimuli on the table and said "find" immediately followed by the sign of the target stimulus (e.g., "find {sign for curtain}").

7.2.5.5 Phase 5: Test selection of tact stimuli and tacting of selection stimuli

The aim of this phase was to evaluate participants' tacting of selection stimuli and selection of tact stimuli (Sub-phases 5a and 5b, respectively). Order of testing was counterbalanced across participants. Target stimuli and stimulus locations were varied pseudo-randomly across trials, and each stimulus was presented twice as target stimulus across two consecutive sessions. Participants' spontaneous signing was recorded throughout.

7.2.5.5.1 Sub-phase 5a: Test tacting of selection stimuli.

On every trial during this sub-phase, the experimenter presented an individual selection stimulus followed by the vocal instruction "what is it?".

7.2.5.5.2 Sub-phase 5b: Test selection of tact stimuli using SCT.

On every trial during this sub-phase, the experimenter simultaneously presented three tact stimuli immediately followed by a combined vocal and signed instruction to select the target stimulus (e.g., "find table" while making {sign for table})

7.2.5.5.3 Sub-phase 5c: Test selection of tact stimuli using spoken instruction.

Identical to Sub-phase 4a, except that tact stimuli were presented.

7.2.5.5.4 Sub-phase 5d: Test selection of tact stimuli using signed instruction.

Identical to Sub-phase 4b, except that tact stimuli were presented.

7.2.5.6 Phase 6: Test intraverbal responding to tact and selection stimuli.

This phase, during which no pictorial stimuli were presented, tested for participants' spontaneous acquisition of intraverbal responding to the names of tact and selection stimuli.

On every trial, the experimenter gave the spoken instruction “sign [stimulus name]” (e.g., “sign strawberry”). Intraverbal responses to all tact and selection stimuli were each tested twice.

7.2.5.7 Phase 7: Test vocabulary.

Identical to Phase 1, except that Stage 2 stimuli were identified for subsequent presentation to individual participants during Phases 8 to 10.

7.2.5.8 Phase 8: Establish selection responding using SCT and test tacting and intraverbal responding (Baseline).

The aims of this phase were, firstly, to establish mimetics for all stimuli identified during Phase 7 for presentation to each participant prior to intervention (Sub-phase 8a), and secondly, to establish selection of those stimuli (Sub-phase 8b). Lastly, tacting of, and intraverbal responding to the names of, those stimuli were assessed (Sub-phases 8c and 8d, respectively). Order of presentation of Sub-phases 8c and 8d was counterbalanced across participants.

7.2.5.8.1 Sub-phase 8a: Establish mimetics.

Procedure identical to that of Phase 2.

7.2.5.8.2 Sub-phase 8b: Establish selection responding using SCT.

Procedure identical to that of Sub-phase 3b.

7.2.5.8.3 Sub-phase 8c: Test selection responding using spoken instruction.

Procedure identical to that of Sub-phase 4a.

7.2.5.8.4 Sub-phase 8d: Test tacting of selection stimuli.

Procedure identical to that of Sub-phase 5a.

7.2.5.8.5 Sub-phase 8e: Test intraverbals for tact and selection stimuli.

Procedure identical to that of Phase 6.

7.2.5.9 Phase 9: Establish tacting using intraverbal-selection to tacting procedures (Intervention).

During this phase, tacting of Set 5 stimuli was established through the following five sub-phases, presented in the same order to all participants. Table 21 summarises the experimenter’s instruction, participants’ correct response, consequence for correct responding, and sub-phase of presentation for each type of trial presented during this phase.

Trial type	Instruction	Response	Consequence	Sub-phase
	Components and sub-phases of trial presentation			
Mimetic-selection	"Find [target stimulus]" and models sign	Imitates sign and selects stimulus	Reinforcement	9b
Mimetic to intraverbal-selection transfer	a. "Find [target stimulus]" and models sign	Imitates sign and selects stimulus	None	9b
	b. "Find [target stimulus]"	Signs stimulus name and selects stimulus	Reinforcement	
Intraverbal-selection	"Find [target stimulus]"	Signs stimulus name and selects stimulus	Reinforcement	9b and 9c
Intraverbal-selection to tact transfer	a. "Find [target stimulus]"	Signs stimulus name and selects stimulus	None	9c
	b. "What is it?" and presents stimulus	Signs stimulus name	Reinforcement	
Tact	"What is it?" and presents stimulus	Signs stimulus name	Reinforcement	9d and 9e

Table 21. Experimenter's instruction, participants' correct response and consequence, and sub-phase of presentation for each type of trial presented during Phase 9.

7.2.5.9.1 Sub-phase 9a. Establish mimetics.

Procedure identical to that of Phase 2.

7.2.5.9.2 Sub-phase 9b. Establish mimetic to intraverbal-selection responding.

The aim of this sub-phase was to bring participants' selection responding under the control of their intraverbal responding to the experimenter's spoken instructions. Initially, mimetic-selection trials were presented, at the beginning of each of which, the experimenter placed three stimuli on the table followed by a simultaneously delivered spoken and signed instruction to "find [target stimulus]" (e.g., "find tortoise"), immediately followed by a pointing prompt to establish participants' selection of that stimulus. If the participant both imitated the sign and pointed to the target stimulus, the experimenter delivered social and tangible reinforcement. If the participant selected the target stimulus without imitating the experimenter's sign, however, reinforcement was not delivered, and the spoken and signed instruction was repeated, immediately followed by hand over hand prompting to allow the participant correctly to produce the sign for the target stimulus' name prior to selection of that stimulus. Prompts were faded over subsequent trials until the participant engaged in correct mimetic-selection responding on a single trial, at which point a mimetic to intraverbal-selection transfer trial was presented. The aim of this type of trial was to bring participants' selection under the control of their intraverbal, rather than their mimetic, responding. Mimetic to intraverbal-selection transfer trials were composed of two elements, the first of which involved the experimenter delivering a spoken and signed instruction to select the target stimulus (e.g., "find tortoise" and {sign for tortoise}), with no reinforcement delivered consequent to participants' accurate mimetic-selection. The second element, presented immediately subsequently, involved the experimenter delivering the spoken instruction “find [stimulus name]” (e.g., “find tortoise”). If the participant responded intraverbally and selected the target stimulus, the experimenter delivered reinforcement. If, however, the participant did not respond intraverbally, the mimetic to intraverbal-selection transfer trial was repeated. This procedure continued until correct intraverbal-selection of a target stimulus was demonstrated on a single trial, at which point, two further intraverbal-selection trials were presented involving the same target stimulus, during which the location of the target stimulus was varied pseudo-randomly. The same procedure was then carried out in relation to another target stimulus, until the criterion of three consecutive correct intraverbal-selections had been meet, at which point stimulus rotation (Lovaas, 2003) involving those two stimuli was carried out. The same procedure was then carried out in relation to all four other target stimuli. When intraverbal-selection responding had been established in relation to all six stimuli, Sub-phase 9c commenced.

7.2.5.9.3 Sub-phase 9c. Establish intraverbal-selection to tact transfer.

The aim of this sub-phase was to establish tacting as a result of participants’ intraverbal-selection responding using intraverbal-selection to tact transfer trials. At no point did the experimenter directly prompt participants’ tacting. Every trial was composed of two elements, the first of which involved the experimenter presenting the spoken instruction “find [target stimulus]” (e.g., “find tortoise”). If the participant correctly engaged in intraverbal-selection, no reinforcement was delivered, and the experimenter presented the target immediately followed by the spoken instruction “what is it?”. If the participant tacted the stimulus appropriately during this component of the first intraverbal-selection to tact transfer trial, expanded tact trials (Sub-phase 9d) were presented for that stimulus. If the participant did not tact the stimulus correctly, however, intraverbal-selection to tact transfer trials were repeated, until appropriate tacting of the target stimulus was demonstrated on a single trial, subsequent to which, expanded tact trials were presented.

7.2.5.9.4 Sub-phase 9d. Expanded tact trials.

Initially, a single distracter trial was presented, during which the participant engaged in a simple non-verbal task (e.g., gross motor imitation). Subsequent to this trial, a tact trial was presented involving the previously employed target stimulus. If appropriate tacting was not demonstrated on that trial, intraverbal-selection to tact transfer trials (Sub-phase 9c) were repeated until criterion for those procedures had again been met, at which point, expanded tact trials recommenced. If, however, appropriate tacting was demonstrated, the number of distracter trials presented prior to presentation of the next tact trial was increased, firstly to two, then to five, then to 10, and, lastly, to 20 trials between tact trials. When the participant had demonstrated correct responding subsequent to three distracter trials involving non-verbal tasks, additional distracter trials involving mastered tacts were interspersed with non-verbal distracter trials. If appropriate tacting was not demonstrated on any tact trial during this process, intraverbal-selection to tact transfer trials were repeated until criterion for those procedures had again been met. When appropriate tacting had been demonstrated subsequent to 20 distracter trials, Sub-phases 9c and 9d were repeated for all remaining Set 5 stimuli.

7.2.5.9.5 Sub-phase 9e. Probe maintenance of tact responses.

At the beginning of every session subsequent to that in which the criterion for expanded tact trials had been met for any intervention stimulus, maintenance of tacting of that stimulus was probed. This procedure was completed before establishment of intraverbal-selection to tact transfer responding for any remaining Set 5 stimulus commenced. When maintenance of tacting of all intervention stimuli had been demonstrated on two consecutive probe trials across two consecutive sessions, Phase 10 commenced.

7.2.5.10 Phase 10: Establish selection responding using SCT and test tacting and intraverbal responding (Testing).

The aims of this phase were, firstly, to assess whether Phase 9 intervention had resulted in participants becoming able to tact novel stimuli for which only selection responding had previously been directly taught, and, secondly, to assess whether participants' selection was under the control of spoken instruction. Lastly, whether participants were able to demonstrate intraverbal signing of the names of novel stimuli was assessed.

7.2.5.10.1 Sub-phase 10a: Establish mimetic responding.

Procedure identical to that of Phase 2.

7.2.5.10.2 Sub-phase 10b: Establish selection responding using SCT.

Procedure identical to that those of Sub-phase 3b.

7.2.5.10.3 Sub-phase 10c: Test selection responding using spoken instruction.

Procedure identical to that of Sub-phase 4a.

7.2.5.10.4 Sub-phase 10d: Test tacting of selection.

Procedure identical to that of Sub-phase 5a.

7.2.5.10.5 Sub-phase 10e: Test intraverbals of tact stimuli.

Procedure identical to that of Phase 6.

7.2.6 Data Recording and Reliability

	Trials		
Phase/Sub-phase	Delivered by	Recorded by	IOA calculated on (%)
1	Experimenter	Video and Observer	100
2	Experimenter or Tutor	Observer	30
3	Experimenter or Tutor	Video or Observer	30
4	Experimenter	Video	100
5	Experimenter	Video	100
6	Experimenter	Video	100
7	Experimenter	Video and Observer	100
8a	Experimenter or Tutor	Video or Observer	30
8b	Experimenter or Tutor	Video or Observer	30
8c	Experimenter	Video	100
8d	Experimenter	Video	100
8e	Experimenter	Video	100
9	Experimenter	Video or Observer	30
10a	Experimenter or Tutor	Video or Observer	30
10b	Experimenter or Tutor	Video or Observer	30
10c	Experimenter	Video	100
10d	Experimenter	Video	100
10e	Experimenter	Video	100

Table 22. Mode of delivery and recording of all trials during each phase of the research, and percentage of trials for which inter-observer agreement (IOA) was calculated.

Table 22 shows mode of delivery and recording of all trials during each phase of the research, and percentage of trials for which inter-observer agreement (IOA) was calculated.

7.3 RESULTS

All six participants completed Stage 1. Three participants did not demonstrate naming during Stage 1, all of whom progressed to and completed Stage 2.

7.3.1 Inter-Observer Agreement

Percentage IOA on participants’ responding was calculated by dividing the total number of agreements between the experimenter’s and tutor’s or observer’s recording of participants’ responses by the total number of agreements and disagreements between those ratings, multiplied by 100. All video-recorded trials were scored by the experimenter and an independent ABA clinician trained in Makaton and SignAlong sign systems. 100% IOA was obtained for Phases 1, 4, 6, and 7, and Sub-phases 8c, 8d, 8e, 10c, 10d, and 10e, and was never less than 92% for any other phase or sub-phase.

7.3.2 Phases 2 and 3: Establish Mimetics for all Stage 1 Signs and Establish Independent Tact and Selection Responses using SCT

Table 23 shows total trials to criterion for mimetic, tact, and selection responding during Phase 2 and Sub-phases 3a and 3b, and total spontaneous mimetics emitted on trials during Sub-phase 3b for all participants. Chris, David, and Josh demonstrated spontaneous mimetics on 100%, 94%, and 84% of selection trials, respectively. Ryan, Mike, and Harry, however, only demonstrated such responding on 30%, 71%, and 75% of selection trials, respectively.

Participants	Mimetics (Phase 2)	Tacts (Sub-phase 3a)	Selections (Sub-phase 3b)	Spontaneous mimetics (Sub-phase 3b)
Chris	12	25	19	19
David	10	28	37	35
Josh	43	47	72	61
Ryan	75	320	143	44
Mike	72	823	435	313
Harry	64	953	612	465

Table 23. Total trials to meet criterion for mimetic, tact, and selection responding during Phase 2 and Sub-phases 3a and 3b, and total spontaneous mimetics emitted on selection trials during Sub-phase 3b for all participants.

7.3.3 Phase 4: Test Selection of Selection Stimuli.

Table 24 shows all participants' total correct stimulus selections under SCT and in response to spoken and signed instructions, and total spontaneous intraverbal responses to spoken instructions. All participants demonstrated correct selection of all stimuli when trials were delivered using SCT. Chris, David, and Josh also correctly selected all stimuli on trials involving spoken and signed instructions, and also responded intraverbally on all trials during which spoken instructions were given. Ryan, Mike, and Harry, however, did not respond intraverbally on any of these trials. Only one of these three participants (Ryan), selected stimuli correctly on every trial on which spoken instructions were given, and Mike and Harry selected correctly on four and no trials, respectively. Ryan, Mike, and Harry achieved 16, 20, and 12 correct responses, respectively, on trials on which signed instructions were given.

Participants	SCT	Signed Instruction	Spoken Instruction	Spontaneous Intraverbal
Chris	20	20	20	20
David	20	20	20	20
Josh	20	20	20	20
Ryan	20	16	20	0
Mike	20	20	4	0
Harry	20	12	0	0

Table 24. All participants' total correct selections of selection stimuli under SCT and in response to spoken and signed instructions, and total spontaneous intraverbal responses to spoken instructions during Phase 4.

7.3.4 Phase 5: Test Tacting of Selection Stimuli and Selection of Tact Stimuli

Figure 13 shows total correct trials involving tacting of selection stimuli and selection of tact stimuli under SCT and in response to signed and spoken instructions, and spontaneous intraverbals emitted by participants during selection of tact stimuli under spoken instruction. Regarding selection of tact stimuli, David correctly selected all five stimuli, irrespective of whether trials were presented under SCT or with spoken or signed instruction, and also responded intraverbally on all trials during which instruction was spoken. Chris and Josh made four and two errors, respectively, when instruction was signed, and Chris also made two errors under SCT and under spoken instruction. All Chris' errors on these trials were made in relation to the same stimulus. Ryan and Mike correctly selected only one tact stimulus, but only Ryan also correctly selected that stimulus on all trials involving SCT and signed or spoken instruction. Neither Harry nor Mike correctly selected any stimulus when instruction was spoken, and these two participants also did not produce any spontaneous intraverbals on those trials. On every trial on which participants correctly selected a tact stimulus under spoken instruction, they also correctly intraverbally signed the name of that stimulus prior to selecting it. Furthermore, on no trial on which participants responded incorrectly was that selection preceded by appropriate intraverbal signing. With regard to tacting selection stimuli, Chris, David, and Josh demonstrated correct tacting of four, five, and three stimuli respectively.

