

EFFECTS OF FUNCTIONAL COMMUNICATION TRAINING
FOR REDUCING CHALLENGING BEHAVIOURS OF NONVERBAL
INDIVIDUALS WITH DEVELOPMENTAL DISABILITIES:

A META-ANALYSIS

by

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Abstract

Although previous narrative reviews have found functional communication training to be an effective intervention to reduce aberrant behaviour, until now, there has not been sufficient data to statistically analyze the various parameters. The current meta-analysis used a regression approach (Center, Skiba & Casey, 1985-1986) to objectively and systematically compare findings across single-case studies in an empirical fashion to examine the growing body of literature demonstrating the effectiveness of functional communication training for nonverbal individuals with developmental disabilities who engage in aberrant behaviour. Fifteen primary research studies generated a total of 76 baseline/treatment comparisons which resulted in 228 effect sizes. The effect sizes were used as the dependent variable in the analysis. The 7 parameters under investigation were: 1) diagnosis/type of disability, 2) form of behaviour, 3) function of behaviour, 4) alternative communicative response, 5) setting, 6) maintenance, and 7) generalization. Analysis on subject sex, primary disability and pre-intervention mode of communication were also examined. The findings indicated that functional communication had a significant impact on reducing challenging behaviours of nonverbal individuals with various developmental disabilities and was equally effective across all parameters except for the function of behaviour, alternative communicative response, and pre-intervention mode of communication. Additional analyses were conducted on the assessment method, treatment design and treatment package. Results indicated that effectiveness varied depending upon the form of assessment that was used prior to intervention. The analyses also indicated a significant 2-way interaction between the assessment method prior to intervention and the treatment package. Methodological

characteristics and their implications for both research and practice as well as areas for future research are discussed.

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Introduction

With the continually changing ideas and philosophies toward education, many teachers are dealing with students and issues that have not been dealt with before. This is especially true in the field of special education where many issues such as community integration, social, and institutional inclusion through placement in regular versus special education settings, and use of aversive versus non aversive interventions have received a great deal attention. Although all these issues are important, one of the more critical issues for teachers is how to deal with students who exhibit challenging behaviours.

There are students currently enrolled in public schools who exhibit challenging behaviours that teachers find extremely difficult to manage, students whose behaviour problems are not managed successfully with standard, classroom-wide programs. These individuals come with a variety of labels, function at various academic and intellectual levels, and are found at any point on the continuum from special to regular education classrooms. However, what they all have in common are patterns of behaviour that teachers find uncontrollable and often, indomitable. The problem behaviours of these students range from dangerous and violent acts of aggression and self-injury, to behaviours that are maladaptive and interfere with their own learning and the learning of other students such as crying, tantrumming, vocal outbursts, and conspicuous stereotypy. Students with developmental disabilities often fall into this category.

As students with developmental disabilities are spending more time in regular classrooms with their peers, it is becoming increasingly evident that sharing the same physical space, and the same administrative arrangement does not automatically lead to developmentally relevant levels of social and instructional inclusion. It has become critical that classroom teachers are given practical and effective strategies to deal with these students. Many of the traditional management procedures and techniques used with students with developmental disabilities who engage in challenging behaviours are no longer viewed as beneficial or even acceptable. Interventions such as transferring students with challenging behaviour to more restrictive and secluded educational placements, suspending or expelling them from school, or prescribing intrusive discipline regimes and/or restrictive medications are not seen as ethical or educationally acceptable behaviour management alternatives. They all have the capacity to limit the students' opportunities for optimal achievement, a satisfying learning experience, and the development of positive interactions with teachers and peers in typical educational contexts.

There is a clear need for a positive, non-aversive, alternative intervention that will enable students requiring behavioural intervention to learn in a regular classroom environment that addresses the academic as well as the social needs. The move must be away from reactive, crisis management interventions that typically disrupt the classroom environment and toward a broader analysis of functional treatments that can avert crises before the need for intrusive interventions arises.

The relatively recent application of a functional analysis framework to understanding challenging behaviours has yielded positive results. Over the past decade a number of researchers have demonstrated that, for the most part, problem or challenging behaviours communicate messages in a social environment. These undesirable forms of social interaction function as alternative forms of social communication for the individual. Carr, Durand, Horner, Mace and many others have demonstrated that thorough assessment and analysis of the communicative functions of challenging behaviours can lead to the identification of effective behaviour management strategies which focus on developing more appropriate and socially acceptable behaviours. This approach is frequently referred to as functional communication training, a term which highlights the emphasis on teaching a more acceptable repertoire of socially communicative behaviours.

Functional communication training has been demonstrated to be an effective proactive behaviour management strategy for a number of individuals with challenging behaviour (e.g., Carr & Durand, 1985; Donnelan, Mirenda, Mesaros, & Fassbender, 1984; Durand, 1990; Northup, Wacker, Berg, Kelly, Sasso, & DeRaad, 1994; Wacker, Steege, Northup, Sasso, Berg, Reimers, Cooper, Cigrand, & Donn, 1990). These authors have shown that functional assessment can help identify specific classes of reinforcers (e.g., communicative functions) that appear to maintain an individual's problem behaviours. This knowledge, in turn, has been applied to the development of effective instructional and contingency management programs. This research has further demonstrated that interventions which focus on operant functions and particularly those based on the results of functional

assessments can be effective where other efforts involving contingency management have failed.

The central goal in functional communication training is to help individuals develop and engage in adaptive, socially desirable behaviours, become active participants in community activities and overcome patterns of destructive and stigmatizing responding. Objectives always include the establishment of desired repertoires of responding, including those repertoires that are functionally incompatible with occurrences of problem behaviour.

Functional communication training is a desirable form of intervention for a number of reasons. First, manding (i.e., requesting) is often an efficient and immediate way for an individual to receive reinforcement. Once the function of the inappropriate behaviour is identified, the individual can be taught an alternative response to achieve the same reinforcement while at the same time reducing the inappropriate behaviour. Second, functional communication training seldom results in negative side effects. The alternative response that is taught is socially acceptable and communicative in nature. It is also more efficient and incompatible with the undesirable behaviour. Third, functional communication training can facilitate other forms of social interactions. Because the new responses are more socially acceptable, students, peers and others working with the individual begin to interact in more positive ways. Fourth, functional communication training provides an ethical and socially acceptable approach to intervention. The most significant value of functional communication training is that it can achieve positive behaviour change without resorting to the use of aversive consequences.

There is a growing body of research which demonstrates the effectiveness of functional communication training with a variety of individuals who exhibit challenging behaviour. Consistent with its origins in applied behaviour analysis, these findings are based almost exclusively on intensive, single-case investigations. Although there has been substantial agreement among these findings and replication of effects, there has not been a systematic review and analysis of these studies. Functional communication training offers an appealing set of procedures and the apparent success of these interventions warrants further investigation. There is a need to explore the details of functional communication training in order to provide people in the field with a more comprehensive plan for implementing it as an effective intervention. Replacing challenging behaviour with communication involves taking a closer look at the function of the behaviour, the types of alternative responses taught, the consequences for the challenging behaviour, as well as the context in which this training takes place. Thus, a review and analysis of this literature should investigate the empirical evidence of support for the effectiveness of functional communication training and focus on factors that may be important to the successful use of this approach.

A number of single-subject design studies have been conducted to examine the effectiveness of functional communication training. Although each of these studies potentially contributes valuable information to the field of special education, one cannot make broad generalizations based on individual studies in isolation. There is no way of knowing whether the subject in a particular study is representative of the general population. Thus, there is a need for an objective means by which to compare these findings across studies in an empirical fashion.

There are a variety of methods available to review previous research, from narrative reviews to reanalysis of research data. Several narrative reviews have addressed functional communication training as an intervention and have concluded that functional communication training is an intervention with great potential. However, narrative reviews rarely investigate the complex relationships among treatment, subjects, and design variables. They are generally limited to broad generalizations about the main effects.

To address the problems of a narrative review, a meta-analysis was selected to synthesize the growing base of information in a consistent, systematic, and objective manner. A meta-analysis is an approach to research integration which applies the concept of data analysis to the quantitative summaries of individual studies. Kavale (1984) presented the following advantages of a meta-analysis: (a) It uses quantitative methods for organizing and extracting information from large databases, (b) it eliminates bias in study selection by not prejudging research quality, (c) it makes use of all information by transforming study findings into commensurable expressions describing the magnitude of experimental effect, (d) it detects statistical interactions by studying the covariation between findings and study features that are quantitatively defined and measured, and (e) it seeks general conclusions. Facts and relationships discovered through a meta-analysis can be of great significance in influencing policy, practice and theory in the field of special education.

Functional communication training is a dynamic enterprise with new methods being defined and incorporated on a regular basis. New research is continually being published. There is a need for research which closely examines the underlying reasons for success and

failure of functional communication training to continue to improve the probability of success that researchers have been experiencing. The current meta-analysis has systematically analyzed current research and has elicited information which contributes to the understanding of functional communication training as a proactive intervention that can be used with nonverbal, developmentally disabled individuals with challenging behaviour.

This population of nonverbal developmentally delayed subjects is of particular interest because of the complexity of the disability and the challenges that educators and caregivers face in their attempts to integrate these individuals into the least restricted environment. Many of these nonverbal subjects have no formal means of communication. Intervention strategies are desperately needed to help these individuals reduce their challenging behaviour and communicate their needs in a socially acceptable manner. Functional communication training is a non-aversive intervention that holds promise for this population of nonverbal developmentally delayed individuals and those who work closely with them.

The following chapter highlights previous studies that have had a significant influence in the area of functional communication training. Chapter 3 is a detailed description of the methodology of the meta-analysis. Chapter 4 details the results of the meta-analysis including both a descriptive analysis and a quantitative analysis and Chapter 5 discusses the results of the meta-analysis and the implications that can be drawn from them.

Review of the Literature

The public education system is continually changing in its ideas and philosophies towards “best practice” in special education. Where students with developmental disabilities were once placed in segregated classes, special schools, and institutions, they are now commonly placed in their neighbourhood schools with their peers. With this shift in thinking has come the need for classroom teachers to develop the knowledge and skills necessary to make sound educational decisions for *all* students including those with developmental disabilities. Classroom teachers, with the help of special educators, are now having to deal with situations that extend beyond the regular academic curriculum. Of these situations, dealing with developmentally disabled students who display challenging behaviour is one of the most difficult hurdles facing regular classroom teachers. Challenging behaviour has been defined as “behaviour emitted by a learner that results in self-injury or injury to others, causes damage to the physical environment, interferes with the acquisition of new skills, and/or socially isolates the learner” (Doss & Reichle, 1991, p. 215). Challenging behaviours may vary significantly in their form, frequency, duration, and intensity. Teachers are struggling with ways to deal with these behaviours that do not conform to the expectations of the regular classroom.

Developmental disabilities is a broad category and refers to a wide range of individuals with a variety of behaviours. Of these behaviours, aggression and self-injury are the most dangerous and maladaptive behaviours are of great concern. Not only are these behaviours a danger to the students themselves, but also to others around them. These

behaviours are serious enough to jeopardize the safety and effective functioning of the individuals and their peers.

Legal mandates and ethical concerns have influenced educators and clinicians to select procedures based on the principal of least intrusive or restrictive treatment. Hence, the documentation of alternative interventions without painful or stigmatizing consequences have been the focus of much recent attention. Functional communication training is one such non-aversive behavioural intervention.

Research in the last decade has demonstrated functional communication training to be an effective non-aversive behavioural intervention for reducing the frequency of severe behaviour disorders (Bird, Dores, Moniz, & Robinson, 1989; Carr & Durand, 1985; Day, Horner, & O'Neill, 1994; Durand, 1993; Durand & Carr, 1991; Durand, Crimmins, Caulfield, & Taylor, 1989; Durand & Kishi, 1987; Horner & Budd, 1985; Horner, Sprague, O'Brien, & Heathfield, 1990; Hunt, Alwell, Goetz, & Sailor, 1990; Sigafoos & Meikle, 1996). A functional assessment of unconventional behaviour and subsequent replacement with socially acceptable and functionally communicative behaviour are more recently being recognized as essential practices with individuals who have developmental disabilities and behaviour problems (Burke, 1990).

Previous narrative reviews (Carr, Levin, McConnachie, Carlson, Kemp, Smith, 1994; Doss & Reichle, 1989; Mirenda, 1997) have concluded that functional communication training is a viable treatment strategy for the reduction of unwanted behaviours in persons

with severe disabilities, however there is no empirical research to date on its relative effectiveness. The following literature review highlights some of the previous relevant contributions to the area of functional communication training. In each case, the intervention attempted to change the behaviour of the individual by assessing the function of the problem behaviour and replacing it with a functionally equivalent communicative alternative. The purpose of this literature review was to examine research studies on functional communication training as an intervention and to systematically summarize the results of these studies across students with various diagnoses and different topographies of behaviour, with a view to identifying the important components of treatment and other variables which may impact on the implementation of functional communication training with particular individuals or groups. It should be noted that single-subject experiments or case study methods of investigation were employed in all of the studies cited.

This chapter begins with an overview of functional communication training, including the theoretical underpinnings, and the relevant assessment and intervention methodologies. The second section will provide a brief review of exemplary functional communication intervention studies which highlight the important impact of this intervention methodology. The final section reviews relevant methodologies for a systematic analysis of the functional communication literature. The chapter ends with the specific research questions to be addressed in the study.

Overview of Functional Communication Training

Before discussing the research results of functional communication training as an intervention, it is important that one has an understanding of the basic principles that lie behind it.

The Theory

All individuals communicate, although the specific communication strategies can vary extensively. We readily acknowledge and accept conventional forms of communication, including spoken language, sign language, and graphic representations. However, there are individuals who do not have the ability to use these conventional forms of communication to meet their needs. Thus, they use less conventional forms of communication which often fall within the context of challenging behaviour. Traditionally, challenging behaviour has been viewed as nonfunctional behaviour that should be suppressed. Recently, a number of investigators have demonstrated that there are many situations where challenging behaviours do, in fact, have a communicative function (Carr & Durand, 1985; Doss & Reichle, 1991; Durand, 1993; O'Neill, Horner, Albin, Storey, & Sprague, 1990).

It has only been in the past decade that functional communication training has emerged as a treatment intervention. Functional communication training is a behavioural intervention that incorporates a comprehensive and systematic assessment of the communicative functions of maladaptive behaviour with procedures to teach an alternative

communicative response directly tied to those functions. Socially acceptable forms of communicative behaviour are matched with the social function of the challenging behaviour to provide an alternative behaviour that is functionally equivalent to the challenging behaviour.

Functional Assessment

The goal of past practice in dealing with challenging behaviour has been to extinguish or eliminate maladaptive or problem behaviour. It has only recently been considered that the problem behaviour may serve a function for the individual displaying it. Functional communication training makes an effort to understand why the behaviour occurred in the first place. It is through this understanding that appropriate, more socially acceptable, alternative behaviours can be taught.

A seminal article suggesting that challenging behaviour has a function was published in 1977, when Carr wrote an article entitled "The Motivation for Self-Injurious Behavior: A Review of Some Hypothesis." Carr's article focused on the motivation, rather than the treatment of self-injurious behaviour, asserting that all behaviour can be traced to its motivational source and is a product of both antecedent and consequential stimuli. More recent evidence elaborates on this hypothesis to say that problem behaviour may be similar to nonverbal forms of communication for those who have limited language abilities (Carr and Durand, 1985; Hunt et al., 1990). Burke (1990) discussed approaches designed to reduce, eliminate, or replace socially unacceptable behaviour in individuals with severe disabilities.

Emphasis was placed on the need to analyze the communicative functions of behaviour and facilitate the development of an individual's communication system.

Functional communication training is a behavioural intervention that incorporates a comprehensive/systematic assessment of the communicative functions of maladaptive behaviour with procedures to teach an alternative communicative response directly tied to those functions. These responses are specific language forms including speech, signing, gestures, and assistive devices that can be used to influence people in order to achieve the desired goal. There are two basic premises underlying this theory:

1. Problem behaviour serves a purpose for the person displaying it.
2. Behaviour is governed by the context in which it occurs.

Functional communication training is always preceded by a functional assessment. A functional assessment is used to predict the purpose of the problem behaviour. The form of the problem behaviour or what the behaviour looks like is not a reliable indication as to why a behaviour is occurring. It is the functional relationship between behaviour and context, rather than the topography of behaviour alone that is indicative of its motivational source or communicative intent (Donnellan, Mirenda, Mesaros, and Fassbender, 1984). It is this function that must be determined before one is in a position to consider appropriate replacement behaviours.

There is also a need to individually select reinforcements because what serves as a reinforcer for some can serve as a punisher for others (Durand et al., 1989). Functional assessment addresses this issue and allows for treatments to be developed to suit individual differences. A number of assessment strategies have been used to assist in developing and confirming a hypothesis regarding the communicative function of a challenging behaviour. These strategies include interviews, direct observations, and environmental manipulations.

An interview is generally comprised of a series of questions or checklists that must be completed by an individual who is quite familiar with the learner and his/her challenging behaviours. Through the interview, one is able to get a description of the behaviour in question, possible events and situations that predict the occurrence of the behaviour, and the identification of the possible functions of the behaviour. It is a relatively quick and easy way to begin identifying factors that result in challenging behaviour. Another tool that is commonly used is the Motivation Assessment Scale (MAS) (Durand, 1990). The MAS is a 16-item questionnaire used to assess the variables maintaining the problem behaviour. Although it is not as detailed as an interview, it is currently the only scale of this kind with demonstrated reliability and validity.

A more reliable form of a functional assessment is through direct observation. Direct observation allows for the opportunity to observe the learner in a broad range of situations. Information is typically gathered on the frequency and/or duration of the behaviour, the antecedents that may influence the behaviour, and the consequences of the behaviour. By carefully recording and analyzing the gathered data, one can look for reoccurring patterns and

predict the motivation behind the behaviour as well as the factors that relate to it. Through the information gathered from the interview(s) and the direct observation(s), one is usually able to determine the function of the challenging behaviour with some degree of certainty. However, there will be occasions when the function of the behaviour is still unclear. It may be necessary to conduct a *functional analysis* which consists of a series of environmental manipulations to test the hypothesis that could not be confirmed through the interview(s) and direct observation(s). Environmental manipulations involve altering particular antecedents or consequences believed to be associated with the learner's challenging behaviour. The behaviour is then observed to see if the changes have influenced the likelihood that the learner will engage in the challenging behaviour.

The study by Iwata, Dorsey, Slifer, Bauman, and Richman (1982) is perhaps the most well-known study in the area of functional analysis. The study included nine subjects with developmental delays who displayed moderate to high rates of self-injurious behaviour. The subjects were observed during four analogue conditions that consisted of the manipulation of antecedent and consequent events to determine which variables maintained the self-injurious behaviour. The 4 conditions the subjects were exposed to were (1) the presence or absence of social attention, (2) high or low academic demands, (3) the presence or absence of tangible items, and (4) a control condition. Different functions were identified for 6 of the 9 subjects, demonstrating that self-injurious behaviour was maintained by different sources of reinforcement. Many of the researchers in subsequent studies have conducted a functional analysis based on the model by Iwata et. al (1982). However, regardless of which methods are

used to determine the function of the challenging behaviour, a functional assessment is essential for implementing an effective intervention.

Once the function of the behaviour has been determined, functional communication training can be implemented to teach the student an appropriate form of communication. As the student is taught to engage in appropriate behaviour by means of functional communication, the appropriate behaviour replaces the inappropriate behaviour. Thus, the two components happen simultaneously with the emphasis on learning.

Functions of Challenging Behaviours

The resulting effect of challenging behaviour is referred to as the *function* of the behaviour. O'Neill et al. (1990) clearly depict the effects of the functions of challenging behaviour (see Figure 1). Challenging behaviour can be divided into two broad categories: to obtain a desired outcome or to avoid/escape an undesired outcome. Both of these categories can be either socially or non-socially motivated. Behaviours that require the interaction of another individual to have a consequence are referred to as socially motivated. Conversely, behaviours that do not require the interaction of another individual to have a consequence are referred to as non-socially motivated. Socially motivated behaviour to obtain a desired outcome can be further divided into those behaviours that are performed to obtain attention and those behaviours that are performed to obtain objects or activities. Similarly, socially motivated behaviour to avoid/escape an undesired outcome can be performed to either avoid/escape attention or avoid/escape objects or activities.

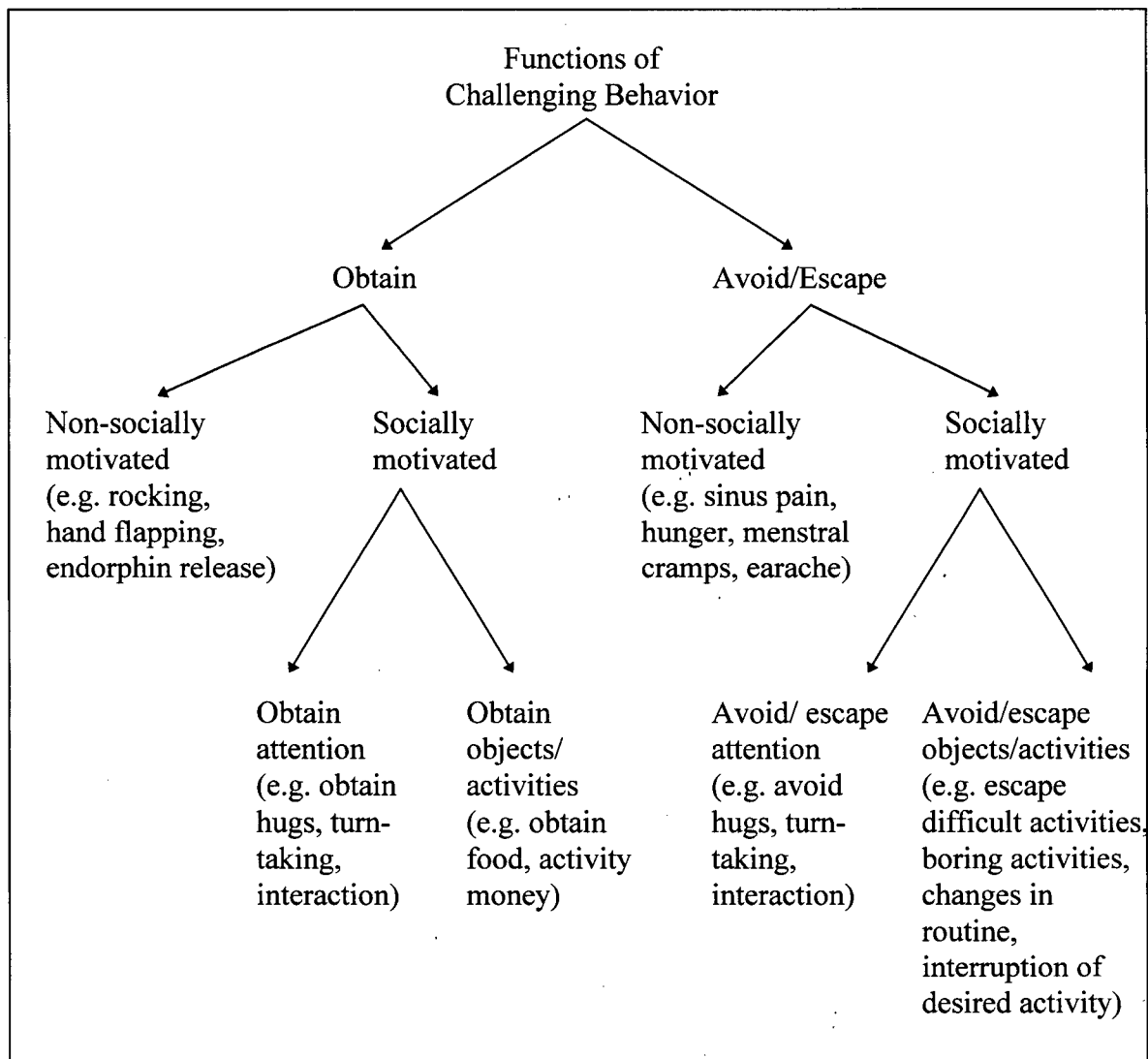


Figure 1. Functions of Challenging Behaviour. Adapted from O'Neill, R.E., Horner, R.H., Albin, R.W., Storey, K., and Sprague, J. (1990). *Functional analysis of problem behavior: A practical assessment guide* (p. 13). Sycamore, IL: Sycamore Publishing Company.

Socially motivated behaviour suggests that the behaviour functions as a form of communication. Behaviour that occurs in social contexts has properties that effect the behaviour of the listener and the intention of the speaker. Hence, problem behaviour may be acquired and maintained because of the social consequences it produces. Understanding the

function of the challenging behaviour helps to determine an equivalent socially acceptable alternative behaviour that can compete with the socially unacceptable behaviour. Therefore, before an intervention procedure is designed, it is important to match the intervention with the social function of the challenging behaviour.

It should be made clear here that the challenging behaviours maintained by non-socially motivated consequences and challenging behaviours that have no communicative intent will not be addressed in this discussion.

Matching the Intervention with a Target Behaviour

Durand et al. (1989) demonstrated the importance of matching the intervention with a target behaviour on 7 students with severe developmental disabilities who exhibited frequent aggression, self-injury, and/or tantrums. In their study, they determined that praise functioned as a reinforcer for the group with attention-maintained behaviour and functioned as a punisher for the students with escape-maintained behaviour. Conversely, a procedural "time-out" functioned as a reinforcer for the students with escape-maintained behaviour and functioned as a punisher for the students with attention-maintained behaviour.

In an earlier study, Carr and Durand (1985) used assessment data to select replacements for misbehaviour across four developmentally disabled children. The intervention consisted of two phases: relevant response and irrelevant response. The results indicated that disruptive behaviour was reduced to low levels after a child was trained to emit

a relevant communicative response but remained high after a child was taught an irrelevant communicative response. Carr and Durand concluded that not all communicative phrases will be effective in reducing behaviour problems. The phrase that is chosen must be functionally related to the specific nature of each child's behaviour problem.

Durand and Crimmins (1987) examined the functional relationship between adult attention, instructional demands, and the psychotic speech of Sam, a young boy with autism. A functional analysis seemed to indicate that the function of Sam's psychotic speech was to escape task demands. Two conditions were constructed to confirm the hypotheses. The first condition involved decreased attention and the second condition involved increased task difficulty. This experimental design was almost identical to the research by Carr and Durand (1985). As expected, the frequency of psychotic speech increased substantially in the second condition.

