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The Challenge of Motivation in Autism: An Investigation utilising the Premack Principle

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Abstract

Reinforcement is considered the most important and most basic tool for motivating and teaching children with autism. However, the identification of potent reinforcers is problematic in autism, and creates a barrier to implementing behavioural intervention approaches. The Premack Principle of reinforcement has been investigated as a model for identifying and arranging reinforcers in children with autism. An assumption of the principle is that highly preferred behaviours can reinforce less preferred behaviours. Empirical research has investigated the repetitive, obsessional and stereotypic behaviour of children with autism as reinforcers. These behaviours are also associated with a number of clinical and educational problems that warrant intervention. The first paper, a literature review, highlights the difficulty of identifying reinforcers in children with autism and reviews the application of the Premack Principle as an alternative approach to determining reinforcers. In particular, the paper discusses the use of obsessional and repetitive behaviour as reinforcers. The second paper seeks to explore a new method of harnessing and using obsessional behaviour as reinforcement in children. The key development of this study is that it uses the Premack Principle to determine reinforcers and contingencies for increasing instrumental activity. The results indicated that instrumental behaviour increased during the contingent condition across all children; however, this increase was not due to a contingent effect. A decrease in contingent behaviour was also observed across all children. Overall, the results predicted by the Premack Principle were not observed.

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The Challenge of Motivation in Autism: An Investigation using Premack's Principle of Reinforcement

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Literature Review

Motivation and the Identification of Reinforcers in Autism: A review

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Motivation and the Identification of Reinforcers in Autism: A review

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Motivation and the Identification of Reinforcers in Autism: A review

Abstract

The identification of potent reinforcers is an essential component for increasing motivation in children with autism. However, reinforcers that typically motivate non-autistic children do not usually motivate children with autism. Together with the characteristic repetitive and obsessional behaviour, the availability of reinforcers is limited and problematic in children with autism. Therefore, it is essential to consider how a broader repertoire of reinforcers may be identified. The present paper will review models of reinforcement and consider their application from animal-based research to applied settings. The application of the Premack Principle will be considered as a model for identifying and arranging reinforcers. This principle assumes that high probability (i.e., highly preferred) behaviour can be used to reinforce less preferred (i.e., low probability) behaviour. This review considers the challenge of identifying reinforcers in children with autism, and applying highly preferred behaviours as reinforcers. A growing body of evidence suggests that the highly preferred obsessional, repetitive, and stereotypical behaviour of children with autism can be used as reinforcers. The clinical and educational problems that these behaviours present will also be reviewed highlighting a need to control them. The clinical implications and future research needs for extending this line of research are discussed.

Introduction

Motivating children with autism is typically a very difficult task that is crucial to their development and learning (Egel, 1985). The identification of reinforcers to motivate children with autism has been problematic because these children are not usually motivated by stimuli that interest other children (e.g., toys), or by social reinforcers (e.g., praise, achievements, or success) (Schreibman & Charlop-Christy, 1998). The behavioural repertoire of children with autism, from which reinforcers can be identified, is further limited by their preoccupation with restricted patterns of interest as well as repetitive and stereotypical behaviour. These cardinal diagnostic features of autism can be highly intrusive and can result in both clinical and educational problems. Traditionally, such behaviour has been considered abnormal and numerous attempts have failed to eliminate it (Howlin, 1999; Ollendick & Matson, 1978). The difficulty of identifying reinforcers in children with autism creates a barrier to implementing intervention based on proven behavioural laws. This has generated a plethora of novel research investigating ways of motivating children with autism and developing techniques for identifying effective reinforcers.

Based on formal characteristics of classical autism (as stated by Kanner, 1943), the problem of motivating children with autism has presented a major challenge to those working in the field. This review seeks to bridge early animal-based research into the naturalistic environment, for developing clinical intervention in response to this problem. This paper will commence by outlining models of reinforcement and review their application to the naturalistic human environment. A review of the research concerned with high probability (i.e., highly preferred) repetitive behaviour will then follow. In particular, it will emphasise the clinical and educational problems associated with this behaviour, and highlight a rationale for intervention. The potential for using obsessional behaviour as a reinforcer will also be addressed. A review of the research concerning the difficulty of motivating children with autism will then follow. This will be used to demonstrate the specific difficulty of identifying reinforcers for children with autism and the extent of the problem in both educational and clinical practice. Finally, this paper will combine the different literatures to establish the efficacy of using repetitive and stereotypical behaviour as reinforcement in children with autism. The Premack Principle will be considered as a theoretical base for identifying and arranging reinforcers in children with autism. Criticisms of the research and suggestions for future research will also be discussed.