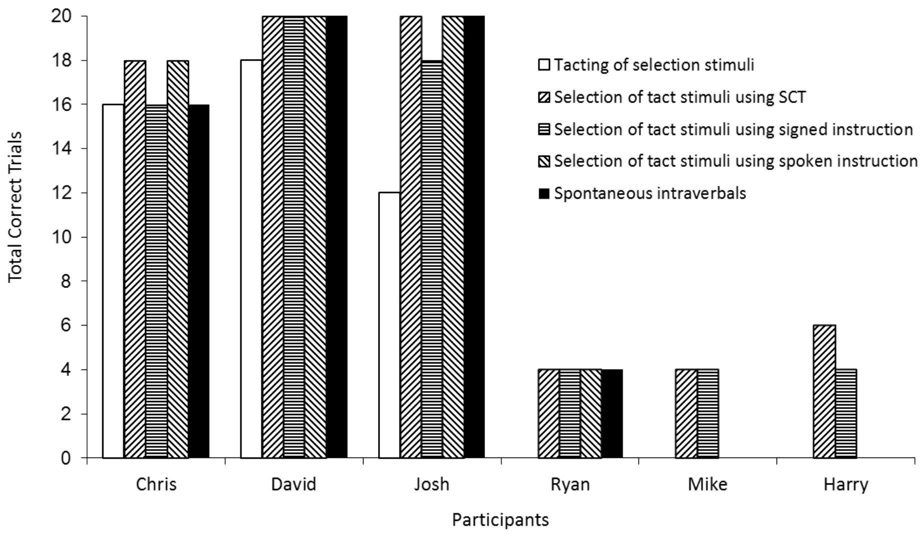

Figure 13. Total correct trials involving tacting of selection stimuli, selection of tact stimuli using SCT, and presentation of spoken and signed instructions (maximum 10 trials per trial type).

7.3.5 Phase 6: Test Responding to Tact and Selection Stimuli

Table 25 shows the total number of names of tact and selection stimuli for which participants produced intraverbals. David, Chris, and Josh responded intraverbally to the names of all tact stimuli, and also responded intraverbally to five, four, and three selection stimuli, respectively. Of the three remaining participants, none responded intraverbally to the names of any tact or selection stimulus, except Ryan, who responded intraverbally to the name of the single tact stimulus that he had selected correctly under spoken instruction during Phase 6.

Participants	Selection	Tact
Chris	16	20
David	20	20
Josh	12	20
Ryan	0	4
Mike	0	0
Harry	0	0

Table 25. Total intraverbal responses to tact and selection stimulus names during Phase 6.

7.3.6 Phases 8, 9, and 10: Establish Selection Responding using SCT and Test Tacting (Baseline), Establish Tacting using Intraverbal-selection to Tacting Procedures (Intervention), Establish Selection Responding using SCT and Test for Tacting (Testing), and Test for Intraverbal-selection using Spoken Instruction

Ryan, Mike, and Harry all completed Stage 2, but demonstrated varying acquisition rates during Phase 9 (intervention). Ryan required a total of 363 trials to tact the five intervention stimuli correctly, and Mike and Harry required 1245 and 1420 trials, respectively. Figure 14 shows all participants' total correct tact responses during each block of Phases 8 and 10, before and subsequent to Phase 9 intervention. No participant demonstrated correct tacting of any selection stimulus prior to intervention. Two participants, however, demonstrated such responding in every testing block subsequent to intervention. These participants also demonstrated correct intraverbal responding on all but two trials during these blocks. Harry also tacted correctly on 16 of 20 trials, all errors relating to the same stimulus, for which intraverbal responding was also absent.

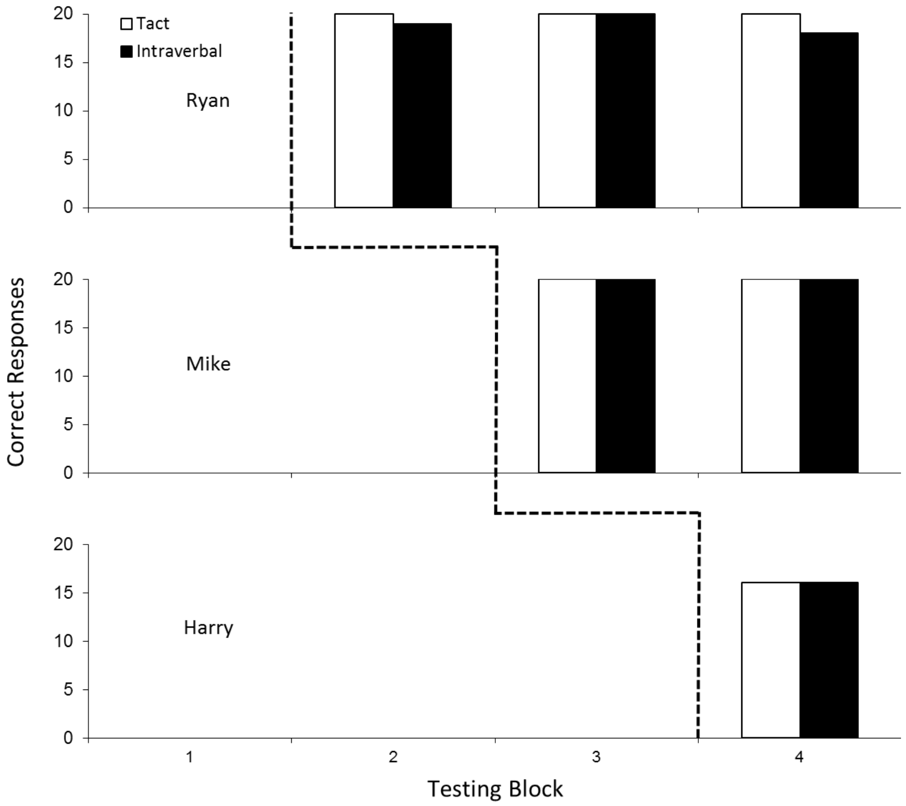

Figure 14. All participants' total correct tact responses during each block of Phases 8 and 10, before and subsequent to Phase 9 intervention. *Note*. Phase line denotes point of intervention.

Table 26 shows the percentage of trials on which participants responded mimetically during establishment of selection responding (Phases 8 and 10). Prior to intervention, no participant consistently demonstrated high levels of mimetic responding. Subsequent to intervention however, Ryan and Mike both demonstrated mimetic responding on all trials, and Harry responded mimetically on 86% of trials.

	Block			
Participants	1	2	3	4
Ryan	43	100	100	100
Mike	52	71	100	100
Harry	78	70	69	86

Table 26. Percentage of trials for all participants during establishment of selection responding on which mimetic responding was also present (Phases 8 and 10). *Note*. Phase line denotes point of intervention (Phase 9).

Figure 15 shows total trials, out of 20, on which participants correctly selected in response to spoken instructions and produced intraverbals to the names of target stimuli. Ryan and Mike demonstrated accurate intraverbal-selection on every trial subsequent to intervention, and

Harry made only two errors, both of which related to the same target stimulus—the stimulus that he had also previously both failed correctly to respond to intraverbally and to tact.

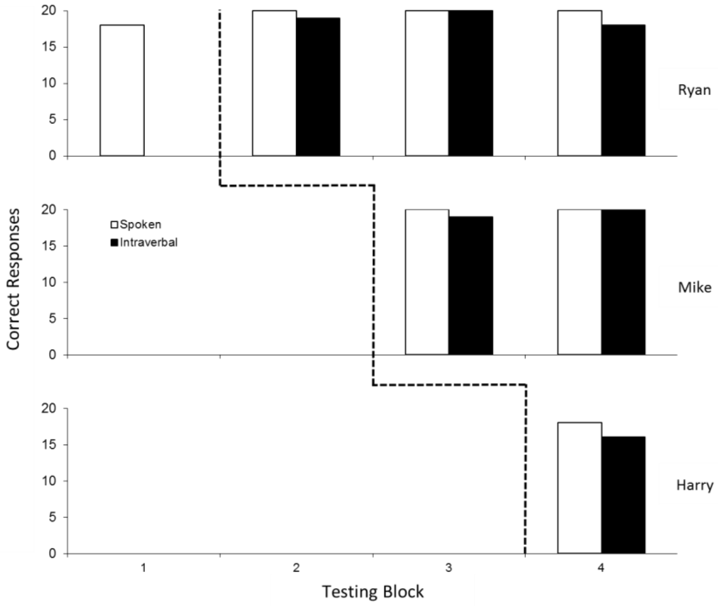

Figure 15. Total trials on which correct selections were made in response to spoken instructions and total trials on which spontaneous intraverbals were produced during such responding.

7.4 DISCUSSION

The present research sought to investigate, among non-vocal children with autism who sign, whether intraverbal responding is functional in the emergence of naming in the same way that echoic responding was demonstrated to be functional among vocal children with autism during the research reported in Chapter 6. Stage 1 assessed whether, subsequent to independent establishment of tact and selection responding, participants would demonstrate intraverbal signing and the bidirectional selection and tacting of stimuli that, together, are definitional of naming. Stage 2 investigated whether, among participants who had not demonstrated such responding during Stage 1, tacting would emerge as a result of an intervention that established intraverbal-selection to tact responding (cf. Horne & Lowe, 1996).

Subsequent to vocabulary testing and establishment of mimetics to Stage 1 stimuli (Phases 1 and 2, respectively), Phase 3 established independent tacting and selection responding using SCT. Varying rates of acquisition and levels of mimetics were observed across participants during establishment of selection responding during this phase. During Phase 4, assessments were carried out to evaluate whether participants' selection of stimuli was under the control of spoken or signed instructions. Spoken instructions were identified as controlling the selections of four participants (Chris, David, Josh, Ryan), all of whom except one (Ryan) were also observed to have intraverbally signed all stimulus names prior to selection. Three of these participants (Chris, David, Josh) had also shown high levels of mimetic responding during Phase 3 selection training, suggesting that, for these participants, intraverbal responding had emerged as a result of exposure to combined spoken and signed instructions (i.e., SCT) during that phase. In other words, signs produced by these participants during selection training were under the control both of the experimenter's modelled signs and spoken instructions, and therefore functioned as mimetics and intraverbals, respectively.

Chris, David, and Josh were also the only participants to demonstrate high levels of correct tacting of selection stimuli and selection of tact stimuli (i.e., both components of the name relation) during Phase 5. For these participants, therefore, it may be suggested that intraverbal responding had resulted in the emergence of bidirectional relations between speaker and listener behaviour in the same way that echoic responding had promoted such responding among vocal participants in the research reported in Chapter 6. The results of Phase 6 provided further confirmation of this finding, indicating that Chris, David, and Josh were also the only participants to have demonstrated spontaneous acquisition of intraverbals for the names of stimuli employed during the establishment of tacting and selection. It should be noted that Josh, who had failed correctly to tact two specific stimuli during Phase 5, also did not demonstrate intraverbal responding to those two stimuli during Phase 6. Because Chris, David, and Josh had demonstrated naming during Stage 1, those participants did not take any further part in the present research. Ryan, Mike, and Harry, however, did not demonstrate bidirectional responding during Stage 1, and therefore progressed to Stage 2.

Stage 2 was designed to evaluate the effectiveness of an intervention that sought to establish generalised tacting on the basis of intraverbal-selection responding. Subsequent to vocabulary testing during Phase 7, Phase 8 confirmed that no participant was able to tact novel stimuli as a result of previously established selection of those stimuli. During Phase 9 intervention, a set of procedures was presented, the aim of which was to change the source of control of participants' signing during selection training under SCT from modelled signs to the spoken instructions, and, on this basis, to produce intraverbal responding. Because, during this process, intraverbal responses were emitted in the presence of pictorial stimuli, it can be suggested that participants' intraverbals had simultaneously functioned as tacts, and that the procedure had thus established combined speaker and listener behaviour during selection trials under SCT. In so doing, therefore, participants had (as had those during the research reported in Chapter 6) become speakers and listeners within the same skin (Horne & Lowe, 1996; Skinner, 1957). In confirmation of this suggestion, the results of Phase 10 indicated that, consequent to intervention, all three participants had become able correctly to tact novel stimuli subsequent to learning to select those stimuli, and that Mike and Harry, who, during Stage 1, had been able to select stimuli correctly only under the control of signed instructions or SCT, had become able also to do so under the control of spoken instructions alone.

Taken overall, therefore, the results of the present research indicate that, among non-vocal children with autism who sign, intraverbal responding can be functional in the emergence of naming in the same way that echoic responding was demonstrated to be functional among the vocal children with autism who participated in the research reported in Chapter 6. Although no published studies have previously attempted to investigate such considerations in the emergence of verbal behaviour among such participants, it should be noted that the present research was able only to investigate the effectiveness of procedures designed to establish the emergence of generalised speaker behaviour consequent to establishment of listener behaviour—the most critical component of the name relation. Owing to a range of practical constraints, investigation of the use of such procedures to promote the emergence of generalised listener behaviour was not possible, and its potential utility therefore remains, at present, undetermined.

It is also worthwhile to consider the present findings in relation to the content of published EIBI curricula, only one of which (ABLLS; Partington & Sundberg, 1998) currently incorporates use of sign language as a form of AAC. Although, within this curriculum, skills are broadly categorised within the framework of Skinner's (1957) verbal operants, no mention is made either of bidirectional verbal relations or of procedures to promote their emergence. In addition, and in common with other, more structurally-based curricula (e.g., Leaf & McEachin, 1999; Lovaas, 1981/2003; Taylor & McDonough, 1996), the ABLLS is organised in such a way that tacting and listener responding are established separately (see Chapter 4). On the basis of the results of Stage 2, therefore, it must be suggested that such organisation may not be optimal in teaching verbal behaviour to children with autism. Indeed, it may be further suggested that the current findings indicate that, among non-vocal children with autism who sign, the teaching procedures employed in the present research offer both an efficient and effective means of integrating the prerequisite bidirectional speaker and listener repertoires of naming, and, thereby, of establishing naming itself.

Lastly, it should be noted that no published applied research has yet attempted to investigate the emergence of bidirectional responding beyond the single-word level. Indeed, in developing their account of naming, Horne and Lowe (1996) did not provide direct theoretical discussion of the contingencies responsible for the emergence of more complex verbal relations. In practice, however, EIBI for autism regularly, and necessarily, goes beyond attempting to establish verbal behaviour at the single-word level, and curricula must therefore detail procedures to teach increasingly complex repertoires of speaker and listener responding. Because of the centrality of this component of intervention to the education of children involved, behavioural clinicians should be in a position to develop intervention procedures informed by theoretical and empirical research that has identified the contingencies necessary for most effectively promoting the emergence of complex verbal relations. Although Horne and Lowe's (1996) account of naming, as noted above, offers many practical and conceptual advantages in understanding and manipulating the emergence of such bidirectional responding, it can be argued that Lowenkron's (1998, 2006) account of joint control can provide additional benefits through the molecularity of its account of the contingencies prerequisite for establishment of generalised multi-component listener behaviour (see Chapter 3). The following chapter therefore reports research carried out to investigate the utility of joint control procedures as a means of establishing generalised listener behaviour to complex instructions in children with autism, and, thereby, as a basis for designing procedures to promote the acquisition of complex verbal behaviour within EIBI for autism.

8. TEACHING GENERALISED LISTENER BEHAVIOUR TO CHILDREN WITH AUTISM

8.1 INTRODUCTION

The research reported in Chapters 6 and 7 was carried out to investigate the roles of the echoic and the intraverbal in the emergence of single-word bidirectional responding in children with autism, and, thereby, to provide controlled evaluation of applied procedures, reported in Chapter 5, that had established generalised speaker behaviour to stimuli to which only listener behaviour had previously been demonstrated. Results confirmed the functionality of the echoic in the emergence of such responding among vocal children with autism, and also that the intraverbal fulfilled a similarly functional role among non-vocal children with autism who sign. It was also observed, however, that although Horne and Lowe's (1996) account of naming offers many advantages in both understanding and establishing such responding at the single-word level, Lowenkron's (1998, 2006) account of joint control may provide additional benefits through its molecular description of the contingencies necessary for establishment of generalised multi-component listener behaviour.

It should be noted that although some research (e.g., Jahr, 2001; Koegel et al., 1988; Krantz, Zalewski, Hall, Fenski, & McClannahan, 1981; Risley & Wolf, 1967) has previously evaluated strategies for establishing speaker behaviour, only a small number of studies have addressed the development of procedures designed to increase listener behaviour beyond the level of single-word conditional discriminations (e.g., select "cup", reject "train"). The majority of such research has investigated the effects of using language matrix training procedures to increase listener behaviour in children with intellectual disabilities (e.g., Bunce, Ruder, & Ruder, 1985; Ezell & Goldstein, 1989; Goldstein, 1983). Language matrices provide a means of generating sets of compound (i.e., multi-element) stimuli from different arrangements of individual stimulus elements.