These studies reemphasize the importance of separating the form from the function of a behaviour. The alternative response must be functionally equivalent to the function of the behaviour. All of us behave to achieve the same desired goals. What differs is the form we use to achieve those goals. Thus our task becomes one of teaching a new, more socially acceptable form of the behaviour as opposed to eliminating the problem behaviour.

Review of Exemplary Studies

Bird et al. (1989) demonstrated the effectiveness of functional communication training as an alternative intervention on two men with mental retardation who exhibited severe aggressive and self-injurious behaviour. In the first study, the exchange of a token representing a break away from demands was taught as an alternative communicative response. There was an immediate and substantial reduction in the episodes of self-injury with the introduction of the functionally equivalent response. Rapid suppression is a necessary criterion when dealing with aggressive and self-injurious behaviours that are potentially harmful to the individual. The frequency of self-injury remained low with the introduction of successive task demands of increasing difficulty and duration. There was also demonstrated increases in spontaneous communication. In the second study (Bird et al.), five signs (i.e., break, music, food, bathroom, and work) were taught as alternative communicative responses. Similar to the first study, there was an immediate reduction in aggressive behaviour following functional communication training. Low frequencies of aggression and self-injury were maintained as the length of training was increased, new staff were introduced, and several program changes were made. This low level of aggressive and self-injurious behaviour was maintained during much of the one-year follow-up period.

Durand and Carr (1991) evaluated the initial effectiveness of functional communication training as an intervention for challenging behaviours exhibited by three students with severe disabilities. The students were taught alternative assistance-seeking and attention-getting phrases to serve the same function as their challenging behaviours. This

study also reported rapid reductions in challenging behaviours immediately following teaching of the functionally communicative response. In most cases, the reduction occurred within a few days of the initial intervention effort.

Steege, Wacker, Cigrand, Berg, Novak, Reimers, Sasso, and DeRaad (1990) examined the maintaining conditions of self-injury exhibited by 2 children who were both nonambulatory, nonverbal, and diagnosed as profoundly mentally retarded with no independent communication skills. Negative reinforcement (i.e., escape from grooming activities) was determined to be the maintaining reinforcer for both children. The treatment packages involved a brief escape from the grooming activities contingent upon a functionally equivalent response that involved reaching and pressing a microswitch that activated a prerecorded message of "stop." The result was a marked decrease in self-injury for both children.

Day, Horner, and O'Neill (1994) investigated multiple functions of problem behaviour in three individuals with severe intellectual disabilities. Results of a functional analysis indicated that the problem behaviour for each subject was maintained by both escape from difficult tasks and access to preferred items. Intervention focused on teaching a functionally equivalent communicative response for each condition. Day et. al. found that each subject's problem behaviour decreased after being trained to elicit one communicative response but was reduced to clinically acceptable levels only after being trained to elicit both functionally equivalent communicative responses, demonstrating that the behaviour was

under multiple control and each condition maintaining the problem behaviour needed to be addressed.

In a similar but more recent study, Sigafoos and Meikle (1996) investigated functional communication training as an intervention for multiply determined problem behaviour in two boys with autism. The results of a functional analysis suggested that aggression, self-injury, and disruption were maintained by both attention and access to tangible items. The focus of the intervention was to replace the aberrant behaviour with functionally equivalent communicative alternatives for both maintaining conditions. However, this study differed from the study by Day et. al. (1994) as it involved the *concurrent* treatment of multiple forms and functions of challenging behaviour. Both boys were taught alternative forms of communication to solicit attention and request preferred objects which was associated with concurrent decreases in aggression, self-injury and disruption.

Durand & Kishi (1987) evaluated a consultation model to provide technical assistance in the areas of behaviour management and curricular design for the treatment of severe behaviour problems exhibited by persons with severe/profound retardation and dual sensory impairments. Although the handicapping condition (i.e., dual sensory impairment) differed from previous studies, the results were consistent. The five subjects in this study were taught alternate communicative behaviours and again, the functional communication training had an immediate effect on reducing their problem behaviour.

The research demonstrates that functional communication training is an effective intervention for a variety of challenging behaviours. Rapid and significant reductions in behaviour have been observed when using this intervention technique with severe aggressive behaviours, self-injurious behaviours, and tantrums as well as with psychotic speech. In addition, multiple functions of problem behaviour can be addressed with functional communication training.

Functional communication training as an intervention strategy appears to be equally effective across the various handicapping conditions that have been studied. Research indicates that interventions have been effective with individuals with a variety of developmental disabilities including mental retardation and/or autism, dual sensory impairments, and psychotic speech disorders. In addition to studies which assess the effectiveness of functional communication training with a variety of subjects, a number of authors have investigated specific characteristics and components of functional communication training.

Response Efficiency

Response efficiency has a considerable impact on the success of functional communication training. Hence, not only must the alternative behaviour be a functionally equivalent, socially appropriate, alternative response, but it must also be behaviourally more efficient for the individual to be motivated to use the new response (Horner and Budd, 1985; Horner and Day, 1991; Horner et. al., 1990).

Horner et. al. (1990) assessed the role of response efficiency in reducing aggressive behaviours with an adolescent diagnosed as having moderate mental retardation and mild spasticity. The effects of two response alternatives for requesting assistance, a high effort/low efficiency response and a low effort/high efficiency response, were compared. Use of the high effort/low efficiency response did not result in a reduction in aggression. The low effort/high efficiency response occurred frequently and was associated with substantial decreases in aggression. This study indicated that response efficiency is an important variable in the successfulness of functional communication training.

Horner and Day (1991) conducted 3 experiments to address the role of response efficiency in functional equivalence training. The first experiment examined the role of response efficiency in terms of physical effort which was similar to a previous study by Horner et al. (1990). In addition, two other experiments were conducted to examine the role of response efficiency in terms of schedule of reinforcement and time delay between presentation of the discriminative stimulus and reinforcer delivery. In each of the three experiments, a functional assessment was conducted to determine the function of the problem behaviour and then, two new functionally equivalent responses were taught. The first new response was a socially appropriate alternative behaviour that was *less* efficient than the problem behaviour on one of the efficiency variables (i.e., effort, schedule, time of day). The less efficient behaviour did not compete with the problem behaviour and did not result in decreases in the targeted behaviour problems. When a new, more efficient behaviour was taught, there were dramatic reductions in the problem behaviours in all three cases.

The research supports the use of functional communication training as an effective intervention for individuals with developmental disabilities. In addition, studies support the principal role of response efficiency when choosing an alternative communicative response. However, to be a meaningful intervention, behaviour change must occur beyond the confines of the treatment settings and with intervention agents who may not be specially trained in behavioural strategies.

Generalization and Maintenance

The literature has indicated that functional communication training has been a successful intervention in producing a positive change in behaviour. However, for functional communication training to be truly effective, it must significantly reduce the challenging behaviour across a variety of people, tasks and settings and continue to be effective over long periods of time, more commonly referred to as generalization and maintenance. Several studies have demonstrated that generalization and maintenance occur when functional communication training is implemented to reduce challenging behaviours of individuals who have developmental disabilities.

Campbell and Lutzker (1993) conducted a case study on an 8 year old boy with no functional communication and with a diagnosis of autism. Functional communication training was used as an intervention to reduce tantrums and aggressive behaviour. The acquisition of functional communication skills resulted in significant decreases in challenging behaviour and more significantly, the effects of functional communication training

transferred to other stimulus conditions. That is, the subject was able to transfer the functional communication skills from therapist to mother, from snack time to entire daily routines, and from the home setting into the community.

Bird et al. (1989) conducted a study using a multiple baseline across teachers implementing functional communication training procedures. There was an immediate and substantial reduction in the episodes of aggression and self-injury with the introduction of functional communication training. The study demonstrated that the new behaviours generalized across three teachers as well as across several program changes. After 7 months of intervention, the subject was introduced to a new classroom and new teacher and after 12 months to a new building. The frequencies of aggressive and self-injurious behaviours continued to remain at a low level despite several environmental changes.

Durand and Crimmins (1987) studied the psychotic speech of a young boy with autism. A functional assessment predicted that the student's psychotic speech served as a means of escaping or avoiding difficult tasks. Thus, the phrase "Help me" was taught as an appropriate escape response to replace the psychotic speech. The intervention resulted in a significant decrease in psychotic speech and six months later, it was reported by the teacher that the student had generalized his use of the phrase "Help me" to appropriate classroom situations and that his psychotic speech was at a level that no longer interfered with tasks in class.

Lalli, Browder, Mace and Brown (1993) used a behavioural consultation approach to reduce challenging behaviour in 3 subjects with severe/profound mental retardation. All three subjects were nonambulatory, had no formal communication, and displayed few interactions with peers. A descriptive analysis provided hypotheses regarding the functions of the subjects' behaviours and a component analysis design was used to assess the effects of the interventions. The first intervention involved placing the problem behaviours on an extinction schedule and providing reinforcement for appropriate behaviours. The second intervention was designed to teach the subjects appropriate, functionally equivalent communication skills, referred to as "adaptive skills training" in the study. The data indicated that the adaptive skills training resulted in low levels of self-injury for the first subject, no aggression for the second subject, and near-zero levels of self-injury for the third subject. Follow up data indicated that low levels of self-injury were maintained for all three subjects.

The research by Durand and Kishi (1987) on reducing severe behaviour problems among nonverbal individuals with severe/profound retardation and dual sensory impairments (i.e., deaf/blind) also demonstrated positive results. The mean rate of aggression exhibited by three of the five students in this study sharply decreased during intervention and remained at that level at the 1-month follow up. A 9-month follow up conducted for one of the three individuals showed continued low levels for the mean rate of aggression. Less initial success was observed for the two other subjects. However, there was a substantial improvement in behaviour at the 9-month follow up for one of the subjects. The staff did not implement the program for the other subject. Thus, follow up revealed successful maintenance for four of the five subjects in this study.

Durand & Carr (1991) suggested that once an alternative behaviour is learned by the student, it is supported with naturally occurring contingencies in the environment. Their study demonstrated the effect of maintenance at 18 months and 24 months following functional communication training. The research also suggested that alternative behaviours can be generalized across teachers, classrooms, and tasks. In their study, new behaviours transferred to teachers who were unaware of and untrained in the procedures. This supports the notion that students can successfully use their newly acquired skills with adults who have different roles, expectations of task demands, and possibly different learning environments.

The initial results of the research on generalization and maintenance of functional communication training for individuals with developmental disabilities have profound implications in our education system regarding transition. As students move through the school from one teacher to another from year to year, they are faced with a number of unfamiliar situations (e.g., new teacher, new classroom assistant, different task demands, new organization, new environment). Initial results suggest that not everyone needs to be trained for the student to experience success. This is true especially if the student is taught an alternative communicative behaviour that is easily recognized and understood by others. However the data at this point in time are sparse. Although further studies examining the generalization and maintenance of functional communication training are needed, an analysis of the available literature is necessary to assess the level of generalization and maintenance of the treatment effects and identify variables that may be related to these effects.

Social Impact

Up to this point, the discussion has been directly related to the primary focus of functional communication training, that is, replacing the socially inappropriate behaviour with a socially acceptable and functionally communicative alternative to reduce challenging behaviour. However, there are other potential effects that can result from effective functional communication training such as a positive social impact.

Functional communication training provides social opportunities for individuals who are often removed from an activity they are engaged in or even from their social environment, due to their challenging behaviour. By replacing the challenging behaviour with a more socially acceptable behaviour, the individual can communicate his/her needs and participate in the social environment without having to be removed or isolated. As a result, the individual not only becomes a more active participant in learning because s/he is spending more time in a "normal" environment, but s/he is also spending more time in an environment that will naturally reinforce the socially appropriate behaviour. The individual learns to communicate behaviour that can produce consistent and useful social effects not only with the teacher or caregivers, but also with peers or other individuals in the environment. However, the literature on the social impact of functional communication training is sparse and there are currently no data to support these assumptions (G. Sugai, personal communication, August 21, 1998).

There is a need for an intervention that can significantly reduce severe challenging behaviours across a variety of individuals and environments. Functional communication training is a very dynamic approach to teaching appropriate behaviours while concurrently reducing inappropriate behaviours. Although there may never be the “ultimate” intervention, functional communication training lends to constant refinement. Treatments can be easily modified as the reinforcer preferences, abilities of the student, or even the function of the behaviour changes. Functional communication training is clearly a proactive approach to dealing with individuals with developmental disabilities who engage in challenging behaviour without the painful or stigmatizing consequences that often accompany other forms of intervention. It certainly holds promise for individuals with challenging behaviours.

Methodology for Review

Although functional communication training is a relatively new field, it has been quickly gaining popularity as an effective behaviour intervention strategy. A number of studies have been conducted over the last decade to examine the important relationship between control via problem behaviour and control via communication. Research has demonstrated that a variety of problem behaviours can be replaced by functionally equivalent communicative responses.

The studies that have examined functional communication training as a behaviour intervention have all been single-subject design studies. These individual studies have contributed significantly to the understanding of functional communication training and have

been of particular value because each has provided the opportunity for intensive observation and analysis of an individual's behaviour. However, the degree to which one can generalize from a single-subject research design is limited. The observed change in behaviour is only representative of a particular subject's behaviour with respect to the baseline and treatment conditions. There is no way of knowing how typical a selected experiment or study is. Thus, there is a need to aggregate the information obtained from single-subject design studies to evaluate the overall effectiveness of functional communication training as an intervention technique and to provide a vehicle for analysis of the specific effects of treatment and those variables related to treatment success.

Gingerich (1984) discussed the importance of the aggregation of single-subject studies with the following reasons:

1. The aggregation of findings from many single-subject studies could strengthen conclusions about the impact of intervention.
2. Sources of variation in outcome can be identified and the conditions and level of generalizability can be established.
3. The power of statistical tests would be increased.

Scruggs, Mastropieri, and Castro (1987) support Gingerich's position and take it one step further by stating that the synthesis of single-subject research is as important, or perhaps more important, than the synthesis of group research efforts for the following reasons:

1. Single-subject research efforts depend to a large degree on replication efforts for demonstration of external validity.
2. A large volume of single-subject literature has appeared in special education literature.
3. Individual studies often do not directly compare the relative effectiveness of particular treatments.

It is apparent that there is a need for a systematic procedure to combine the results of independent studies. Although traditional narrative reviews have been used to integrate single-subject design research, they are generally unsystematic and fall short of meeting rigorous scientific standards. Well respected authors in the field (Glass, 1978; Pillemer and Light, 1980) have noted that the reviews are subject to problems of replicability and reliability. Subjective decisions must be made in a narrative review process. The standards used in the inclusion and exclusion of studies vary from reviewer to reviewer. A meta-analysis offers significant advantages over traditional methods of research synthesis. It attempts to statistically accumulate the findings from a large body of literature into an integrated review.

The effect size statistic represents the basic element in a meta-analysis. The effect sizes calculated from the individual studies become the dependent variables in a meta-analysis. The independent variables are the study features identified as important characteristics. They not only provide a description of findings in general, but also a description of how findings vary with respect to substantive and methodological features of

the studies. The aggregation of the effect size data resulting in an average effect size provides data on the overall effects as well as various subsets related to the independent variables. Average effect sizes can be compared and contrasted in an effort to establish facts and dependable relationships that can help evaluate the overall effectiveness of a specific intervention and whether it is consistently effective in inducing a behaviour change. This information would assist in making more informed decisions about the use of a specific intervention. Finally, it would hopefully serve to direct future efforts of researchers and be used to influence policy, practice or theory in special education.

A number of different methods for calculating the effect size of single-subject research have been explored by different researchers and none without having difficulties. However, Allison and Gorman (1993) claim that the calculation of effect size developed by Center, Skiba and Casey (1985-1986) is clearly the most sophisticated of the approaches that have been developed to date. Center et. al. used the piecewise regression model in their investigation of non-aversive procedures in the treatment of classroom behaviour problems. In their investigation, the inclusion of both change in level and change in slope provided a more complete description of the effects of treatment over time and resulted in more accurate estimates of effects when linear trends were present. They found that the piecewise regression model resulted in a more conservative estimate of mean effect size for a group of single-case studies than does a simple ANOVA model due to its ability to take both trend and change in trend into account.

In summary, a quantitative synthesis of functional communication training was beneficial at this time as there is overwhelming evidence that functional communication is an effective intervention. However, no systematic review has been undertaken to date. Second, functional communication training has been applied to a variety of populations, in a number of settings, and by a number of researchers and has resulted in a variety of outcome measures including an increase in appropriate behaviours and a decrease in inappropriate behaviours. Third, various related independent variables have been identified in the studies but the impact that they have had on functional communication training is not known. Fourth, a number of studies have included follow up to test for generalization and maintenance. Although the initial results have been favourable, broad generalizations could not be made without further analysis. Therefore a systematic analysis was necessary to study the overall effectiveness of functional communication training, the variables related to the treatment effects, and the generalization and maintenance of the treatment effects.

Meta-analysis is now an accepted methodology for systematic analysis of treatment outcome research. Given that the research on functional communication training has been almost exclusively single case studies, there was a need to apply appropriate methodology that would allow a review of identified effects to related variables in the literature. The piecewise regression approach developed by Center et al. (1985-1986) is such a quantitative methodology for synthesizing single-case research.

Several "leaders in the field" were contacted while exploring the idea of a meta-analysis in the area of functional communication training. Initially, two specific questions

were asked: 1) whether they knew if a meta-analysis had already been conducted on functional communication training and, 2) whether they felt it was a worthwhile project to undertake. From the responses that were received, it was confirmed that a meta-analysis had not yet been done on functional communication training as it is a relatively new intervention method. Dr. Edward Carr, a researcher from State University of New York (Stony Brook), indicated through written correspondence that he felt there were now enough published papers that a meta-analysis could be done. Furthermore, he would be very interested in the results, should one be carried out. Several other researchers in addition to Carr expressed a keen interest in the results of a meta-analysis in the area of functional communication training.

Research Questions

Results of the review of literature support the use of the piecewise regression model developed by Center et al. (1985-1986) to conduct a meta-analysis in order to summarize previous research on functional communication training and analyze its overall effectiveness on individuals with severely limited communication skills. The degree of effectiveness, maintenance, and generalizability of alternative behaviours across individuals with a variety of developmental disabilities was the focus of this analysis.

The meta-analysis addressed the following research questions:

1. What is the degree of effectiveness of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals across various developmental disabilities?
2. To what degree do the following parameters, (a) form of behaviour, (b) function of the behaviour, and (c) alternative communicative response, influence the success of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals with developmental disabilities?
3. Does the treatment setting affect the success of functional communication training?
4. What are the effects of maintenance and extent of generalizability when functional communication training has been implemented across nonverbal individuals with developmental disabilities?
5. What other independent variables (e.g., chronological age, mental age, language age, sex) affect the success of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals with developmental disabilities?

This research study attempted to closely examine the underlying reasons for success and failure of functional communication training to continue to improve the probability of success that researchers have been experiencing. It is hoped that the results of the meta-analysis elicited information which will contribute to influence current practice working with

nonverbal developmentally disabled individuals with challenging behaviour. The following chapter will provide specific detail on the methodology of this study.

Methodology

This chapter will explain in detail the specific methodology that was used in this study. The first section identifies the purpose of the study and the specific research questions that were explored in the meta-analysis of the literature on functional communication training. The second section describes the data collection method that was used including identification of the target population, the search for studies to be included in the analysis, and the criteria for inclusion and exclusion from the research database. The third section details the procedures that were used for the coding of study features and the calculation of effect sizes. Also included in this section is the methodology that was used to measure the reliability of the data. The final section describes the design of the meta-analysis and includes definitions of the parameters of functional communication training that were investigated.

Purpose of the Study

The purpose of this study was to summarize previous research on functional communication training and to analyze its overall effectiveness on nonverbal developmentally delayed individuals with severely limited communication skills. It investigated the effects of several parameters that may contribute to the effectiveness of functional communication training as an intervention to reduce challenging behaviour. A quantitative methodology or meta-analysis was used to synthesize the results of single-case experiments in order to provide a more standardized form of research review. Effect sizes describing treatment effect were generated using the piecewise regression approach

developed by Center, Skiba, & Casey (1985-1986). The degree of effectiveness, maintenance, and generalizability of alternative behaviours across individuals with a variety of developmental disabilities was the key focus.

Specifically, the meta-analysis addressed the following questions:

1. What is the degree of effectiveness of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals across various developmental disabilities?
2. To what degree do the following parameters, (a) form of behaviour, (b) function of the behaviour, and (c) alternative communicative response influence the success of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals with developmental disabilities?
3. Does the treatment setting affect the success of functional communication training?
4. What are the effects of maintenance and extent of generalizability when functional communication training has been implemented across nonverbal individuals with developmental disabilities?
5. What other independent variables (e.g., chronological age, mental age, language age, sex) affect the success of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals with developmental disabilities?

Data Collection

Target Population

The population chosen for the meta-analysis was all published experimental studies and case studies from 1985 to 1996 which employed single-subject design research to study the effects of functional communication training as an intervention for nonverbal individuals with developmental disabilities who display challenging behaviours. Developmental disabilities is a broad category and refers to a wide range of individuals with a variety of behaviours. For the purpose of this meta-analysis, an individual with a developmental disability was one who had been formally identified by the researcher as having a developmental delay, a moderate mental handicap, a severe mental handicap, a multiple handicap, a behaviour disorder, or autism. Individuals who had been identified as having brain damage or a sensory impairment were also included. The individuals must also have been identified as being nonverbal with limited communication skills for inclusion in this study. Challenging behaviours were defined as any behaviour resulting in aggression, self-injury, tantrums or maladaptive/socially inappropriate behaviour.

Literature Search

The major goal of the literature search was to implement a search strategy that yielded a representative and unbiased sample of relevant studies. In order to accomplish this, a combination of search strategies was employed. Cooper (1982) briefly described five

techniques to retrieve information on a research problem: (1) the “invisible college” approach, (2) the ancestry approach, (3) the descendancy approach, (4) the use of abstracting services, and (5) the on-line computer search.

The “invisible college” approach is the most informal. It refers to networking with researchers working on similar areas who are aware of each other. Several of the “leaders in the field” were identified and were contacted in an effort to learn of any research, especially those that have not yet been published. These researchers included Dr. Edward Carr, State University of New York (Stony Brook); Dr. Glen Dunlap, University of Florida; Dr. Mark Durand, State University of New York (Albany); Dr. Wayne Fisher, The Kennedy Institute; Dr. Robert Horner, University of Oregon; Dr. Pat Mirenda, University of British Columbia; Dr. John Northup, Louisiana State University; Dr. Joe Reichle, University of Minnesota; Dr. Joseph Scotti, West Virginia University; and Dr. David Wacker, University of Iowa. Dr. Jeff Sigafoos from the University of Queensland in Australia was also contacted.

The ancestry approach retrieves information by “tracking” citations from one study to another. Most reviewers are aware of studies that focus on the same area, and these studies provide bibliographies which may cite earlier, related research. Reference lists of all relevant studies were examined to identify any new studies not already included. Two recently published books in particular were recommended by Durand (personal conversation, June, 1995): Communication-Based Intervention for Problem Behavior: A User’s Guide for Producing Positive Change (Carr, Levin, McConnachie, Carlson, Kemp, and Smith, 1994) and Communicative Alternatives to Challenging Behavior: Integrating Functional

Assessment and Intervention Strategies (Reichle & Wacker, 1993). Both books were reviewed and citations of any additional research not already found were investigated.

The descendency approach, or the Social Science Citation Index (from 1984 forward) was used to retrieve studies that cited papers central to the topic of functional communication training, which was then screened for topic relevance. The Social Science Citation Index allows a researcher to trace the effects of earlier work on subsequent research.

On-line computer search of ERIC and Psychological Abstracts databases was conducted using the following descriptors and combinations thereof:

adaptive behaviour	communication training
alternative communication	developmental disabilities
augmentative communication	functional communication
behaviour	functional communication training
behaviour change	functional equivalence
behaviour disorders	intervention
behaviour modification	non-aversive treatment
behaviour problems	nonverbal communication
challenging behaviour	response efficiency
communication	single-case experiment
communication problems	social behaviour
communication skills	social influences

In addition, journals frequently cited in previous reviews of behaviour problems, special education or communication were manually searched. The journals published from 1985 to 1996 that were searched included:

American Journal on Mental Retardation

AAC: Augmentative and Alternative Communication

Behavior Modification

Behaviour Research and Therapy

Education and Training of the Mentally Retarded

Journal of Applied Behavior Analysis

Journal of Autism and Developmental Disorders

Journal of the Association for Persons with Severe Handicaps

Mental Retardation

Research in Developmental Disabilities

One of the threats to internal validity associated with the data-gathering phase of reviewing the studies was that the review probably did not include all of the studies that exist. The second threat to internal validity was that the studies retrieved may not be representative of all studies in the target population. Generally, published studies show larger effects than unpublished studies (Smith, 1980), presumably as a result of the greater motivation of researchers, reviewers, and editors to publish findings that reach statistical significance than those that do not. Therefore, with the exception of abstracting services, all of the approaches suggested by Cooper (1982), as well as a manual search, were systematically explored in an

attempt to ensure that as many studies as possible were located and at the very least, were a representative sample of studies in this area. With the availability of on-line computer access through the university and the accessibility of home computers, it was felt that a thorough search was conducted without the use of an abstracting service.

Through personal conversations on three separate occasions, Glen Dunlap, Mark Durand, and Pat Mirenda expressed that the first "real research" in the area of functional communication did not come about until 1985. For the purpose of this meta-analysis, the search began from 1985.

Criteria for Inclusion

The studies that were included in the meta-analysis met several criteria. The criteria for inclusion were as follows:

1. Subjects display challenging behaviours to obtain a desired outcome or to avoid/escape an undesired outcome.
2. Subjects display challenging behaviours that are socially motivated, suggesting that the behaviour functions as a form of communication.
3. Subjects have been formally diagnosed as having a developmental delay, including subjects diagnosed as having a moderate mental handicap, a severe/profound mental handicap, a multiple handicap, a behaviour disorder, autism, brain damage, or a sensory impairment.

4. Subjects have a language age significantly below the expected level of development.
5. Subjects are nonverbal prior to intervention.
6. Functional communication training is used as a treatment or intervention in an attempt to reduce challenging behaviour.
7. The data for each subject are presented as an individual graph. No graph that aggregates data across subjects will be used.
8. Graphs include five or more data points in both the baseline and treatment phases to ensure the stability of results.