Theoretical Models of Reinforcement

Colloquially speaking, if you do something and like it, you will be more likely to do it again, than if you do something and don't like it. This common sense view is consistently held by learning theorists, regardless of their persuasion, and is experienced by most people in everyday life. In the process of applying operant reinforcement procedures to encourage desired behaviour, the identification of an effective reinforcer is essential. Considerable emphasis is placed on the appropriate selection of suitable reinforcers, which are central to any contingent arrangement. However, Pace, Ivancic, Edwards, Iwata, and Page (1985) recognise that the process of reinforcement selection is often taken for granted, and failed attempts to effect behaviour change can be considered a result of poor stimulus selection rather than mismanagement of the contingency. This first section will review two theoretical models of reinforcement: the empirical law of effect and the Premack Principle, highlighting the inadequacy of traditional approaches and the applicability of differential-probability models for use in applied clinical settings.

The Empirical Law of Effect

The empirical law of effect (Skinner, 1935; Spence; 1956) simply asserted that some consequences have a response-increasing property (i.e. a reinforcer), whilst others do not. Specifically, this law states that stimulus events are reinforcers if, when presented after a response, the result is an increase in the performance of that response. The consequence of an instrumental response (as defined by a behaviour that occurs because it is effective in producing certain consequences) is important for determining whether that response will happen again. However, there is little agreement over the specific property of the consequence that makes it reinforcing, despite a general acceptance that the probability of an instrumental response is increased by some consequences and not by others. The empirical law of effect produced a pragmatic approach to instrumental learning, which developed from failure to resolve this theoretical issue.

Konarski, Johnson, Crowell, & Whitman (1981) suggest there are many techniques that have been used to identify reinforcers that appear to be based on the empirical law of effect. These include empirical demonstration, use of known reinforcers, the use of a reinforcer menu, and the presentation of many stimulus events. Amongst the most popular is the empirical demonstration method (Premack, 1965; Timberlake & Allison, 1974). This determines the effectiveness of a stimulus as a reinforcer by noting its effect upon behaviour before it can be classed as a reinforcer. Although this and other techniques based on the empirical law of effect usually result in the identification of a potent reinforcer, there are several disadvantages of using the empirical demonstration approach in applied settings to guide reinforcer selection. First, most salient of the inadequacies is the inability of the law of effect to predict reinforcers (Aeschleman and Williams, 1989; Konarski, et al., 1981), relying instead on a post hoc analysis of reinforcement. Critics have denounced this post hoc descriptive explanation of a reinforcer as being circular (Postman, 1947; Timberlake & Allison, 1974). Second, the empirical demonstration approach does not provide the necessary analysis to explain and understand the phenomenon of positive reinforcement (Domjam, 1998), and may in fact preclude it. The clinical importance of this suggestion, as stated by Pierce and Epling (1980), is that reliance on the empirical demonstration approach will prevent advances in our understanding and identification of reinforcers. This approach of using reinforcers only on the basis that they work will ultimately provide an inadequate selection of effective reinforcers for applied use. Moreover, Konarski (1981) states that the mechanisms underlying the reinforcement fail to be addressed, further preventing the development of a more powerful technology of behaviour.

The Premack Principle

The Premack Principle, also referred to as the probability-differential hypothesis (Premack, 1959), provides a departure from the empirical law of effect. This approach makes predictions about potential reinforcers on the analysis of free operant response rates of several responses (Aeschleman & Williams, 1989).

Premack asserts that, "any response A will reinforce any response B, if and only if the independent rate of A was greater than that of B" (Premack, 1959, p.220). This suggests that virtually any high probability response (i.e., highly preferred) can be used to reinforce a low probability response (i.e., less preferred). The principle theorises that reinforcers are responses with a higher free performance probability of occurrence relative to the instrumental response (Premack, 1959, 1965, 1971). Thus, the relative free performance levels of responses are considered the mechanism of the reinforcement effect. In order to formulate comparable units of behaviour for diverse activities, duration in seconds is widely used as a common measure of responses. Thus, responses that take up a greater proportion of available time are considered more probable than responses on which less time is spent. By providing a means of valid, empirical prediction of reinforcers, the Premack Principle has strengthened a noncircular definition of reinforcement. Furthermore, Premack implied that reinforcers cannot be defined independently of the responses that they reinforce and are therefore considered relative and not absolute.