Figure 16 shows an example of a 3 x 3 language matrix (adapted from Esper, 1925) within which nine two-element colour-noun pictorial stimuli can be generated by arranging three colour elements (e.g., 'red', 'blue', 'green') into the columns of the matrix and three noun elements (e.g., 'car', 'boat', 'plane') into the rows. As in a multiplication table, the content of each cell in the matrix is the product of the intersection of an individual row and a column, each cell providing, in this example, a unique colour-noun combination ('red car', 'green car', 'blue car', 'red boat', 'green boat', etc.). Discrimination training procedures are typically employed to teach a subset of the stimuli within an individual matrix, with generalisation of listener responding subsequently assessed using conditional discrimination test trials involving presentation of all other stimuli in the matrix (i.e., all previously unpresented colour-noun combinations).

	Red	Blue	Green
Car	Red car	Blue car	Green car
Boat	Red boat	Blue boat	Green boat
Plane	Red plane	Blue plane	Green plane

Figure 16. Example of a 3 x3 language matrix (adapted from Esper, 1925) in which six pictorial stimulus elements (here represented by their names) composing the row and column headers combine to produce nine two-element compound pictorial stimuli.

Research has indicated the effectiveness of matrix training procedures in promoting the acquisition of listener responding in children with intellectual disabilities using preposition-object (Bunce et al., 1985), agent-action (Goldstein, 1983), object-location (Ezell & Goldstein, 1989), and action-object (Mineo & Goldstein, 1991; Striefel, Wetherby, & Karlan, 1976) procedures. On the basis of such findings, Peterson, Larson, and Riedesel (2003, p. 140) have suggested that matrix training procedures may provide a means of establishing generalised listener behaviour in children with autism, thereby complementing existing language training procedures to provide "a comprehensive generative language training program" within the context of EIBI for autism.

Although such findings have provided initial evidence of the effectiveness of language-matrix training procedures, comparatively little attention has been focused on theoretical interpretation of the research. Some researchers have suggested that training on a language matrix may allow participants to formulate a "combination rule" that subsequently governs their selection of novel stimuli (Mineo & Goldstein, 1990; Striefel et al., 1976). Specific training on one element of every novel multi-element stimulus has nevertheless always proved necessary for generalisation to occur, as Mineo and Goldstein (1990) have pointed out. Importantly, a number of researchers have also reported that teaching children to echo the experimenter's verbal behaviour can lead to improved accuracy of performance and generalisation on a range of receptive language based tasks (Charlop, 1983; Ezell & Goldstein, 1989; Koegel, Dunlap, Richman, & Dyer, 1981; see Chapter 6). Such data have further led researchers to propose that speaker behaviour may facilitate the development of complex listener behaviour (Ezell & Goldstein, 1989; Mineo & Goldstein, 1990).

Although strongly indicative of the centrality of verbal behaviour to generalised listener responding, only one theoretical account has so far attempted to provide a molecular description of how generalised multi-component listener responding actually comes about (Lowenkron, 1998, 2006). As discussed in Chapter 3, joint control describes how the interaction of the echoic and the tact results in generalised stimulus selection (i.e., generalised listener behaviour). According to Lowenkron (1998, 2006), joint control occurs at the moment when these verbal operants come jointly to exert control over a single, common, verbal response topography. Through repeated exposure to multiple stimulus exemplars, joint control can, itself, become established as a generalised, or higher order, class of behaviour that controls specific responses on the basis of the sudden increase in response strength that occurs at the moment when joint control occurs (Palmer, 2006). On this basis, it should be noted, jointly controlled responding can occur in relation to abstract dimensions such as colour, size, shape, prepositions, and multiple-word descriptions (Lowenkron, 1998, 2006).

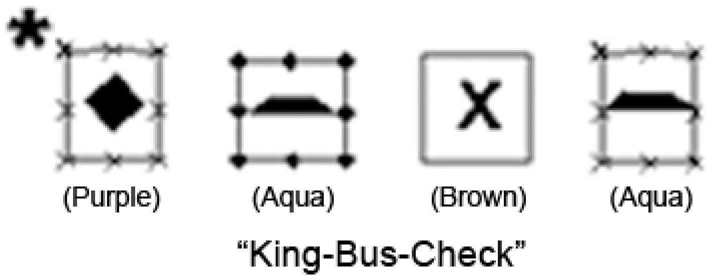

Figure 17. Example of a typical trial array composed of four individual three-element (i.e., shape, colour, border) arbitrary visual stimuli employed by Lowenkron (2006, Experiment 1). *Note.* Asterisk denotes target stimulus for spoken sample stimulus indicated in quotes.

In a study using a match-to-sample methodology (Lowenkron, 2006), eight typical children, aged between 5 and 7 years, were taught to select every member of a six-member set of arbitrary compound stimuli in response to spoken three-element "descriptions" of those stimuli. Each description was composed of three arbitrary words, each denoting the shape, colour, or border type of an individual compound stimulus (see Figure 17). Although children learned to select (i.e., display listener behaviour towards) each of the six compound stimuli in response to their descriptions, subsequent generalisation testing revealed that no child could accurately tact (i.e., engage in speaker behaviour towards) the stimuli despite having previously received more than 400 selection training trials. Participants additionally failed to show generalised selection responding when, in a subsequent test, they were asked to select novel compound stimuli composed of the individual elements that had formed components of the compound stimuli presented previously during the training phase. In addition, although participants were subsequently taught to tact the individual elements of the compound stimuli presented individually, all remained unable to demonstrate generalised selection responding. Such responding was only achieved after tacting of all elements combined (i.e., feature, colour, and shape) of every compound stimulus presented had been established. On the basis of these findings, it was concluded that the tact component of joint control is a necessary prerequisite for the emergence of generalised listener responding.

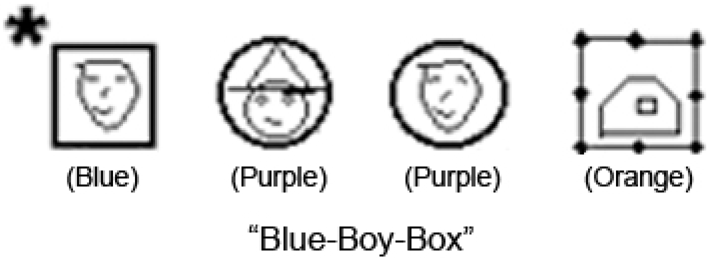

Figure 18. Example of a typical trial array composed of four individual four three-element (i.e., shape, colour, border) visual stimuli employed by Lowenkron (2006, Experiment 2). *Note.* Asterisk denotes target stimulus for spoken sample stimulus indicated in quotes.

In a second experiment using different participants and stimuli but the same match-to-sample methodology, Lowenkron (2006) investigated the role of the echoic (and self-echoic) component of joint control using a set of stimuli composed of three familiar elements (shapes, colours, and borders). As during the previous experiment, participants were taught, during an initial phase, to select compound stimuli in response to spoken three-element descriptions. Each description was composed of three familiar words describing the three familiar elements of the compound target stimulus presented for selection (see Figure 18). Subsequent testing for generalisation of tacting presented novel multi-element stimuli, each composed of different combinations of the stimulus elements that had composed stimuli during training. During this testing phase, all participants were able successfully to tact the novel multi-element stimuli presented. After participants had demonstrated accurate tacting of these stimuli, the role of echoing and self-echoing (i.e., repeated echoic rehearsal) in selection responding was explored. On each trial during this second phase of the experiment, time delays were employed between the spoken sample descriptions provided by the experimenter and presentation of visual comparison stimuli. To prevent self-echoic rehearsal during these delays, participants were asked to read numbers from a constantly changing numeric display presented contiguously with the comparison stimuli. It was found that, when self-echoics were prevented in this way, accurate selection declined as a function of increased time delay to the point at which accurate responding ceased. This finding suggested that self-echoic rehearsal is functional in selection responding over time, and that, therefore, listener behaviour is verbal in nature (cf. Schlinger, 2008).

It follows from this account that, to establish generalised listener responding to novel spoken word combinations, selection responses must occur under joint tact and echoic/self-echoic control. Extrapolation of these findings to applied contexts would further suggest that teaching children with autism to engage in listener behaviour based on "mediated" (i.e., verbally controlled) selection may provide an effective means of establishing generalised responding to novel combinations of known stimuli in the absence of additional teaching. Given the generalisation deficits typically displayed by such children in responding to language, the development of a strategy to facilitate remediation of these deficits would have important clinical implications.

Using children with autism who were already able to name stimuli, and whose speaker and listener repertoires were at the level of single-word discriminations, the present research was carried out to explore the effects of establishing jointly controlled responding to non-arbitrary compound pictorial stimuli composed of two-word colour-noun combinations. The present research also sought to investigate the extent to which, having learned to respond under joint control to one set of stimuli, participants would be able to respond correctly to novel sets of stimuli composed of untrained two-element (i.e., colour-noun and agent-action) combinations. By investigating the use of joint control procedures as a means of establishing generalised listener behaviour in children with autism, the present research thus aimed to provide additional evaluation of joint control as a conceptual framework for understanding the interaction of speaker and listener behaviour, and as a basis for promoting the acquisition of verbal behaviour within applied contexts.

8.2 METHOD

8.2.1 Participants

Three boys with autism (M_{age} = 6.6 years, age range: 6-8 years) participated in the present research. Each had previously received a diagnosis of Autistic Spectrum Disorder and all had vocal verbal behaviour. One participant (Dane) had only recently learned to respond vocally but had previously used sign language. Although this participant's tact responses were vocal, he often also signed words while speaking them. All participants had previously received

EBIC-based EIBI, and had mastered beginner level skills up to and including naming (see Chapters 4 and 5). All participants were able to sit at a table and respond to adult instructions for up to 30 min consecutively. Ethical Approval from the University of Southampton and Informed Consent for all participating children from parents was obtained prior to the research.

8.2.2 Setting

All experimental sessions were conducted in a quiet room in each participant's own home, within which the experimenter and child sat on opposite sides of a small table. Each child's home-based tutor was also present during all experimental sessions and sat approximately two metres away from the table behind the child.

8.2.3 Procedure and Materials

For two participants (Adam and Gary), the experiment consisted of six phases (Phases 1 to 5 and 8). Dane received two supplementary training and testing phases (Phases 6 and 7). All participants' Phase 5, 7, and 8 sessions were video-recorded. Owing to technical difficulties during Phase 2 testing, only one of Adam's two sessions, two of three of Gary's sessions, and two of four of Dane's sessions were video recorded. Figure 19 shows the experimental procedure for all participants.

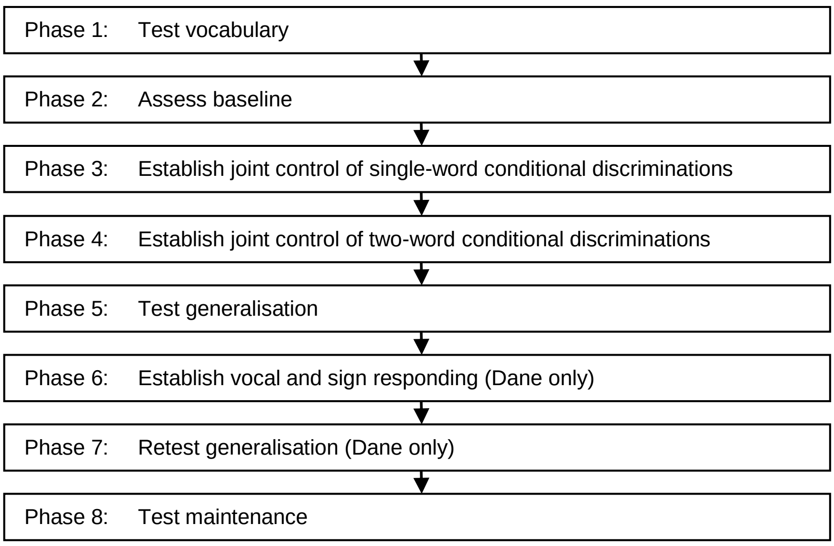

Figure 19. Overview of experimental procedure for all participants (Phases 1 to 8). *Note.* Only Dane received Phase 6 vocal and sign training and Phase 7 generalisation retesting.

8.2.3.1 Phase 1: Test vocabulary.

Phase 1 tested participants' vocabulary to ensure that each participant was able to demonstrate appropriate speaker and listener responding to the names of all simple (i.e., single-element) stimuli and all individual elements of compound stimuli to be presented subsequently during the experiment. During this phase, all participants were required, in separate testing blocks, to tact, echo, and select each of 10 simple pictorial stimuli and 20 pictorial stimulus elements, each presented on an individual laminated card (10cm x 8cm). Simple stimuli were composed of colour photographs of everyday objects and animals (clock, cup, shoe, bike, table, hat, plate, boat, pen, duck). Stimulus elements were six black and white line drawings of objects (train, car, spoon, plane, house, ball), four colour photographs of "agents" (dog, teddy, baby, cat), six colour swatches (red, blue, yellow, green, orange, purple), and four black and white line drawings depicting actions (sleeping, eating, drinking, reading). Figure 20 shows examples of elements of compound stimuli presented during this phase of the experiment.

Figure 20. Examples of (from left to right) action (eating), colour photograph (cat), and object (plane) elements of compound stimuli presented during pre-experimental vocabulary testing (Phase 1).

Order of presentation of tact, echoic, and selection testing blocks was varied pseudo-randomly across participants. During tact testing, the experimenter placed stimuli individually on the table in front of the participant and gave one of the following verbal instructions; "what is it?" (for objects, animals, and photographs), "what colour?" (for colour swatches), or "what is he doing?" (for actions). During echoic testing, the experimenter did not present any visual stimulus but simply gave the vocal instruction "say [sample name]" (e.g., "say teddy"). During selection testing, four comparison stimuli, each from the same class of stimuli as the sample, were placed intermixed in pseudo-random order in a row on the table in front of the participant who was then asked to select the target stimulus in response to the verbal instruction "find [target stimulus name]" (e.g., "find teddy"). The position of the target stimulus was varied pseudo-randomly across trials and never remained in the same location for more than two consecutive trials. Each participant was exposed to all 90 possible trial configurations (i.e., tacting, echoing, and selecting each of 10 simple stimuli and 20 stimulus elements). If participants did not respond correctly on any trial, that trial was immediately represented. Criterion for proceeding to Phase 2 was correct responding on either the first or second presentation of every trial.

8.2.3.2 Phase 2: Assess baseline.

A multiple-probe multiple-baseline across-participants design was employed during this phase with participants assigned randomly to two (Adam), three (Gary), or four (Dane) week baselines. Each participant was tested individually and every participant's sessions were conducted on the same day of the week at weekly intervals. During each session, participants' selection of each compound stimulus to be presented subsequently during the experiment was tested. Each compound stimulus was composed of a combination of two of the stimulus elements presented during Phase 1. Three sets of unique compound pictorial stimuli were employed. Set 1 consisted of nine stimuli, each composed of a line drawing of one of three objects (car, spoon, train) depicted once in one of three colours (red, blue, yellow). Set 2 consisted of nine additional stimuli, each composed of a line drawing of one of three common objects (house, plane, ball) depicted once in one of three colours (orange, purple, green). Set 3 consisted of 16 further stimuli, each composed of a photograph of one of four agents (baby, dog, teddy, cat) engaging in one of four actions (eating, drinking, sleeping, reading). Set 1 and 2 stimuli thus provided "colour-object" combinations and Set 3 stimuli provided "agent-action" combinations.