Criteria for Exclusion

Studies were excluded from the analysis if the subjects met one or more of the following criteria:

1. Subjects are merely behaviour problems in the regular class.
2. Subjects have not been formally diagnosed with a developmental disability.
3. Subjects display challenging behaviours maintained by non-socially motivated consequences (e.g., self stimulation).
4. Subjects display behaviours that have no communicative intent.

Coding of Characteristics and Effect Size

Variables Coded

A coding booklet was developed for recording descriptive data about the studies. A multiple choice format was used and the data were classified under the following 7 categories: 1) Study identification (e.g., study I.D.#, authors, year of publication), 2) Subjects (e.g., gender, chronological age, primary disability), 3) Setting (e.g., treatment setting), 4) Research Design (e.g., experimental design, experimental control, observer training), 5) Treatment (e.g., form of the target behaviour, function of the behaviour, alternative communicative response), 6) Process (e.g., reliability), and 7) Calculation of effect sizes. The complete coding booklet can be found in Appendix B.

Calculation of Effect Sizes

The basic unit of observation in the meta-analysis was the effect size, which is an index of the magnitude of the effect of one variable (or set of variables) on another variable (or set of variables). Center et.al. (1985-1986) have presented the most sophisticated methodology for calculating effect size in single-subject design studies to date (Allison & Gorman, 1993). Center et. al. developed a piecewise regression approach in which the effects of level, trend, or changes in slope can be calculated as well as their combined effect using the formula:

$$Y = b_0 + b_1X + b_2t + b_3X(t - n_a) + e$$

In the above equation, Y represents the observed value on the dependent variable, b_0 is the regression constant, X is a dummy coded variable for treatment ($0 = \text{baseline phase}$, $1 = \text{treatment phase}$), t represents the successive days of observation, n_a is the number of data points in the baseline phase, and e represents error variance. b_1X represents the effects of treatment on level, b_2t represents the effects of treatment on trend, and $b_3X(t - n_a)$ represents the effects of treatment on slope (from the baseline to treatment phase).

It is important to note that the level difference specified by the model (b_1X) is the level difference from the end of the first phase to the beginning of the second phase, not the mean difference (see Figure 2). The term b_1X represents the mean difference only when there is no linear trend in either baseline or treatment.

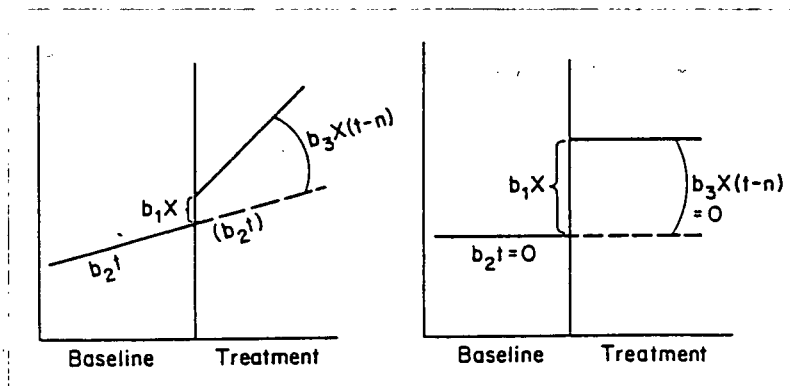


Figure 2. Interacting effects of level and slope: b_2t represents the slope present in the baseline phase, whereas $b_3X(t-n)$ represents the change in slope from the baseline to the treatment phase. b_1X represents change in level. This term is an estimate of the mean difference between phases if and only if the slope for both phases is zero (on right) (Skiba, Casey, & Center, 1985-1986).

In order to calculate the effect size, one must first compute the full model to obtain the associated R^2 . The model is then computed leaving out the parameters of the effects that is to be estimated and the associated R^2 is obtained. The R^2 s are then converted to an incremental F-ratio using the following formula:

$$[(R_f^2 - R_r^2) / M] / [(1 - R_r^2) / (N - k - 1)]$$

R_f^2 represents the R^2 from the full model, R_r^2 represents the R^2 from the reduced model, M is the number of parameters whose effects one is estimating, N is the total number of data points, and k is the number of parameters in the full model, not including the regression constant. Changes in ES_{level} , ES_{slope} and the combined effects of level and slope, $ES_{\text{level \& slope}}$, were computed by converting the F-ratio to an effect size index d , using the formula by Wolf (p. 35, 1986).

$$d = \frac{2\sqrt{F}}{\sqrt{\text{d.f. (error)}}}$$

Reliability of Data

Raw scores were retrieved from the graphs provided in each study included in the meta-analysis. Standard drafting equipment was used to estimate the points on the graphs.

Figure 3 provides an example of data retrieval from one of the graphs from the study by Durand (1993). Each baseline-treatment comparison was coded separately and interrater agreement was computed for 10% of the comparisons using a criterion-referenced intraclass correlation coefficient to provide information on both interobserver agreement and intraobserver reliability.

Raw data were obtained from original researchers wherever possible. The original raw data were compared to the raw scores retrieved from corresponding baseline-treatment comparisons to check for reliability of data retrieval. Once again, interrater agreement was computed using a criterion-referenced intraclass correlation coefficient.

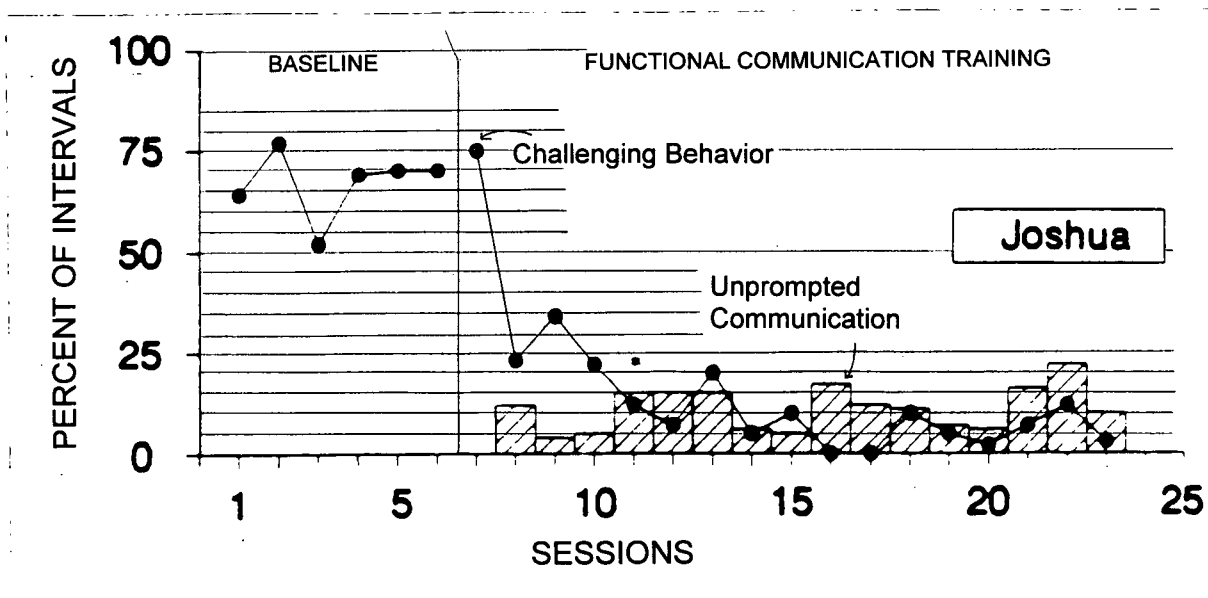


Figure 3. A Sample of the Data Retrieval Procedure. The graph represents the percent of intervals of challenging behaviour and unprompted communication for Joshua. The * signifies the session in which the student reached criterion responding on communication training (Durand, 1993). Standard drafting equipment was used to estimate the points on the graph.

Design of the Analysis

The current study investigated the main effects and interactions of the following seven parameters of functional communication training: diagnosis/type of disability, form of behaviour, function of behaviour, alternative communicative response, setting, maintenance, and generalization. They were defined as follows:

1. *Diagnosis/type of disability*: The diagnosis or type of disability was coded according to the formal diagnosis as stated in the research. This included the following diagnoses: developmental delay, severe/profound mental handicap, moderate mental handicap, brain damage, autism, behaviour disorder, physical disability, sensory impairment (hearing impairment/visually impairment), and multiple handicap. When an individual fell into more than one category, the primary handicapping condition determined the category under which the individual was placed.
2. *Form of behaviour*: Form of behaviour was based on the characteristics reported by study authors and was coded into the following categories: severe aggression, tantrums, self-injury, or maladaptive/socially inappropriate behaviours.
3. *Function of behaviour*: The function of challenging behaviour was coded as socially motivated behaviour (a) to obtain attention, (b) to obtain objects or activities, (c) to avoid/escape tasks/activities or (d) a

combination of two or more of the above, also referred to as multiple functions.

4. *Alternative communicative response*: Conventional forms of communication were coded into categories of sign language, gestures, token exchange, graphic representations (e.g., picture communication cards), and assistive devices.
5. *Setting*: The setting was defined as the location where the treatment or intervention took place and included a special school or program, a hospital or clinical environment, a home or living unit, a community preschool, or a group home.
6. *Maintenance*: Maintenance was defined as any investigation following the end of treatment.
7. *Generalization*: Generalization was investigated across changes in individuals interacting with the subject, changes in tasks, and changes in setting.

The main effects and interactions of other subject and treatment variables that may affect the success of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals with developmental disabilities were also investigated. Both substantive and methodological characteristics were included in the analysis.

Differences between effect sizes associated with categories within each parameter were tested, using a one-way analysis of variance, with mean effect sizes for ES_{level} , ES_{slope} , and $ES_{\text{level and slope}}$ as the dependent measures. A two-way analysis of variance was also employed to examine the interactions among the identified parameters wherever there were sufficient cases to allow for such comparisons.

The effect sizes were calculated for follow up intervention phases in studies where data existed. For these calculations, the initial baseline phase was used as the comparison to long term outcomes with the assumption that the baseline would be uncontaminated by multiple phase changes.

In addition to the aforementioned analyses, several sub-analyses were undertaken to investigate whether the individual studies and specific characteristics of their designs had an influence on the outcome of the results. Of particular interest were (a) whether the outliers had a significant effect on the mean effect sizes, (b) whether the number of subjects representing a particular study had an effect on the mean effect sizes, (c) whether the number of baseline and treatment data points had an effect on the mean effect sizes, (d) whether the source of baseline data had an effect on the mean effect sizes, (e) whether the aggregated baseline/treatment data had an effect on the mean effect sizes, and finally, (f) whether the study measured behaviour with interval data or frequency data, and if they had an effect on the mean effect sizes.

Summary

A meta-analysis was undertaken to cumulate and integrate the results of a number of studies that examine the implementation of functional communication training as an intervention to reduce challenging behaviour in nonverbal individuals with developmental disabilities. A thorough literature search of studies which examine functional communication training was conducted using a variety of methods. Studies were selected if they met all the criteria for inclusion and did not meet any of the criteria for exclusion. Coding of the studies included both methodological and substantive characteristics as well as data to calculate effect sizes. The piecewise regression approach was used to generate effect sizes from the selected studies. This approach was selected because of the advantages it has over the simple ANOVA model as it accounts for changes in both level and slope to provide a more complete description of a single case experiment. The coded data were analyzed to determine the effectiveness, maintenance, and generalizability of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals with developmental disabilities. The results of the analysis are presented in the following chapter.

Results

Introduction

The purpose of the meta-analysis was to provide a systematic review and analysis of single case studies that examine functional communication training as an intervention used to reduce challenging behaviour among nonverbal individuals who have a developmental delay. Although narrative reviews have found positive results for functional communication training, there has been a need for a more standardized form of research review. This meta-analysis has summarized previous research and has provided empirical evidence on the effectiveness of functional communication training.

Each study selected for the meta-analysis was coded and effect sizes were calculated in order to conduct a quantitative synthesis. Raw data were retrieved from individual graphs in the studies. Effect sizes were calculated from baseline-treatment comparisons using a piecewise regression approach (Center et. al., 1985-1986) for 34 subjects.

In addition to an investigation of the overall effectiveness of functional communication training, the impact of seven parameters of functional communication training were investigated in the analysis: (1) form of the behaviour, (2) function of the behaviour, (3) alternative communicative response, (4) primary disability, (5) treatment setting, (6) maintenance and (7) generalizability. In addition to the subject's primary disability, two other specific subject characteristics were included in the analysis, gender and

preintervention form of communication. The interactions among the treatment, design variables and subject characteristics were analyzed in an attempt to uncover any important or critical components of functional communication training that may have an impact on the intervention to reduce challenging behaviour.

The specific research questions under investigation were:

1. What is the degree of effectiveness of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals across various developmental disabilities?
2. To what degree do the following parameters, (a) form of behaviour, (b) function of the behaviour, and (c) alternative communicative response, influence the success of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals with developmental disabilities?
3. Does the treatment setting affect the success of functional communication training?
4. What are the effects of maintenance and extent of generalizability when functional communication training has been implemented across nonverbal individuals with developmental disabilities?
5. What other independent variables (e.g., chronological age, mental age, language age, sex) affect the success of functional communication training

as an intervention to reduce the challenging behaviour of individuals with developmental disabilities?

Assessment and treatment characteristics were added to the analysis as it became apparent that these parameters were critical components of functional communication training and could provide valuable information to practitioners and researchers.

This chapter presents the analysis of the data that was drawn from the studies selected for the meta-analysis. The first section provides a descriptive analysis of the study characteristics including subjects, methodology, behaviours, treatment, follow up, treatment integrity and interobserver agreement. It provides a context for the quantitative synthesis. The second section, the quantitative synthesis, addresses the specific research questions under investigation. The quantitative synthesis examines the overall effects of functional communication training as well as the main effects associated with each parameter under investigation. The interactions between the treatment packages and the identified parameters were examined where there were a sufficient number of cases to warrant such analyses.

Overall, the intent of this chapter is to present both qualitative and quantitative data to explore the parameters of functional communication training in order to provide practitioners and researchers in the field with a more comprehensive understanding of functional communication training.

Descriptive Analysis

Studies

Studies were located using a combination of methods as described in the methodology section (Chapter 3). The initial criterion for study selection was studies that investigated the effectiveness of functional communication training as an intervention to reduce aberrant behaviour of individuals with developmental disabilities. Thirty-three studies met the initial criteria. The 33 research articles then had to meet eight specific criteria for inclusion in the study. The specific criteria critical to this investigation included subject characteristics (e.g., nonverbal prior to the investigation), behaviour characteristics (e.g., challenging behaviours that were socially motivated), treatment (e.g., functional communication training is used as a treatment) and presentation of the results (e.g., treatment results for each subject is represented by an individual graph). There were also 4 criteria for exclusion which addressed the subject characteristics as well as behaviour characteristics (e.g., behaviours that have no communicative intent). If a study met one or more of the four criteria for exclusion, the study was rejected from the meta-analysis. A detailed description of the criteria for inclusion and criteria for exclusion is presented in Appendix A.

In the final analysis, 15 studies, ranging from 1987 to 1996, met all the criteria for inclusion and were selected for the meta-analysis. The studies are listed in Table 1. Ten of the 15 studies selected were published in the Journal of Applied Behavior Analysis. The other five studies appeared in Augmentative and Alternative Communication, Journal of the

Association for Persons with Severe Handicaps, Behaviour Modification and Journal of Developmental and Physical Disabilities. It was interesting to note that more than one-half of the studies originated from the University of Iowa or the University of Oregon.

Table 1. Publication Information and Institutional Affiliation for Studies Included in the Meta-Analysis

Author	Year	Title	Institution	Journal
Campbell and Lutzker	1993	Using Functional Equivalence Training to Reduce Severe Challenging Behavior: A Case Study	California State University University of Judaism	Journal of Developmental and Physical Disabilities
Day, Horner and O'Neill	1994	Multiple Functions of Problem Behaviors: Assessment and Intervention	Boise Group Homes University of Oregon	Journal of Applied Behavior Analysis
Durand	1993	Functional Communication Training Using Assistive Devices: Effects on Challenging Behavior and Affect	State University of New York at Albany	Augmentative and Alternative Communication
Durand and Kishi	1987	Reducing Severe Behavior Problems among Persons with Dual Sensory Impairments: An Evaluation of a Technical Assistance Model	State University of New York at Albany Syracuse University	Journal of The Association for Persons with Severe Handicaps
Fisher, Piazza, Cataldo, Harrell, Jefferson and Conner	1993	Functional Communication Training With and Without Extinction and Punishment	The Kennedy Institute and Johns Hopkins University of School Medicine	Journal of Applied Behavior Analysis
Horner and Day	1991	The Effects of Response Efficiency of Functionally Equivalent Competing Behaviors	University of Oregon Boise Group Homes	Journal of Applied Behavior Analysis
Horner, Sprague, O'Brien and Heathfield	1990	The Role of Response Efficiency in the Reduction of Problem Behaviors Through Functional Equivalence Training: A Case Study	University of Oregon	Journal of The Association for Persons with Severe Handicaps

(table continues)

Table 1. (continued)

Author	Year	Title	Institution	Journal
Lalli, Browder, Mace and Brown	1993	Teacher Use of Descriptive Analysis Data to Implement Interventions to Decrease Students' Problem Behaviors	Lehigh University University of Pennsylvania Lancaster-Lebanon Intermediate Unit	Journal of Applied Behavior Analysis
Marcus and Vollmer	1996	Combining Noncontingent Reinforcement and Differential Reinforcement Schedules as Treatment for Aberrant Behavior	Louisiana State University	Journal of Applied Behavior Analysis
Northup, Wacker, Berg, Kelly, Sasso and DeRaad	1994	The Treatment of Severe Behavior Problems in School Settings Using a Technical Assistance Model	University of Iowa	Journal of Applied Behavior Analysis
Peck, Wacker, Berg, Cooper, Brown, Richman, McComas, Frischmeyer and Millard	1996	Choice-Making Treatment of Young Children's Severe Behavior Problems	University of Iowa	Journal of Applied Behavior Analysis
Shukla and Albin	1996	Effects of Extinction Alone and Extinction Plus Functional Communication Training on Covariation of Problem Behaviors	Florida International University University of Oregon	Journal of Applied Behavior Analysis
Sigafoos and Meikle	1996	Functional Communication Training for the Treatment of Multiply Determined Challenging Behavior in Two Boys with Autism	University of Queensland Autistic Children's Association of Queensland	Behavior Modification
Steege, Wacker, Cigrand, Berg, Novak, Reimers, Sasso and DeRaad	1990	Use of Negative Reinforcement in the Treatment of Self-Injurious Behavior	University of Iowa	Journal of Applied Behavior Analysis
Wacker, Steege, Northup, Sasso, Berg, Reimers, Cooper, Cigrand and Donn	1990	A Component Analysis of Functional Communication Training Across Three Topographies of Severe Behavior Problems	University of Iowa	Journal of Applied Behavior Analysis

Eighteen studies from the initial selection process did not meet all of the criteria for inclusion. The primary reasons for rejection of studies from the meta-analysis were because all of the subjects in the studies were verbal, or the studies lacked sufficient data to calculate effect sizes. Two studies were rejected because the data were aggregated across time periods, one study did not measure aberrant behaviour, and graphs were not available in one study. In one other study, the subject engaged in self-stimulation, a behaviour considered not to be socially-motivated and therefore ineligible for the meta-analysis.

Most eligibility criteria were clearly stated in the research articles. In a few cases where the eligibility status was unclear, a second reader was consulted to discuss differences, coming to a consensus on the article in question.

Subjects

The 15 studies selected for inclusion in the meta-analysis included a total of 44 subjects, with a range of 1 to 5 subjects per study and a median of 3. However, not every subject in the 15 studies was eligible for inclusion in the meta-analysis. Of the 44 subjects, 34 subjects were accepted and 10 were rejected. Of the 10 subjects who did not meet the inclusion criteria, 6 were verbal, 2 subjects lacked adequate baseline data, 1 subject was not taught to use functional communication as an intervention, and 1 subject engaged in self-stimulation.

Every study reported the sex of the subjects. Twenty-four subjects were male and 10 subjects were female. The chronological age of the subjects was reported in 14 of the 15 studies. The age varied for subjects that were included in the meta-analysis. Among the studies that reported age, the range was 1.8 - 34 years with fairly equal distribution. The overall mean age was 11.26 years.

Typically, subjects were selected for a study on the basis of a referral for assessment and treatment for behaviour problems. Several of the subjects were at risk of being removed from their current placement because of the severity of their behaviour. It is interesting to note that for all of the subjects in the studies, a behaviour disorder was not reported as the primary handicapping condition. Rather, the challenging behaviour was described as a socially unacceptable behaviour that was engaged in by the subject who had a developmental disability. Eighty-two percent of the accepted subjects were reported to have a severe or profound mental handicap, although only 77% of the studies listed it as the primary handicapping condition. The rest of the subjects were reported to have a developmental delay (5.9%), a moderate mental handicap (5.9%) and autism (11.8%). A secondary handicapping condition was reported for 20 of the subjects which included a severe or profound mental handicap, autism, a sensory impairment, a multiple handicap, a dual sensory impairment or a physical handicap. Three subjects were reported to have cerebral palsy and another 3 subjects were reported to have secondary disabilities but were not defined in the study.

All of the subjects selected for the study were nonverbal prior to the intervention. Upon analysis of the pre-intervention modes of communication, 21 subjects (61.8%) were

reported to have no formal means of communication, 1 subject used picture communication (2.9%), 2 subjects used signing (5.9%), 5 subjects used gestures (14.7%), 3 subjects reached for objects (8.8%) and 1 subject (2.9%) used leading. Although 1 subject was reported to have a “vocal repertoire” and another subject was reported to make vocalizations, neither served a communicative function. Both subjects were considered to be nonverbal and were included in this study. The mode of communication prior to intervention was not reported for one subject.

A broad range of treatment settings were reported ranging from clinical to educational and vocational settings. Twenty-one percent of the subjects were treated in a hospital setting, 15% in the home or living unit, 15% in a group home and 3% in a community preschool. Thirty-eight percent of the subjects were treated in a special class, school or program. Three of the studies did not report treatment setting. Characteristics of each of the study subjects are summarized in Table 2.

Target Behaviours

The target behaviour for intervention in this meta-analysis was aberrant behaviour. The treatment method is based on increasing functionally and socially acceptable methods of communication while decreasing the degree of socially inappropriate or aberrant behaviour. More specifically, the individual is taught a socially acceptable, functionally equivalent communicative response to replace the aberrant behaviour. Among the 34 subjects in this analysis, four *forms* of aberrant behaviour were identified, based on characteristics reported

by study authors: aggression, tantrums, self-injury and maladaptive/socially inappropriate behaviour. Aggression was typically defined as forceful hitting, kicking, pushing, scratching, pinching, biting or throwing objects at another person. Self-injury was defined as instances of forceful striking, biting, slapping, scratching, poking or banging one's own body parts such that repetition of the behaviour over time resulted in tissue damage. Tantrums were defined as inappropriate vocalizations such as yelling, screaming and crying. Maladaptive/socially inappropriate behaviour included disruption, property destruction or non-compliance. Disruption and property destruction was defined as forceful banging, throwing, pulling, pushing, overturning, tearing, or climbing on objects not made for that purpose. Non-compliance was defined as pushing or putting away objects needed for a task or leaving a task area altogether.

Table 2. Descriptive Information on Subjects Included in the Meta-analysis

Study	Student's Name	C.A.	Sex	Primary Handicap	Form of Behaviour	Function of Behaviour
Campbell & Lutzker, 1993	Don	8.0	M	autism	tantrum, aggression	escape, tangible
Day et. al., 1994	Brandi	9.0	F	severe/profound MH	self-injury	tangibles, escape
	Dawn	34.0	F	same	self-injury	tangibles, escape
	Jamie	18.0	M	same	aggression	tangibles, escape
Durand, 1993	Michelle	5.5	F	moderate MH	aggression	escape, attention
	Peter	15.0	M	severe/profound MH	self-injury	escape
	Joshua	3.5	M	severe/profound MH	tantrums	tangibles
Durand & Kishi, 1987	Tina	20.0	F	severe/profound MH	aggression	escape

(table continues)

Table 2. (continued)

Study	Student's Name	C.A.	Sex	Primary Handicap	Form of Behaviour	Function of Behaviour
Durand & Kishi, 1987 (con't)	John	20.0	M	severe/profound MH	aggression	escape
	Jim	21.0	M	same	self-injury	tangibles
	Kim	21.0	F	same	self-injury	attention
Fisher et. al., 1993	Art		M	severe/profound MH	aggression, self-injury	escape
	Jan		F	same	self-injury	tangibles, attention, escape
	Bob		M	same	self-injury	escape
	Abe		M	same	self-injury	tangibles
Horner & Day, 1991	Paul	12.0	M	severe/profound MH	aggression	escape
	Peter	14.0	M	same	self-injury	escape
Horner et. al., 1990	David	14.0	M	moderate MH	aggression	escape
Lalli et. al., 1993	Al	10.0	M	severe/profound MH	self-injury	attention, escape
	Bob	10.0	M	same	aggression	attention
	Mary	14.0	F	same	self-injury	attention
Marcus & Vollmer, 1996	Rob	4.0	M	severe/profound MH	aggression	tangibles
	CJ	5.0	M	autistic	tantrum	tangibles
Northup et. al., 1994	Mike	5.0	M	severe/profound MH	self-injury	escape
	Kit	9.0	F	same	self-injury	attention
	Jane	8.0	F	same	self-injury	attention
Peck et. al., 1996	Alexander	1.8	M	developmental delay	maladaptive	attention
	Kevin	2.0	M	same	aggression	escape
Shukla & Albin, 1996	David	19.0	M	severe/profound MH	maladaptive, socially inappropriate	escape

(table continues)

Table 2. (continued)

Study	Student's Name	C.A.	Sex	Primary Handicap	Form of Behaviour	Function of Behaviour
Sigafoos & Meikle, 1996	Dale	8.0	M	autism	aggression, self-injury, tantrums, maladaptive/socially inappropriate	attention, tangibles
Steege et. al., 1990	Ann	5.0	F	severe/profound MH	self-injury	escape
	Dennis	6.0	M	same	self-injury	escape
Wacker et. al., 1990	Bobby	7.0	M	autism	self-injury	tangible
	Jim	9.0	M	severe/profound MH	aggression	escape

M = male; F = female; MH = mental handicap

The form of aberrant behaviour engaged in by each subject is summarized in Table 2. Self-injury was the behaviour under investigation in well over half (56.6%) of the analyses. The next most frequent form of aberrant behaviour that appeared in the analyses was aggression (27.6%). Tantrums and maladaptive/socially inappropriate behaviour were less frequently investigated, at 7.9% and 5.3% respectively. In one case (2.6%), the specific form of the behaviour was not identified.