The main tenets of the Premack Principle will now be outlined for producing the reinforcement effect. According to Premack an assessment of response probability between at least two responses (one being the desired instrumental response) is essential to measure their relative free performance levels. The method by which this is calculated is critically important, since it is about the issue of response probability assessment that Premack's Principle revolves. Typically, unrestricted choice of responding is provided, without any contingency arrangements, under a fixed *paired-operant baseline* condition. The response that is allocated the largest amount of time is designated the contingent response (Domjam, 1998). A *contingent phase* then follows, during which a reinforcement contingency can be established based on the operant baseline levels of responding. The ratio of high probability (contingent) responding and low probability (instrumental) responding is calculated from baseline measures. This ratio is then increased in order to create a reinforcement schedule. An effective reinforcement contingency arrangement, as defined by the Premack Principle, exists when the programmed schedule requirements restrict the high probability behaviour below its free-operant baseline duration. This results in an increase in low probability response in order to reinstate the high probability response back to its baseline level. Operationally, an effective reinforcement schedule exists if $I/C > L_{pb}/H_{pb}$, where I and C are the schedule requirements for the instrumental and contingent responses, respectively, while L_{pb} and H_{pb} represent the respective paired-operant levels of low probability behaviour and high probability behaviour. Timberlake (1979) suggests that an increase in low probability behaviour could be explained by either a reinforcement effect of the contingency arrangement, or as a result of restricted access to the high probability response. In other words, an increase may occur in some other behaviour if an individual is deprived of a large portion of responding, within the confines of an experimental constraint. The inclusion of a matched control *condition* is necessary for demonstrating an effective reinforcement contingency arrangement. This involves restricting the high probability response in the absence of a low probability response requirement. This ensures whether any increase in low probability behaviour occurred independently of the contingency arrangement. Together, these three conditions are essential for establishing a reinforcement effect according to the Premack Principle.

Knapp (1976) summarised four conceptual and clinical advantages of the Premack Principle as an approach for selecting reinforcers. First, it provides an easy method for a prior selection of reinforcers and a way of measuring the reinforcing potential of a stimulus. Second, it offers a testable hypothesis of reinforcing mechanism. Third, it provides a simple means with which to utilise reinforcing events and behaviours in the naturalistic environment. Fourth, it permits the use of reinforcing events that are more natural to an organism. Miltenberger (1997) proposes that through environmental manipulation and properly structured external conditions, any behaviour could essentially be made highly probable or improbable in accordance with the Premack Principle. This paper will now consider the validity and generality of the Premack Principle for use beyond the laboratory.

Extrapolation of animal-based laboratory research to the clinical realm

Danaher (1974) states that the move from the animal laboratory to a naturalistic clinical environment is a difficult task complicated by substantial differences in cognitive and environmental complexity. Thus, the identical application of animal laboratory procedures to humans may not appear appropriate, and some degree of heuristic "borrowing" is required. Danaher suggests that the use of animal data to substantiate a procedure applied to the clinical situation raises the question of generalisation and, therefore, demands empirical demonstration that conceptual parameters are maintained in the transition, and that the requisite data can be obtained in the naturalistic environment. A review of laboratory-based and naturalistic applications of the principle will now follow.

Experimental evidence of the Premack Principle

Extensive laboratory based animal studies have provided support for the Premack Principle (Bauermeister & Schaeffer, 1974; Holstein & Hundt, 1965; Hundt & Premack, 1963; Premack, 1959, 1962, 1963, 1972; Premack, Schaeffer & Hundt, 1964; Schaeffer, 1965, 1967; Scaheffer, Hanna, & Russo, 1966). Representative of this research is a study by Premack in 1965, in which he demonstrated his principle in studies of drinking and wheel turning in laboratory rats. By changing deprivation conditions, Premack altered the probabilities of the drinking and wheel-running responses. The first experiment deprived the rats of water but did not deprive them of the opportunity to run in the wheel. Drinking was more probable than running under these circumstances, and running was effectively reinforced by the opportunity to drink. In the second experiment there was no water deprivation. Under such conditions, the rats were more likely to run in the wheel than to drink. Now, drinking was effectively reinforced by the opportunity to run in the wheel. However, drinking could no longer be used to reinforce running. This study demonstrated that activities (running and drinking) could be used interchangeably as instrumental and reinforcing responses, depending on the rat's state of water deprivation. In each case, the opportunity to engage in the more probable response became an effective reinforcer of the less probable response.

In contrast to the animal studies, comparatively fewer studies have investigated the principle with human participants in naturalistic settings. Early applied research has demonstrated the clinical value of the Premack Principle for selecting and applying reinforcers in adults, children, students, clinical patients and children with learning disabilities (Allen & Iwata, 1980; Ayllon & Azrin, 1968;