A match-to-sample methodology was employed, within which, on every trial, four stimuli were presented on a laminated sheet of card (20cm x 18cm). Every trial presented three incorrect comparison stimuli and one target stimulus, the location of which varied pseudo randomly across trials (see Figure 21). On every trial involving Set 1 stimuli, two stimuli shared a common object element and two shared a common colour element. For example, a typical trial (as illustrated in the left hand panel of Figure 21) might present "blue car" as the target stimulus and "blue train", "red car", and "red train" as incorrect comparisons. On every trial involving Set 2 stimuli, two stimuli shared a common object element and two shared a common colour element. For example, a typical trial (as illustrated in the middle panel of Figure 21) might present "orange ball" as target stimulus and "orange plane", "green ball", and "green plane" as incorrect comparisons. On every trial involving Set 3 stimuli, two stimuli shared a common agent element and two shared a common action element. For example, a typical trial (as illustrated in the right hand panel of Figure 21) might present "cat eating" as target stimulus and "dog eating", "cat reading", and "dog reading" as incorrect comparisons.

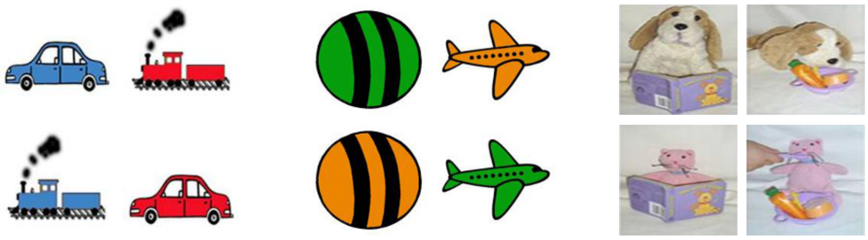

Figure 21. Examples of four-stimulus arrays presented during baseline assessment trials (Phase 2), involving (from left to right) Set 1, Set 2, and Set 3 stimuli.

Three blocks of trials were presented during every session, each composed of either Set 1, Set 2, or Set 3 stimuli. Order of presentation of blocks was varied pseudo-randomly across participants. During each block, every stimulus was presented twice as target stimulus. On each trial of every block, the experimenter initially presented an individual sheet of stimuli followed, within 2-s, by the verbal instruction "where is [target stimulus name]" (e.g., "where is cat drinking"). The experimenter did not provide feedback consequent to participants' responses during this phase. To maintain participants' on-task behaviour, however, the experimenter asked participants to carry out a familiar action or imitative response between every two or three trials for which a previously identified reinforcer was presented. A total of 68 trials was presented to each participant during this phase.

8.2.3.3 Phase 3: Establish joint control of single-word conditional discriminations.

The aim of this phase was to establish jointly controlled selection of the 10 simple pictorial stimuli previously presented during Phase 1. To achieve this, the experimenter initially spoke the name of an individual stimulus (e.g., "phone") while using a joint control gestural prompt (Tu, 2006) that involved pointing to her mouth to draw the participant's attention to her verbal utterance and to reduce the likelihood of the participant engaging in listener behaviour (e.g., looking for the stimulus named) in response to the verbal instruction. Immediately subsequent to this, the experimenter pointed to the participant to prompt echoic responding. If the participant did not immediately echo the experimenter's utterance, the experimenter said "say [stimulus name]" (e.g., "say phone") while pointing to the participant as an additional prompt to echoic responding. This procedure was repeated until the participant responded echoically to the experimenter's initial verbal instruction alone (i.e., the experimenter's initial utterance of the stimulus' name). When echoic responding had been established in relation to an individual stimulus' name, self-echoic responding was taught in relation to that name, as follows. Immediately subsequent to the participant emitting an echoic in response to the experimenter's initial verbal instruction, the experimenter pointed again at the participant as a prompt to repeat the initial echoic (i.e., as a prompt for self-echoic responding). Immediately consequent to the participant's spontaneous production of a sequence of consecutive responses composed of an echoic followed by one or more self-echoic responses, a card (20cm x 18cm) was placed on the table in front of the participant on which was depicted the previously named pictorial stimulus as sample and three comparison stimuli from the same set. The experimenter then immediately used hand over hand prompting to ensure that the participant selected the target from among those stimuli. The same array of stimuli was then represented until the participant was immediately able to respond both echoically and self-echoically and accurately to select the target stimulus as a result of his own verbal behaviour. Subsequent to establishment of jointly controlled responding to a first stimulus in this way, the procedure was repeated in relation to all nine other simple pictorial stimuli. As soon as the participant was able to demonstrate jointly controlled responding at 100% accuracy in relation to all 10 visual stimuli on 10 consecutive trials across two consecutive training sessions, Phase 4 commenced. Figure 22 illustrates a successfully completed Phase 3 training trial subsequent to establishment of jointly controlled selection responding in relation to the stimulus "phone".

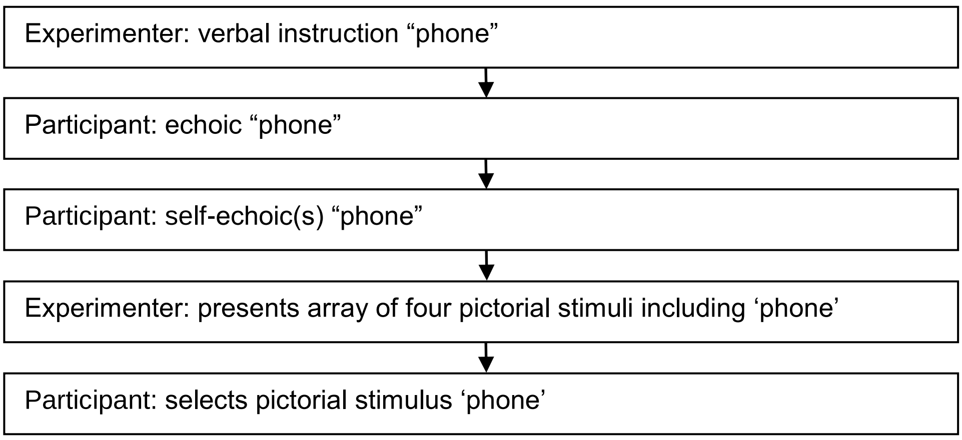

Figure 22. Example of a successfully completed Phase 3 training trial subsequent to establishment of jointly controlled responding to the pictorial stimulus 'phone'.

8.2.3.4 Phase 4: Establish joint control of two-word conditional discriminations.

This phase presented only Set 1 stimuli previously presented during Phase 2 testing and was composed of the following two sub-phases, presented in the same order to all participants.

8.2.3.4.1 Sub-phase 4a: Establish two-word tacts.

On every trial, the experimenter placed four laminated cards (10cm x 8cm) in a row on the table in front of the participant, each of which presented a single Set 1 compound stimulus (e.g., blue car, red car, blue train, red train), followed, within 2-s, by spoken instruction to "tell me what they are". Immediately subsequent to this instruction, the experimenter pointed to the left hand card on the table and prompted the participant's full two-word tact for that stimulus (e.g., "blue car"). If the participant immediately echoed the experimenter's spoken instruction, the procedure was repeated in relation to the second stimulus from the left in the array, and, subsequently, in the same manner, in relation to the remaining two stimuli in the array. If the participant did not echo the experimenter's tact on any trial, however, the experimenter's spoken instruction was repeated until appropriate responding was established. Subsequent to accurate echoing of the experimenter's tact in relation to all four stimuli, the experimenter presented the spoken instruction to "tell me what they are". If the participant successfully tacted each of the stimuli on the table, the location of the stimuli was changed and the instruction to "tell me what they are" repeated in relation to each stimulus, to control for potential order effects. This procedure was repeated until participants were able accurately to tact all nine Set 1 stimuli twice on 18 consecutive trials, across two consecutive sessions. When this criterion had been met, Sub-phase 4b commenced.

8.2.3.4.2 Sub-phase 4b: Establish selection based on self-echoics.

On every trial, one of the laminated cards (20cm x 18cm) previously presented during Sub-phase 4a was placed on the table in front of the participant. Within 2-s of presentation, the experimenter vocally tacted one of the stimuli on the card and employed joint control gestural prompting to establish the participant's echoic and self-echoic responding in relation to that stimulus (see Section 8.2.3.3). Selection responding was then established in relation to that stimulus using hand over hand prompting. Prompt fading was then employed until an accurate unprompted sequence of echoic, self-echoic, and selection responding was established in relation to that stimulus. This procedure was then repeated in relation to all three other stimuli presented on the card. When accurate echoic, self-echoic, and selection responding had been established in relation to each of these stimuli, a different card was presented and the procedure repeated. When participants were able to respond accurately in this way to all nine Set 1 stimuli on 18 consecutive trials across two consecutive sessions, Phase 5 commenced.

8.2.3.5 Phase 5: Test generalisation.

Procedure identical to that of Phase 2.

8.2.3.6 Phase 6: Establish vocal and sign responding (Dane only).

Owing to a specific pattern of errors observed in Dane's responding to three specific elements of compound stimuli presented during Phase 5 (see Section 8.3.6, below), this participant was exposed to two additional teaching procedures that both prompted and differentially reinforced the emission of appropriate signed responses when separately echoing and tacting the names of those stimuli. This was accomplished using the following two sub-phases.

8.2.3.6.1 Sub-phase 6a: Establish echoic-sign responding.

Initially, the experimenter spoke the name of one of the three stimulus elements and immediately modelled the sign for that word for Dane to imitate. If Dane echoed the word but did not imitate the sign, the experimenter provided hand over hand prompting to produce the correct sign. If Dane imitated the sign but did not echo the spoken word, the experimenter repeated the word with the additional vocal prompt to “say [stimulus name]” (e.g., “say purple”). Physical and vocal prompts were faded until Dane was able simultaneously to echo and sign appropriately in response to the experimenter’s initial spoken instruction. When Dane had demonstrated errorless simultaneous echoic and sign responding to all three stimulus elements in a single session, Sub-phase 6b commenced.

8.2.3.6.2 Sub-phase 6b: Establish vocal-sign tact responding.

Initially, the experimenter presented an individual pictorial stimulus element and immediately delivered the spoken instruction corresponding to that stimulus (e.g., “what colour?” or “what is he doing?”, in relation to colour and action stimulus elements, respectively). Correct responses were followed by immediate social reinforcement. Incorrect responses resulted in removal of the pictorial stimulus for 5-s prior to representation paired with immediate vocal or physical prompting to correct responding.

8.2.3.7 Phase 7: Retest generalisation (Dane only).

Procedure identical to that of Phase 5.

8.2.3.8 Phase 8: Test maintenance.

This phase was presented 30 days after completion of Phase 5 testing (participants Adam and Gary) or Phase 7 retesting (Dane), but was otherwise identical to Phase 5.

8.3 RESULTS

All participants completed the experiment. Figure 23 shows each participant's percentage correct responses during Phases, 2, 4, 5, 7, and 8 of the experiment.

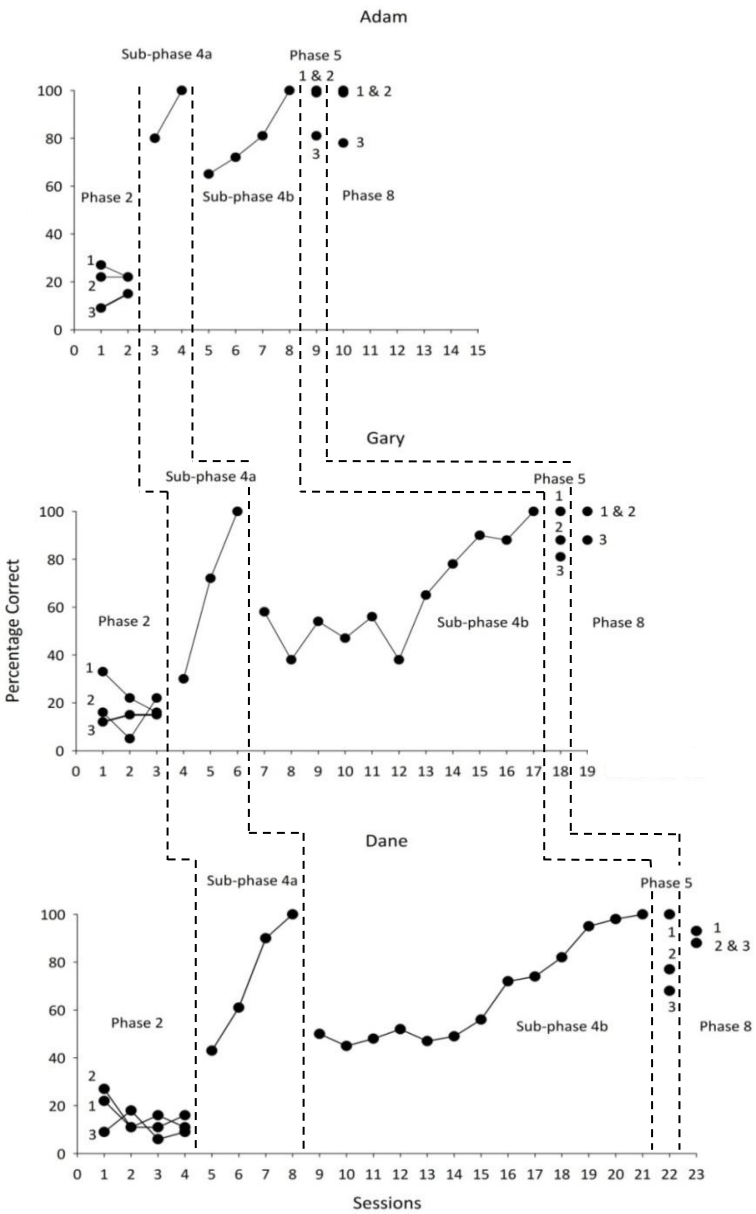

Figure 23. Each participant's percentage correct responses in all sessions during Phases, 2, 4, 5, and 8 of the experiment. *Note*. Phase lines denote points of transition between phases.

8.3.1 Recording and Reliability

Each participant's verbal and selection responding was scored by the experimenter and by his tutor during every Phase 2, 5, and 7 session. Each participant's responding was scored by the experimenter during all Phase 3, 4, and 6 sessions, and by his tutor on 13 of a total of 37 of these sessions. In addition, an independent clinician also scored video-recordings of seven of 12 of all children's video-recorded Phase 2, 5, and 7 sessions. Reliability was calculated as the percentage of trials on which both or all three observers agreed in their scoring. Inter-rater agreement was 94% for Adam, 97% for Gary, and 91% for Dane across all sessions assessed.

8.3.2 Phase 1: Test Vocabulary

All participants met the 100% accuracy criterion for tacting, echoing, and selecting all pictorial stimuli and stimulus elements during their first testing session. No participant required more than 97 trials to meet criterion (the minimum number of trials required to meet criterion was 90). Adam met criterion in 95 trials (5 errors), Gary in 93 trials (3 errors), and Dane in 97 trials (7 errors). All errors made by all participants were on selection responses. No prompting or retraining was required on any error trials, however, because all participants spontaneously produced a correct response subsequent to incorrect responding.

8.3.3 Phase 2: Assess Baseline

		Baseline assessment stimuli and selection responses					
		Set 1 (18 trials)		Set 2 (18 trials)		Set 3 (32 trials)	
Participant	Vocal Response	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Adam	Echoic	0	0	1	0	0	0
	Self-echoic	0	0	0	0	0	0
	Partial echoic	4	6	3	3	4	17
	None	0	8	1	10	0	11
Gary	Echoic	2	0	0	0	1	0
	Self-echoic	0	0	0	0	0	0
	Partial echoic	1	14	3	11	2	20
	None	1	0	1	3	1	8
Dane	Echoic	0	0	0	1	1	0
	Self-echoic	0	0	0	0	0	0
	Partial echoic	4	14	3	14	4	20
	None	0	0	0	0	0	7

Table 27. Each participant's mean vocal responses on correct and incorrect selection trials across baseline assessments (Phase 2).

Table 27 shows each participant's mean vocal responses on correct and incorrect selection trials (i.e., trials on which the target stimulus or an incorrect comparison were selected, respectively) across baseline assessment sessions, and also mean trials on which vocal responses were absent. Partial echoics were defined as echoing only one element of a two-element stimulus name. No participant responded correctly on more than 33% of trials and no participant emitted full echoics in response to the experimenter's vocal instruction on more than 11% of those trials. No participant engaged in any self-echoic responding on any trial during this phase.

8.3.4 Phase 3: Establish Joint Control of Single-word Conditional Discriminations

Criterion for establishment of joint control of single-word conditional discriminations was 100% accurate jointly controlled selection responding on 10 consecutive trials across two consecutive sessions. Adam required 33 trials across three sessions to meet this criterion, Gary required 70 trials across four sessions, and Dane required 45 trials across five sessions.