The hypothesized purpose for the subject engaging in challenging behaviour is referred to as the *function* of the behaviour. The functions of subject behaviours fall into three broad categories: to obtain attention, to obtain tangibles or to escape/avoid tasks. It has been suggested that all 3 of these categories are socially motivated and serve as a form of communication. The function of aberrant behaviour engaged in by each subject is

summarized in Table 2. Of the 76 baseline-treatment comparisons, 36 comparisons (47.4%), examined the effects of functional communication training on a subject engaged in challenging behaviour to avoid/escape tasks. Fifteen comparisons (19.7%) examined the effects of functional communication training on a subject engaged in challenging behaviour to obtain attention and 23 comparisons (30.3%) examined the effects of functional communication training on a subject engaged in challenging behaviour to obtain tangible items.

Alternative Behaviours

Alternative behaviours refer to the new, socially acceptable communicative response developed through the assessment for functional communication training. Based on the hypothesized function of the aberrant behaviour, each subject was taught a new, socially acceptable, functionally equivalent response. Five general forms of alternative communicative behaviour were employed across the 34 subjects included in this analysis and are summarized in Table 3. Signing was the most frequently taught alternative form of communication and was evident in 43.4% of the comparisons. In all but one of these cases, the subject was taught to communicate at a single word level. In one instance, where physical effort was being examined, the subject was required to sign a complete sentence. An augmentative communication device was used in 25% of the comparisons. In each of these cases, the subject was taught to press a microswitch which played a prerecorded message in order to communicate. In the study by Durand (1993), the subjects were trained to use a Wolf™ communication board or an Introtalker™. In the case study by Horner et. al., (1990),

the subject was trained to use a Canon Communicator™. The remaining 3 studies (6 subjects) that used an augmentative communication device did not report the specific device that was used. Picture communication or communication cards was the alternative mode of communication in 11.8% of the comparisons. Gestures were used in 11.8% of the comparisons and token exchange was used in 2.6% of the comparisons as the alternative form of communication. The alternative form of communication for one subject in the study by Fisher et. al. (1993) was not specified and was simply referred to as a “communication response.”

Table 3. Treatment Information on Subjects Included in the Meta-Analysis

Study	Student's Name	Alternative Form of Communication	Message	Treatment Package
Campbell & Lutzker, 1993	Don	sign sign and point	“please” “Please drink”, “Please eat”	FCT
Day et. al., 1994	Brandi	signing and pointing speech	“want” “go”	FCT + Extinction FCT
	Dawn	signing and pointing picture communication (card with printed word)	“want” “help”	FCT + Extinction FCT
	Jamie	signing and pointing picture communication (card with printed word)	“want” “break”	FCT + Extinction FCT, FCT + Delay
Durand, 1993	Michelle	Wolf™ and head pointer	“I want to be with the group”	FCT + Extinction
	Peter	Introtalker™	“I want to take a break”	FCT + Extinction
	Joshua	Wolf™	“I want more”	FCT + Extinction

(table continues)

Table 3. (continued)

Study	Student's Name	Alternative Form of Communication	Message	Treatment Package
Durand & Kishi, 1987	Tina	tokens	"I want a break" written on a token	FCT
	John	tokens	"I want a break" written on a token	FCT
	Jim	signing	request access to favourite tangibles	FCT
	Kim	signing	request for adult attention	FCT
Fisher et. al., 1993	Art	signing	"go"	FCT FCT + Punishment
	Jan	signing	"more"	FCT + RCB
		clapping	"more", "finished"	FCT + Extinction
		signing	request for adult attention	
	Bob	not specified	"go"	FCT + Punishment
	Abe	signing	not specified	FCT + RCB FCT + Punishment
Horner & Day, 1991	Paul	signing (sentence)	"more"	FCT + RCB
		signing (word)	"break"	
	Peter	signing	"help"	FCT-FR 3 + RCB FCT + RCB
Horner et. al., 1990	David	Canon Communicator M TM	"Help, please"	FCT
Lalli et. al., 1993	Al	pointing to a photo	request access to preferred activities	FCT + Extinction
	Bob	gesture (hand/arm wave) tangible symbol (toy)	"hello", request attention	FCT-FI 5, FCT-FI 15
	Mary	gesture (tap on teacher's arm)	request for attention	FCT-FI 3, FCT-FI 5

(table continues)

Table 3. (continued)

Study	Student's Name	Alternative Form of Communication	Message	Treatment Package
Marcus & Vollmer, 1996	Rob	picture communication (card with printed word), gesture (touching experimenter's hand)	"toys please"	FCT + Non-contingent Reinforcement
	CJ	gesture (touching palm of therapist's hand), signing, speech	"music"	FCT + Delay
Northup et. al., 1994	Mike	button microswitch	"I'd like a break now, please"	FCT
	Kit	microswitch, headphones and music	request for attention	FCT
	Jane	microswitch	"Please come here"	FCT
Peck et. al., 1996	Alexander	microswitch and ball	"Somebody come here, please"	FCT + Extinction
	Kevin	picture communication (card with printed word) speech	"play"	FCT + Extinction
Shukla & Albin, 1996	David	sign	"break"	FCT + Extinction
Sigafoos & Meikle, 1996	Dale	gesture (tapping the teacher's hand three times)	request for attention	FCT
		picture communication (line drawing) and pointing	"food", "drink", or "toy"	
Steege et. al., 1990	Ann	microswitch	"Stop!"	FCT
	Dennis	microswitch	"Stop!"	FCT
Wacker et. al., 1990	Bobby	signing	request for tangible (yellow bowl)	FCT + Punishment FCT + Extinction
	Jim	signing	"please", "eat"	FCT FCT + Extinction

FCT = functional communication training; FI = fixed interval reinforcement schedule; FR = fixed ratio reinforcement schedule; RCB = reinforced or allowed to engage in challenging behaviour

Description of Treatment

Functional communication training is an intervention that is conceptually quite simple but does in fact, follow a specific process. This process includes two major components, assessment and training. First, an assessment is conducted to identify the antecedents and/or consequences maintaining the aberrant behaviour and to develop a hypothesis as to the function of the aberrant behaviour. Once the function of the behaviour has been identified, the individual is trained to emit a socially appropriate, communicative response that serves the same function or produces the same consequences as the aberrant behaviour. In addition, attempts are made to make the aberrant behaviour nonfunctional or at least less functional than the new communicative response.

Every study included in this investigation began with an assessment of the subjects' aberrant behaviour in order to develop a hypothesis of the function of the behaviour. A functional analysis or an analogue assessment based on the model of Iwata et. al. (1982) was used to assess the function of the behaviour for 67.6% of the subjects. Briefly, these assessments consist of direct manipulations of a general class of consequences (e.g., attention, tangibles and escape) hypothesized to maintain problem behaviour during carefully controlled conditions to identify functional relationships. The rest of the subjects were assessed with the Motivation Assessment Scale (M.A.S.) (20.6%) or a descriptive analysis (11.8%). The M.A.S. is a scale that includes 16 questions about the possible influence of social attention, escape, tangibles, and sensory feedback on challenging behaviour (Durand & Crimmins, 1992). Responses are rated on a 7-point Likert-type scale, totaled and ranked to

hypothesize what is considered to be the primary function of the challenging behaviour.

Descriptive analysis, used only in 2 studies, included scatter plot analysis (Touchette, MacDonald & Langer, 1985), interviews and direct observations.

Once the function of the aberrant behaviour was known or the hypothesized function of the subject's behaviour was identified, functional communication training was then implemented to teach the subject a functionally equivalent and socially acceptable form of communication to replace the inappropriate behaviour.

Functional communication training has typically been identified as a specific treatment package for aberrant behaviour. However, in the 15 studies identified in this meta-analysis, the actual intervention procedures varied considerably. In addition, some studies combined functional communication training with various other operant procedures (e.g., extinction, punishment). In order to draw general conclusions about the effects of functional communication training, it was necessary to define the intervention and to categorize the various treatment packages. The specific components included in the treatment package for each subject are summarized in Table 3.

"Functional communication training" was the treatment package described for 35 of the 76 comparisons (46.1%). However, in almost every case, functional communication training did not occur in isolation. Studies incorporated procedures such as physical and verbal prompting, praise, shaping, graduated guidance, errorless backward chaining, neutral redirection and fading techniques as part of the treatment package referred to as functional

communication training. Using the procedures delineated in the treatment package, when a subject correctly performed the new, functionally communicative response, he/she was rewarded with what was originally motivating the subject to engage in the aberrant behaviour.

Forty-one of the 76 comparisons (53.9%) used a combination of functional communication training and another form of intervention as the treatment package. Twenty of the 76 comparisons (26.3%) combined functional communication training with extinction of the challenging behaviour. In this treatment package, the subject was rewarded for correctly performing the new communicative response and was ignored when s/he engaged in aberrant behaviour.

Three comparisons (3.9%) combined functional communication training with delay. In the delay condition, the subject was required to perform the appropriate functional communication response a specified number of times (e.g., 3 times) before s/he was rewarded with the hypothesized reinforcement. Although this treatment package was still functional communication training, the schedule of reinforcement made it a more difficult or demanding task and merited a category of its own.

Eight comparisons (10.5%) combined functional communication training with punishment. The subject was reinforced for performing the functionally communicative response and was punished when s/he engaged in aberrant behaviour. Punishment took a variety of forms and included verbally reprimanding the subject, verbally prompting and

physically guiding the subject to complete a specified number of requests (e.g., picking up the materials that were thrown), and a 30-second basket hold time-out. It was interesting to note that 7 of the 8 comparisons involving functional communication and punishment were from the study by Fisher et. al. (1993).

Another 8 comparisons (10.5%) investigated functional communication training while also reinforcing or allowing challenging behaviour (i.e., self injury, aggression, tantrums and maladaptive/socially inappropriate behaviour). In this treatment package, the subject was rewarded with the hypothesized reinforcement for engaging in functional communication or aberrant behaviour.

In one comparison, in the study by Horner and Day (1991), functional communication training was combined with a delay component as well as reinforcing or allowing challenging behaviour. Lastly, in a study by Marcus and Vollmer (1996), functional communication training was combined with non-contingent reinforcement in which the individual received access to preferred reinforcers on a fixed-time schedule, independent of occurrences of aberrant or adaptive behaviours.

Generalization and Follow Up

The data on both generalization and follow up to demonstrate that the subjects can transfer new communicative responses to novel situations were very limited. Three studies reported enough data on generalization across tasks to calculate effect sizes. From the 3

studies, 8 baseline-generalization across tasks comparisons were generated for analysis. Another 3 studies reported enough data to calculate effect sizes on generalization across settings. Six baseline-generalization across settings comparisons were generated from the 3 studies.

Only 3 of the 15 studies reported adequate data to examine the long term effects of functional communication training. The 3 studies generated 7 effect sizes on follow up data. Unfortunately, only one study reported the length of time between the intervention and the follow up (9 months). The other 2 studies did not report the time between intervention and follow up. Such limited data restrict the conclusions that can be drawn for the analysis of maintenance of treatment effects.

Treatment Integrity & Interobserver Agreement

Treatment integrity was reported in only 3 studies. One study measured treatment integrity by the percentage of student target behaviours that were followed by the specified consequence (within two 10-s intervals). Observers from a second study recorded occurrences of therapists' implementation of negative reinforcement contingencies (i.e., escape from task) and therapists' implementation of guided compliance procedures. Authors reported a 100% level of treatment integrity in both of these studies. In a third study, percentage trials during training that the subject performed correctly without assistance, frequency of praise statements by the teacher, and the delivery of prompts and corrections by

the teacher were recorded. Agreement averaged 100%, 89% and 93% respectively for each of these aspects of treatment integrity.

Observer training and interobserver agreement were reported consistently throughout the studies. Twelve of the 15 studies reported that observer training occurred prior to the intervention. Every study selected for the meta-analysis reported some index of interobserver agreement. In general, the indices of interobserver agreement presented were percentage agreements. Nine of the 15 studies reported interobserver agreement specifically for the aberrant behaviour with a range of 85% to 98.75% agreement. One study simply reported 2 instances of disagreement for the first subject and 1 instance of disagreement for the second subject. The other five studies reported interobserver agreement across all variables with a range of 83% to 98% agreement.

Experimental Control

The experimental design of the studies was examined on 2 levels. First, at the study level, the experimental control that was employed in each study was categorized. Second, the treatment design within subject was categorized. The experimental control was not consistent across subjects in all of the 15 studies. Some of the studies used a different type of experimental control for each subject. Therefore, the experimental control as well as the treatment design will be described at the subject level.

Experimental control fell into 1 of 3 categories. The first was a simple AB nonreversal design where the target behaviour was measured during a baseline period and then during the administration of the experimental treatment. Seven of the subjects (20.5%) fell into this category. The second type of experimental control was the reversal condition which was similar to the AB design except that a second baseline condition was added. Experimental designs such as ABA, ABAB, and other variations of the reversal condition were included in this category. Fourteen subjects (41.2%) were subjected to a reversal condition. Finally, a multiple baseline design was implemented to control for extraneous variables in assessing treatment effects. Again, 14 subjects (41.2%) fell into this category of experimental control. In 4 of the studies, treatments were investigated across 3 or more subjects. Three of the studies involved only 1 subject across 2 or 3 treatment conditions. Variations of the multiple baseline design were included in this category. One subject in the study by Fisher et. al. (1993) was counted twice as 2 separate treatments were conducted, one using a multiple baseline design and another using a simple AB design.

Treatment Design

The treatment design not only varied from study to study, but also across phases and was specific to the subject. The treatment designs within subjects were classified into 1 of 5 designs: (a) simple, (b) reversal, (c) change, (d) variation, or (e) combination. A simple design was defined as simply a baseline phase followed by an intervention phase (AB design). Eleven of the subjects (32.4%) fell into this category. The reversal design included a return to the baseline condition after the treatment condition. A reversal design or a variation

of one (e.g., ABA, ABAB) was used for two of the subjects (5.9%). Change was defined as a change in intervention after returning to baseline (e.g., ABACA). This treatment design involved functional communication training for 2 different functions of behaviour (e.g., want training and escape training) or functional communication training and another form of intervention (e.g., punishment, extinction, etc.). Change was the within treatment design for 6 of the subjects (17.6%). In the variation design, the treatment remained the same with slight modifications such as changes in the fixed ratio of reinforcement (e.g., FR1 to FR3), changes in the physical effort required when signing (e.g., signing a sentence to signing one word), changes in the object used to communicate (e.g., a toy vs. a switch) and changes in the time delay before receiving reinforcement (e.g., 1 sec. vs. 3 secs.). The variation within subject design was employed for 4 of the subjects (11.8%). The last within subject treatment design, a combination design, was employed for 11 of the subjects (32.4%). A combination design was defined as an intervention where two or more forms of intervention were implemented at the same time and within the same phase (e.g., functional communication training and extinction).

Comparisons

Baseline-treatment comparisons were derived from individual graphs provided in the original studies. The 34 subjects from the 15 accepted studies resulted in a total of 76 different comparisons with a mean of 2.2 comparisons generated from each subject. Data from 26 of the 34 subjects generated over half of the comparisons (55.3%) at one or two comparisons per subject (see Table 4). It should be noted that the data from 4 of the 5

subjects that generated 4, 5 and 6 comparisons each were from the same study by Fisher et. al. (1993). This one study generated a total of 19 of the 76 comparisons (25%) that were used in the meta-analysis. Data from the other subject that generated 6 comparisons were from the case study by Campbell and Lutzker (1993).

Table 4. Number of Comparisons Generated from Each Subject

# of Comparisons per Subject	# of Subjects	Total Comparisons
1	10	10
2	16	32
3	3	9
4	2	8
5	1	5
6	2	12
Total	34	76

In 34.2% of the comparisons, true baseline data were not presented in the original study. When a true baseline was not available, the data points from the functional analysis or analogue assessment were considered as baseline data. The data from the functional analysis or analogue assessment were accepted as baseline data provided a graph was available, it had enough points to draw adequate data, and the behaviour was measured in the same way during treatment. Effect sizes were generated from each of these baseline-treatment comparisons.

Summary

To summarize, 15 studies were published between 1985 and 1996 which reported the results of functional communication training with nonverbal, developmentally delayed

subjects. These studies met the established criteria and included appropriate data of outcomes for 34 subjects for inclusion in the meta-analysis. Approximately three quarters of these subjects were considered to have a severe or profound mental handicap and all were nonverbal, the majority having no formal means of communication prior to the implementation of functional communication training. Most subjects engaged in self-injury and aggressive target behaviour, and most were taught to substitute some form of signed communication as the appropriate alternative communicative response. The majority of studies used a functional analysis to determine the function of aberrant behaviour. Although all studies in this review conducted a functional assessment, a variety of treatment components were included in many studies. Over half of the treatment comparisons used a combination of functional communication training and some other form of intervention.

The next section will report the results of the quantitative analysis of functional communication training. The overall effects of functional communication training, the main effects associated with each parameter under investigation, and the interactions between treatment packages and the identified parameters where there were sufficient number of cases will be presented.

Quantitative Synthesis

All of the studies selected for the meta-analysis were read and coded using an 8 page coding booklet developed for recording the descriptive data about the studies (see Appendix B). Data were entered into a spreadsheet-like facility and the SPSS 6.1 for Windows Student

Version statistical package was used for all calculations. The results of the statistical calculations are presented below. The first section addresses the first research question presented in the study and examines the overall effects of functional communication training. Also included in this section are the results of analyses of several characteristics of the data and the effects of specific coding criteria undertaken in the meta-analysis. The other four research questions which reflect the effects of various parameters of functional communication training are addressed in the analysis of main and interaction effects.

Overall Effects

The overall effects of functional communication training were analyzed to address the first research question: "What is the degree of effectiveness of functional communication training as an intervention to reduce challenging behaviour on nonverbal individuals across various developmental disabilities?"

From the 15 studies, a total of 76 baseline-treatment comparisons using a functional communication training package yielded a total of 228 effect sizes for change in level, change in slope, and combined effects of change in level and slope. The mean effect sizes for differences between baseline and treatment, standard deviation and range are listed in Table 5. A one sample t-test revealed that all effect sizes were significantly different from 0 at the .01 level of significance, indicating that on all indicators of effect, functional communication training yielded a significant impact on the aberrant behaviour.

Table 5. Overall Mean Effect Sizes of Functional Communication Training

Variable	n	Mean	Std. Dev.	t	Range
ES _{level}	76	2.52	1.76	12.46*	.11 - 6.95
ES _{slope}	76	1.48	1.68	7.68*	.00 - 13.63
ES _{level & slope}	76	2.34	1.46	13.93*	.40 - 9.65

* $p < .01$

A number of potential characteristics of the effect size data were of supplementary interest to this analysis. In light of this interest, several sub-analyses were undertaken prior to conducting further analyses of treatment effects.

Many of the effect sizes calculated from the comparisons were very large. Twenty-seven of the comparisons in the ES_{level} condition had effect sizes that were greater than 3.00, 6 comparisons in the ES_{slope} condition had effect sizes that were greater than 3.00, and 19 comparisons in the ES_{level & slope} condition had effect sizes that were greater than 3.00. Only 2 studies, Marcus and Vollmer (1996) and Shukla and Albin (1996) did not have any values where the effect size was greater than 3.00. However, upon visual inspection, one effect size in the ES_{slope} condition (13.63) appeared to stand out as an outlier in the distribution overall. ES_{slope} was recalculated with the 13.63 value removed. The adjusted ES_{slope} was $1.32 \pm .91$, still a significant effect size.

Although other effect sizes greater than 3.00 were present, they appeared to be equally distributed. However, in light of the fact that extreme outliers in a quantitative synthesis can have undue effects on the findings of an analysis (Pillemer & Light, 1980), a second analysis was conducted where the effect sizes for level, slope, and combined level and slope that were

more than 3 standard deviations from the mean were arbitrarily set to a value of 3 standard deviations from the mean. This is the same procedure used to minimize the undue effects of outliers in the meta-analysis by Skiba, Casey, & Center (1985-1986). The results of the calculations for effect sizes with adjusted means are presented in Table 6. Of the 228 effect sizes generated for level, slope and combined level and slope, 52 effect sizes were adjusted. Mean effect sizes were only slightly smaller than the initial calculation. A one sample t-test also revealed results similar to the initial analysis. The results indicated that the effect sizes were still significantly different from 0 at the .01 level of significance and that the overall effect of functional communication training is significant.

Table 6. Overall Mean Effect Sizes of Functional Communication Training with Effect Sizes Adjusted to a Maximum of 3.00.

Variable	n	Mean	Std. Dev.	t	Range
ES _{level}	76	1.98	1.00	17.37*	.11 - 3.00
ES _{slope}	76	1.31	.87	13.18*	.00 - 3.00
ES _{level & slope}	76	2.03	.79	22.35*	.40 - 3.00

* $p < .01$

The number of comparisons and thus the number of effect sizes drawn from each of the studies were not equal in their contribution to the meta-analysis. Five of the 34 subjects contributed approximately 1/3 of the 76 comparisons. In order to account for the subjects who had a significantly larger contribution of comparisons to the meta-analysis, a mean effect size for each subject was calculated. Mean effect sizes were recalculated with each subject being represented only once. The results are presented in Table 7. Again, the results were similar to the overall effect sizes represented in Table 5. A one sample t-test was conducted

to see if the observed mean effect sizes were significantly different from 0. All were found to be significantly different from 0 at the .01 level of significance.

Table 7. Overall Mean Effect Sizes of Functional Communication Training Using Subject Means

Variable	n	Mean	Std. Dev.	t	Range
ES _{level}	34	2.63	1.60	9.60*	.18- 5.96
ES _{slope}	34	1.29	.81	9.32*	.05 - 3.58
ES _{level & slope}	34	2.29	1.07	12.48*	.67 - 5.33

* $p < .01$

The effect of number of baseline and treatment data points was also investigated. Fifteen of the comparisons had a baseline of fewer than 5 points, with a minimum of 3 baseline data points in one comparison and 4 baseline data points in the other 14 comparisons. Eight comparisons had a treatment phase with a minimum of 4 data points. By excluding these comparisons, 30% of the data would have been lost. In order to check for biases in the data, a one-way ANOVA was conducted to determine if any significant differences exist between data with fewer than 5 points and data with 5 or more points. The means and standard deviations are presented in Table 8.

Table 8. Mean Effect Sizes by Number of Baseline and Treatment Points

Parameter	n	ES _{level}		ES _{slope}		ES _{level & slope}	
		X	SD	X	SD	X	SD
Baseline Data							
< 5 data points	15	3.03	1.61	1.29	1.05	2.63	1.49
= or > 5 data points	61	2.39	1.78	1.52	1.80	2.26	1.46
Treatment Data							
< 5 data points	8	3.63	2.05	1.34	.87	2.87	1.35
= or > 5 data points	68	2.39	1.69	1.49	1.75	2.27	1.47

The mean effect sizes for baseline data and treatment data appeared to be somewhat larger when fewer than 5 data points were available, both in the case of ES_{level} and $ES_{\text{level} \& \text{slope}}$. The reverse was true for ES_{slope} . A one-way ANOVA indicated that there were no significant differences between comparisons with less than 5 baseline and/or treatment points and comparisons with 5 or more baseline and/or treatment points at the .05 level of significance. Given these results, the comparisons involving at least 3 data points were included in all subsequent analyses.

Several characteristics of the individual studies resulted in variations of data collection. These variations were coded and analyzed. In the following section, effect sizes were calculated and mean comparisons were made for each of the variations of data collection for the meta-analysis.

Several authors did not collect or report true baseline data, but included sufficient assessment data or functional analysis data to construct a baseline for the purpose of this meta-analysis. An analysis was undertaken to compare the effect size differences that might be attributed to the source of baseline data.

Fifty of the 76 comparisons (65.8%) were true baseline-treatment comparisons. That is, there was a baseline phase prior to the treatment phase and data for both baseline and treatment phases were graphically represented. In the case where a baseline phase was not available, the functional analysis or assessment phase was used to generate the control condition or baseline data provided that it was represented by a graph. In 26 of the 76

comparisons (34.2%) the functional analysis data or assessment data were used as baseline data and compared to the treatment conditions.

The mean effect sizes for comparisons that used true baseline data and comparisons that used functional analysis or assessment data were calculated to determine if a significant difference existed between the two sources of data. The mean effect sizes for level, slope and combined level and slope are presented in Table 9.

Table 9. Mean Effect Sizes by Source of Baseline Data

	n	ES _{level}		ES _{slope}		ES _{level & slope}	
		X	SD	X	SD	X	SD
True Baseline	50	2.17	1.88	1.66	1.99	2.26	1.68
Functional Analysis/ Assessment	26	3.18	1.30	1.13	.67	2.48	.91

An analysis of variance (ANOVA) was conducted to determine whether there was a significant difference in mean effect size for comparisons that used true baseline data and those that used functional analysis or assessment data as baseline data. Results of the ANOVA revealed a significant difference in change in level mean effect size for comparisons that used true baseline data versus those that used functional analysis or assessment data for the baseline phase ($F(1, 74) = 6.04, p < .05$). Mean effect sizes for change in slope and change in combined level and slope did not differ based on the source of baseline data.

As discussed earlier, a number of the studies also lacked sufficient data within a single baseline or treatment phase. However, in some of the studies, sufficient data were

available across phases to construct a baseline or treatment phase. The term “constructed baseline data” or “constructed treatment data” was used to define an aggregation of more than 1 phase. The term constructed baseline was used when more than 1 baseline phase preceded the treatment condition under investigation and was aggregated for the comparison. A constructed baseline was used in 17 of the 76 comparisons (22.4%). The term constructed treatment was used when more than 1 treatment phase of the same condition(s) followed the baseline phase and was aggregated for the comparison. Constructed treatment data were used in 9 of the comparisons (11.8%). In 7 of the comparisons (9.2%), both constructed baseline data and constructed treatment data were used in the same comparison. For over half of the comparisons (56.6%), the data from one baseline phase and one treatment or follow up phase were used in the baseline-treatment comparison. The mean effect sizes for change in level, change in slope, and change in level and slope comparing true baseline/treatment data with constructed baseline/treatment data are presented in Table 10. No significant differences were found between the observed means for true baseline/treatment data and constructed baseline/treatment data at the .05 level of significance.