Bateman, 1975; Hartje, 1973; Homme, deBaca, Devine, Steinforst, & Rickert, 1963; Mitchell & Stoffelmayr, 1973; Mithaug & Mar, 1980; Wasik, 1970). Knapp (1976) provides an early review of studies conducted with humans in laboratory settings and applied settings, as well as case studies and anecdotal accounts. Despite support for the Premack Principle in laboratory-based research, three crucial weaknesses are identified in the research attempting to apply the principle to human experimental and applied settings. First, Danaher (1974) suggests that in response to the difficult adaptation of animal-based laboratory procedures to the human environment, the Premack Principle has been modified on a number of occasions and few studies even meet the minimum of the standard test conditions. In particular, studies have selected reinforcers based on the implication of the Premack Principle rather than conducting an empirical assessment of response probability (e.g., Ayllon & Azrin, 1968), which can prove to be a laborious task. However, Konarski et al. (1981) conclude that this prevents a sufficient evaluation of the Premack Principle with humans. Furthermore, the modifications also limit the degree to which the Premack Principle can provide a foundation for the results. A second criticism of the evaluative research (e.g., Allen & Iwata, 1980; Premack, 1959) is the inadequacy of the single-case designs that have been used, in particular the lack of an appropriate condition controlling for noncontingent reinforcement effects. Third, inappropriate response measures have been used (including frequency or preference) when researchers have had difficulty defining behaviour in terms of duration. Again, this has prevented the proper basis for baseline comparisons according to Premack (1965).

Aside from the methodological weaknesses, Timberlake and Allison (1974) suggest that the Premack Principle provides a testable alternative to the empirical law of effect, allowing a priori identification and measurement of the reinforcing potential of a stimulus. Knapp (1976) suggests further advantages of this approach for the identification and utilisation of reinforcing events in the applied setting, where reinforcers are conceptualised as behaviours rather than static objects or events. This permits the use of reinforcing events that may be more natural to the individual, depending on the relative ranking of behaviours. Therefore, application of the Premack Principle can be considered to have both conceptual and clinical implications for identifying reinforcers in the clinical field (Konarski et al., 1981).

<u>Summary</u>

The concept of differential probability, arising from the Premack Principle, has advanced our understanding of reinforcement and has encouraged the application of reinforcement procedures to a variety of clinical and applied areas. Furthermore, the range of activities and responses that can exert reinforcing effects is emphasised, as long as the probability exceeds that of the instrumental response. The extrapolation of knowledge and technique from the animal laboratory has resulted in some modification of the Premackian procedure. These modifications have enabled the principle to be utilised and applied beyond the laboratory with humans. In addition to the methodological weaknesses and modifications, a thorough evaluation of the principle has not been possible with human participants. The majority of research investigating the use of the Premack Principle with human subjects has focussed upon the applications for clinical use rather than upon further verification of the theory. Consequently, there is little definitive support for the Premack Principle. However, the clinical value of its implications are evident.

The literature addressing the Premack Principle has been used to look at its application for identifying and applying reinforcers with humans in naturalistic settings. The principle proposes that highly preferred behaviours can be used to reinforce less preferred behaviours. This review now focuses on the specific application of the Premack Principle to the population of individuals with autism for increasing motivation. It will first consider the highly preferred obsessional behaviour of children with autism and the problems that this can present.

Autism and Obsessional Behaviour

Autism is a behaviourally defined developmental disorder of early childhood, estimated to affect up to 20 children per 10,000 based on recent surveys (Fombonne, 1999). There is now consensus that autism is a biologically based disorder and a consequence of organic dysfunction, with a strong genetic component (Minshew, Sweeney, & Bauman, 1997; Lord, Cook, Levanthal & Amaral, 2000). Diagnosis is based on qualitative impairment in reciprocal social interaction, communication, and behaviour (American Psychiatric Association, 1994; World Health Organisation, 1992; Szatmari, 2000), which can often dramatically impair educational performance.

Of the many core diagnostic features of autism, impaired behaviour has been considered for many years as problematic in individuals with autism (Smith & Van Houten, 1996). A positive correlation has been reported in overall severity of autism with overall severity of stereotypy (Lewis & Bodfish, 1998). Siegel (1996) reports that these behaviours emerge through general developmental patterns, and commonly become associated more specifically with autism by the age of three or four years old, steadily increasing in complexity. Surprisingly, there is a relatively small amount of the research literature devoted to the understanding and investigation of repetitive behaviour in autism, in comparison to the social and communicative deficits (Jones, Walsh, & Sturmey, 1995; Turner, 1999). This is concerning given the prevalence of repetitive behaviours in many though not all autistic individuals, the common use of repetitive behaviour as a diagnostic tool by clinicians, and the frequent attempts made to reduce it clinically.

Towards a definition of obsessional behaviour

A wide range of abnormally restricted, repetitive and stereotyped behaviour has been associated with autism. Reports of characteristic abnormal behaviour include motor mannerisms, echolalia, non-functional rituals, compulsions, obsessions, self-injury, and specific patterns of interest and objects (Baron-Cohen, 1989; Bodfish, Crawford, Powell, Parker, Golden & Lewis, 1995; Bodfish, Symons, Parker & Lewis, 2000; Lewis & Bodfish, 1998; Turner, 1999).