8.3.5 Phase 4: Establish Joint Control of Two-word Conditional Discriminations

8.3.5.1 Sub-phase 4a: Establish two-word tacts.

Criterion for establishment of two-word tacts was 100% accurate tacting on 18 consecutive trials across two consecutive sessions. Adam required 42 trials to meet criterion during his first session and Gary required 76 trials. Both Adam and Gary met criterion for this phase during their second and third sessions. Dane required a total of 114 trials to meet criterion across his first and second sessions, but met criterion during his third and fourth sessions.

8.3.5.2 Sub-phase 4b: Establish selection based on self-echoics.

Criterion for selection based on self-echoics was 100% accurate emission of self-echoics on 18 consecutive trials across two consecutive sessions. Despite having met criterion for Sub-phase 4a, however, no participant met criterion for Sub-phase 4b without prompting. Adam required 90 trials across four sessions to meet criterion, Gary required 226 trials across 11 sessions, and Dane required 286 trials across 13 sessions to meet criterion.

8.3.6 Phase 5: Test Generalisation

Table 28 shows each participant's total vocal responses on correct and incorrect selection trials during Phase 5, and also trials during which vocal responses were absent. All participants displayed highly accurate selection responding in relation to all stimuli. On average, participants demonstrated 100% selection accuracy in relation to previously trained "colour-object" Set 1 stimuli, 88% accuracy in relation to untrained "colour-object" Set 2 stimuli, and 69% accuracy in relation to untrained "agent-action" Set 3 stimuli. All participants also engaged in echoic or self-echoic responding on a high percentage of trials on which they made correct selection responses. In relation to Set 1 stimuli, participants emitted echoic responses on 100% of correct selection trials, and additionally emitted self-echoics on 85% of those trials. In relation to Set 2 stimuli, participants emitted echoic responses on 100% of correct selection trials, and additionally emitted self-echoics on 91% of those trials. In relation to Set 3 stimuli, participants emitted echoic responses on 89% of correct selection trials, and additionally emitted self-echoics on 84% of those trials.

		Generalisation testing stimuli and selection responses					
		Set 1 (18 trials)		Set 2 (18 trials)		Set 3 (32 trials)	
Participant	Vocal Response	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Adam	Echoic	18	0	18	0	26	4
	Self-echoic	10	0	16	0	24	0
	Partial echoic	0	0	0	0	0	2
	None	0	0	0	0	0	0
Gary	Echoic	18	0	15	0	26	0
	Self-echoic	18	0	15	0	26	0
	Partial echoic	0	0	0	3	0	6
	None	0	0	0	0	0	0
Dane	Echoic	18	0	14	4	15	0
	Self-echoic	18	0	12	0	13	0
	Partial echoic	0	0	0	0	7	10
	None	0	0	0	0	0	0

Table 28. Each participant’s total vocal responses on correct and incorrect selection trials during generalisation testing (Phase 5).

In relation to Set 3 stimuli, Adam and Gary achieved 81% accuracy of selection responding. Adam both echoed and self-echoed on 26 of 26 correct selection trials and Gary performed likewise on 24 of 26 correct selection trials. Dane, however, echoed on only 15 of 22 correct selection trials, and self-echoed on only 13 of those trials. This participant emitted partial echoics on his remaining seven correct selection trials and also on all 10 of the trials on which he responded incorrectly. Analysis of Dane's selection errors carried out immediately subsequent to completion of generalisation testing revealed that his selection errors related to three specific anomalies in his verbal repertoire: Firstly, he failed to select correctly on trials in which “purple” was one element of the compound target stimulus. Dane also repeatedly made errors when the experimenter’s vocal instruction contained the elements “drinking” and “eating” and when either of the pictorial representations of those actions was an element of the compound target stimulus. Consequent analysis of video-recordings of Dane's performance on these trials showed that when the experimenter’s vocal instruction contained the word "purple" (e.g., "purple plane"), Dane echoed both elements of the stimulus name but only signed the object element of the stimulus. Additionally, when the experimenter's vocal instruction involved the word "drinking", he produced a sign similar to "eating" and echoed only one or other element of the experimenter's instruction. To establish whether remediation of these errors in Dane's verbal behaviour would result in correct selection of stimuli involving those elements, additional training and generalisation retesting phases was carried out (Phase 6). Data from this phase and subsequent generalisation retesting (Phase 7) are presented in Section 8.3.7, below.

8.3.7 Phases 6 and 7: Establish Vocal and Sign Responding and Retest Generalisation (Dane only)

Dane required a total of 76 trials across three sessions to meet the criteria for these phases. Table 29 presents Dane's total vocal responses on correct and incorrect selection trials during generalisation retesting (Phase 7), and also trials on which vocal responses were absent.

		Generalisation retesting stimuli and selection responses (Dane only)					
		Set 1 (18 trials)		Set 2 (18 trials)		Set 3 (32 trials)	
Participant	Vocal Response	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Dane	Echoic	18	0	18	0	27	5
	Self-echoic	12	0	18	0	24	2
	Partial echoic	0	0	0	0	0	0
	None	0	0	0	0	0	0

Table 29. Dane's total vocal responses on correct and incorrect selection trials during generalisation retesting (Phase 7).

8.3.8 Phase 8: Test Maintenance

Table 30 shows each participant's total vocal responses on correct and incorrect selection trials during maintenance testing, and also trials on which vocal responses were absent. All participants maintained a high level of accuracy in their selection responding but showed a lower level of echoic and self-echoic responding in relation to Set 1 and 2 stimuli. On average, participants demonstrated 96% selection accuracy in relation to Set 1 stimuli, 92% accuracy in relation to Set 2 stimuli, and 85% accuracy in relation to Set 3 stimuli. All participants also engaged in echoic or self-echoic responding on a high percentage of correct selection trials. In relation to Set 1 stimuli, participants emitted echoic responses on 85% of correct selection trials, and additionally emitted self-echoics on 59% of those trials. In relation to Set 2 stimuli, participants emitted echoic responses on 91% of correct selection trials, and additionally emitted self-echoics on 66% of those trials. In relation to Set 3 stimuli, participants emitted echoic responses on 91% of correct selection trials, and additionally emitted self-echoics on 78% of those trials.

		Maintenance testing stimuli and selection responses					
		Set 1 (18 trials)		Set 2 (18 trials)		Set 3 (32 trials)	
Participant	Vocal Response	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Adam	Echoic	10	0	13	0	19	4
	Self-echoic	0	0	5	0	15	2
	Partial echoic	0	0	0	0	0	2
	None	8	0	5	0	7	0
Gary	Echoic	18	0	15	0	25	3
	Self-echoic	14	0	13	0	22	1
	Partial echoic	0	0	0	3	0	4
	None	0	0	0	0	0	0
Dane	Echoic	15	3	15	3	29	0
	Self-echoic	15	0	13	0	26	0
	Partial echoic	0	0	0	0	0	3
	None	0	0	0	0	0	0

Table 30. Each participant's total vocal responses on correct and incorrect selection trials during maintenance testing (Phase 8).

8.4 DISCUSSION

The present research sought to investigate the role of joint control in the emergence of generalised listener responding by teaching children with autism, whose speaker and listener repertoire was at the level of single-word discriminations, actively to engage in jointly controlled responding to two-element compound pictorial stimuli. The research additionally investigated the extent to which, having learned to respond under joint control to one set of colour-noun stimuli, participants would be able to demonstrate generalised listener behaviour in relation to two novel sets of two-element stimuli (i.e., colour-noun and agent-action compounds).

Phase 1 confirmed that all participants could demonstrate speaker and listener behaviour specific to all simple stimuli and individual elements of compound stimuli to be presented subsequently during the experiment, and that subsequent failure to respond correctly could therefore not be attributed to unfamiliarity with the stimuli, or with the names of the stimuli, presented. Nevertheless, during Phase 2 baseline assessment, no participant was able to demonstrate listener behaviour (i.e., accurate selection responding) to criterion in relation to any two-element Set 1, 2, or 3 compound stimuli. During this phase, it was also observed that participants engaged in echoic responding at a very low level, and that, although occasional partial echoics (i.e., echoing of only one element of a two-element stimulus name) were emitted, no participant engaged in any self-echoic responding.

Phase 3 was carried out to establish jointly controlled responding at the single-word level to individual stimuli that were not presented during any subsequent phase of the experiment. The aim of this phase was to establish jointly controlled responding as a higher order class of behaviour without confounding results observed through additional exposure to stimuli to be employed later in the experiment. Phase 4 continued this process by teaching jointly controlled responding in relation to two-element Set 1 stimuli as a basis for subsequent assessment of generalisation of listener responding during Phase 5. Despite having learnt to use two-word tacts to criterion in relation to Set 1 compound stimuli during Sub-phase 4a, participants were not able to show corresponding listener behaviour during Sub-phase 4b until they had been specifically trained to select stimuli under the joint control of simultaneously emitted tacts and echoics.

Phase 5 evaluated whether establishment of jointly controlled responding in relation to one set of two-element stimuli would result in the emergence of generalised listener responding (i.e., whether it would lead to accurate responding to the two-element Set 2 and 3 compound stimuli that had previously been presented during baseline assessment and demonstrated not to occasion accurate selection responding). Crucially, results indicated the emergence of generalised listener behaviour in relation to all of those stimuli. Within those results, however, variation was observed in Adam's echoic and self-echoic responding in relation to Set 1 (colour-object) and Set 3 (agent-action) stimuli. For this participant, self-echoics were emitted on only 10 of 18 correct selection trials involving Set 1 stimuli. In accordance with Michael's (1996) suggestion, however, it would seem plausible to explain this low level of overt verbal responding with regard to stimulus familiarity: Adam had, by this stage of testing, received extensive exposure to Set 1 stimuli, which may therefore not have occasioned the overt self-echoic behaviour observed in relation to less familiar Set 2 and 3 stimuli. Although it was not possible directly to evaluate the suggestion within the current procedure, it would seem likely that Adam's self-echoic behaviour in relation to Set 1 stimuli had, through repeated exposure, become covert and thus unobservable. The increase in Adam's overt self-echoic responding observed in relation to less familiar Set 2 and Set 3 stimuli would not undermine this hypothesis. It is also worthy of note that, although all participants selected incorrectly on some trials during this phase, no self-echoic ever preceded an incorrect response (cf. Tu, 2006). These data provide converging evidence for the suggestion that when self-echoics do not occur, correct selection cannot occur either: It was only under joint control of both tact and echoic/self-echoic responding that correct selection was observed. A similar pattern of responding was also evident in Gary's performance, within which incorrect responses were always preceded by a partial echoic, rather than a full echoic or self-echoic. In addition to demonstrating the emergence of generalised listener behaviour as a result of the establishment of joint control, therefore, the data from this phase suggest that the relation between joint control and environmental complexity would provide a further profitable area for research.

As previously noted, Dane's responding during Phase 5 differed from that of the other two participants in several ways. Firstly, because of specific anomalies in his vocal and signed verbal behaviour, he made a larger number of selection errors than either of the other two participants. As also noted, Dane had only recently begun to use vocal behaviour rather than signing as his principal means of communication, and all his selection errors occurred on trials on which he was unable to produce accurate signs for elements of the experimenter's spoken instruction or an element of the visual target stimulus. This finding provides further support firstly for the assertion that individual responses are usually multiply controlled (Skinner, 1957), and, more specifically, for the proposition that if an incomplete match exists between currently functional response topographies, or if one component of a response topography is missing, joint control and, therefore, generalised listener behaviour, cannot occur (cf. Sidener & Michael, 2006). Further to investigate the potentially functional relations observed between the anomalies in Dane's verbal behaviour and the errors in his selection responding during Phase 5, this participant was given additional training to use all available response forms (i.e., vocal and signed) in relation to those stimulus elements that had occasioned anomalous verbal behaviour during Phase 6. Phase 7 evaluated the effects of this training, by retesting the generalisation of listener responding previously tested during Phase 5. The results observed supported the conclusion that the relations between Dane's speaker and listener behaviour were functional. During Phase 7, Dane's selection responding was observed to be at a level of accuracy similar to that of the other two participants during Phase 5. In addition, Dane was observed to have engaged in echoic and self-echoic responding on a percentage of correct selection trials commensurate with that of Adam and Gary during that phase.

Phase 8 evaluated participants' maintenance of jointly controlled responding and was carried out 30 days after generalisation testing (or, in Dane's case, retesting) had been completed. Results indicated that participants had maintained accurate selection of stimuli in all three sets but that, for Adam and Gary, variability in echoic and self-echoic responding had increased. Adam, for example, produced no overt self-echoics in relation to Set 1 stimuli and overt echoics only on only a minority of those trials. This participant maintained 100% correct selection of Set 1 stimuli, however, these data again supporting the hypothesis that initially overt verbal behaviour had become covert as a result of specific environmental contingencies (e.g., complexity, familiarity, or temporal delay). The results observed thus further support the conclusion that joint control is a sufficient precondition for the emergence of generalised listener responding to multi-component instructions. Also, and more importantly, the data additionally support the hypothesis that listener behaviour is not simply non-verbal behaviour that sets the occasion for the emission of speaker behaviour (cf. Michael, 1985; Schlinger, 2008; Skinner, 1957), but that it is verbal behaviour in its own right. In accordance with Horne and Lowe's (1996) and Lowenkron's (1998, 2006) suggestions, the present research therefore indicates that individuals become speaker-listeners in their own right, and, thereby, respond verbally to their own verbal behaviour.

Relations are further suggested between the verbal behaviour of participants in the present research and reports of the verbal behaviour of other children with autism noted in research into echolalia and language comprehension (i.e., listener behaviour). For example, Charlop (1983) reported that echolalia can facilitate acquisition of listener behaviour in such populations, but did not provide theoretical explanation of the results observed. It would seem plausible to suggest that joint control may provide this explanation. Although it is essential to differentiate between echolalia and echoic responding, in that the former is a pathological feature of autism and typically functions to provide only automatic (i.e., intrinsic or non-environmentally based) reinforcement, echoic behaviour is directly related to sources of reinforcement external to the individual. Nevertheless, under certain circumstances, it would seem possible to reinterpret existing data relating to echolalia in a way that would indicate that the context in which its functions were evaluated allowed it to function as echoic responding, thereby facilitating the emergence of generalised listener behaviour. The applied potential of utilising existing echoics as a means of teaching generalised listener responding to children with autism has already been noted by Leung and Wu (1997, p. 60), who stated that "incorporating [such behaviour] into instruction is simple and attractive because few effective and practical methods exist for enhancing the language skills of children with autism". With regard to the suggestion previously made that echoic responding occurs at a higher level in relation to unfamiliar rather than familiar environmental stimuli, a range of authors have also noted that echoic responding typically increases in novel environments (Carr, Schreibman, & Lovaas, 1975; Leung & Wu, 1997) and in unfamiliar teaching settings (Charlop, 1986). The present research may also provide a new perspective on research involving matrix training procedures. Although such procedures have always employed specific training on one element of every novel stimulus compound presented as a basis for producing generative listener behaviour, the present research suggests that such training may, in fact, be unnecessary. Generalisation of responding to novel stimuli can occur in the absence of such specific training if joint control has been previously established as a higher order class of responding, as it was during Phase 4 of the present research.

Overall, the results of the present research support the following conclusions. Firstly, at a theoretical level, that joint control is, itself, a higher order class of generalised responding that, once acquired, permits generalisation of listener behaviour to novel stimuli in the absence of specific reinforcement (Lowenkron, 1998, 2006). With regard to clinical application, this finding would further support the conclusion that joint control may provide an efficient yet effective means of establishing generalised listener behaviour to multi-component instructions in children with autism. The results lastly indicate that conceptualising speaker and listener behaviour as fundamentally distinct repertoires to be established independently during intervention cannot provide an optimal means of establishing generalised language in a population characterised by generalisation deficits (cf. Leaf & McEachin, 1999; Lovaas, 1981/2003; Partington & Sundberg, 1998; Taylor & McDonough, 1996). Rather, it would suggest that EIBI curricula will maximise the benefits of intervention by utilising procedures that specifically manipulate existing verbal repertoires to produce remediation of skills within verbal repertoires that are in deficit.