Table 10. Mean Effect Sizes for True Baseline/Treatment Data and Constructed Baseline/Treatment Data

	n	ES _{level}		ES _{slope}		ES _{level & slope}	
		X	SD	X	SD	X	SD
True Data	43	2.52	1.79	1.52	2.08	2.34	1.60
Constructed Data	33	2.51	1.75	1.42	.96	2.33	1.29

Aberrant behavior was measured either by interval or frequency in the selected studies. Measurement by frequency included those studies which measured the aberrant

behaviour by number of occurrences in a specific interval of time (e.g., number of hits per minute). Measurement by interval included those studies which measured the aberrant behaviour on a percentage basis (e.g., percentage of trials or intervals). Thirty-one of the comparisons (40.8%) measured aberrant behaviour with percent interval data while 45 comparisons (59.2%) measured aberrant behaviour with frequency data. The mean effect sizes for comparisons that used percent interval data and comparisons that used frequency data were calculated and are presented in Table 11. Results indicated that comparisons with effect sizes drawn from frequency data resulted in a larger effect size for ES_{level} and $ES_{\text{level \& slope}}$.

Table 11. Mean Effect Sizes for Interval and Frequency Data

	n	ES_{level}		ES_{slope}		$ES_{\text{level \& slope}}$	
		X	SD	X	SD	X	SD
Interval	31	1.72	1.67	1.73	2.42	2.17	1.92
Frequency	45	3.06	1.63	1.31	.86	2.45	1.05

An ANOVA was conducted to determine whether there was a significant difference in mean effect size between interval data and frequency data. Results of the ANOVA revealed that the effect size for change in level was significantly larger for studies that reported frequency data than for those that reported interval data ($F(1, 74) = 12.21, p < .05$).

Results of the analysis of study characteristics and data collection methods indicated that some differences in effect sizes could be attributed to reporting characteristics of studies, specifically source of baseline data and the method by which aberrant behaviour is measured.

However, the differences noted were relatively few and inconsistent in effect on level, slope and combined level and slope to require separation for subsequent analyses. Thus, all subsequent analysis were conducted with the original effect size estimates as described earlier.

Main Effects

Form, Function and Alternative Behaviour. The parameters associated with the behaviour of the subjects address the second research question: "To what degree do the following parameters, (a) form of behaviour, (b) function of the behaviour, and (c) alternative communicative response, influence the success of functional communication training as an intervention to reduce the challenging behaviour of individuals with developmental disabilities?" The mean effect sizes for level, slope and combined level and slope for the form of the behaviour, the function of the behaviour, and the alternative form of communication are presented in Table 12.

The effect sizes for form of behaviour ranged from .66 to 4.35 with the majority of the smaller effect sizes reflecting smaller changes in slope between baseline and treatment phases. However, an ANOVA revealed that there were no significant differences between the forms of behaviour for ES_{level} , ES_{slope} and $ES_{\text{level \& slope}}$. The results indicate that functional communication training is an equally effective intervention regardless of the form of aberrant behaviour engaged in by the subject. It should be noted here that the small n 's for some of the categories (i.e., multiple behaviours, maladaptive/socially inappropriate and tantrums) may result in unstable effect size estimates.

Table 12. Mean Intervention Effect Sizes by Form, Function and Alternative Behaviour

Parameter	n	ES _{level}		ES _{slope}		ES _{level & slope}	
		X	SD	X	SD	X	SD
Form of Behaviour							
Aggression	21	2.48	1.65	1.51	1.09	2.29	1.08
Tantrums	6	2.13	.74	.66	.58	1.70	.59
Self-Injury	43	2.47	1.90	1.62	2.06	2.43	1.72
Maladaptive/Socially Inappropriate	4	2.94	1.39	1.41	.71	2.19	.95
Multiple Behaviours	2	4.35	3.16	.71	.50	3.17	2.11
Function of the Behaviour							
To Obtain Attention	15	4.09	1.88	1.34	.67	3.31	1.49
To Obtain Tangibles	23	1.97	1.46	1.52	2.73	2.07	1.86
To Avoid/Escape Tasks	36	2.31	1.55	1.51	1.07	2.16	.99
Multiple Functions	2	.81	.82	1.36	.44	1.31	.18
Alternative Behaviour							
Picture communication	9	3.42	1.93	1.08	.64	2.96	1.86
Signing (word)	32	1.94	1.51	1.61	2.37	2.13	1.64
Augmentative Communication Device	19	2.71	1.50	1.77	.95	2.34	.90
Gestures	9	4.34	1.77	.94	.64	3.22	1.24
Tokens	2	.41	.33	.88	.11	.71	.05
Signing (sentences)	1	2.85		.61		2.12	

Analysis of the effect sizes for function of behaviour indicated an overall difference in the effects of functional communication training depending on the maintaining variable(s) (i.e., to obtain attention, to obtain tangibles, to avoid/escape tasks). A relatively high mean effect size for change in level ($ES_{\text{level}} = 4.09 \pm 1.88$) and change in combined level and slope ($ES_{\text{level \& slope}} = 3.31 \pm 1.49$) was exhibited for subjects whose behaviour was maintained by obtaining attention. An ANOVA revealed that the mean effect sizes differed significantly by function of the behaviour both in terms of change in level ($F(3, 72) = 6.81, p < .05$) and change in level and slope combined ($F(3, 72) = 3.23, p < .05$).

Post hoc comparisons using the Tukey HSD procedure with a significance level of .05 revealed that in terms of both change in level and change in combined level and slope, functional communication training resulted in significantly larger effect sizes when treating subjects who exhibited challenging behaviour which functioned to obtain attention than it did for subjects who exhibited challenging behaviour in order to obtain tangibles, to avoid/escape tasks, or subjects who engaged in challenging behaviour that serve multiple functions.

The alternative behaviour used in functional communication training was coded into 6 categories: (1) picture communication, (2) signing (one word), (3) augmentative communication devices, (4) gestures, (5) tokens, and (6) signing (sentences). Results of an ANOVA comparing the relative effect of different forms of communication indicated a significant difference in mean effect size for change in level for the alternative behaviour ($F(5, 66) = 4.54, p < .05$).

Post hoc comparisons using the Tukey HSD procedure with a significance level of .05 revealed that treatments which taught gestures as an alternative mode of communication resulted in larger changes between baseline and treatment than the treatments which taught token exchange or signing at a word level.

Treatment Setting. Treatment setting was the parameter under investigation in the third research question: "Does the treatment setting affect the success of functional communication training?" Main effects were calculated for treatment setting to determine whether location of the intervention had an impact on the outcome of functional

communication training. Mean effect sizes indicated that regardless of treatment setting, functional communication training was a positive form of intervention. The mean effect sizes for level, slope and combined level and slope are presented in Table 13. It should be noted that although the mean effect sizes for the community preschool setting are relatively lower than the other conditions, it is based on an n of 1 and may not be representative of all community preschools.

Table 13. Mean Intervention Effect Sizes by Treatment Setting

Parameter	n	ES _{level}		ES _{slope}		ES _{level & slope}	
		X	SD	X	SD	X	SD
Special School/Program	13	3.05	1.94	1.32	.76	2.65	1.35
Hospital/Clinical	7	1.87	1.49	2.08	.91	2.11	.82
Home/Living Unit	5	3.17	1.26	.78	.72	2.46	.94
Community Preschool	1	1.48		.75		1.06	
Group Home	5	2.62	1.09	.90	.37	2.00	.76

An ANOVA indicated a significant difference in the effect size for change in slope between baseline and treatment for studies conducted in different treatment settings ($F(4, 26) = 2.98, p < .05$).

Post hoc comparisons using the Tukey HSD procedure with a significance level of .05 revealed that functional communication training in a hospital or clinical setting resulted in significantly greater changes in slope between baseline and treatment when compared with treatments implemented in a home or living unit.

Generalization & Follow Up. An analysis of generalization and follow up data was undertaken to address the fourth research question: "What are the effects of maintenance and extent of generalizability of functional communication training across individuals with different developmental disabilities?" Very limited data were available to analyze generalization and maintenance of treatment effects. Data from 8 comparisons were aggregated to calculate a main effect for generalization to new tasks. The main effects for generalization to new tasks were compared to baseline levels to test whether level of behaviour during generalization was significantly different from levels observed during baseline. The mean effect sizes for level, slope and combined level and slope are presented in Table 14. Data from 6 comparisons were aggregated to calculate the main effect for generalization to other settings. The mean effect sizes for level, slope and combined level and slope for generalization to other settings are presented in Table 15.

Table 14. Mean Intervention Effect Sizes for Generalizability of Treatment to New Tasks

Variable	n	Mean	Std. Dev.	t	Range
ES _{level}	8	3.10	1.64	5.36*	1.12 - 6.38
ES _{slope}	8	1.50	1.06	3.99*	.00 - 2.71
ES _{level & slope}	8	2.49	1.08	6.49*	1.24 - 4.51

* p < .01

Table 15. Mean Intervention Effect Sizes for Generalizability of Treatment to Other Settings

Variable	n	Mean	Std. Dev.	t	Range
ES _{level}	6	1.98	1.57	3.08*	.23 - 4.22
ES _{slope}	6	1.17	.60	4.83**	.43 - 1.91
ES _{level & slope}	6	1.85	.81	5.58**	1.12 - 3.04

* p < .05; ** p < .01

One sample t-tests were conducted to determine if the mean effects for generalization of treatment to other tasks or settings were significantly different from zero. All effect sizes were found to be significantly different from zero.

Similarly, limited data were available to analyze the effects of functional communication training in a follow up phase. However, where there were sufficient data, the difference between baseline and follow up was examined. The results are summarized in Table 16. The mean effect sizes indicated that even at the follow up stages, functional communication training continued to have a positive impact on the subjects' behaviour, with all effect sizes significantly different from zero.

Table 16. Mean Intervention Effect Sizes for Follow Up

Variable	n	Mean	Std. Dev.	t	Range
ES _{level}	7	4.08	1.59	6.79*	2.29 - 6.95
ES _{slope}	7	1.24	.59	5.60*	.39 - 1.91
ES _{level & slope}	7	3.10	1.11	7.41*	1.81- 4.92

* p < .01

Although the results are in favour of functional communication training for generalization to new tasks and settings and for maintenance or follow up, it should be noted that the analyses depend on a relatively small numbers of subjects and caution should be exercised in the interpretation of these results.

Subject Characteristics. The fifth and final research question had to do with independent subject characteristics. The specific question asked was: "What other independent variables (e.g., chronological age, mental age, language age, sex) affect the

success of functional communication training as an intervention to reduce the challenging behaviour of individuals with developmental disabilities?" Most of the studies did not report adequate data on mental age and language age. However, sufficient data were available on three specific and relevant subject characteristics for further investigation: gender, the primary disability or handicapping condition, and the pre-intervention mode of communication. The mean effect sizes for functional communication training were calculated for each of these subject characteristics and are presented in Table 17.

Table 17. Mean Intervention Effect Sizes by Gender, Primary Disability and Pre-Intervention Mode of Communication

Parameter	n	ES _{level}		ES _{slope}		ES _{level & slope}	
		X	SD	X	SD	X	SD
Gender							
Male	56	2.51	1.70	1.62	1.90	2.38	1.53
Female	20	2.55	1.96	1.09	.70	2.21	1.27
Primary Disability							
Developmental Delay	4	3.17	.99	1.33	.83	2.32	.70
Severe/Profound	57	2.45	1.87	1.57	1.84	2.38	1.61
Mental Handicap							
Moderate Mental Handicap	3	2.38	1.82	2.97	1.14	2.91	.62
Autism	12	2.67	1.49	.71	.48	2.01	1.02
Mode of Communication							
No formal communication	46	2.34	1.66	1.60	2.00	2.23	1.50
Picture communication	2	5.96	1.16	1.48	.15	5.33	2.39
Sign Language	4	4.50	1.34	.86	.56	3.48	.93
Gestures	10	3.68	1.39	1.15	.80	2.90	.99
Reaching	10	.92	.48	1.21	1.00	1.23	.53
Vocalizations	2	2.46	.36	.80	1.04	1.85	.29

The mean effect sizes for male and female subjects were examined to determine whether functional communication training was differentially effective for different sexes.

The results of a one-way ANOVA indicated that functional communication training is an effective treatment for males and females with similar mean effect sizes for both.

Based on the selection criteria for studies to include in the meta-analysis, all subjects had challenging behaviour and were developmentally delayed. However, the majority of the authors reported the primary handicapping condition by a formal diagnosis. The primary handicapping condition of the subjects that were reported by the authors were 1 of the following 4 conditions: developmental delay, severe/profound mental handicap, moderate mental handicap and autism. In order to determine if functional communication training was differentially effective for subjects with particular handicaps, an analysis of mean effect sizes for the primary handicapping condition or disability was undertaken. A one-way ANOVA indicated that there were no significant differences between effects for subjects with different primary disabilities. That is, effect sizes for functional communication training appeared to be equal across the 4 categories of developmental disabilities.

The mode of communication prior to functional communication training was examined to determine whether there is a difference in the effectiveness of functional communication training amongst subjects with specific communication skills prior to intervention. Results of the ANOVA comparing mean effect sizes for different pre-intervention modes of communication indicated a significant difference in effect size for change in level ($F(5, 68) = 7.27, p < .05$) and change in combined level and slope ($F(5, 68) = 4.47, p < .05$).

Post hoc comparisons of changes in level between groups using the Tukey HSD procedure with a significance level of .05 revealed that functional communication training has overall significantly less effect on subjects who used reaching as a form of communication than subjects who used gestures, sign language or picture communication prior to intervention. In addition, functional communication training was found to result in greater changes in level for subjects who used picture communication prior to intervention than subjects who had no formal means of communication.

Post hoc comparisons for changes in combined level and slope revealed that functional communication training resulted in greater effect sizes for subjects who engaged in picture communication prior to intervention than those who engaged in reaching or have no formal means of communication.

Supplementary Analyses

The following analyses were not part of the initial proposal, but emerged from a closer examination of the literature and were determined to be worthy of investigation and further analysis. This section will present supplementary analysis on assessment method prior to intervention, treatment design across subjects, and treatment package.

Assessment Method. The initial assessment of a subject's challenging behaviour plays a significant role in choosing an appropriate and effective form of functional

communication. Although it was not the intention to examine the assessment characteristics, it was an area that could possibly disclose meaningful information.

As described in an earlier section, three forms of assessment were reported in the 15 studies, a functional analysis or analogue assessment, the M.A.S., and a descriptive analysis. The form of assessment prior to intervention was analyzed to identify whether it had a significant impact on the outcome of functional communication training. The results are summarized in Table 18. Results of the ANOVAs revealed that studies using the different assessment methods differed in the degree of change in level ($F(2, 31) = 4.51, p < .05$) and in combined level and slope ($F(2, 31) = 6.18, p < .05$).

Table 18. Mean Intervention Effect Sizes by Assessment Method

Parameter	n	ES _{level}		ES _{slope}		ES _{level & slope}	
		X	SD	X	SD	X	SD
Descriptive Analysis	4	4.57	1.80	1.06	.38	3.69	1.57
M.A.S.	7	1.92	1.48	1.01	.45	1.65	.97
Functional Analysis / Functional Assessment	23	2.50	1.39	1.42	.92	2.24	.79

Post hoc comparisons using the Tukey HSD procedure with a significance level of .05 indicated that the mean effect size for change in level and change in combined level and slope was greater for subjects whose behaviour was assessed by a descriptive analysis than for those who were assessed with the M.A.S. or by a functional analysis or analogue assessment.

Treatment Design and Treatment Package. In addition to the assessment method, effects of two other aspects of the intervention were examined, treatment design and treatment package. The two parameters were examined to determine if the type of treatment design or the specific functional communication treatment package had an impact on the success of the intervention.

Although there was a tremendous amount of variation in treatment designs amongst the subjects, treatments with similar types of designs were collapsed into one of 5 categories, simple, reversal, change, variation and combination, as described in the descriptive analysis of this chapter. The mean effect sizes and standard deviations for studies using each category of design are presented in Table 19. An ANOVA indicated that there were no significant differences at the .05 level between studies using different treatment designs.

Table 19. Mean Intervention Effect Sizes by Treatment Design and Treatment Package

Parameter	n	ES _{level}		ES _{slope}		ES _{level & slope}	
		X	SD	X	SD	X	SD
<i>Treatment Design</i>							
Simple	19	2.45	1.46	1.07	.77	1.91	.98
Reversal	4	2.27	1.32	1.49	.87	2.20	.96
Change	13	2.85	1.51	1.51	1.20	2.54	.98
Variation	9	3.63	1.70	1.06	.60	2.70	1.09
Combination	31	2.13	2.01	1.83	2.38	2.43	1.95
<i>Treatment Package</i>							
FCT	35	2.74	1.77	1.37	1.00	2.37	1.15
FCT and Extinction	20	2.86	2.01	1.88	2.85	2.88	2.15
FCT and Delay	3	2.81	.67	1.25	1.07	2.21	.66
FCT and Punishment	8	1.50	.68	1.63	.99	1.73	.49
FCT and RCB	8	2.09	1.85	.94	1.02	1.82	1.24
FCT (FR3) and RCB	1	.88		1.16		1.11	
FCT and Non Contingent Reinforcement	1	.43		1.18		.97	

FCT = functional communication training; FR = fixed interval reinforcement schedule; RCB = reinforced or allowed to engage in challenging behaviour

The mean effect sizes for the seven treatment packages were also examined. The mean effect sizes and standard deviations are presented in Table 19. An ANOVA indicated that the mean effect sizes for the seven treatment packages did not differ.

Interaction Effects

The interaction effects of treatment characteristics, selected subject characteristics, and treatment packages were examined. In order to ensure adequate cell frequencies, functional communication plus extinction, delay, punishment, and challenging behaviour, as well as FCT (FR3) and challenging behaviour and FCT and non contingent reinforcement were collapsed into one category and was labelled "FCT and other interventions". The FCT category stood on its own. The treatment characteristics of particular interest were the form and function of the behaviour, the alternative mode of communication, and the assessment method. The specific subject characteristics that were examined were gender, primary disability and pre-intervention form of communication. These analyses were restricted to those combinations of variables with sufficient number of study effects to compute interaction effects.

Interaction Effects Between Treatment Characteristics. In order to determine if treatment packages were differentially effective for subjects with different forms of behaviour, a 2-way ANOVA was undertaken. The form of behaviour variables that had adequate data were aggression, tantrums and self-injury. Maladaptive/socially inappropriate behaviour and multiple behaviour forms were not included in the ANOVA, excluding 6

potential comparisons. The analysis did not reveal any significant differential treatment effects for the different forms of behaviour.

A similar analysis was undertaken to summarize differential treatment package effects depending on the function of aberrant behaviour of the subjects. Adequate data were available for 3 of the 4 functions of behaviour: to obtain attention, to obtain tangibles and to avoid/escape tasks. Results of the analysis indicated that there were no statistically significant interactions between the function of the behaviour and treatment packages.

Sufficient data were available for 4 of the 6 categories of alternative behaviour, picture communication, signing (word), augmentative communication, and gestures, to allow an analysis of potential differential treatment package effects. Data were insufficient for tokens and signing (sentences) which resulted in the exclusion of 3 comparisons. Results of the ANOVA revealed that there were no significant interaction effects between the 4 categories of alternative behaviour and the treatment package.

The interactions between assessment method and treatment package were also examined. The results of the 2-way ANOVAs revealed a significant main effect for change in level for the three assessment approaches as identified earlier and a significant 2-way interaction at the .05 level of significance both in terms of change in level and change in combined level and slope.

In order to interpret these significant interaction effects, cell means were plotted. Figure 4 presents the change in level effect size means and Figure 5 presents the change in combined level and slope effect size means for each treatment across the three assessment methods. Functional communication training combined with other interventions exhibited a clear advantage ($ES_{\text{level}} \text{ mean} = 5.96$; $ES_{\text{level \& slope}} \text{ mean} = 5.33$) over functional communication training alone ($ES_{\text{level}} = 3.24$; $ES_{\text{level \& slope}} \text{ mean} = 2.51$) when a descriptive analysis was the form of initial assessment. Functional communication training combined with other interventions exhibited a slight advantage ($ES_{\text{level}} \text{ mean} = 2.41$; $ES_{\text{level \& slope}} \text{ mean} = 2.02$) over functional communication training alone ($ES_{\text{level}} \text{ mean} = 1.56$; $ES_{\text{level \& slope}} \text{ mean} = 1.38$) when the M.A.S. was the form of initial assessment. The reverse was true when functional analysis was the form of initial assessment with functional communication training alone at a slight advantage ($ES_{\text{level}} \text{ mean} = 2.72$ and $ES_{\text{level \& slope}} \text{ mean} = 2.50$) over functional communication training combined with other interventions ($ES_{\text{level}} \text{ mean} = 2.12$; $ES_{\text{level \& slope}} \text{ mean} = 2.16$).

Interaction Effects Between Subject Characteristics. Three subject characteristics were analyzed to determine if an interaction effect was present, gender, primary disability, and pre-intervention mode of communication. The results of a two-way ANOVA for gender and treatment packages indicated that there were no statistically significant interaction effects between the gender of the subject and the treatment package.

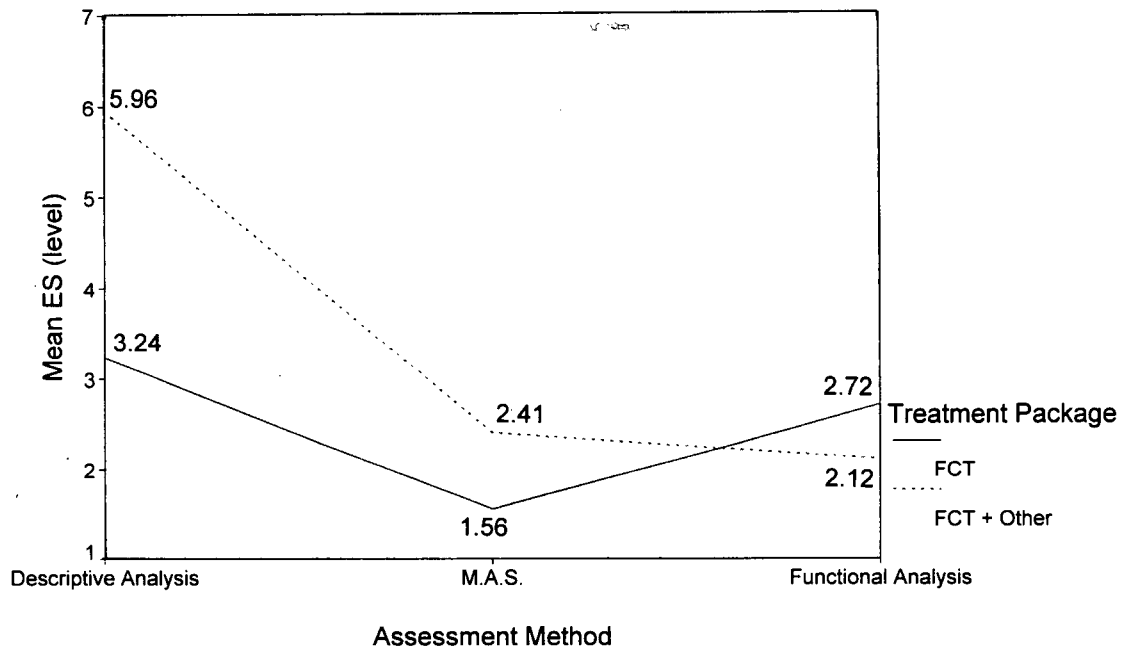


Figure 4. Interaction Effects for Change in Level Effect Size Means for Treatment Package Across Three Assessment Methods

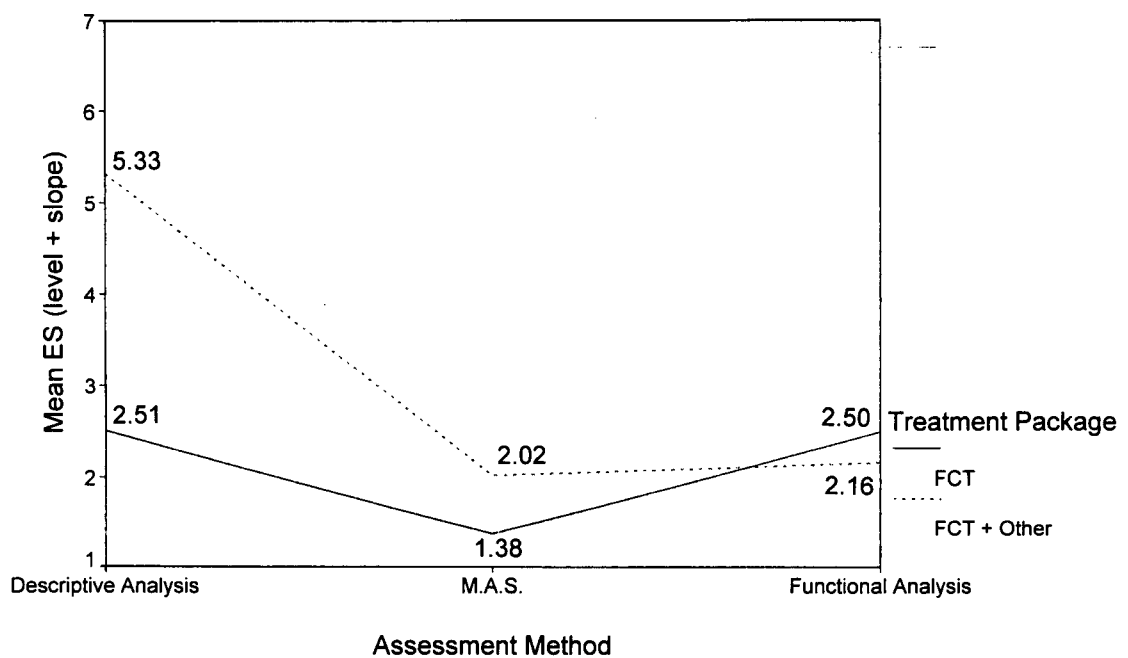


Figure 5. Interaction Effects for Change in Combined Level and Slope Effect Size Means for Treatment Package Across Three Assessment Methods

A two-way ANOVA for the interaction between the primary disability and treatment package was conducted for 3 of the 4 disability categories, severe/profound mental handicap, moderate mental handicap and autism. Results of this analysis indicated that there were no statistically significant interaction effects between the primary handicapping condition and the treatment package.