There is little consensus on terminology with regards to the abnormal repetitive behaviour observed in autism (Wicks-Nelson & Israel, 1991; Bodfish et al., 2000). Consequently, a plethora of terms has been used to describe essentially the same behaviour (Jones et al., 1995), highlighting the inconsistency and variation within and between the definitions that exist. Repetitive behaviour is an encompassing term describing a variety of behaviours observed in autism. Frith (1989) distinguished between simple stereotyped behaviour and the more complex and elaborate sequences of thoughts or interest fixations found in autism. More recently, Turner (1999) offered a concise sub-division of repetitive behaviour into lower-level behaviours and higher-level behaviours. Repetition of movement is considered to be characteristic of lower-level behaviours (including dyskinesias, stereotyped movements, repetitive manipulation of objects, and repetitive forms of self-injury), whereas higher-level behaviours involve more complex restricted, repetitive and stereotyped patterns of behaviour (such as object attachments, insistence on the maintenance of sameness, repetitive language and obsessional preoccupation with stereotyped or restricted objects or patterns of interest). Turner (1999) notes that the highest level repetitive behaviour described in autism is circumscribed obsessional interests. Anecdotal clinical evidence indicates that these interests can range from obsessional preoccupations with unusual objects or aspects of the environment (such as washing machines and running water) to obsessional interests seen in "typical" hobbies (such as train engines).

In a systematic study of abnormal repetitive behaviour in autism, Bodfish et al., (2000) determined the occurrence and severity of specific topographies of repetitive behaviour in individuals with autism compared with non-autistic individuals with learning disability. Results indicated that subjects with autism were characterised by a higher occurrence of repetitive behaviour with more varied topography. Increased severity of compulsions, self-injury and stereotypy was also characteristic of autistic subjects relative to matched controls. However, the varieties of repetitive behaviour associated with autism are not exclusive and were observed in many psychiatric, developmental and neurological disorders. The study by Bodfish et al., focussed on abnormal behaviour that was easily quantified, such as stereotypy.

Therefore, it is difficult to generalise the findings to more complex forms of abnormal behaviour (such as circumscribed interests and obsessions).

Within the literature, discussion has begun to focus on whether a complex classification is necessary, and whether it is in fact possible. Indeed, the variation alone that exists between autistic individuals makes it extremely difficult to adequately define the impaired behaviour. Moreover, repetitive behaviour can be regarded as idiosyncratic and functionally exclusive to each autistic individual. The term 'obsessional behaviour' will be adopted in the current literature review to refer to the obsessional preoccupations that children with autism demonstrate with specific objects, themes and circumscribed interests. The broader term "repetitive behaviour" will be used interchangeably to refer to any behaviour meeting the diagnostic criteria.

Specificity of repetitive behaviour to autism

Repetitive behaviour on face value may not be exclusive to autism. Comparisons have been drawn between the stereotyped behaviour in autism and a variety of other clinical groups, in an attempt to better understand the role of stereotypy in autism by first understanding it in non-handicapped or normal populations. Bodfish et al. (2000) have reported that different forms occur in a variety of psychiatric disorders (e.g. schizophrenia, obsessional compulsive disorder), neurological conditions (e.g. Parkinson disease, Tourette syndrome), and have a high prevalence in specific learning disabilities (e.g. Down's syndrome) (Evans &Gray, 2000), and non-specific learning disabilities (Bodfish et al, 1995). During early childhood, low-level stereotyped motor movements are not unique to autism. Investigations into stereotyped behaviour in autism have reported similarities with populations of developmentally delayed children, and repetitive behaviour is commonly observed in normally developing infants and young children (e.g. Evans, Leckman, Carter, Reznick, Henshaw, King & Pauls, 1997). This suggests it is a part of normal motor development (Willemsen-Swinkels, Buitelaar, Dekker, & van Engeland, 1998; Thelen, 1981; Smith & Van Houten, 1996). What differentiated the behaviour in the normal infant group was the marked characteristic age of onset and decline of the behaviours, suggesting that low-level stereotypies did not form a homogenous group of behaviours specific to autism. Conversely, certain classes of higher-level repetitive behaviour (such as obsessional behaviour) have been shown to be particularly characteristic of, and perhaps even restricted, to autism (Kanner, 1943; Wing & Gould, 1979; Turner, 1999).

Repetitive behaviour has been studied in many individuals from other clinical populations, including learning disabilities, neurological disorders, visual impairment and psychiatric disorders such as schizophrenia. Despite the apparent topographical similarities of these stereotypies within other populations, Jones et al. (1995) argued that the organisation of the stereotypical behaviour patterns may differ with regard to the frequency and duration with which they are shown, and to their social or communicative use. This is a contention shared by Frith (1989) and Smith & Van Houten (1996). It is unclear however, what level of behaviour they were referring to, highlighting the continuing variation and confusion with behavioural classification.

Therefore, it may be inappropriate to assume that these topographically similar behaviours are serving the same function across different disorders. Indeed, Jones et al. (1995) proposed that it may be easier to describe repetitive behaviour as a class or discrete entity lying on various continua, than to generate a formal definition based solely on topography. This may be necessary given the diverse prevalence of repetitive behaviour in other clinical populations, and the continuing debate over the specificity of repetitive behaviour to autism.