9. GENERAL DISCUSSION

9.1 INTRODUCTION

This chapter will firstly provide a summary of the main findings of the research presented in Chapters 5 to 8, above (Section 9.2), and, secondly, will address conceptual implications for the analysis of verbal behaviour suggested by that research (Section 9.3). The applied relevance of results observed to the design and implementation of curricula for intervention in autism is discussed in Section 9.4, and Section 9.5 concludes the thesis.

9.2 SUMMARY OF MAIN FINDINGS

This thesis has reported a programme of research the principal aims of which were, firstly, to investigate whether functional accounts of language development can provide an effective means of promoting the emergence of generalised verbal behaviour in children with autism, and, secondly, to evaluate the ways in which interactions between speaker and listener behaviour can be manipulated to maximise the effectiveness of language interventions for children with autism.

Chapter 5 reported the findings of research carried out during SCAmP to evaluate the effectiveness of the EBIC as a curriculum for EIBI in autism. As described in Chapter 4, the EBIC is the first curriculum for EIBI to integrate functional accounts of language acquisition (e.g., Horne & Lowe, 1996; Lowenkron, 1998, 2006; Skinner, 1957; Sundberg & Michael, 2001) within the wider psychological research literature on autism and child development (e.g., Charman et al., 1997; Dube et al., 2004; Eikeseth et al, 2002; Green et al., 2002; Jahr, Eldevik, & Eikeseth, 2000; Mundy, Sigman, & Kasari, 1990; Schlinger, 1995; Stone, 1997) as a basis for remediating skills deficits across all areas of children’s development. Analysis of participating children’s progress across the 190 finite and generalised skills composing the EBIC’s three curricular domains indicated a direct relationship between the number of skills children acquired during EIBI and changes in intellectual outcome. Moreover, rapid acquisition of vocal verbal skills early in intervention, rather than pre-intervention IQ, was associated with greatest gains in skills and intellectual functioning. Crucially, results further indicated that early acquisition of echoics was associated with greatest gains subsequent to 24 months of intervention. The relationships observed between participants’ verbal behaviour, intellectual functioning, and skills acquisition within the EBIC therefore provided strong support not only for the EBIC itself as a framework for delivering EIBI, but also for the application of techniques derived from functionally-based accounts of verbal behaviour (e.g., Horne & Lowe, 1996, 1997; Lowenkron, 1998, 2006; Skinner, 1957, 1989; Sundberg & Michael, 2001) as a means of promoting language acquisition among children with autism.

Although compelling, the results reported in Chapter 5 were obtained within an applied context, and, for this reason, a programme of additional research was carried out to provide controlled constructive replication of key aspects of results observed. Chapter 6 reported the first of these studies, which was carried out to investigate the effectiveness of procedures designed to enable vocal children with autism to acquire the bidirectional responding definitional of naming (Horne & Lowe, 1996). Results indicated that, subsequent to initial assessment, all participating children were able to select (i.e., demonstrate listener behaviour towards) stimuli that they had previously learned to tact, but that they nevertheless remained unable to tact (i.e., demonstrate speaker behaviour to) stimuli that they had previously learned to select. In accordance with previous findings (e.g., Lowe et al., 2002), therefore, participants were only able to demonstrate one component of the name relation (i.e., listener behaviour as a result of establishment of speaker behaviour) consequent to independent establishment of tact and selection responding. Subsequent to a verbally-based intervention that taught participants to tact as result of their own combined selection and echoic responding, however, all participants became able to tact novel stimuli that they had previously only learned to select.

As noted, however, despite intensive teaching, many children with autism remain non-vocal, and, therefore, the results reported in the Chapter 6 were not of direct relevance to designing language interventions for children who cannot produce vocal speech. For this reason, the research reported in Chapter 7 was carried out to investigate the emergence of naming among non-vocal children with autism who use sign language as their primary form of communication. Overall, a similar pattern of results was observed among these children to that previously observed among vocal children with autism. Subsequent to independent establishment of speaker and listener responding, these children failed to demonstrate bidirectional responding during initial assessment, but, subsequent to an intervention that taught them to tact as a result of their own intraverbal and selection responding, they became able to tact novel stimuli that they had previously only learned to select. Results indicated, therefore, that, for these non-vocal participants, the intraverbal relation was functional in the emergence of bidirectional responding in the same way that the echoic had been for the vocal participants who participated in the research reported in Chapter 6.

Overall, therefore, the research reported in Chapters 6 and 7 demonstrated the effectiveness of procedures directly derived from Horne and Lowe’s (1996) account of naming as a means of establishing generalised speaker behaviour as a result of establishing listener behaviour. At a theoretical level, therefore, Chapter 6 demonstrated the functional role of the echoic in the acquisition of bidirectional responding, and Chapter 7 extended that finding to demonstrate the functional role of the intraverbal in the acquisition of naming among non-vocal children with autism who sign. Although, as evident from the results observed, Horne and Lowe’s (1996) account of naming offers both practical and conceptual advantages in understanding and manipulating the emergence of bidirectional verbal behaviour, it nevertheless remains limited to addressing language acquisition up to the second year of life, when children’s verbal behaviour is still at the single-word level.

Because, in practice, EIBI must necessarily seek to establish comprehensive repertoires of verbal behaviour that go beyond the use of single-words, the research reported in Chapter 8 was carried out to investigate the effectiveness of procedures designed to establish generalised multi-component listener behaviour, utilising Lowenkron’s (1998, 2006) account of joint control. In theoretical terms, this account determines that, to establish generalised listener behaviour to novel spoken word combinations, selection responding must occur under the joint (i.e., simultaneous and combined) control of tact and echoic (or self-echoic) responding. Extension of these suggestions to an applied context resulted in the development of a procedure that aimed to teach children with autism, whose speaker and listener repertoires were at the level of single-word discriminations, to engage in listener behaviour based on verbally controlled (i.e., “mediated”) selection of two-element compound pictorial stimuli. The research additionally investigated the extent to which, having learned to respond under joint control to one set of colour-noun compound stimuli, participants were able to demonstrate generalised listener behaviour in relation to novel sets of colour-noun and agent-action compound stimuli. Results confirmed that bringing participants’ listener behaviour under the joint control of their combined echoic/self-echoic and tact responding resulted in highly accurate selection of novel compound stimuli, indicating that specifically teaching children with autism to engage in verbally controlled selection responding results in the emergence of generalised listener behaviour.

In summary, therefore, the research reported in this thesis indicates that the EBIC provides an effective framework for EIBI in autism and that theoretical accounts of naming (Horne & Lowe, 1996) and joint control Lowenkron (1998, 2006) can be utilised to inform the development of effective procedures for establishing functional interactions between speaker and listener behaviour, and, hence, generalised verbal behaviour, in both vocal children with autism and non-vocal children with autism who sign.

9.3 CONCEPTUAL IMPLICATIONS FOR THE ANALYSIS OF VERBAL BEHAVIOUR

The research summarised above arose, initially, from the practical need to design an effective curriculum for University-led EIBI during SCAmP that was not only behavioural in terms of the procedures and techniques it utilised, but in its theoretical underpinnings. Although the principal orientation of such an endeavour was necessarily applied, important conceptual considerations were raised, not only regarding classification of the controlling variables of skills to be taught during intervention, but also regarding the design of intervention procedures directly based on theoretical and applied research into interactions between speaker and listener behaviour. On this basis, two theoretical accounts (Horne & Lowe, 1996; Lowenkron, 1998, 2006) informed the research reported in the present thesis, both of which are considered below in relation to the results of the research reported.

As described in Chapter 3, Horne and Lowe (1996, 1997) have provided a detailed description of the name relation as a basis for understanding the development of interactions between speaker and listener behaviour in typically developing pre-school children. Drawing on a range of empirical findings from both within and beyond the field of behaviour analysis, Horne and Lowe (1996, p. 190) have described naming as a “circular relation” that incorporates seeing an object, speaking the name of that object, hearing that self-generated name, and attending to the object again. In this way, therefore, naming incorporates listener, echoic, and tact responding in a way that enables the child, as a listener, to respond to his own behaviour as a speaker (Horne & Lowe, 1996). Similarly, in conceptualising interactions between speaker and listener behaviour, Lowenkron (1998, 2006), in his account of joint control, has sought to describe the sources of stimulus control that result in the emergence of listener behaviour as a generalised, or higher order, class of responding. As defined by Lowenkron (1998, p. 332), “joint control is a discrete event, a change in stimulus control that occurs when a response topography, evoked by one stimulus and preserved by rehearsal, is emitted under the additional control of a second stimulus”, and therefore describes the process by which the echoic and tact exert simultaneous and combined control over a single, common, verbal response topography (Lowenkron, 1998, 2006).

Although naming and joint control share similarities with regard both to the behaviour they seek to describe and its controlling variables, it should be noted that, for Lowenkron (1996b, 1997), joint control is a fundamental component of the name relation, in that it describes the process by which generalised listener behaviour emerges in relation to stimuli that children have previously learned only to tact, and should therefore be considered to be an additional behavioural process, absent from Horne and Lowe's (1996) account. Two questions follow from this contention: Firstly, can Lowenkron's (1996b, 1997) proposal that joint control is necessary for naming to occur be supported? And, secondly, to what extent can naming and joint control be reconciled as means of understanding and manipulating the emergence of generalised verbal behaviour?

Among a range of commentaries published in response to Horne and Lowe's (1996) account of naming, Lowenkron (1996b, 1997) and Michael (1996) both discussed the ways in which naming itself may emerge as a generalised operant. In doing so, as noted above, Lowenkron (1996b, 1997) suggested that joint control provides a vital, yet unacknowledged, component of the name relation, and that, although he did not contest Horne and Lowe's (1996) assertion that tacting results from the fusion of listener and echoic responding, proposed that joint control is nevertheless necessary to explain how children become able to respond as listeners to stimuli that they have only previously tacted. It should be noted that Horne and Lowe (1996, 1997) have argued that joint control is not a necessary component of the name relation in this way, because, during tact training, children simultaneously acquire listener behaviour. By the time a typical child experiences tact training, therefore, she will have already acquired an extensive listener repertoire (e.g., orientating to objects in response to spoken names and selecting them when asked to do so). In illustration of this suggestion, for example, during establishment of tacting, a caregiver may present a novel object to a child and say ‘‘Look, a teddy! Can you say ‘teddy’? What's this?’’, thereby requiring the child to echo the word "teddy". Upon hearing the novel stimulus /teddy/, the child will orientate first to the caregiver and then to the teddy at which the caregiver is looking. As she looks at the teddy, the child next says ‘‘teddy", which utterance the caregiver reinforces (Horne & Lowe, 1997). As a result of such a process, therefore, "in reinforcing the would-be tact, caregivers at one and the same time reinforce both echoic behavior and appropriate listener behaviour" (Horne & Lowe, 1997, p. 290).

In relation to this debate, it should be noted that the results of the research reported in Chapter 6 support Horne and Lowe's (1996) views regarding the lack of necessity of joint control for naming, in that, during Stage 1 (see Section 6.3.3), participants correctly selected tact stimuli without engaging in self-echoic rehearsal and also only demonstrated limited echoic behaviour. Although it might be suggested that covert echoic rehearsal had, in fact been present and functional on this occasion, it is unlikely that the participants in the research were capable of engaging in such behaviour. Furthermore, if they had behaved in this way, it should have been expected that they would also have been able to tact stimuli that they had previously learned to select—behaviour that was not observed among any participants, all of whom required intervention to increase echoic responding for demonstration of generalised tacting to emerge. Furthermore, the bidirectional responding demonstrated by non-vocal children with autism during the research reported in Chapter 7 additionally confirmed that joint control is not necessary for establishing selection of tact stimuli. No participant in this research who had previously selected such stimuli engaged in intraverbal rehearsal during selection responding, but, rather, emitted only a single intraverbal response prior to correct stimulus selection.

Although differences exist between Horne and Lowe's (1996) and Lowenkron's (1998, 2006) conceptualisations of the emergence of generalised listener behaviour, both accounts highlight the centrality of echoic, listener, and tact responding in the establishment of combined speaker-listener behaviour as a generalised verbal operant. So, it may be asked, can the accounts to be reconciled? A possible way of achieving such rapprochement has been suggested by Michael (1996), who proposed that joint control develops when a child, upon being instructed to locate an object by a caregiver, needs visually to search an area that has become larger, or more complex, than those in which selection responding was established as a generalised skill. Thus, when a temporal delay exists between the presentation of an instruction and the presentation of an object "one would expect the occurrence of echoic and self-echoic behaviour because it permits continued exposure to the [caregiver's instruction] during the delay resulting from a prolonged search. Any object that evokes the same response that is being made self-echoically is then the correct object at which to point" (Michael, 1996, p. 298).

If such delayed selection responding thus involves variables additional to those controlling the kind of immediate selections described by Horne and Lowe (1996), it can be inferred that those variables require explanation additional to that provided by an account of naming. It can also be argued that Lowenkron (1998, 2006), in accordance with Michael's (1996) suggestion, has provided this explanation, through his suggestion that overt or covert verbal rehearsal, rather than an initial verbal S^D, had controlled his participants' selection responding under a range of temporal delays (Lowenkron, 1984, 1988). Although Lowenkron (1998, 2006) additionally proposed that such findings indicate the necessity of joint control for the occurrence of naming, it must be noted that the conditions under which joint control had been demonstrated were different, in two principal ways, from those described within the name relation. Firstly, as noted, Horne and Lowe's (1996) account does not discuss the effects of temporal delay, and, secondly, as described above, it also does not attempt to discuss responding beyond the single-word level (i.e., to complex or compound stimuli). According to Horne and Lowe (1996), because tacting emerges as a result of differential reinforcement of combined listener and echoic responding, listener responding must also already be entailed. In the absence of temporal delay and in the presence of simple stimuli, therefore, when a child selects for the first time an object that she has previously learned only to tact, such a response is, in fact, not novel, and, therefore, the additional behavioural process proposed by Lowenkron (1996b, 1997) is not necessary to achieve a full explanation of results observed, or of naming.

It must also be remembered that acquisition of naming coincides with the dramatic increase in verbal behaviour demonstrated by typical children between 18 and 24 months of age commonly referred to as the "naming explosion". Because of this, it would seem plausible to suggest that, in the typically developing child, the emergence of naming signifies the establishment of a basic verbal repertoire that combines joint attention, echoing, listener responding, and tacting. As Skinner (1957) has noted, however, as soon as a basic verbal behaviour repertoire has been established, further explanations become necessary to account for the interactions of its parts, because "verbal behavior is usually the effect of multiple causes. Separate variables combine to extend their functional control, and new forms of behavior emerge from the recombination of old fragments. All of this has appropriate effects upon the listener, whose behavior then requires analysis in its own right. Still another set of problems arises from the fact, often pointed out, that a speaker is normally also a listener. He reacts to his own behavior in several important ways. Part of what he says is under the control of other parts of his verbal behavior. We refer to this interaction when we say that the speaker qualifies, orders, or elaborates his behavior at the moment it is produced" (Skinner, 1957, p. 10). Although joint control may not be necessary to explain naming, there can be little doubt that a large proportion of complex listener behaviour is, however, under multiple sources of control. Lowenkron’s (1998, 2006) account of joint control can, therefore, be argued to provide both a reasonable and parsimonious description of such controlling variables.

The research reported in Chapter 8 supported the suggestion that, when a listener is required to respond to novel multi-component instructions, selection responding is multiply controlled. Results indicated that participants demonstrated generalised listener behaviour to novel compound stimuli in response to two-component instructions only after selection responding had been brought under the joint control of both their echoic/self-echoic responding and their tacting. It may therefore be suggested, on the basis of this finding and the proposals described above, that, although naming is necessary for the development of verbal behaviour during the first two years of life, at some point during this period, either when instructions become more complex or temporal delay occurs between an instruction and the opportunity to select a specified object (e.g., when the child is asked to go and get two items from a different room), such selection becomes jointly controlled by echoic and tact responding. Such behaviour would not be possible at all, however, if the child were not able to name, because he would not otherwise be able to select objects that he had previously only tacted.

In conclusion, therefore, it can be proposed that, although joint control is not necessary for naming, naming is necessary for joint control. Although some aspects of Horne and Lowe’s (1996) and Lowenkron’s (1998, 2006) accounts can be reconciled, in that they are both concerned with explaining the roles of the echoic, listener responding, and tacting in the establishment of bidirectional responding, they are essentially distinct accounts of different types of behaviour.