The categories for no communication, signing (word) and gestures had adequate cell frequencies to compare treatment package effects. A 2-way ANOVA was conducted without the categories of picture communication, reaching and vocalizations. The results of the ANOVA revealed that there were no statistically significant interactions between treatment package and the 3 categories of pre-intervention modes of communication.

Reliability

The raw scores for 76 comparisons were retrieved from the graphs provided in each study included in the meta-analysis. Standard drafting equipment was used to estimate each of the data points. A second independent rater was employed to independently estimate data points in 8 (10%) randomly selected comparisons. Interrater reliability was estimated by calculating criterion referenced intraclass correlation coefficients (Suen & Ary, 1989) for each of the 8 data sets. Intraclass correlation coefficients were selected to test the reliability because they provide information on both interobserver agreement as well as intraobserver reliability. That is, the reliability estimate accounts for both random error and observer bias.

Results revealed 100% intraclass correlation agreement on 6 of the 8 comparisons with a range of 99.9% - 100% agreement for the 8 comparisons.

In addition, authors of all 15 studies were contacted in an effort to retrieve original data. Requests for original data were sent to the authors of all 15 studies. The response was limited with 4 of the 15 authors responding to the request for data. Raw data from only one author, Dr. J. Sigafoos, was obtained. Two comparisons were tested for reliability, resulting in a 100% agreement using the intraclass correlation statistical approach.

Summary

The first section of this chapter has provided a descriptive analysis of a selected group of single case studies that examine functional communication training as an intervention to reduce challenging behaviour of nonverbal individuals with developmental delays. The second section has presented the results of a quantitative synthesis of data across a variety of variables to examine the effectiveness of functional communication training. The quantitative analysis appears to support functional communication training as a successful and highly effective intervention method for nonverbal subjects who engage in socially inappropriate challenging behaviour.

The following chapter will discuss the results of the meta-analysis and its implications on the practical implementation of functional communication training as an intervention to reduce the challenging behaviour of nonverbal individuals who have a developmental delay.

In addition, suggestions will be made for future research directions. The advantages and limitations of this particular model for analyzing and synthesizing single-subject research as well as specific issues surrounding this method of quantitative analysis will also be discussed.

Discussion

Introduction

There has recently been a great interest in assessment and intervention in order to reduce, eliminate, or replace challenging behaviour in individuals with severe disabilities. Functional communication training is quickly becoming a favourable alternative to past interventions because of its proactive approach. Burke (1990) states that "A functional analysis of unconventional behaviour and subsequent replacement with socially acceptable and functional communicative abilities are being recognized as essential practices with individuals who have developmental disabilities and behaviour problems" (p. 82-83). Functional communication training is an approach which incorporates just these "essential practices."

Doss and Reichle (1989), in their narrative review, discussed the idea of "behaviour as communication" and stated that communication instruction "may be a viable treatment for the reduction of excess behaviors in persons with severe disabilities" (p. 111). Doss and Reichle's definition of excess behaviour referred to socially unacceptable behaviours acquired and maintained because of the social consequences they produce. Empirical support for this approach to reducing challenging behaviour is growing (Doss & Reichle, 1989; Durand, 1990; Durand & Crimmins, 1991). However, there has been little or no documentation on functional communication training from a quantitative perspective. The current analysis was conducted to examine and synthesize the existing literature on functional

communication training using the quantitative measure of an effect size. Single-subject design studies on functional communication training were analyzed to determine the overall effectiveness of functional communication training as a non-aversive intervention to reduce challenging behaviour of non-verbal individuals. A systematic analysis of 7 specific parameters were examined to determine what impact they have on functional communication training outcomes.

The results of the present review strongly support past literature (Burke, 1990; Doss & Reichle, 1989; Mirenda, 1997; Reichle & Johnston, 1993) on the effectiveness of functional communication training. The empirical data and what the data suggests with respect to the effectiveness of functional communication training are discussed in the present analysis. This chapter also suggests some interesting points of discussion in the use of functional communication training from a more practical perspective. Other findings suggest areas of deficit and concern that need to be addressed.

A systematic discussion of this review will be done in the context of the research questions that were posed at the beginning of the study. The first section will address the overall effectiveness of functional communication training. The second section of the discussion will address the main effects of the specific parameters that were under investigation. Specifically the parameters that will be discussed will be (a) form of the behaviour, (b) function of the behaviour, (c) alternative mode of communication, (d) treatment setting, (e) generalization and maintenance, (f) follow up, (g) subject characteristics, (h) assessment characteristics, (i) treatment design, and (j) treatment package.

The third section will discuss the interaction effects of functional communication training. Next, there will be a brief discussion about the characteristics of the individual studies and their implications on the meta-analysis. Both statistical and procedural methodological characteristics and the impact on the results of the study will be discussed. Finally, the implications for education and suggestions for future research will be addressed.

Overall Effects

Central to this investigation and the overriding question that drives this analysis is: “What is the degree of effectiveness of functional communication training as an intervention to reduce challenging behaviour of individuals across various developmental disabilities?” The results of the analysis across 34 subjects indicate that functional communication training is a highly effective intervention in the reduction of challenging behaviour across a number of parameters. The overall mean effect sizes from the analysis of functional communication training were consistently large across change in level, change in slope, and change in combined level and slope and reflect its effectiveness as a treatment for use with nonverbal individuals with challenging behaviour. The large mean effect size of the change in level describe the significant and immediate reaction of the effects of functional communication training.

The total data set for this analysis included effect size estimates based on 76 baseline-treatment comparisons. Although this allows for a comprehensive test of the effectiveness of functional communication training with this population, a variety of characteristics of the

data set and the methods used to generate it necessitate some caution in the interpretation of the results. A number of these potential concerns were investigated and results of these analyses were presented.

One of the concerns in the analysis of overall effect sizes was the number of extremely large effect sizes that were calculated from the individual comparisons. So that these large numbers would not skew the results, the effect sizes for each comparison were arbitrarily set to a maximum value of 3. The assumption was that this would result in a more accurate representation of mean effect sizes. Surprisingly, the mean effect sizes were only slightly lower than the original mean effect sizes. The large effect sizes, which were potentially “outliers,” had a minimal effect on the outcome of the analysis which would indicate that functional communication training has overall impressive results.

A second concern with the overall effect sizes was the disproportionate contribution of effect sizes by each of the subjects. A few of the subjects were over represented in the meta-analysis relative to the others. The potential of these studies skewing the results was a distinct possibility. In order to account for the unequal contribution of effect sizes, mean effect sizes for each subject were calculated. The overall effect sizes were recalculated using the mean effect size for each subject so that each subject was represented only once. The results did not indicate a substantial difference between initial overall effect sizes and mean effect sizes recalculated with each subject represented only once. Therefore, we can assume that the unequal contribution of effect sizes by each of the subjects did not skew the results.

However, it can not be assumed that this will always be the case. In future studies, it may be necessary to weight the contribution by each of the subjects to ensure equal representation.

A third concern that should be mentioned here is the limited number of baseline and treatment data points in the original data. Less than 5 data points in either the baseline phase or the treatment phase in some of the comparisons, raised some question as to the stability of the data. However, by excluding these comparisons, a great deal of potentially valuable information would have been lost. Had there been a significantly large number of studies that met the criteria for inclusion for this meta-analysis, the loss of these data would not have been as great a concern. However, the number of available studies was limited, since this is an intervention that has only recently achieved recognition in the research literature.

In order to check for a bias in studies that lacked baseline or treatment data points, an analysis was conducted comparing baseline data and treatment data with less than 5 points to baseline and treatment data with 5 or more points. A comparison of baseline data and treatment data with less than 5 data points and 5 or more data points indicated that there were no significant differences between the two sets of data. This analysis suggests that the data for both baseline and treatment phases were relatively stable in this study. A more detailed discussion of the potential value of complete baseline data will be presented later in this chapter.

Even in light of the concerns about outliers, unequal contribution of data from subjects, and lack of baseline and treatment data points, the data suggest that functional

communication training is a highly effective form of intervention with a substantial impact on challenging behaviour for individuals who are nonverbal. However, one must take caution in interpreting the outcome of the results, as the inclusion of comparisons with potential outliers, disproportionate contributions of data from subjects, and limited baseline and treatment data points may reflect either an underestimate or overestimate in the overall mean effect sizes. On the other hand, throwing out all of the data that do not strictly adhere to the requirements of the meta-analysis would result in too few studies to conduct a meta-analysis altogether.

The next section will discuss the main effects with respect to the research questions under investigation. The discussion will begin with the main effects of the form of the behaviour, the function of the behaviour, and the alternative mode of communication followed by a discussion on the treatment setting and generalization, maintenance and follow up of functional communication training. Finally, the specific subject characteristics, assessment characteristics, treatment designs, and treatment packages will be discussed.

Main Effects

Form, Function and Alternative Communicative Response

With respect to the second research question on the effects of form, function and alternative communicative response, the effect sizes were rather substantial. A visual analysis of the means suggests that regardless of the form, function or alternative communicative

response, functional communication training is a highly effective intervention. The following will briefly touch on each of the three parameters.

Form. The results of the analysis indicate that functional communication training is effective for all forms of behaviour (i.e., aggression, tantrum, self injury and maladaptive/socially inappropriate behaviour). Although there were no significant differences between the forms of behaviour, it is interesting to note that the highest effect sizes were for what would be considered the most problematic forms of behaviour, self-injury and aggression, behaviours whereby an individual can cause physical harm to oneself or others. Both of these forms of behaviour had the largest n 's (aggression $n = 21$ and self-injury $n = 43$) so one can possibly assume that these are problem behaviours of greatest concern and are the most frequently addressed. This assumption is supported by Bird et. al. (1989) in their study. They stated that aggression and self-injury are two of the most dangerous maladaptive behaviours exhibited by persons with developmental disabilities in their opening remarks.

Maladaptive/socially inappropriate behaviours had equally large mean effect sizes. One explanation for the large mean effect sizes for the maladaptive/socially inappropriate behaviours is that for 3 of the 4 comparisons the behaviour was, in fact, physically harmful to the individual (i.e., line pulling and chewing tubes attached to the subject's central line and altering the settings on the intravenous infusion pump (Peck et. al., 1996)) but did not meet the criteria to be classified as self-injury. Thus, the majority of reported functional communication training interventions were undertaken with individuals who exhibited significant and severe behaviour difficulties across these categories. In addition to severe

aggression and self-injurious behaviour, Carr and Durand (1985) also included violent temper tantrums as behaviours that significantly restrict the lives of those who engage in them. Thus, functional communication training has a similar, substantial impact on a large number of subjects.

Function. The analysis clearly indicates that regardless of the function of the behaviour (i.e., to obtain attention, to obtain tangibles or to avoid/escape tasks) functional communication training is an effective intervention. However, the mean effect sizes for change in level and change in combined level and slope appear to be slightly larger for subjects who exhibit challenging behaviour in order to obtain attention than subjects who exhibit challenging behaviour to communicate other needs. It is possible that the subjects requesting attention may be more social and truly have a desire to interact with others while those requesting tangibles or avoiding/escaping tasks may not necessarily have a desire to interact with others and may only be interacting to express their needs. Given that functional communication training is a social form of intervention, based on a social-communicative hypothesis (Carr, 1977), it would be reasonable to assume that subjects requesting attention have a desire to socially interact with others and would be more likely to respond positively to such an intervention. However, there have been no data that measure the subject's desire to socialize. Furthermore, it would be difficult to test this hypothesis without substantial data on the affective characteristics of the subjects.

Another explanation that can account for the slightly larger mean effect sizes for change in level and change in combined level and slope for subjects who exhibit challenging

behaviour in order to obtain attention may be related to the individuals who responded to the subjects displaying the challenging behaviour. The research by Durand and Kishi (1987) suggested that staff tend to interact more with students who engage in attention-maintained behaviour and interact less with clients engaged in escape-maintained behaviour. The data also indicated that staff may interact less with clients who engage in behaviours maintained by tangible consequences. In addition, Durand and Kishi hypothesized that staff may inadvertently be negatively reinforced to interact less with students who engage in escape-maintained behaviour because by making fewer demands, staff may find these students better behaved. This suggests that there is a dynamic relationship between the learner's responding and the behaviour of others and warrants further examination.

From a practical point of view, the knowledge that those who engage in challenging behaviour for attention are more likely to benefit from functional communication training provides direction in terms of the implementation of such an intervention. Where it is hypothesized that the challenging behaviour of a subject serves a particular function, that is the function that must be addressed. However, where an assessment suggests that the challenging behaviour serves multiple functions, it may be reasonable to begin by addressing the attention if, in fact, attention is one of the functions of behaviour in question.

Alternative Communicative Behaviour. The analysis revealed that regardless of the alternative form of communication that was selected for the subjects in the individual studies, functional communication training is an effective intervention. Functional communication training resulted in relatively high mean effect sizes for change in level and change in

combined level and slope when gestures or picture communication was selected as the alternative mode of communication for the subjects. In fact, functional communication training resulted in significantly higher effect sizes for subjects who use gestures when compared with subjects who use token exchange or signing at a word level. The large mean effect sizes for functional communication training when gestures is the alternative mode of communication is not surprising in light of the fact that in the experimental situation, the individual responding to the subject is informed and trained to respond to the gesture. A gesture is not as clearly identifiable as pointing to a specific picture or pressing a microswitch for a taped message. However, the individual responding to the gesture can anticipate the subject's request and may very well respond to what appears to be close approximations of the gesture.

Signing is a mode of communication somewhat similar to gestures, but possibly more precise in nature. The mean effect sizes of functional communication training when signing was selected as the alternative mode of communication, resulted in lower, but still significant mean effect sizes. What would be a true test of the effectiveness for the alternative modes of communication would be the degree of generalization to the subjects' natural environment with untrained individuals responding to the messages.

On a more practical level, it should be recognized that, although, statistically, gestures are an effective mode of communication, they are rather idiosyncratic in nature. In terms of generalization to other individuals and different environments, the new receiver of the information may not understand what is being communicated. Durand (1993) expressed

similar concerns with sign language stating that “a potential problem with this approach [sign language] is that few individuals in most communities are familiar enough with manual signs to understand even basic requests. In addition, the signs made by many students are frequently idiosyncratic and are difficult to understand by even experienced teachers” (p.168).

This is certainly an issue that needs to be considered when selecting an alternative mode of communication. Possible alternatives to manual signs and gestures are the use of various alternative and augmentative communication systems. These strategies include, no tech or low tech devices such as picture communication with use of symbols, pictures and words (Mirenda, 1985) and high tech devices with voice output systems (Durand, 1993), which may be more practical alternatives. The current study revealed that the mean effect sizes of functional communication training when picture communication or augmentative communication devices were selected as the alternative mode of communication were positive and support the use of these strategies.

In order for functional communication training to be successful, the alternative mode of communication must be selected, taking into consideration the individual subject characteristics. As part of the assessment procedure prior to implementation of functional communication training, it is necessary to determine the most appropriate mode of communication for a particular individual. It is critical that the alternative message serve the same function as the challenging behaviour and is as easy or easier for the subject to implement in terms of effort. Durand and Carr (1987) demonstrated the importance of

matching the communicative function to be established as directly as possible to the social motivation of the challenging behaviour and once the communicative function had been identified, the importance of selecting a response topography that will compete with the efficiency of the existing challenging behaviour that is to be replaced. A brief discussion on assessment procedures will be addressed in a later section of this chapter.

Treatment Setting

The statistical analysis indicates that functional communication training results in significant, beneficial changes in subject behaviour in all treatment settings. With respect to the research question regarding treatment setting, the analysis indicates that functional communication training results in the greatest changes in subject behaviour and reductions in aberrant behaviour when conducted in a hospital or clinical setting. These results are not surprising since the environment can be controlled in a hospital or clinical setting, therefore the results can be quite dramatic. In a hospital or clinical setting, the behaviour of the subject can be systematically manipulated by the presence or absence of different antecedent and consequent stimuli and the effects of these manipulations on challenging behaviours can be documented. In this way, apparently random displays of behaviour can be interpreted to predict patterns of responding.

Although the results obtained in hospital or clinical settings have been impressive, these settings are highly artificial. If treatment occurs in a hospital or clinical setting there is still a need for follow up in the natural environment for generalization purposes. It is unlikely

that generalization will occur from a hospital or clinical setting to a natural setting unless a natural setting is included in the training process.

Berg and Sasso (1993) point out several recurring issues that hinder the progress they believe is possible in the treatment of challenging behaviour. They claim that the success of a functional assessment is dependent upon two factors: 1) the relevance of the assessment results to the criterion setting (i.e., the setting in which the treatment will ultimately be implemented), and 2) the integrity with which the subsequent intervention recommendations are implemented and continued over time (p. 343). When the intervention occurs in a separate location from the ultimate intervention setting, such as a hospital or clinical setting, it may limit the degree to which the results meet these two criteria for success.

Berg and Sasso (1993) identified several benefits associated with conducting assessments of challenging behaviour within the natural setting. First, the relationship between maintaining variables within hospital or clinical settings and those operating in classroom settings is unclear. Clinic-based functional analyses have proven to be an effective means of identifying general classes of maintaining contingencies. However, these maintaining contingencies may not be the same contingencies operating in other settings, such as the classroom. By conducting the assessment in the natural setting, it can reduce the need to infer what other variables may be operating.

A second benefit associated with conducting assessments of challenging behaviour within the natural setting may be that this is the most effective means for ensuring

intervention integrity. Berg and Sasso (1993) state that a lack of follow-through by caregivers in implementing and maintaining intervention recommendations has been an ongoing problem for both inpatient and outpatient clinics. They point out two reasons why a failure to implement the intervention plan as recommended may occur. First, the caregiver may not accept the recommendations because of the complexity of the intervention plan, the time required, or conflicting philosophies regarding the appropriateness of different interventions. Second, caregivers may be willing to implement the plan but do so incorrectly. In such cases, errors are most likely due to the inability of the caregiver to generalize across settings or activities. Involving caregivers from the initial assessment process through to the treatment intervention may increase the likelihood that they will take some ownership for the implementation of the intervention and continue to participate. However, research on the effects of treatment integrity on functional communication training is limited and warrants further investigation.

Along the same lines as the first point raised by Berg and Sasso (1993), conducting an evaluation within the individual's natural environment has the potential of minimizing problems because the activities, people, materials, and circumstances common to the environment are incorporated into the functional assessment and can be addressed specifically as intervention recommendations are developed.

Given the high mean effect sizes in all treatment setting situations, one must determine whether a clinical setting or a natural setting is the optimal setting for functional communication training based on the individual situation. A clinical setting may very well be

the optimal treatment setting for initial training effects. However, one must then also program for generalization to the natural setting because the success of interventions such as functional communication training relies heavily on the context in which it occurs.

It is becoming more recognized that interventions should be conducted in socially normative environments. Lalli et. al. (1993) conducted an experimental analysis in the natural environment with teachers providing the reinforcers. This allowed the authors to conduct all assessments in the classrooms and to avoid removing the students from the instructional environment. This procedure limited the differences between the experimental analysis and natural conditions and therefore, the amount of inference needed between the findings obtained in the different settings.

Conducting interventions such as functional communication training in socially normative environments is not only “best practice” from the point of view of inclusion but makes sense from the standpoint of the generalization and maintenance skills and transition to the community environments in which a person will ultimately reside. It is encouraging to note that 80% of the treatments in the current analysis occurred in schools and special classes, home or living units, group homes and even a community preschool. These settings are more representative of the natural environments in which individuals with developmental disabilities will use their functional communication skills.

Generalization, Maintenance and Follow Up

Generalization and maintenance, two of the most important challenges facing those in the field of developmental disabilities, are certainly goals of any intervention including functional communication training. To be considered meaningful, behaviour change must occur beyond the confines of the treatment settings, with intervention agents who may not be specially trained in behavioural strategies, and over extended periods of time.

Campbell and Lutzker (1993) demonstrated the generalization of functional communication training skills from the therapist to the mother, from requesting a snack to other daily routine tasks, and from the home setting into the community (e.g., movies, buses, stores). In this case study, functional communication training served as an intervention with effects that transferred and were maintained across several stimulus dimensions, attributable to sequential training and the introduction of natural maintaining contingencies.

Campbell and Lutzker's (1993) study support the current analysis which reveals that functional communication training is an effective intervention and generalizes both to new tasks (Campbell & Lutzker, 1993; Northup et. al., 1994; Steege et. al., 1990) and new settings (Campbell & Lutzker, 1993; Fisher et.al., 1993; Peck et. al., 1996). However, the data for the meta-analysis are limited. The analysis consists of only 6 comparisons for generalization across settings and 8 comparisons for generalization across tasks representing 3 subjects and 5 subjects respectively. Because of the small sample sizes for both, generalizability across

settings and generalizability across tasks, the mean effect sizes from the current analysis may not be representative of the population and should be interpreted with caution.

For functional communication training to be effective, generalization must occur not only across new tasks and new settings, but also across other individuals. That is, the subject must be able to communicate wants and needs to individuals other than the caregiver or the person responsible for implementing the intervention. To this end, it is necessary to evaluate whether untrained persons can understand and respond to the requests being made by the individuals eliciting the new response. Durand and Carr (1991) demonstrated that the results of functional communication training transferred to teachers who were unaware of and untrained in the procedures suggesting that everyone interacting with the subject may not have to be trained. Another study by Durand and Carr (1992) was designed to assess the ability of functional communication training to reduce attention-maintained challenging behaviour and to be maintained with untrained persons. The results of the study demonstrated that students who received functional communication training used their attention-getting phrases and these were appropriately responded to by the naïve trainers.

The above studies demonstrate that functional communication successfully generalized across other individuals. However, none of the studies selected in the current analysis measured the effect of functional communication training when generalized across other individuals (e.g., other classroom teachers, family members, peers).

There is no doubt that functional communication training is an effective intervention for nonverbal, developmentally disabled individuals in a controlled environment, but if the new behaviour cannot be transferred to more natural situations, there is little practical use for the intervention. Durand and Carr (1991) point out the importance of generalization and maintenance in their study. They state that "the value of functional communication training may lie not only in its ability to reduce challenging behaviour initially, but also in its role in facilitating maintenance and application to new settings (p. 262)." Fisher et. al. (1993) take it a step further and suggest that "functional communication training may produce this impressive generalization because, once trained, the client, rather than the parents, teachers, or other care takers becomes the change agent (p. 23). Durand (1990, 1992) referred to this process as the communicative responses recruiting "natural communities of reinforcement." The process of recruiting natural communities of reinforcement was delineated by Baer and Wolf (1970) and refers to behaviours that result in positive consequences from those in the environment without explicit training.

For skills to be useful, they must extend beyond training situations to those situations experienced in day-to-day living. Steege (1990) suggests two strategies for future researchers to increase the possibility of maintenance. First, Steege suggests that once a treatment match is identified, various treatment options can be recommended and the caregivers can be asked to rate the acceptability of the treatment options relative to their applicability to the home and school settings. Second, Steege recommends that analysis and treatment should be implemented in the subject's natural environment and/or by parents and teachers thus

reducing the amount of transfer needed between the treatment setting and the home or school settings.

Follow up, which is closely tied to maintenance, is important in measuring the long term effects of any intervention. The relatively high mean effect sizes in the current analysis comparing baseline and treatment effects in the follow up phase indicate that functional communication training has good long term effects. However, similar to the data on generalization, only 3 studies selected for the meta-analysis representing 7 comparisons and 6 subjects, included follow up data in their report. Furthermore, only one study reported the length of time between the actual treatment phase and follow up phase, which was 9 months. Meyer and Evans (1993), in their discussion of publication standards, list a number of features they consider to be essential information for published intervention research. Among these features are evidence of generalization and maintenance and follow-up of one year or more.

Although the data indicate positive results for follow up, the results must be interpreted with caution as the mean effect sizes from the small sample size may not be representative of the population. It is clear from the limited data that further research is necessary to determine whether functional communication training is truly effective across other individuals, new tasks and new environments. Future studies will require more stringent controls and precise recording of data (e.g., time between intervention and follow up period) to gain further understanding about the effects of functional communication training.

Additional research must also be conducted in natural settings with specific tests of generalization and the treatment must focus on maintenance over extended periods of time.

The current investigation reinforces previous critiques (Mirenda, 1997) that have acknowledged the need for longitudinal research studies in the area of functional communication training. One explanation for the lack of maintenance and follow up data in the research reviewed lies in the purpose of the studies. Mirenda suggests that as functional communication training has only recently gained popularity in the field of behavioural analysis, many of the studies have been conducted to investigate a specific aspect of functional communication training. Long-term effects have not been a primary concern. However, now that data from empirical research have shown strong support for functional communication training as a positive form of intervention for individuals with challenging behaviour, maintenance and long-term effects must be investigated.

Subject Characteristics

Specific subject characteristics (e.g., gender, mental age, language age, primary handicapping condition, preintervention form of communication) are of particular interest to determine whether they have a significant impact on the effectiveness of functional communication training. However, the authors did not present sufficient subject information on some characteristics to allow an analysis. Sufficient information was provided in the individual studies on the subject's gender, primary handicapping condition, and preintervention mode of communication to conduct an analysis.

Three times as many males as females were represented in the current study which is reflective of the true population of those who engage in challenging behaviour. As would be expected, functional communication training is an equally effective intervention for both male and females.

The current research identified 4 types of primary handicapping conditions amongst the 34 subjects included in the analysis. The analysis indicates that functional communication training is an effective intervention for individuals who have each of the 4 primary disabilities reported (i.e., developmental delay, severe/profound mental handicap, moderate mental handicap and autism). However, it should be noted that this analysis focuses on a specific population of students, that is, students who are nonverbal. Therefore the study does not reflect **all** individuals with these 4 handicapping conditions, only those who are nonverbal.

It would be safe to assume that the four handicapping conditions identified in this analysis are representative of the most prevalent handicapping conditions of nonverbal subjects who are developmentally delayed and engage in challenging behaviour within the realm of empirical studies. One would expect that similar results would be obtained from subjects with other developmental disabilities but caution should be exercised when generalizing beyond this group without using representative populations. Further investigation is still needed.

The pre-intervention mode of communication is something of interest. Although functional communication is an effective intervention for subjects with any form of communication prior to intervention as well as those with no formal communication system, the analysis indicates that subjects who used reaching as a mode of communication had the least effective results relative to the other modes of communication. Those who used picture communication prior to intervention had significantly more success than those who had no formal communication at all. One explanation for this phenomenon could be that subjects who have a more sophisticated form of communication *prior to* intervention are more likely to grasp the concept of functional communication training than those who have no form or a very primary form of communication. However, there has been no research that examines the relationship between the pre-intervention mode of communication and the effectiveness of functional communication training. Future studies should include a detailed description of the subjects mode of communication prior to functional communication training. To date, the focus has been on functional assessment to determine the function of the behaviour. Little emphasis has been placed on the pre-intervention form of communication if it has been something other than the challenging behaviour.