Repetitive behaviour and IQ

The majority (between 75% to 80%) of autistic individuals are reported to have an intellectual impairment (Sigman, Arbelle, & Dissanayake, 1995). Evidence suggests that the occurrence of repetitive behaviour in autism is perhaps mediated by level of cognitive ability. In a study by Bartak and Rutter (1976), children with autism with an IQ below 70 were systematically compared to children with an IQ above 70. This revealed a close similarity between the groups in terms of the main diagnostic phenomena of autism. However, a substantial difference in the presentation of stereotypies between the two groups was also reported, with the low IQ group showing more stereotypies. In summary, low IQ or the presence of intellectual impairment is likely to be associated with a greater occurrence of repetitive behaviours in autism, a view shared by Lewis and Bodfish (1998).

The problem of Repetitive Behaviour: A Rationale for Intervention

The literature reports many varied attempts at reducing repetitive behaviour using contingency modification procedures and graded change, as well as teaching and prompting alternative activities (Turner, 1999 provides a comprehensive review of each procedure). This suggests that repetitive behaviour may pose significant problems requiring clinical intervention. Although a review of the intervention literature is beyond the scope of the present review, a rationale for intervention is rarely included in intervention studies attempting to reduce it. It would appear that researchers share a similar assumption that decreasing repetitive behaviour in autism is appropriate in all cases, without reporting reasons for their decisions. A brief review of the clinical problems that repetitive behaviour can present will now follow, highlighting clinical implications for the necessary inclusion of a rationale for decreasing repetitive behaviour.

First, repetitive behaviour has been demonstrated to interfere with the acquisition of new skills. For example Lovaas, Litownick and Mann (1971) demonstrated that repetitive behaviour significantly interfered with response latencies to auditory stimuli. However, a study by Klier and Harris (1977) noted that in autistic individuals with higher mental age scores, the interference with learning was less notable, suggesting that repetitive behaviour may sometimes but not always interfere with learning. Specifically, obsessional behaviour can create an additional problem for learning when it operates as a highly preferred activity, making it difficult to motivate the child to engage in an academic activity (e.g. Morrison & Rosales-Ruiz, 1997). Second, Koegel, Firestone, Kramme and Dunlap (1974) studied the effect of suppressing stereotyped self-stimulation on spontaneous play, and concluded that stereotypy interferes with the development of spontaneous, appropriate play. Third, the implications for obsessional behaviour on social interaction can form part of the criteria upon which to base the decision to reduce it. Jones, Wint and Ellis (1990) examined the social consequences of repetitive behaviour, concluding that there was clear justification for intervention stemming from the sufficiently negative social consequences of engaging in the behaviour. Finally, significant comorbidity between self-injurious behaviour and repetitive behaviour is reported. Guess and Carr (1991) have shown that the intensity of repetitive behaviour can increase at times to the point where the behaviour becomes self-injurious, although both types of behaviour can also occur independently of one another (Rojahn, 1986). In individuals with autism, displaying repetitive behaviour, are at substantial risk through less evidently self-injurious forms of stereotyped behaviour. For example, Jones et al. (1995) highlighted the possible consequences of pica, suggesting that poisoning and infection are highly likely.

Together, these studies present a clear rationale for attempting to change the frequency and intensity of repetitive behaviour evident in children with autism. There is a need to generate a clear rationale before intervention is applied, considering the current and potential harmfulness of the behaviour and whether it is restricting opportunities for a full-integrated lifestyle. Despite the negative relationship between repetitive behaviour and learning in children with autism, there is some evidence to suggest that self-stimulation can be manipulated in a contingent fashion to facilitate learning (e.g. Chock & Glahn, 1983; Sugai & White, 1986). This has implications for investigating the properties that permit and promote learning in the face of self-stimulatory behaviour.

Methodological problems

Freeman et al. (1981) highlight that an objective method for quantifying specific pathognomonic behaviours has not yet been established, more recently confirmed by Lewis and Bodfish (1998). This is complicated by the heterogeneity of repetitive behaviour since different sets of behaviour have been shown by different subgroups of autistic individuals (e.g. Bartak & Rutter, 1976).

There has been a reliance on inappropriate checklists and rating scales to quantify repetitive behaviour, relying on parental reports with minimal direct observation (Freeman et al., 1981). The use of checklists and rating scales assumes that attempts are being made to confirm prior definitions of repetitive behaviour. Given the continuing call for a complex classificatory system, one can assume that the prior definitions employed in the studies have assumed different classifications of repetitive behaviour.