9.4 IMPLICATIONS FOR THE DESIGN AND IMPLEMENTATION OF CURRICULA FOR INTERVENTION IN AUTISM

It has been estimated that half of all children with autism fail to develop speech (Lord et al., 2004). For this reason, and because the large majority of human interpersonal interactions centre around vocal verbal behaviour, any educational intervention programme for autism must necessarily focus heavily on establishing and developing the prerequisite and constituent components of such behaviour. Although, as described in Chapter 2, operant techniques have, for some years, been used to teach a range of language skills to children with autism (see Goldstein, 2002, for a review), few systematic attempts have been made to integrate functional accounts of verbal behaviour within EIBI curricula for autism. Instead, structural interpretations of child and language development have been employed as a basis for developing language-based educational interventions that rely primarily on differentiation between receptive and expressive language. Necessarily, therefore, tension exists between the functional procedures and techniques currently used to teach language skills and the structural frameworks within which they are employed.

It should, nonetheless, be noted that such conceptual distinctions may not be critical when children with autism have very limited verbal and non-verbal behaviour, because EIBI programmes need simply focus on establishing single-word tacting, selection, manding, and motor imitation repertoires, which can be taught regardless of conceptual framework for intervention. When designing interventions for children with autism who have already acquired such basic verbal repertoires, and for whom more complex verbal behaviour involving multiple tact combinations (i.e., descriptions), tact conditional discriminations (i.e., answering different questions regarding the same non-verbal stimulus), and complex listener responding (i.e., following multi-component instructions) must be taught, however, use of structurally-based interventions may result in the establishment of verbal behaviour controlled by environmental variables other than those functional among typically developing children. Because of such considerations, in the past few years, an increasing number of clinicians have begun to work within the only currently available framework for intervention to incorporate functional classes of verbal behaviour (Partington & Sundberg, 1998; Sundberg & Partington, 1998; see Chapters 2 to 4).

Because of the considerations described above, and as a result of the research reported in Chapters 5 to 8, it is now argued that teaching verbal behaviour to children with autism must move beyond classification of skills in terms of elementary verbal operants to incorporate analyses of the ways in which such classes of behaviour interact to establish complex verbal behaviour. The consequences of not doing so are far-reaching. For example, failure to incorporate accounts of naming (Horne & Lowe, 1996) and joint control (Lowenkron, 1998, 2006) within the design of curricula, and, thereby, the interventions that they inform, will result in the continued requirement for children to be taught responses in every operant class of behaviour, regardless of whether such skills have been classified using Skinner's (1957) taxonomy of verbal behaviour or not. Because the aim of EIBI is to equip children with autism with skills necessary for independent functioning across a wide-range of real world contexts, interventions that focus on teaching every single requisite response for a given situation (i.e., that establish finite classes of behaviour) cannot be optimal, or, indeed, often even efficient. Instead, clinicians must focus on developing procedures for intervention that enable children to acquire novel responses in the absence of any teaching subsequent to intervention (i.e., to establish generalised classes of behaviour). On the basis of the research reported in this thesis, it is suggested that the following sections provide general guidance that will assist clinicians in designing comprehensive interventions to establish generalised repertoires of verbal behaviour in children with autism.

9.4.1 Establishing Elementary Verbal Operants and Naming

When commencing intervention, teaching should initially focus on establishing verbal behaviour at the single-word level across verbal operants. When children are ready to acquire tacting, such behaviour should be taught in such a way as to establish naming via the kind of selection-echoic transfer procedure described in Chapter 6. Use of such a procedure will bring two principal advantages. Firstly, it will enable the child to begin to learn novel responses for herself, or, in other words, to establish the meta-skill of "learning how to learn". Secondly, it will produce substantial economies in teaching effort. Because generalisation will already have been established through the acquisition of naming as a higher order skill, all novel vocabulary will subsequently only need to be taught either as a tact *or* as a listener response, rather than as a receptive response and as a tact, as proposed by currently available curricula (Leaf & McEachin, 1999; Lovaas, 1981/2003; Partington & Sundberg, 1998; Taylor & McDonough, 1996).

9.4.2 Establishing Multiply Controlled Responding

When basic verbal behaviour has been established, children will need to learn both to respond to, and to use, more complex forms of verbal behaviour. The research presented in Chapter 8 demonstrated that teaching children to respond to their own verbal behaviour prior to stimulus selection established generalised listener responding to two classes of compound stimuli. It is reasonable to suggest that such findings could be extended to other classes of compound stimuli, including noun/noun, adjective/noun, and preposition/noun combinations. In this way, the requirement, suggested by published EIBI curricula (Leaf & McEachin, 1999; Lovaas, 1981/2003; Partington & Sundberg, 1998; Taylor & McDonough, 1996) and existing research into matrix training (e.g., Bunce et al., 1985; Ezell & Goldstein, 1989; Goldstein, 1983) for directly teaching potentially limitless combinations of individual multi-component instructions can be rendered unnecessary. Although not yet subject to direct empirical validation, the above findings also suggest the possibility that establishment of generalised responding can be extended to include such advanced listener skills as story comprehension and sequencing of past events. On the basis of the research reported in Chapter 7, it would further appear reasonable to suggest that such critically important generalised repertoires could similarly be taught to non-vocal children with autism who sign on the basis of their intraverbal responding.

9.4.3 Establishing Perspective Taking

"Perspective taking" (Sigman & Capps, 1997), or, as it is often termed, "Theory of Mind" (Baron-Cohen, Leslie, & Frith, 1985; Premack & Woodruff, 1978), can be defined as the ability to "understand (however implicitly) that people have beliefs and desires about the world, and that it is these mental states (rather than the physical state of the world) which determine a person's behaviour" (Happé, 1994, p. 38). Indeed, such a "theory of mind is considered to be one of the quintessential abilities that makes us human" (Baron-Cohen, 2001, p. 174), an ability characteristically in deficit among children with autism (Baron-Cohen et al., 1985) Although very little research exists to inform the design of effective procedures for teaching perspective taking to children with autism, it has been suggested that Skinner's (1957) analysis of private events may offer practical insights into the development of such procedures (Schlinger, 2009). For example, Skinner (1957) has described how the verbal community teaches individuals to respond verbally to their own private events through tacting the specific public events that accompany their private counterparts. For example, upon seeing a child crying because his toy is broken, a carer may say "Oh, poor thing, you are feeling really sad!", or, after seeing a child rubbing her hand after touching a nettle, a teacher may say "Does that sting? Is your hand hurting?". Through repeated exposure to such learning experiences, Skinner (1957) suggests, children become able to respond verbally to their own private events, and, as a result of this covert behaviour, also become able to infer or predict the private events of others by tacting the public events to which those individuals have been, are, or will be exposed (i.e., to engage in perspective taking). It is suggested, therefore, that intervention to establish perspective taking should focus on teaching children to tact their own private events before attempting to teach them to tact the private events of others. As a prerequisite for establishing both forms of behaviour, however, it should be noted that attainment of advanced speaker and listener repertoires, as described above, will necessarily be a prerequisite.

9.4.4 Establishing the Reinforcing Properties of Others

As discussed in Section 9.3, the research reported in this thesis has strongly supported the effectiveness of procedures derived from functional accounts of language in teaching verbal behaviour to children with autism. Nevertheless, and crucially, however, it must be remembered that failure to develop verbal behaviour is not considered to be the primary deficit of autism (e.g., Rogers & Pennington, 1991). Indeed, research has indicated that deficits in the acquisition of verbal behaviour may, in fact, not result primarily from considerations relating to verbal behaviour itself, but from the paucity of opportunities for learning such behaviour that result from core deficits in interpersonal interaction and other repertoires of social behaviour (e.g., Mundy, Sigman, & Kasari, 1990). Several researchers (e.g., Bijou & Ghezzi, 1999; Lovaas et al., 1966) have attempted to operationalise the variables controlling the component behaviours of such deficits with regard to the insusceptibility that children with autism typically display to secondary reinforcers (i.e., aspects of interpersonal interactions, such as social attention, that serve as reinforcers for typically developing children). Indeed, as Lovaas et al. (1966, pp. 118-119) has observed, it "follows that the child who has failed to acquire such reinforcers, should demonstrate a deficiency in the behaviors which would have been reinforced. In the extreme case of complete failure to acquire secondary reinforcers, the child should evidence little, if any, social behaviors. That is, the child should fail to attend to people, fail to smile, fail to seek company, to talk, etc., because his environment has not provided him with the rewarding consequences for such behaviour to increase or because he is unable to appreciate that consequences are rewarding. It is apparent that such failure in the acquisition of secondary reinforcers need not be complete, but may be partial". For reasons as yet undetermined, the biological aetiology of autism results in a range of susceptibilities and insusceptibilities to reinforcement that differ from those observed among typically developing children. It seems only sensible to suggest, therefore, that environmental failure to establish people themselves, or their attention, approval, or voices, as conditioned reinforcers will be likely to have potentially devastating effects on the development of verbal behaviour among children with autism. Therefore, any intervention must seek not only to teach verbal behaviour itself, but to establish the presence, actions, and speech of others as conditioned reinforcers that will serve to develop and maintain verbal behaviour, both during intervention and beyond.

It should be noted that, in working to establish ecologically valid sources of social reinforcement, every EIBI programme, whether structured around behavioural or psycholinguistic models, faces the same fundamental difficulty: How can behaviour be established for which typically reinforcing stimuli do not function as reinforcers? In other words, how can social behaviour be established through interaction with other people, when such interactions are not naturally reinforcing? Although research addressing such questions was beyond the scope of this thesis, the necessity of obtaining answers for enhancing the effectiveness of intervention for autism cannot be overstated. For this reason, a final suggestion must be made that future research into designing interventions for autism must place heavy priority on the rapid establishment of the social reinforcers prerequisite for the acquisition of verbal behaviour. Only when key aspects of human interpersonal interactions have obtained reinforcing properties can the full effectiveness of operant techniques be brought to bear on establishing generalised verbal, and non-verbal behaviour, among children with autism.

9.5 CONCLUSIONS

In Chapter 1, the principal aims of this thesis were defined in relation to the following two questions:

1. Can functional accounts of language development provide an effective means of promoting the emergence of generalised verbal behaviour in children with autism?
2. In what ways should interactions between speaker and listener behaviour be manipulated to maximise the effectiveness of language interventions for children with autism?

On the basis of the literature reviewed in Chapters 2 to 4, and the research presented in Chapters 5 to 8, these questions can be answered as follows.

1. Skinner (1957, p. 12) stated that his interpretive analysis of language was “inherently practical and [that it suggested] immediate technological applications at almost every step”. Both subsequently published research (see Sautter & Leblanc, 2006, for a review) and the research reported in this thesis support this far-reaching suggestion. Indeed, it can be proposed that Skinner’s (1957) taxonomy of verbal behaviour has provided behavioural clinicians not only with a means of understanding functional classes of verbal behaviour, both finite and generalised, in relation to their controlling variables, but also, thereby, of manipulating such classes of behaviour to maximise the effectiveness of educational interventions for autism. By designing procedures directly derived from Skinner’s (1957), and other, consequent, functional accounts of verbal behaviour (e.g., Horne & Lowe, 1996; Lowenkron, 1998, 2006) clinicians have both the conceptual and practical means for developing conceptually systematic

interventions not only to teach generalised verbal behaviour to children with autism, but to establish a wide range of other related, and unrelated, key life skills.

2. Horne and Lowe's (1996) account of naming and Lowenkron's (1998, 2006) account of joint control both have wide-ranging practical implications for the design of interventions to enable children with autism to become speakers and listeners within the same skin. Although, as observed above, differences exist between these accounts regarding the emergence of generalised verbal behaviour, both nevertheless highlight the centrality of the echoic as the verbal operant that enables children to become both speakers of their own listening (Horne & Lowe, 1996) and listeners to their own speaking (cf. Lowenkron, 1998, 2006)—a theoretical assertion strongly confirmed by the findings of the research reported in this thesis. On this basis, it can therefore be suggested that, only through full appreciation of the crucially important role of the echoic and the multiple functions it serves in the development of generalised verbal behaviour, can interactions between speaker and listener behaviour be manipulated to maximise the effectiveness of language interventions for children with autism. Only in this way will children with autism be able to acquire and emit verbal behaviour under the same ecologically valid sources of stimulus control that establish and maintain the verbal behaviour of typical developing children.

For these reasons, and in final conclusion, it must lastly be stated that, regarding the design and implementation of behavioural interventions for autism at least, Lewin (1951, p. 169) was indeed correct in his observation that "there is nothing so practical as good theory".

10. APPENDIX A

The Early Behavioural Intervention Curriculum (EBIC), showing all 190 finite and generalised skills taught.

Early Behavioural Intervention Curriculum (EBIC)

VISUO-SPATIAL

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**1**	G	Identical 3d Match to Sample								
B	**2**	G	Identical 2d Match to Sample								
B	**3**	G	Identical 3d/2d Match to Sample								
B	**4**	G	Sorting								
B	**5**	G	Attention Shifting								
B	**6**	G	Non-identical Match to Sample								
											\12
I	**7**	F/UN	Associative Match to Sample								
I	**8**	G	Patterning								
											\4

MOTOR IMITATION

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**9**	G	With objects								
B	**10**	G	Gross motor								
B	**11**	G	Fine motor								
B	**12**	G	Oral Motor								
B	**13**	G	Chains								
B	**14**	G	Block building								
B	**15**	G	Follow my leader								
											\14
I	**16**	G	Building from memory								
I	**17**	F/UN	Receptive building								
I	**18**	G	2 step with a time delay/tempo								
I	**19**	G	Simple observational learning								
											\8
A	**20**	G	Complex observational learning								
											\2

ECHOIC

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**21**	G	Vocal Play								
B	**22**	G	Imitates single sounds								
B	**23**	G	Imitates sound combinations								
B	**24**	G	Imitates single words								
											\8
I	**25**	G	Imitates sentences								
I	**26**	G	Vriations in volume								
											\4
A	**27**	G	Variations in pitch								
A	**28**	G	Variations in tone								
											\4

PLAY

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**29**	F/L	Cause/effect toys								
B	**30**	F/L	Puzzles and shape sorters								
B	**31**	G	Play Imitation								
B	**32**	G	Parallel Play								
B	**33**	G	Independent toy play								
B	**34**	G	Independent toy play stations (transition)								
B	**35**	G	Turn taking (simple)								
											\14
I	**36**	F/UN	Rule-based Turn Taking								
I	**37**	G	Independent symbolic play								
I	**38**	G	Imaginative building								
											\6
A	**39**	G	Narrates own play								
A	**40**	F/L	Pretends to be (simple)								
A	**41**	G	Object substitution								
A	**42**	G	Role play (scripted, unscripted)								
A	**43**	G	Symbolic play with substitution								
A	**44**	G	Tells a story using props								
A	**45**	G	Charades								
											\14

SOCIAL

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**46**	G	Mands with eye-contact								
B	**47**	G	Turns to own name								
B	**48**	G	Respondent Joint Attention								
B	**49**	G	Responds to greetings								
											\8
I	**50**	G	Initiating Joint Attention								
I	**51**	G	Reciprocates comments								
I	**52**	G	Initiates greetings								
I	**53**	G	Delivers a message								
											\8
A	**54**	G	Extends comments								
A	**55**	G	Expresses confusion								
A	**56**	G	Provides instructions								
A	**57**	F/L	Acts upon others gestures								
A	**58**	G	Maintains conversation								
A	**59**	G	Initiates conversation								
A	**60**	F/L	Reacts to NV cues of listener								
A	**61**	G	Demonstrates empathy and pro-social behaviour								
											\16

MAND

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**62**	G	Points to desired items								
B	**63**	F/UN	Mands visible desired items								
B	**64**	F/UN	Mands actions								
B	**65**	G	Mands non-visible desired items								
B	**66**	G	Mands for help								
B	**67**	G	Mands to stop an activity								
B	**68**	F/L	Mands with colours								