Assessment Characteristics

The implementation of a functional assessment has consistently been described as being important in the implementation and evaluation of behavioural interventions in order to (a) determine the motivating factors for targeted behaviour and (b) design an intervention that takes these factors into account. In addition, emphasis has been on identifying a functionally

equivalent alternative response that can replace target behaviour. A match between the original function of behaviour and the new function of behaviour is vital. As would be expected, all studies included in this meta-analysis included at least one form of functional assessment, thus supporting importance of an assessment prior to intervention.

Functional communication training was reported to be an effective intervention regardless of the form of assessment prior to intervention. However, the mean effect sizes of treatment effects for subjects who were assessed by a descriptive analysis were significantly larger than the for those who were assessed by a functional analysis or the M.A.S.. Several explanations could account for these differences. One explanation could be that through a descriptive analysis, the individual is observed during a variety of situations in order to identify a reliable relationship between the problem behaviour and the antecedents and consequences of the behaviour. The descriptive analysis attempts to reveal the situations in which the problem behaviour occurs most frequently or with the greatest intensity and what consequences follow. A functional analysis is performed in a more controlled environment and may excluded some of the variables that may be influencing the subject's behaviour.

Mace and Lalli (1991) demonstrated the need to use a descriptive analysis to examine the variety of situations in which an individual engaged in bizarre speech. In this study, previous functional analyses failed to produce a differentiated response pattern. The individual's bizarre speech occurred equally across all assessment conditions. A descriptive analysis was conducted to observe the subject during a variety of naturally occurring situations. Upon close observation of the data from the descriptive analysis, the researchers

found that the bizarre speech occurred most frequently during situations in which social interaction was unavailable and less frequently during situations in which one-to-one adult interaction was available. The descriptive analysis also revealed that the bizarre speech generally produced attentive reactions from staff and, during task situations, the subject chose to disengage from work-related activities. Based on this information, a subsequent functional analysis was conducted which revealed that the subject's bizarre speech was, in fact, maintained by staff's attentive reactions but not by the termination of task-related activities.

A second explanation for the significantly large mean effect sizes of treatment effects for subjects who were assessed by a descriptive analysis could be that a descriptive analysis is used by a specific group of researchers, with particular kinds of problems or settings, which lend themselves to larger treatment effects. Functional analyses have been criticized as being too complex, time consuming and burdensome (Axelrod, 1987). Durand and Crimmins (1988) have suggested that due to the necessity for stringent environmental control over both measurement and environmental events, functional analyses may be too complex for use in typical settings such as a classroom.

A final explanation for the large mean effect sizes could be related to the small sample size of the descriptive analysis group. With only 4 comparisons, the results may not be reflective of the population and may be more influenced by sampling error. Therefore the large mean effect sizes of treatment effects for subjects who were assessed by a descriptive analysis must be interpreted with caution.

Another point of interest is that functional analysis was chosen as the form of assessment in two-thirds of the studies selected for the meta-analysis. Lalli and Goh (1993) have also recognized that most of the studies to date using pre-intervention assessment procedures have used some form of functional analysis. A functional analysis is the most precise, rigorous and controlled method of conducting a functional assessment. It is the only approach that allows a clear demonstration of a functional relationship between the environmental events and the behaviour problems. However, an analogue assessment/condition in which a severe behaviour might occur could place both the subject and the therapist in a position of some risk. For both therapeutic and ethical reasons, this may not be a tolerable situation for some individuals with severe behavioural problems. In such instances, it may be necessary to rely more on descriptive analysis conducted in the natural environment to suggest possible functional relationships.

In contrast to the functional analysis, the descriptive analysis describes the interactions between the subjects behaviour and the environment, without the manipulation of variables that are associated with the problem behaviour. In most cases, clinical researchers are more interested in identifying and evaluating the mechanisms that maintain aberrant behaviour and less in the absolute magnitude or rate of responding (Marcus & Vollmer, 1996).

Recently there has been a push by researchers supporting the use of functional assessment procedures in which the intensity of the assessment matches the complexity of the problem behaviour (O'Neill, Horner, Albin, Sprague, Storey, & Newton, 1997). That is, if

less rigorous and easy to implement assessment procedures can confidently predict the variables that are maintaining the problem behaviour, it is not necessary to use more rigorous and precise procedures. If, however, a procedure does not generate enough information, more intense methods of assessment may be necessary. In any case, what is agreed upon is that an accurate assessment is a vital component in functional communication training and the more thorough and complete it is, the more knowledgeable and informed the decisions for intervention will be.

Arndorfer, Miltenberger, Woster, Rortvedt and Gaffaney (1993) demonstrated that the brief experimental analysis consisting of 4 to 6 sessions, developed from the results of a descriptive assessment, was adequate to verify the function of behaviour for 5 children. From the results of their study, Arndorfer et. al. (1993) have suggested that it may be preferable to employ a brief experimental analysis, especially when an extended experimental analysis is impractical. In addition, they suggest that the results indicate an ABC (i.e., Antecedent, Behaviour, Consequence) assessment, in combination with a behavioural interview may be an adequate method of conducting a functional assessment. Finally, they suggest that when resources or time are limited, an interview paired with a minimum number of observation sessions may be all that is necessary to complete a sufficient functional assessment. Although a functional analysis is the only method that permits a causal relationship between the variable and the behaviour, it may not always be necessary when a clear relationship has already been identified through descriptive assessment methods.

Mirenda (1997) suggests that future research should aim to refine existing assessment procedures and work towards increasing the efficiency and simplicity in a variety of settings. She also suggests that research is needed to identify how to best provide instruction to an increasing array of professionals who are being asked to provide instruction in functional communication training.

Treatment Design

Five basic treatment designs (i.e., simple, reversal, change, variation and combination) and variations of the treatment designs were employed in the research studies selected for analysis. These designs are described in detail in Chapter 4. Despite the variations in treatment designs, there were no significant differences between the mean effect sizes of treatment effects. The treatment designs had no apparent effect on the effectiveness of functional communication training.

However, there were some differences in treatment design with respect to specific design features. Single-subject experiments should be designed to have high internal validity to rule out factors other than the treatment variable as possible causes of changes in the dependent variable, in this case, the effect size. Internal validity can be achieved by design techniques such as reliable observation, repeated measurement, description of experimental conditions, and baseline and treatment stability.

All of the studies employed techniques to ensure reliable observation. A majority of the studies described specific procedures in making observations, including carefully training the observers and operationally defining the behaviours to be observed. All of the studies checked for and had a high degree of interobserver reliability.

Only a few of the researchers demonstrated replication of effects of treatment. In most cases, the researchers used an ABAC type pattern where after implementing a treatment, there was a return to baseline and the next phase demonstrated a variation of the treatment or a different treatment altogether. Researchers should incorporate repeated measurement with the same observers, same instructions to the subject, and the same environmental conditions into future studies to increase the internal reliability of the studies.

All of the studies selected for the analysis appear to have a description of the baseline and treatment in sufficient detail to permit replication. The precise specification of baseline and treatment conditions would allow researchers to replicate the treatment conditions within an experiment, as suggested above, thus reducing the threat of internal validity. Furthermore, precise specification would allow other researchers to replicate the baseline and treatment conditions, thus reducing the threat of the external validity of the experiment.

A number of studies had very short baseline and/or treatment phases, increasing the risk of internal validity because of the potential lack of stability of the baseline and treatment phases. In the current meta-analysis, an additional analysis was conducted to determine if any significant differences existed between data with fewer than 5 points and data with 5 or more

points. The results revealed that there were no significant differences. Thus, one can assume that the short baseline and/or treatment phases were stable. However, in future studies, it is recommended that sufficient data are collected for both baseline and treatment phases where possible to increase the internal validity.

Two case studies (Campbell & Lutzker, 1993; Horner et. al., 1990) were also included in the analysis. Although case studies often lack scientific rigor, the case studies included in the current analysis provided detailed descriptions of the techniques carried out to treat the behaviour problems. The case studies provided information that closely approaches that which can be obtained by experimentation such as objective data, problems that have a long history, problems for which frequency or rate was stable prior to treatment, and immediate and clear change once treatment was instituted. The two case studies also met the criteria for inclusion to be included in the meta-analysis.

Despite the differences in the specific design features of the treatment designs, no differences in treatment effects were noted between the studies.

Treatment Package

It is a positive sign that over two-thirds of the studies report a multi-component intervention rather than focusing on functional communication training in isolation. This suggests that researchers are investigating a variety of factors relevant to challenging behaviour and that functional communication training is one component of an effective

intervention. However, Fisher et. al. (1993) point out that this factor may also limit the generality of functional communication training as an intervention method.

Functional communication training has typically been identified as a specific treatment package, yet the intervention procedures have varied considerably. Many of the studies included in the meta-analysis reported the effects of functional communication training combined with other operant procedures such as extinction (Durand, 1993; Fisher et. al. 1993; Peck et. al., 1996), punishment (Fisher et. al., 1993; Wacker et. al., 1990) or multiple behavioural recommendations (Durand & Kishi, 1987). The variation of treatment packages raises an important question in terms of what the necessary components of treatment design and treatment packages are in order for functional communication training to be maximally effective. This is also of great importance to practicing educators in terms of implementation of the intervention.

The large main effects with relatively small differences in mean effect sizes across all treatment packages and no significant differences between the various treatment packages in the meta-analysis suggests that functional communication training alone is equally as effective as when functional communication is combined with other operant procedures. Thus, it may not be necessary to implement aversive procedures such as punishment in order to reduce challenging behaviours. Furthermore, the data suggest that it may not be necessary to allow the subject to engage in challenging behaviour while implementing functional communication training. If functional communication training is effective without being combined with other operant procedures, the question "Why would researchers include these

different components in the treatment packages?" must be addressed and warrants some discussion.

The safety of the subject and those around him/her is always the most important priority. There are times when the subject is engaged in a behaviour that is dangerous to himself/herself (i.e., self-injurious behaviour) or to others (i.e., severe aggression). Wacker et. al. (1990) described the use of functional communication training with three individuals and used specific consequences with two of them. It was observed that hand-biting and aggression were significantly reduced with a package of procedures including negative consequences (i.e., time-out from positive reinforcement for the first subject and graduated guidance for the second). The authors observed that when they tried to remove the negative consequences as part of the package, the challenging behaviours increased. It was concluded that some individuals may require mild forms of negative consequences, at least initially.

In a majority of cases, functional communication training packages include contingencies for aberrant responding as well as contingencies for appropriate responding. For example, while providing reinforcement contingencies for mand responses, Carr and Durand (1985) placed all aberrant behaviour on extinction. Durand (1993) instructed teachers to ignore all challenging behaviours or block all potentially serious behaviours.

In the study by Wacker et. al., (1990), functional communication training was part of a treatment package that included punishment for inappropriate behaviour. Following treatment, a component analysis was conducted to examine the separate contributions of the

treatment components. The results suggested that both functional communication training and punishment were necessary components to maximize the reductions in destructive behaviours. In the same study, functional communication training and guided compliance were also combined to achieve a quick reduction of maladaptive behaviour for one child who engaged in aggressive behaviour. Wacker et. al. concluded that if quick results are considered important for treatment, then consequences for both appropriate and inappropriate behaviour may be needed.

Fisher et. al. (1993) concluded that functional communication training may be an important component of a treatment package for destructive behaviour in children with severe to profound mental retardation or autism. As in the study by Wacker et. al. (1990), the combination of functional communication training and punishment was superior to functional communication alone or functional communication training plus extinction to reduce severe destructive behaviour.

The results of these studies indicate that contingencies for both appropriate and inappropriate responses are necessary for functional communication training to be successful and maximally effective in reducing self injurious and severe aggressive behaviour. When functional communication training packages are based on the results of functional analysis and contain contingencies for both appropriate and inappropriate behaviour, relatively quick initial results can be achieved (Steege et. al., 1990; Wacker et. al., 1990).

Sigafoos and Meikle (1996) suggest that for individuals with limited or no formal communication skills, functional communication training will likely involve teaching new forms of verbal behaviour. Because the new behaviour is perhaps unlikely to occur independently or fluently, it may be difficult to ensure greater efficiency of the communicative alternative, especially during the early stages of intervention. In such cases it may be necessary to supplement functional communication training with procedures such as extinction or punishment to reduce the efficiency of the challenging behaviour. Consistent with this suggestion, Shukla and Albin (1996) have demonstrated positive results for functional communication and extinction.

In contrast to the above studies, Peck et. al. (1996) provides evidence that it may be possible to reduce the need for extinction and punishment in functional communication training packages if the duration and quality of reinforcement for the communicative responses are maximized. Although the initial research is positive, further research is required.

The goal of intervention for individuals who engage in challenging behaviour is to motivate them to engage in an appropriate response alternative (Mace & Roberts, 1993). The data from the current analysis do not support one particular treatment package. However, it does suggest that it may be necessary to tailor treatment packages to meet individual needs and to match the environmental context of the problem behaviour. There is no "generic" intervention. Functional communication training is really a package of procedures that

involve multiple, distinct components combined to address the challenging behaviour and to a lesser degree, other responses in the individual's repertoire.

The research literature on the effects of treatment packages based on functional communication training is still relatively small and additional study is clearly warranted. Further investigation is necessary to determine how to individualize functional communication treatment packages to reduce challenging behaviour in the most efficient and effective manner.

General Discussion About Main Effects

There are very few main effect differences within each parameter in the current analysis on functional communication training with the exceptions of function of behaviour, alternative mode of communication, treatment setting, pre-intervention mode of communication and assessment method. Although each of these parameters revealed a significant difference from a scientific point of view, whether this new information is practical information and is meaningful to the practitioner is questionable.

A main effect difference was revealed for the function of the behaviour. The analysis revealed that there was a significant difference in the mean effect size of treatment effects for individuals who engage in aberrant behaviour in order to gain attention. However, this new information will not be the primary source of information when selecting an appropriate intervention method. The form of intervention will be dependent upon data collected on the

function of the subject's behaviour as well as other subject characteristics to determine the most appropriate alternative form of behaviour. Similarly, an analysis of the alternative mode of communication revealed a significant difference in the mean effect size for gestures. Again, this information may have an impact on the decision making process when choosing an alternative mode of communication. However, the data collected on the individual subject characteristics will determine the most appropriate alternative mode of communication.

The analysis of treatment setting indicates that functional communication training results in the greatest changes in subject behaviour and reductions in aberrant behaviour when conducted in a hospital or clinical setting. Although this information provides scientific data to support the validity of conducting treatment in hospital and clinical settings, it does not necessarily guide the efforts of practitioners in implementing practices in the most appropriate setting. There are a number of arguments that contradict the practicality of conducting functional communication training in a hospital or clinical setting. These arguments were discussed in an earlier section on treatment setting.

Another main effect of the analysis suggests that functional communication training is more likely to be successful with individuals with a more sophisticated pre-intervention mode of communication. However, rarely does one select subjects who require intervention based on their pre-intervention mode of communication. Although the data provide empirical evidence to support the effectiveness of functional communication training, especially for those who use picture communication prior to intervention, they provide little direction to help guide the efforts of practitioners.

Finally, the main effects of treatment for subjects who were assessed by a descriptive analysis were significantly larger than the for those who were assessed by a functional analysis or the M.A.S.. This data support the use of descriptive analysis to identify and evaluate the mechanisms that maintain challenging behaviour as opposed to the more rigorous and controlled functional analysis or analogue assessment.

In addition to the above, it should be pointed out that where there are significant differences, they are not consistent across change in level, change in slope, and change in combined level and slope. The following hypotheses could possibly explain the lack of main effect differences among the effect sizes.

Given the large mean effect sizes for the various parameters of functional communication training, it may be that the treatments that are administered on an individual basis are so powerful that it is difficult to differentiate the effectiveness of variation in specific parameters. However, the large standard deviations may also account for the failure to find significant differences amongst the subject and treatment characteristics.

Another hypothesis to account for the lack of main effect differences in effect sizes could be due to the inconsistencies within a single parameter. For example, although there are 4 specific categories that fall under the parameter of 'form of behaviour' (i.e., aggression, tantrums, self injury, and maladaptive/socially inappropriate behaviour), there is still variability within each category (e.g., the degree of severity, the length of each incident, etc.) Although functional communication training is generally highly effective, no single

parameter is uniformly effective across all subjects and all behaviours. In order to differentiate the effectiveness of variation in specific parameters, it would be necessary for future studies to provide accurate and complete descriptions of any potentially essential subject and environmental variables. Detailed descriptions would possibly allow for more specific and accurate categorization of parameters provided that adequate data were available in each of the categories.

Interactions

While one might have expected interaction effects to be present in the meta-analysis, only one interaction effect between assessment method and treatment package was revealed. The analysis indicates a significant interaction effect for the mean effect size in change in level and change in combined level and slope between functional communication training and functional communication training combined with other forms of intervention. A large part of this interaction effect may be attributed to the difference between the mean effect size of functional communication with other interventions and the mean effect size of functional communication training alone in the descriptive analysis.

In the following section, methodological issues and the adherence to certain standards of practice will be discussed. Other study characteristics and the methodological characteristics along with their limitations will also be addressed.

Characteristics of Individual Studies and Their Impact on the Analysis

The studies selected for the meta-analysis were essentially the “subjects” of the study. Because of the large variation amongst studies, selection of the subjects to be included in this meta-analysis had to be quite specific, hence the criteria for inclusion and the criteria for exclusion. However, even within the studies that met all of the criteria, there is still a tremendous amount of variation from study to study in terms of, data collection, treatment design, treatment packages, subject characteristics, and methodological characteristics. Two study characteristics (i.e., number of data points and method of measuring behaviour) were examined quantitatively to determine whether they have an impact on the mean intervention effects. Although results suggested minimal differences, it pointed to some important methodological practices which should be addressed. Of greatest concern was the lack of data, both in the baseline phase and in the treatment phase. Also of concern was the discrepancy between the two different methods by which behaviour was measured across studies. Each of these concerns will be addressed below.

In the area of behavioural analysis, it is expected that researchers establish a stable baseline measure of the target behaviour prior to intervention which will allow for comparison with levels of behaviour during intervention. Although a majority of studies undertook baseline measurement, a significant number (34.2%) of studies did not collect adequate baseline data prior to undertaking intervention. Similarly, it is expected that researchers also establish a stable treatment measure of the target behaviour during intervention to compare with the initial levels of behaviour during baseline. The studies

without baseline data began treatment once a hypothesis was established from data collected using the assessment methods. Where baseline data did exist, a number of the studies lacked a sufficient number of baseline data points (19.7%) within one phase. Likewise, where treatment data did exist, a number of studies lacked a sufficient number of treatment data points (10.5%) within one phase. The lack of baseline and/or treatment data make comparison between target behaviour prior to intervention and target behaviour during intervention less reliable because one cannot be sure that the agent causing the change in behaviour is, in fact, the treatment. Also, because of a possible lack of stability in baseline or treatment data, the data may either overestimate or underestimate the actual degree of behaviour change.

One must wonder why baseline data are not taken before implementation of the intervention in an experimental situation. One explanation to account for the authors not including true baseline data may be the urgency to reduce the behaviour that the individual is engaging in. The behaviour may be causing such harm to the individual or to other individuals that the need to reduce or stop the aberrant behaviour takes precedence over obtaining baseline data.

Another explanation for lack of baseline data may simply be that the journal editors do not require this information. Meyer and Evans (1993) acknowledge that researchers fail to meet publication standards in the presentation of behaviour modification research and state that journal publication standards should require greater adherence to basic features, one of

them being “sufficient baseline/intervention phase data reported to allow calculation of effectiveness statistics.”

Where baseline data were not available, the functional analysis or functional assessment phase was used to generate the control condition or baseline data. The statistical analysis indicates a significant difference between comparisons that used true baseline data and those that used a functional analysis or functional assessment to approximate the baseline. The larger mean effect sizes for comparisons that used functional analysis or functional assessment data may be because functional analysis or functional assessment is performed in a more controlled situation where a specific behaviour is being measured and other potentially interfering variables are not present. In a true baseline situation, the same control does not exist and outside variables may have an effect on the overall intervention.

From a statistical point of view, this procedure makes analysis difficult because effects cannot be measured from a baseline or control. Also with limited baseline data and/or treatment data, there is a question of stability of the results. If the purpose of the investigation is for empirical research, a baseline phase prior to intervention may be essential to the study. However, from a practical point of view, if the purpose of the intervention is simply to reduce or eliminate the inappropriate behaviour, a baseline phase may not be a priority. The purpose of the study must clearly be examined.

The second methodological practice that was investigated was the method by which behaviour data were reported. Studies measured behaviour either by frequency or interval.

The effect size was significantly larger for studies that reported frequency data than for those that reported interval data. The larger effect size for studies that reported frequency data may be due to the level of sophistication of the data collection procedure. Frequency data are more accurate measurements in that they measure the actual occurrence of behaviour whereas interval data measure the average occurrence of behaviour within a specific time interval. That is, interval data estimate the occurrence of behaviour. The discrepancy between the results for studies that reported frequency data and studies that reported interval data demonstrates the need for greater consistency in data collection and reporting methods.

Several other points worth noting but which were not quantitatively analyzed were experimental control, administration of the intervention and data collection, treatment integrity, and the source of data for the meta-analysis. Each of these are briefly discussed below.

A majority of the studies (80%) selected for this analysis conducted some form of experimental control to ensure that the treatment was indeed responsible for the treatment effect. Both reversal designs and multiple baseline designs were employed in the studies. There are few overall concerns in the methodology of the individual studies that in turn, impact on the meta-analysis.

One of the potential concerns of the treatment designs is that in many cases the treatment was administered by the teacher or observer who was also responsible for observation and measurement of the behaviour. The accuracy of the data collection could

have been questionable when such a procedure is employed. However, all studies reported high interobserver reliability for observational measures and the accuracy of data collection was not a concern in this analysis.

Of particular concern is the lack of measurement of treatment integrity. All of the studies reported observer training but only 3 of the studies reported the accuracy to which the treatment was implemented according to procedure. In terms of empirical research, it is important that researchers measure and report treatment integrity to ensure that the results of functional communication training are due to treatment effects and not to other extraneous variables. In future analyses, it is essential that treatment integrity be addressed in order to reach accurate conclusions about treatment effectiveness.

Another potential concern is the possibility of multiple-treatment interference. In a number of studies (53.3%), the subjects were exposed to more than one experimental treatment condition (e.g., ABACA) and the functional communication training condition was not necessarily the first treatment phase. The possibility existed that prior experimental treatment conditions would effect the results of the functional communication training condition. However, upon visual analysis of the study data (graphs) selected for the meta-analysis, the data appeared to return to, or near to baseline levels during the reversal phase. Had the behaviour not returned to baseline levels, and a single cause for failure to revert to baseline could not be identified, the inclusion of phases beyond the initial A-B phase could have been problematic.

The source of data for the meta-analysis was the individual graphs presented in the published research. A number of graphic representations of the data were found to be inaccurate. In several of the graphs, the points on the graphs were inaccurately placed or not clear due to the large size, irregular shape and/or overlapping of the points. To compound this problem, the need to enlarge the graphs in order to determine the value of each of the points may have distorted the image. In addition, it was discovered that the increments on the y-axis on some of the graphs were irregular, making it difficult to determine the exact data points with confidence. (Refer to Appendixes C, D and E.)

The next section will discuss some of the limitations related to the methodology of the meta-analysis.

Methodological Characteristics and Their Limitations

This section will address the statistical methodology employed in this analysis to calculate the effect sizes as well as the procedural methodology used to gather and synthesize the data. The limitations of both, statistical and procedural methodology will also be addressed.

Statistical Methodology

The introduction of a form of quantitative analysis, specifically the piecewise regression model, is significant in the synthesis of single-subject research in that it can

provide support to a visual analysis. When visually reviewing studies, the problems of reliability are compounded as the number of studies being reviewed increases. A statistical model can synthesize a large number of studies in a methodical manner. Using a quantitative rather than a qualitative bases for analyzing the effectiveness of treatment may eliminate some of the subjective biases that can be present in a narrative review.

Skiba, Casey and Center (1985-1986) conducted a meta- analysis on non-aversive procedures in the treatment of classroom behaviour problems. They felt that the piecewise regression model employed in their investigation provided a good first step toward a usable and conceptually valid effect sizes for the quantitative synthesis of single-case studies selected for this analysis. A similar statement can be made about the current analysis. One of the advantages of the piecewise regression model is that it takes both change in level and change in slope into account thereby providing more information than a model that provides a simple comparison of means and according to Skiba et. al., (1985-86), "probably results in more accurate estimates of effects when linear trends are present in either the baseline or the treatment phase." A parametric model may also be a more practical alternative for the collection of behavioural data because it can be used over a shorter period of time. A time-series analysis requires extensive measurements per phase over a longer period of time. When investigating challenging behaviour that may be harmful to the individual or to others around him/her, time is often a critical factor.

Skiba et. al. (1985-1986) note four specific limitations using the piecewise regression approach to conducting a quantitative analysis and are presented in their study. The first

limitation expressed by Skiba et. al., is the interpretation of the effect size measure. Three separate but statistically interdependent effect sizes were generated rather than one. The effect size for change in level is comparable to the between-group effect size when there is no slope in baseline and treatment. However, it is less clear as to what the effect size for change in slope and change in combined level and slope represent. Skiba et. al. have suggested that the attention to change in slope as well as change in level effects may result in a more complete description of the effects of functional communication training over time. The change in level effects appear to describe the immediate reaction of a subject to functional communication training. It is possible that a change in combined level and slope may predict the long-term effects that might be expected of this treatment.

A second limitation expressed by Skiba et. al. (1985-1986) was one of publication bias. As in the current analysis, only published experiments were included in the analysis by Skiba et. al.. This may have resulted in an overestimate of true effect size.

Third, among the studies reviewed in the study by Skiba et. al. (1985-1986) there was a clear subject selection bias, favouring children exhibiting the most extreme behaviour problems. Similarly, in the current analysis, subjects were not randomly chosen but were often selected because they were the subjects with the most severe cases of challenging behaviour. Therefore, the current study is probably not representative of the population of *all* non-verbal, developmentally delayed students with challenging behaviour but is more accurately representative of nonverbal, developmentally delayed students with the most severe forms of challenging behaviour.