Many studies have varied in the use of adequate control groups to take into account the chronological age of the target population, developmental level, and comparison participants. It is likely that many of the inconsistent and contradictory findings may have resulted from this. Lewis and Bodfish (1998) review a range of different measurement instruments used in previous studies of repetitive behaviour in autism. They conclude that, although reliable instruments have been established for a specific selection of repetitive behaviours, their use in examining differential diagnosis or as an independent categorisation of repetitive behaviour is not evident. It remains ambiguous, therefore, whether distinctions can be permitted between or among potentially co-occurring repetitive behaviour in individuals with autism, using these instruments.

The literature reviewed has been used to demonstrate that obsessional behaviour is highly preferred in children with autism, yet it can present problems in both clinical and educational contexts, frequently warranting intervention. This has established a rationale for intervention particularly in an educational context. This paper will now consider the issue of motivation in children with autism and the difficulty of identifying and applying reinforcers in this population.

Motivation and Autism

Motivating developmentally disabled children has historically been a very difficult task, particularly so for children with autism (Egel, 1981, Dunlap, Koegel & Egel, 1979). The apparent lack of motivation that children with autism demonstrate has been shown to interfere with efforts to engage them in educational services (Dunlap & Koegel, 1980; Dunlap et al., 1979), and consequently these children are often described as unresponsive or unmotivated to respond to educational tasks (Rutter, 1966). This has major implications for their cognitive development and indeed the motivation of educational staff to work with them.

A wealth of early research has reported the negative influence of repeated experiences of failure on increasing task avoidance, and reducing motivation and performance in children with autism (e.g. Clark & Rutter, 1979). Furthermore, Churchill (1971) demonstrated that during repeated exposure to failure, actual pathological failure of children with autism dramatically increased. These findings have implications for developing techniques to increase motivation and academic performance, and reduce the possibility of failure and task avoidance.

Autism and reinforcement

The established use of applied behaviour analysis as an effective early and intensive behaviourally based intervention for autism is recognised (e.g. Jensen & Sinclair; 2002; Smith, 1996). Rosenwasser and Axelrod (2001) conclude that among the numerous treatments available, the best empirically evaluated approache is applied behaviour analysis. The principles of applied behaviour analysis have demonstrated utility for promoting and maintaining learning and behaviour change in students with autism spectrum disorders, stemming from the pioneering work of Lovaas and his colleagues (Heflin & Alberto, 2001; Lovaas, 1987, 1993; Lovaas & Buch, 1997; Lovaas, Koegel, Simmons and Long, 1972; McEachin, Smith & Lovaas, 1993; Lovaas & Smith, 1989). In a review of research into the effectiveness of the Lovaas programme of behavioural early intervention for children with autism, Connor (1998) concludes that early intervention can achieve positive outcomes. Behaviour analytic intervention is now widely used in both clinical and educational interventions for people with developmental disorders. Importantly, both stimulus control and reinforcement theory can be systematically managed for learning and instruction through the application of reinforcement contingencies.

Vollmar and Iwata (1991) consider reinforcement as the most important and most basic tool for motivating and teaching children with autism. In order to apply reinforcement procedures to modify behaviour and motivate children with autism, the identification of an effective reinforcer is necessary. Unfortunately, four factors make the identification of potent reinforcers problematic in autism, and create barriers to implementing proven behavioural laws and established behavioural treatment approaches. First, typical reinforcers that are commonly used with non-children with autism, such as social praise, achievement, or success (Schreibman, 1988; Schreibman & Charlop-Christy, 1998) do not usually motivate children with autism. Second, the restrictive repertoire of interests, characteristic of autism, limits the range of reinforcers that can be used. Such limitations could result in excessive use of a small number of effective reinforcers that are open to satiation effects (Egel, 1981). Third, the preferences that children with autism display can vary day-to-day, across academic sessions and between different teachers (Farmer-Dougan & McGee, 1986). The changeable nature of obsessional interests in childhood autism thus establishes the need for ongoing reinforcer assessments (see Mason, McGee, Farmer-Dougan, & Risley, 1989 for a comprehensive discussion). Fourth, Koegel and Mentis (1985) provided an early review in the area of motivation in autistic and other children, suggesting that children with autism may be capable of functioning at a higher level than they typically perform. Consideration is given to the frequent failure that children with autism experience and are exposed to through their disability, and to an unusual level of non-contingent reinforcement. Koegel and Mentis suggest that exposure to such frequent failure may produce a learned helplessness state of low motivation with a resulting low level of functioning.

The use of food reinforcers has afforded some success in motivating children with autism (Howlin, 1999; Egel, 1981). However, rapid satiation and administration difficulties limit the effectiveness of this primary reinforcer. The importance of these findings has implications for motivating developmentally disabled children, in which variation in the presentation of reinforcing stimuli can help to decrease the chance of satiation or habituation (Rincover, Newsom, Lovaas, & Koegel, 1977), and reduce the chance of frequent failure.