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I	**69**	F/UN	Mands action and object								
I	**70**	F/UN	Mands for missing items								
I	**71**	G	Mands using simple sentence								
I	**72**	G	Mands with adjectives								
I	**73**	F/L	Mands for attention								
I	**74**	F/L	Answers YES/NO to visual choices								
I	**75**	G	Answers YES/NO to verbal choices								
I	**76**	G	Mands using prepositions								
I	**77**	G	Mands from conditional verbal choices								

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A	**78**	G	Mands with complex sentence								
A	**79**	F/UN	Mands for information based on direct MO								
			Where								
			What								
			Who								
			Which								
			When								
			How								
			Why								
A	**80**	F/UN	Mands for information based on verbal MO								
			Where								
			What								
			Who								
			Which								
			When								
			How								
			Why								

\6

TACT

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**81**	F/UN	Reinforcers								
B	**82**	F/UN	Nouns								
			objects								
			2d								
			people								
			locations								
			animals								
			Body parts								
B	**83**	G	Multiple items								
B	**84**	G	Naming								
B	**85**	F/UN	Action/verbs								
B	**86**	F/L	Colours								
											\12
I	**87**	F/L	Adjectives								
I	**88**	G	Descriptions (simple)								
I	**89**	G	Carrier phrases								
I	**90**	G	Question discrimination								
I	**91**	G	Tells missing item								
I	**92**	G	Senses								
I	**93**	G	Yes/no factual								
I	**94**	G	Conditional Questions								
I	**95**	F/I	Prepositions								
I	**96**	G	Comparisons								
I	**97**	G	Gender								
I	**98**	F/L	Weather								
I	**99**	G	Plurals								
I	**100**	F/L	Occupations								
											\28
A	**101**	G	Personal pronouns								
A	**102**	G	Possessive pronouns								
A	**103**	G	Verb tenses								
A	**104**	G	Tacts item on complex description								
A	**105**	G	Wh discrimination (novel qus)								
A	**106**	G	Complex descriptions								
A	**107**	G	Answers questions past event								
A	**108**	G	Describes a past event								
											\16

LISTENER

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**109**	F/L	Contextual instructions								
B	**110**	F/L	Gesture-cued instructions								
B	**111**	F/UN	Selects reinforcers								
B	**112**	F/L	Sound discrimination								
B	**113**	F/UN	Receptive instructions (actions & body parts)								
B	**114**	F/UN	Labels								
			objects								
			2d								
			people								
			locations								
			animals								
			Body parts								
B	**115**	F/UN	Instructions with objects								
B	**116**	G	Action/verbs								
B	**117**	F/UN	Agent does action								
B	**118**	F/L	Selects by corresponding sound (LFFC)								

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	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
I	**119**	G	Selects by function (LFFC)								
I	**120**	G	Selects parts/whole (LFFC)								
I	**121**	G	Selects by category (LFFC)								
I	**122**	G	Joint control								
I	**123**	G	2 step instructions								
I	**124**	G	2 step labels								
I	**125**	G	Multiple discrimination								
I	**126**	F/L	Weather								
I	**127**	G	Plurals								
I	**128**	F/L	Occupations (LFFC)								
I	**129**	G	Gender								

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	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
A	**130**	G	Possessive pronouns (reversal)								
A	**131**	G	Acts out a story								
A	**132**	G	Conditional statements								
A	**133**	G	Negation								
A	**134**	G	Follows complex instructions								
A	**135**	G	Selects on complex descriptions								
A	**136**	G	Story comprehension								

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INTRAVERBAL

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**137**	F/UN	Fills in sentences								
B	**138**	F/L	Fills in songs								
B	**139**	F/UN	Intraverbal signing								
B	**140**	G	Tells animal/item when told sound								
B	**141**	G	Tells sound when told animal								

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I	**142**	G	Tells items when told function								
I	**143**	G	Tells item when told feature								
I	**144**	G	Tells class when told item								
I	**145**	G	Tells function when told item								
I	**146**	G	Lists features when told items								
I	**147**	G	Lists items within a class								
I	**148**	G	Answers Yes/No questions								
I	**149**	G	Conditional questions/discrim								
I	**150**	G	Intraverbal stories								
I	**151**	G	Tells item when given a description								
I	**153**	G	Answers WH questions on single items (conditional discrimination)								

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A	**153**	G	Describes absent items								
A	**154**	G	Associative questions								
A	**155**	G	Intraverbal webbing								
A	**156**	F/UN	Answers WH question on topics								
A	**157**	G	Reciprocates a story								
A	**158**	G	Completes a story								
A	**159**	G	Tells a story								
A	**160**	G	Reports on covnersation								

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ABSTRACT

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
A	**161**	G	Same/different								
A	**162**	G	Why/Because								
A	**163**	G	Before/After/First/Last								
A	**164**	G	Sequencing temporal events								
A	**165**	G	Emotions								
A	**166**	F/UN	Describes what is wrong and why								
A	**167**	F/L	Describes what doesn't belong and why								
A	**168**	G	Describes absurdity and why								
A	**169**	G	Predictions								
A	**170**	G	Inferences								
A	**171**	G	Perspective taking								

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ACADEMIC

	Number	Type	Skill	Probe	Start	End	Items	Level	Trained	Mastered	Score
B	**172**	G	Hold pen/pencil tripod grasp								
B	**173**	G	Scribbles								
B	**174**	G	Imitates drawing strokes								
B	**175**	G	Copies simple drawings								
B	**176**	G	Colouring								
B	**177**	F/UN	Draws on request								
											\12
I	**178**	F/L	Traces letters								
I	**179**	F/L	Copies letters and numbers								
I	**180**	F/L	Selects and tacts shapes								
I	**181**	G	Counts with 1:1 correspondence								
I	**182**	F/UN	Reads numbers								
I	**183**	G	Matches quantity to numeral								
I	**184**	G	Intraverbally counts to specific number								
I	**185**	G	Gives a specific quantity								
I	**186**	F/L	Reads phonics								
I	**187**	G	Matching sound/word								
I	**188**	G	Takes dictation (phonics)								
I	**189**	G	Phonetic reading								
I	**190**	F/L	KS1 Sight reading								
											\28

11. APPENDIX B

Example EBIC Programme Sheet used during EIBI (Object Imitation).

PROGRAMME SHEET: OBJECT IMITATION

LEARNING OBJECTIVE: Child will imitate the action with objects that the tutor is modelling

ITEM MASTERY CRITERION: Child imitates action with object when three objects are presented on the table

SKILL MASTERY CRITERION: Child will imitate any action with any novel object on first trial without requiring prior teaching

S^D: "Do this." [tutor performs action with an object]

R: Child imitates specified action

TEACHING PROCEDURE:

The tutor sits facing the child.

1) Mass trials: Child should master twenty items in isolation before random rotation between three mastered items is introduced. New items should continue to be introduced in isolation, until they are ready to be presented randomly in a field of three with other mastered items.
2) Begin with an errorless learning approach - provide whatever prompting is necessary to ensure success. Work to fade prompting to zero by differentiating reinforcement. Reinforce greater for responses that require less prompting.
3) Random rotation: once Child has demonstrated independent responding on 20 items in isolation, present the most consistent items in a field of three. Randomise positions before each new trial.
4) Introduce items as per Item List (not necessarily in order), independently of whether Child likes the action or not. Do start, however, with actions that are fairly easy to execute, like bells and other musical instruments

PREREQUISITE SKILL: Object manipulation, hand-eye co-ordination

SUBSEQUENT SKILLS: Play imitation, Block imitation

DEVELOPMENT OF BASIC SKILL:

SKILLS	Introduced date	Mastery date
Three items presented in mirror position of pair object		
Object actions mixed with motor imitations		
Three items presented in mixed (non-ordered) positions with pair objects		
Chains: only one Instruction for up to 10 consecutive imitations with no SR in between		

N.B. The goal of this most basic imitation program is to gain generalised imitation, not teaching of specific simple skills.

GENERALISATION:

Procedure: Present novel actions every three sessions.

Evaluation Criteria: Mastery is defined as accuracy on 19 out of 20 first trial probes in which NOVEL actions are presented for imitation.

12. APPENDIX C

Example EBIC Item List used during EIBI (Object Imitation).

	Item	Introduced	Mastered	Hold	Generalisation
1	Shake Bells				
2	Shake Maracas				
3	Bang tambourine with hand				
4	Bang drum with stick				
5	Put hat on				
6	Wave flag				
7	Shake water bottles				
8	Shake rice boxes				
9	Put block in bucket				
10	Wipe face				
11	Hug Teddy				
12	Castanets				
13	Drink from empty cup				
14	Eat from spoon				
15	Push car				
16	Stack two blocks				
17	Put money in piggy bank				
18	Bang two sticks				
19	Bang triangle with stick				
20	Open book				
21	Scribble on paper				
22	Wipe table				
23	Put bracelet on				
24	Put necklace on				
25	Put phone by ear				
26	Play piano				
27	Open/shut scissors				

13. APPENDIX D

The SCAmP Tutor Assessment Tool (STAT).

SCAmP Tutor Assessment Tool (STAT)

Name:						
	Probationary Tutor	Tutor	Lead Tutor	Supervisor	Parent	Other
Date of Session:						
Time of Session:						
Name of Child:						
Hours of one-to-one teaching:						
Name of Observer/Rater:						

Extra Notes (Please note if tutor or child are sick and any other extraneous circumstances)

____

____

____

____

Rating Scale:

2 = Excellent

1 = Satisfactory

0 = Needs Work

Organisation of Session

Work area clear of distractions	2	1	0
Previous session notes and other relevant messages read	2	1	0
Materials are correct for the task	2	1	0
Materials are organised before presenting the task to the child	2	1	0
Child is seated appropriate to task	2	1	0
Equipment is varied or moved between trials as appropriate	2	1	0
Tasks are mixed with others as appropriate	2	1	0
Breaks given appropriately	2	1	0
Opportunities for skill generalisation maximised throughout session	2	1	0
Remains in control of session at all times	2	1	0
Room and materials are left in order	2	1	0
Pass/Fail			

Downtime

Maintains instructional control	2	1	0
Child is reinforced for appropriate responses	2	1	0
Able to maintain child's attention	2	1	0
Appropriate choice of downtime activity	2	1	0
Manages inappropriate behaviours (e.g. self-stimulation, inattention, task avoidance, etc.)	2	1	0
Pass/Fail			

Instructions

Child's attention established before presenting Sd	2	1	0
Presented Sd in a clear, firm voice	2	1	0
Keeps pace of presentation speedy	2	1	0
Sd given as directed in the programme	2	1	0
Sd given only once	2	1	0
Child's name not overused	2	1	0
Pass/Fail			

Child's response

Target behaviour determined prior to delivery of trial	2	1	0
Child is allowed a maximum of three seconds to respond	2	1	0
Child's response is free of inappropriate behaviours	2	1	0
Pass/Fail			

Prompting

Use of correct type of prompt for the situation (e.g. n-n-p)	2	1	0
Delivers minimal prompt required for correct response	2	1	0
Prompt is delivered simultaneously with or immediately after Sd unless fading procedure is being used.	2	1	0
Prompt is not accompanied by chatter or show of emotion	2	1	0
Prompt results in the child making the correct response	2	1	0
Demonstrates correct fading of prompts	2	1	0
Prompts were used to avoid prolonged failure	2	1	0
Is sensitive to inadvertent prompts (e.g. positional, glances, patterns, etc.)	2	1	0
Prompted trials were followed by unprompted trials unless fading procedure being used	2	1	0
There was a 3-second prompt delay on probe trials	2	1	0
Pass/Fail			

Positive Consequences

Reinforcement presented immediately and briefly	2	1	0
Tangible reinforcement always paired with praise/social consequences	2	1	0
Praise given in a positive tone	2	1	0
Reinforcement contingent on target behaviour	2	1	0
Rate of reinforcement appropriate and consistent with reinforcement schedule	2	1	0
Reinforcement given with energy, animation and variety	2	1	0
Reinforcement types varied to avoid satiation	2	1	0
Reinforcement presented often enough to maintain co-operation	2	1	0
Undesired chains of behaviour not reinforced	2	1	0
Reinforcement accepted by the child (e.g. child smiled, laughed, ate the edible, took and engaged in the toy, did not recoil or pull away from touch)	2	1	0
Tasks and session finish on a positive	2	1	0
Ensures approximately 80% success rate for each task	2	1	0
Use of differential reinforcement	2	1	0
Uses inter-trial intervals as appropriate	2	1	0
Pass/Fail			

Informative and Corrective Information

Says ‘no’ in a flat but clearly audible tone	2	1	0
Child is given minimal attention	2	1	0
Materials are quickly rearranged for next trial	2	1	0
Child’s attention is re-established (if appropriate) and Sd presented for next trial	2	1	0

For disruptive behaviour

Says ‘No [Name of behaviour]’ or ‘look’ or ‘hands down’ within one second of the start of the disruptive behaviour in a firm ‘in charge’ tone	2	1	0
Follows quickly with physical guidance to redirect, with behavioural momentum, with restitution or other as directed	2	1	0
With more serious behaviours, follows intervention as set out in programme	2	1	0
Correct management of self-stimulatory and inappropriate behaviour	2	1	0
Consultation with supervisor, team leader or parent about correct procedure for behaviour management for the future	2	1	0
Pass/Fail			

Behaviour Shaping

Provides positive reinforcement to appropriate task behaviour (e.g. nice sitting and looking)	2	1	0
Does not use threats or bribes	2	1	0
Tasks arranged so that difficult tasks occurred between easier tasks	2	1	0
Incorporated a good balance of play into overall session	2	1	0
Did not bore the child by continuing mastered programmes	2	1	0
Ends programme when child is successful	2	1	0
Pass/Fail			

Incidental Teaching

Opportunities for Incidental Teaching are given throughout the session	2	1	0
Incidental Teaching targets are implemented	2	1	0
Child is encouraged to request for items at appropriate times using an appropriate communication system	2	1	0
Language used by tutor is appropriate for child’s level of understanding	2	1	0
Child’s (rather than tutor’s) motivation is followed	2	1	0
Did not ask questions (e.g. what’s this? What do you want?) i.e. time is child-directed not adult-led	2	1	0
Pass/Fail			

Teaching Techniques

Demonstrates knowledge of terminology	2	1	0
Demonstrates knowledge of discrete trial training	2	1	0
Demonstrates knowledge of teaching stages	2	1	0
Demonstrates knowledge of teaching techniques such as shaping and chaining	2	1	0
Appropriately introduces new targets as old ones are mastered	2	1	0
Pass/Fail			

Recording

Clear about what constitutes a correct response (no false achievements given)	2	1	0
Writes session notes clearly and correctly	2	1	0
Records accurately in the programme file	2	1	0
Pass/Fail			

Professional Behaviour

Works well as part of the team	2	1	0
Is responsive to feedback and constructive criticism	2	1	0
Relationships with parents are within appropriate boundaries (confidentiality)	2	1	0
Relationship with child is within appropriate boundaries	2	1	0
Punctual	2	1	0
Attends all sessions and team meetings regularly	2	1	0
Notifies family as appropriate for cancellations	2	1	0
Uses time wisely	2	1	0
Dresses appropriately	2	1	0
Pass/Fail			

In order to pass, tutor must score a minimum of 1 in every item. 2s will be calculated separately.

Additional Notes:

14. APPENDIX E

Example Informed Consent form completed by the parents of all children who participated in the research presented in Chapters 6 to 8.

STATEMENT OF CONSENT

I, *[parent's name]*, have read the attached information about the research to which this form relates.

My child's name is:

I understand that I may withdraw my consent and discontinue participation at any time without penalty or loss of benefit to myself or my child. I understand that data collected as part of this research project will be treated confidentially, and that published results of this research project will maintain my confidentially. In signing this consent letter, I am not waiving my legal claims, rights, or remedies. A copy of this consent letter will be offered to me.

(Circle Yes or No)

I give consent for my child to participate in the above research	Yes	No
I give consent for my child to be videotaped	Yes	No
I understand that these videotapes will be destroyed after analysis	Yes	No
I would like to be provided with a write up of the research, or if it is published, a copy of the printed article	Yes	No

Signature: Date:

I understand that if I have questions about my child's rights as a participant in this research, or if I feel that my child has been placed at risk in any way, I can contact the Chair of the Ethics Committee, School of Psychology, University of Southampton, Southampton, SO17 1BJ. Phone: (023) 80 59 XXXX.

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