Lastly, Skiba et. al. (1985-1986) raise the issue of multiple-treatment interference or the inability to clearly pinpoint a single cause for failure to return to baseline in a reversal design make the inclusion of phases beyond the initial AB phase problematic. However, as discussed earlier in the chapter, the possibility of treatment conditions from an earlier phase in the experiment affecting the results of a subsequent phase was of little concern in the current meta-analysis.

Skiba et. al. (1985-1986) note that threats such as maturation are adequately controlled by the piecewise regression model, which includes a correction for linear trends over time. However, maturation is not a concern as the time frame for all of the studies included in the current analysis is very short.

Threats such as history are less well controlled. However, Skiba et. al. (1985-1986) argue that the threat is reduced by the aggregation of studies, since it is unlikely that a common historical event will influence all studies in the same way. The same argument can be applied to the current study.

The current analysis provides statistical data using the piecewise regression model to support the database of empirical research on functional communication training. However, the data must be interpreted with the above limitations in mind. "Even with these limitations, however, the analytical model used in this meta-analysis represents a clear improvement over current methods used to analyze data from single-case experiments" (Skiba et. al, 1985-1986).

Procedural Methodology

As previously expressed by Skiba et. al. (1985-1986), one of the limitations to any meta-analysis is the biases favouring published studies. In this current analysis, only published studies were included. Thus, it is highly likely that a bias favouring functional communication training exists, which would result in the effects of the meta-analysis being an overestimate of true effect size that might be obtained with functional communication training.

Several studies were rejected from the analysis because of the format of the graphical representation of the behaviour. Both the practice of presenting group means on one graph or representing results in a cumulative manner resulted in data that could not be analyzed in this investigation using the current methodology.

Also, discussed in an earlier section titled "Characteristics of Individual Studies and Their Impact on the Analysis," is a lack of accuracy in several of the graphs in the published studies. Thus, it was difficult to confidently retrieve data from the published graphs in a number of cases.

In order to accurately retrieve data, it is imperative that the original data source (i.e., journals) be precise. Another alternative to retrieve data is to request the original data from the authors of the studies. However, this may be a more time consuming and expensive method with sometimes futile results.

In addition to the graphical representation of the behaviour is the descriptive component of the studies. Some of the authors were quite vague in their descriptions of the subjects or of the procedures of the study. For example, one study reported the subject as developmentally delayed. In the broadest sense of the word, this could have meant any number of specific disabilities (e.g., autism, moderate mental handicap, etc.) but was coded as developmentally delayed for lack of specific information. Other studies listed a number of disabilities a particular individual had but did not specify which disability was the predominant one. Limited or vague descriptive information limits the ability of the researcher to accurately code information from a particular study and limits the degree or detail that can be extracted from the meta-analysis.

Implications for Educational Practice

Although functional communication training has only recently gained popularity, the results of the analysis point towards a promising alternative to past forms of intervention for individuals with challenging behaviour. The current analysis targets nonverbal individuals who have a developmental delay and engage in challenging behaviour, probably the most difficult students to integrate into the home, school and community environments. Foster-Johnson and Dunlap (1993) state that the presence of challenging behaviour such as swearing, defiance, self-stimulation, and other inappropriate or disruptive acts is one of the most serious issues facing teachers in special education. From the perspective of students with special needs, they may have complicated and challenging behaviours that restrict their

opportunities to benefit from educational experiences. These intense behaviours reduce their quality of life and limit their opportunities to participate in the community.

Functional communication training provides individuals with challenging behaviour an opportunity to function in a more socially acceptable manner and to live more 'normal' lives, in home, school and community environments, thus improving the quality of life. The opportunity for individuals to become more socially proficient or develop new and more positive interpersonal relationships also becomes a possibility. These are ultimately the goals that educators and caregivers need to strive for if the individuals are to become full participants in their family and community environment.

Because functional communication training is an effective intervention at any age, it seems reasonable to assume that the earlier intervention occurs, the more advantageous it would be to individuals who engage in challenging behaviour and those who are closely associated. Early intervention is valued by researchers and service providers (e.g., educators) as an essential component to assist individuals with developmental disabilities. There is encouraging evidence that early intervention is effective for young children with serious problem behaviours as well. Dunlap and Fox (1996) claim that behavioural research provides support for the conclusion that greater improvements may be expected if intervention is begun when the child is very young.

The early years of development appear to be a critical period for the acquisition of communication skills. Thus, it is likely to be an especially salient period of time for an

intervention such as functional communication training, which is focused on the development of communication skills. Interestingly, Dunlap and Fox (1996) discuss the importance of early intervention and identify three components that are crucial for the short- and long-term benefits of young children with disabilities and problem behaviours, the first being the development of functional communication skills.

The evidence from the analysis suggests that functional communication training is an equally effective form of intervention regardless of the setting in which training occurs. In light of this knowledge, a movement away from the clinical or hospital setting and into a less restrictive and more natural environment (i.e., home, school and community) seems appropriate from a practical point of view. Meyer and Evans (1993) suggest that strategies developed in a clinical setting may have little or no relevance to the intervention required in a typical or more natural setting. Individuals with challenging behaviours must be given the opportunity to learn and apply more appropriate and socially acceptable behaviours, such as functional communication, in a meaningful environment. Such an environment would also offer a natural context to generalize functional communication skills.

The successful implementation of functional communication training has broad implications for the caregivers (e.g., parents, teachers, community support workers) who are required to support individuals with challenging behaviour. Caregivers in the home, school and community environments will need to learn how to implement functional communication training and then learn to generalize the strategy to a variety of natural settings common to the individual's daily routines. This requires inservice training, not only for the individuals

directly involved with the implementation, but also for others who provide indirect support. All members involved in working with an individual who engages in challenging behaviour must be knowledgeable in functional communication training so that they can contribute to the intervention process with their area expertise and a common goal in mind. Burke (1990) suggests that this education provides for a more consistent and integrated approach amongst the team of professionals. Support personnel can range from care givers in the home (e.g., mother, relative) to educators in the school environment (e.g., classroom teacher, special education teacher, speech language pathologists), as well as medical personnel (e.g., occupational therapists, psychologists). Ongoing support will be required throughout the implementation stages. Once training is implemented, follow through is an important step in ensuring the success of functional communication training in terms of maintenance and long term success.

Functional communication training, if implemented on a larger scale, may have an impact on the structure of the school system. Durand, Berotti and Weiner (1993) discuss the need for systems to be in place in order for functional communication training to be successful. They name factors such as additional resources, staff training, consultant services and organizational restructuring important in order for any intervention for severe challenging behaviour to be successful.

Very few studies have addressed the need for a systems change as an important component of successful intervention. Durand and Kishi (1987) evaluated a consultation model to provide technical assistance for the treatment of severe behaviour problems

exhibited by persons with severe/profound retardation and dual sensory impairments. The authors felt that where success was limited, lack of improvement seemed to be attributable to the failure of staff to implement the recommendations. One explanation was the lack of administrative support. There were no formal administrative systems that supported the changes. Thus, exemplifying the need for administrative support.

Fewer classes for students with challenging behaviours may be necessary if more students with challenging behaviour are integrated into regular classes. This may result in a reorganization of support personnel. Educators once assigned to special classes can be trained to facilitate the implementation of functional communication training to support school based teams and other caregivers in community environments where these students are expected to be functioning. In addition, there may be a greater need to collaborate more closely with other professionals beyond the school system. Johnson and Reichle (1993) support this notion and state that "It is vitally important that in the future applied researchers work closely with service delivery systems to develop a continuum of pre-service and in-service activities that prepare educators and professionals in related disciplines to design and implement assessment/intervention procedures in a transdisciplinary fashion." (p. 233).

The implementation of functional communication training poses some challenges to the education system just as any new practice would. However, the challenges faced by educators and policy and decision makers seem small in comparison to the potential benefits to individuals who engage in challenging behaviour and the caregivers who live and work with them.

Future Research

Given that the notion of behaviour as communication and that the whole field of functional communication training is a relatively new concept in the field of behaviour analysis, one would expect that there would be several areas that require further research. From a scientific point of view, further research is required to support the validity of functional communication training. However, from a practical point of view, further research is required in order to guide the efforts of practitioners to implement functional communication training as an intervention to work with individuals who engage in challenging behaviour. Suggestions for areas of further research for both practical and scientific reasons will briefly be discussed.

The current study applies only to a nonverbal population of developmentally delayed individuals. It would seem logical to assume that functional communication training would also be successful with other individuals who are verbal with developmental delays. A number of studies by researchers such as Edward Carr, Mark Durand, Joseph Lalli, John Northup, David Wacker and a host of others have already conducted research with this population but a quantitative analysis has yet to be undertaken. Other individuals who have disabilities with limited speech and chronic or acute behaviour problems would also be a likely population in which functional communication training would have positive effects. However, research should not be limited to these specific groups. In fact, any population of subjects who engage in challenging behaviours may be likely candidates to benefit from functional communication training and should be investigated.

Functional assessment is a critical component of functional communication training. A wide variety of assessment methods are available to conduct functional assessments. Further development and improvement of existing assessment procedures is necessary to ensure a wide range of antecedent conditions and consequences have been considered to accurately determine the function of the aberrant behaviour. These assessment procedures are also required to develop effective procedures for intervention. In addition, further research is needed to develop techniques for conducting accurate assessments for a variety of naturally occurring situations in a variety of settings.

Of equal interest and importance is the variety of functional communication treatment packages that have been implemented by investigators to reduce or eliminate aberrant behaviour, all with some degree of success. Research is needed to identify or select the optimal techniques for functional communication training and for responding to the challenging behaviour that occurs during instruction. In order to examine specific techniques with any degree of accuracy, additional studies with clear, precise and detailed descriptions of treatment methodology are required. In addition, further research is required to determine if and when it is best to include an additional operant procedure (e.g. punishment) to functional communication training and which operant procedure should be included. It is highly likely that there is no one optimal treatment package and it may be that different treatment packages are needed to meet individual needs. Further investigation is clearly warranted to investigate which functional communication treatment package is most appropriate for specific populations and how this is best determined.

Very little research has been conducted to investigate the generalizability of functional communication training. Research to determine how to select an alternative mode of communication that is effective and generalizable to others is needed. For functional communication training to be maximally effective, untrained persons must be able to understand and respond to requests. In addition to generalization across other individuals, research on generalization across settings and generalization across tasks is needed and is now recognized as critical to long-term behaviour change (Horner, Dunlap, & Koegel, 1988). Future research is also needed to examine collateral behaviour change. Of particular interest would be changes in the affective dimensions of the individual such as emotion, motivation and stress to develop our understanding of persons who engage in challenging behaviour. Both positive and negative collateral behaviour changes need to be examined and reported.

Although studies on various subjects, assessments methods, and intervention techniques are necessary to further the research and application of functional communication training, this type of information would not necessarily appeal to caregivers who are confronted with the very real consequences of challenging behaviour on a day-to-day basis. For practitioners and caregivers, a procedure to document the positive changes in intervention goals such as integration in social settings, peer relationships, greater participation in integrated activities, and "quality of life" factors are important and would be more meaningful. Also, long-term follow up is needed if one equates long term maintenance with an improved quality of life.

Finally, in light of the current meta-analysis, it would be beneficial to have more stringent journal publication standards in future studies. This would require researchers to include a more detailed description of specific subject characteristics (e.g., setting, language, prior behavioural interventions) and precise and adequate data for baseline and treatment, maintenance, generalization, follow up, treatment integrity, and the emergence of collateral effects, often not included in published research reports and clearly not included in the majority of the research studies selected for this meta-analysis. Stringent publication standards would allow for a more precise quantitative analysis to facilitate the discovery of setting treatments and behaviour interactions that would be impossible to identify through a solely visual analysis.

“Self-stimulatory” behaviour was not addressed in this analysis because it is not generally considered to be a socially motivated behaviour. However, Durand and Carr, (1987) have hypothesized that some forms of repetitive stereo-typed behaviour may come to serve social functions (e.g., escape from aversive situations). Teaching a functionally equivalent communicative alternative to escape-motivated stereotyped behaviour can be an effective form of intervention for this problem. It is conceivable that behaviours that are considered to be self-stimulatory by virtue of their topography (e.g., rocking back and forth) may be maintained by social consequences such as the removal of demands or obtaining other extrinsic reinforcers. Future meta-analysis should include self-stimulatory behaviours that are socially motivated.

There is no doubt a need to further our understanding and knowledge base about functional communication training and the impact it can have on individuals with challenging behaviour. This knowledge base must be constructed through both empirical research and clinical practice to be of maximum benefit to all parties involved with individuals who engage in challenging behaviour.

Summary

This research supports a most promising practice of functional communication training for non-verbal individuals who engage in challenging behaviour. The analyses revealed consistently large overall effects and main effects for each of the parameters in the initial research questions. These results undeniably support the growing body of literature and narrative reviews on the positive effects of functional communication training (Durand, Berotti, & Weiner, 1993; Mirenda, 1997; Wacker, Peck, Derby, Berg, & Harding, 1996).

Despite the positive results, there is clearly a need for further research to further explore other factors that may contribute to the success of functional communication training. In addition, the current investigation has highlighted the need for further research and development in a number of areas concerning the statistical methodology as well as the procedural methodology for conducting a meta-analysis.

Reichle and Johnston (1993) state that, "The inclusion of less suppressively oriented intervention options [like functional communication training] has resulted in great

achievements in managing challenging behaviour and at the same time has contributed to the dignity and empowerment of the learners being served.” (p. 75). It is hopeful that there will be continued developments in functional communication training and as educators, caregivers and others involved with individuals who engage in challenging behaviour become more familiar with the intervention procedures, that it will become a more common practice. Meyer and Evans (1993) point out that research reports of interventions for persons with developmental disabilities traditionally have been expected to fulfill two quite different functions. First, research literature is the scientific database to support the validity of recommended most promising practices. Second, these same reports are expected to be a source of information to guide efforts of practitioners to implement those most promising practices.

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Appendix A

Criteria for Inclusion and Criteria for Exclusion

Author: _____

Title: _____

Journal: _____

Criteria for Inclusion:

- ☐ Subjects display challenging behaviours to obtain a desired outcome or to avoid/escape an undesired outcome.
- ☐ Subjects display challenging behaviours that are socially motivated, suggesting that the behaviour functions as a form of communication.
- ☐ Subjects have been diagnosed as developmentally delayed, including subjects diagnosed as moderate mentally handicapped, multiply handicapped, behaviour disordered, autistic, brain damaged, and sensory impaired.
- ☐ Subjects have a language age significantly below the expected level of development.
- ☐ Subjects are nonverbal prior to the intervention.
- ☐ Functional communication training is used as a treatment in an attempt to reduce challenging behaviour.
- ☐ The investigation presents individual graphs of the data.
- ☐ The data for each subject is presented as an individual graph. No graph that aggregates data across subjects will be used.
- ☐ Only graphs including five or more data points in both the baseline and treatment phases will be included to ensure the stability of results.

Criteria for Exclusion:

- ☐ Subjects who are merely behaviour problems in a regular class.
- ☐ Subjects who have not been formally diagnosed with a developmental disability.
- ☐ Subjects who display challenging behaviours maintained by non-socially motivated consequences.
- ☐ Subjects who display behaviours that have no communicative intent.

Appendix B

Coding Booklet for Functional Communication Meta-Analysis

A. STUDY IDENTIFICATION

	COL	VARIABLE	DESCRIPTION
	1	ID	Study and Subject Identification #
	2	AUTH	Authors
	3	YR	Year of Publication
	4	SOURC	Journal: 1 AAC: Augmentative and Alternative Communication 2 Behavior Modification 3 Journal of Applied Behavior Analysis 4 Journal of the Association for Persons with Severe Handicaps 5 Mental Retardation 6 Other Journal _____
	5	INSTIT	Institution
	6	CODER	Coder of the Study
	7	DATE	Date Coded
	8	SUB	Number of Subjects in the Study
	9	SUB-A	Subjects Accepted from the Study
	10	SUB-R	Subjects Rejected from the Study

(table continues)

Appendix B. (continued)

B. SUBJECTS

	COL	VARIABLE	DESCRIPTION
	11	GEN	Gender of the Subject 1. Male 2. Female
	12	C.A.	Chronological Age (Yrs / Mos)
	13	COMM	Current Mode of Communication 1. No communication 2. Picture Communication 3. Sign Language 4. Augmentative Communication Device 5. Gestures 6. Reaching 7. Leading 8. Other
	14	DISAB	Terminology Used to Describe the Primary Disability 1. Developmentally Delayed 2. Severely/Profoundly Mentally Handicapped 3. Moderately Mentally Handicapped 4. Brain Damaged 5. Autistic 6. Behaviour Disordered 7. Sensory Impaired (hearing impaired/visually impaired) 8. Multiply Handicapped 9. Other
	15	DISAB-2	Secondary Disability (Use codes from Row 14)

(table continues)

Appendix B. (continued)

C. SETTING

	COL	VARIABLE	DESCRIPTION
	16	SCH	Treatment Setting: 1. Regular Day School (Classroom) 2. Resource Room 3. Self-contained Day School 4. Residential School 5. Hospital 6. Home / Living Unit 7. Other
	17	C.SIZE	# of Students in the Class/Setting

(table continues)

Appendix B. (continued)

D. METHODOLOGY

	COL	VARIABLE	DESCRIPTION
	18	DESIGN	Experimental Design 1. Simple Design (A-B) 2. Reversal Design (A-B-A-B) 3. Change (A-B-A-C-A) 4. Variation (A-B-A-B'-B'') 5. Combination (A-B-A-B+C-A)
	19	CONTROL	Experimental Control 1. Reversal 2. Multiple Baseline 3. No Control (Case Study)
	20	OBS.TR.	Did the observer receive training prior to recording data? 1. Yes 2. No
	21	I.A.	Interobserver Agreement 1. Yes 2. No
	22	I.T.	Integrity of Treatment 1. Yes 2. No
	23	GEN.I.	Program Generalizability to Other Individuals 1. Yes 2. No
	24	GEN.S.	Program Generalizability to Other Settings 1. Yes 2. No
	25	GEN.T.	Program Generalizability to New Tasks 1. Yes 2. No
	26	FOL	Time (From End of Treatment to Follow Up Phase)

(table continues)

Appendix B. (continued)

D. METHODOLOGY (continued)

	27	BASELINE	Source of Baseline Data 1. True Baseline Data 2. Functional Analysis/Assessment Data
	28	DATA	True Data or Constructed Data 1. True Baseline and Treatment 2. Constructed Baseline 3. Constructed Treatment 4. Constructed Baseline and Treatment
	29	RECORD	Form of Data Collection 1. Interval 2. Frequency

(table continues)

Appendix B. (continued)

E. TREATMENT

	COL	VARIABLE	DESCRIPTION
	30	ASSM	Behavioural Assessment Method 1. Descriptive Analysis 2. M.A.S. 3. Functional Analysis / Analogue Assessment
	31	FORM	Form of the Behaviour 1. Aggression 2. Tantrum 3. Self-Injury 4. Maladaptive / Socially Inappropriate Behaviour
	32	FUNC	Function of the Behaviour 1. Obtain Attention 2. Obtain Objects / Activities 3. Avoid / Escape Motivated 4. Multi-function
	33	BEHAV	Alternative Communicative Behaviour 1. Picture Communication 2. Sign Language (word) 3. Augmentative Communication Device 4. Gestures 5. Tokens (object exchange) 6. Sign Language (sentences)
	34	TXPKG	1. Functional Communication Training 2. Functional Communication Training and Extinction 3. Functional Communication Training and Delay 4. Functional Communication Training and Punishment 5. Functional Communication Training and Challenging Behaviour 6. Functional Communication Training and Non-contingent Reinforcement

(table continues)

Appendix B. (continued)

F. PROCESS

	COL	VARIABLE	DESCRIPTION
	35	RELORIG	Reliability of Data Recovered From Graphs Against Original Data (% Accuracy)
	36	2RELORIG	Reliability of Data Recovered From Graphs Against 2 nd Person (% Accuracy)

(table continues)

Appendix B. (continued)

G. EFFECT SIZE

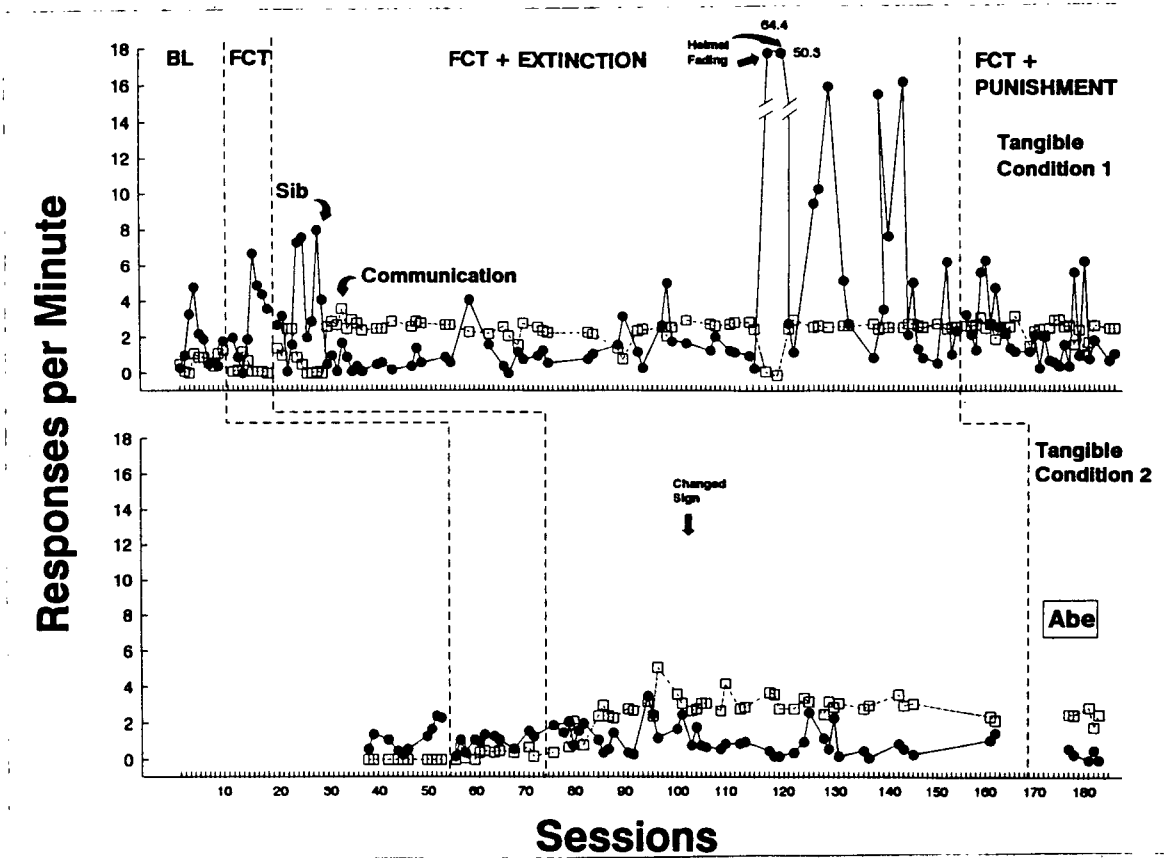
Calculation of Effect Size of Treatment

Baseline vs _____
(Define treatment)

	COL	VARIABLE	DESCRIPTION
	37	#BASE	Number of Baseline Data Points
	38	TYPE	Type of Baseline 1. True Baseline 2. Constructed Baseline 3. Baseline from Functional Analysis
	39	# TX	Number of Treatment Data Points
	40	TYPE TX	Type of Treatment Data 1. True Treatment Data 2. Constructed Treatment Data
	41	TOTDAT	Total Number of Data Points in Baseline and Treatment Phases
	42	DF	Degrees of Freedom ($N - k - 1$)
	43	R ² FULL	Regression Squared (full model)
	44	R ² W/OL	Regression Squared (without level)
	45	R ² W/OS	Regression Squared (without slope)
	46	R ² W/OL+S	Regression Squared (without level and slope)
	47	FL	F-Ratio (level)
	48	FS	F-Ratio (slope)
	49	FL&S	F-Ratio (combined level & slope)
	50	ESL	Effect Size (level)
	51	ESS	Effect Size (slope)
	52	ESL&S	Effect Size (combined level & slope)

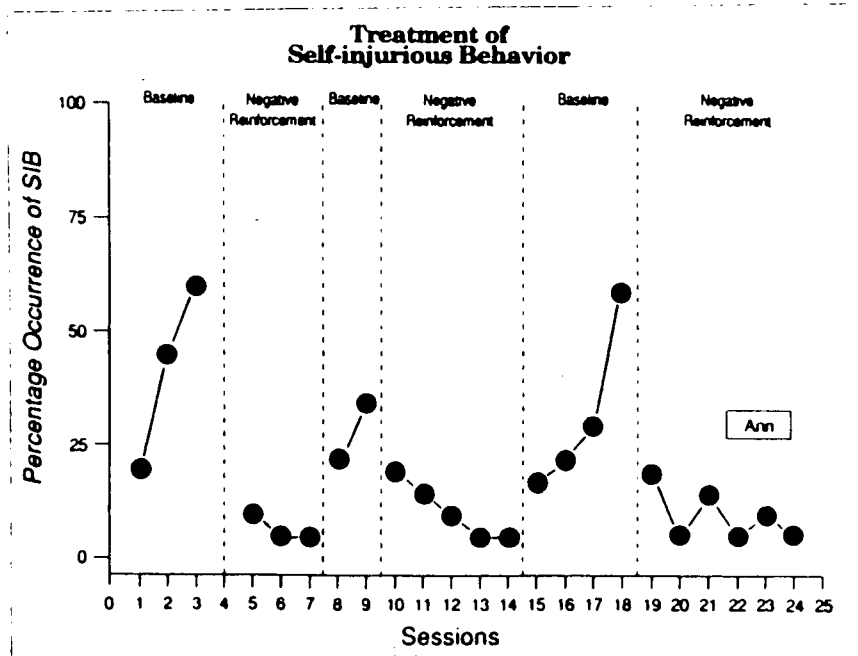
Appendix C.

An example of a graph with data points that overlap and are distorted.



Appendix D.

An example of a graph with data points that are incorrectly placed. The results section of this study indicates that there were no occurrences of self-injurious behaviour during sessions 6, 7, 13, 14, 22 and 24. However, the graph indicates that there were approximately 5 occurrences of self-injurious behaviour during these sessions.



Appendix E.

An example of a graph with unequal increments on the y-axis.