Natural variation exists in the preferred activities of typical children. In addition to the restricted and idiosyncratic preferences of children with autism, the identification of potent reinforcers can be extremely limited and difficult. Furthermore, attempts at using reinforcement systems have been met with varied success (e.g. Charlop & Haymes, 1996; Charlop, Kurtz & Casey, 1990; Schreibman, 1988). Central to efforts attempting to effect behaviour change is the potency of the reinforcer that is applied. Consequently, several lines of research have addressed strategies to increase motivation to learn in children with autism, which will now be addressed. Mason et al. (1989), however, note that the quality of the reinforcer used in both applied research and clinical practice has received sporadic attention.

Several studies have demonstrated that the motivation of children with autism can be significantly increased by allowing the opportunity for them to engage in child-preferred activities, rather than those selected by the adult (Dyer, Bell, Koegel, 1983; O'Dell, & Koegel, 1981; Koegel, Dyer, & Bell, 1987). In a study addressing the social avoidance behaviour of children with autism, Dyer et al. (1983) found that decreased levels of social avoidance behaviour were exhibited when children engaged in their preferred activities. They concluded that this allowed the children to direct the social situation and to experience increased success thereby reinforcing social approach behaviour. Broader generalisation and maintenance of the behaviour was also reported to have occurred. Such early studies demonstrate the significance and value of utilising reinforcement contingencies occurring in the everyday life of children with autism to increase their motivation.

The major type of interaction reported to occur between adults and children with autism appears to be adult-directed demands and requests (Duchen, 1983). It is possible that such a control bias has an effect on the motivation of children with autism, especially when requests are made that do not incorporate any child-preferred activities. In a study investigating the effect of child versus adult initiated communication, Wetherby (1982) found that child initiated communication was frequently observed during a free-play setting with an adult assuming a non-directive style. This highlights the value of affording children with autism the opportunity to engage in preferred activities, rather than those selected by an adult. Allowing shared control over choice of activity or topic and incorporating activities of choice can potentially increase the motivation of children with autism.

Identification of potent reinforcers

Several methods have been developed for identifying potential reinforcers on an individual basis, because of idiosyncratic reinforcer effects and the variability across and within children with autism (Mason et al., 1989; Pace et al., 1995). In view of the limitations and difficulties associated with identifying reinforcement systems, and the regularly changing nature of interests in children with autism, Mason et al. suggest the need for ongoing assessments of preference is evident. A considerable emphasis is placed on appropriate selection of suitable reinforcement schedules and contingencies in the process of applying operant reinforcement techniques. However, the process of reinforcement selection is often taken for granted (Pace et al. 1983) and failed attempts to effect behaviour change can be considered a result of poor stimulus selection (Repp, Barton, & Brulle, 1983). Moreover, ineffective methods for determining reinforcer potency and durability may also account for the failure of standard techniques (O'Brien & Repp, 1990). The traditional approach to reinforcer assessment relies on a post-hoc analysis, focusing on factors external to the individual. However, as previously discussed, the identification of potent reinforcers in autism and the children's response to them is largely restricted and overshadowed by the triad of impairments, particularly obsessional behaviour.

A systematic validation of stimulus preference has been developed for use with children with autism to identify high-value reinforcers (Pace et al., 1989).

Individual child preference for a range of items representing a variety of sensory qualities was established by measuring approach, avoidance, smiling, vocalisation and compliance to instructions. Unfortunately, ongoing assessments of preference with children with autism can be immensely time-consuming. Instead, it may be more beneficial to utilise preferred behaviours that children with autism present, given their comparative stability. Though, the problem of how to harness and control such behaviour, also overshadowing the identification of post hoc reinforcers, becomes apparent.

The development of more powerful motivational techniques has expanded over recent years, though still presents a major challenge to clinicians and researchers alike. Whilst specific variables influencing the motivation of children with autism have been identified, comparatively less research has addressed how the motivation of these children can be enhanced in the natural environment. A prerequisite of effective motivational techniques involves the identification of a potent reinforcer; this has been shown to be problematic in children with autism. This paper will now bring together early laboratory research and the difficulty of motivating children with autism. It will examine literature utilising the highly preferred behaviours of children with autism as potential reinforcers.

Autism, reinforcement and obsessional behaviour

It has long been recognised that the most preferred behaviours of children with autism are often aberrant behaviours involving stereotypy and obsessional preoccupations (Lovaas et al., 1972). Traditionally, there has been reliance upon reductive procedures to decrease these aberrant behaviours in autism, ranging from milder forms of punishment (such as over-correction), through more intrusive procedures (such as physical restraint). However, difficulties associated with the elimination of aberrant behaviour in children with autism are well documented (e.g. Favell, McGimsey & Jones, 1978; Foxx & Azrin, 1973; Marchant, Howlin, Yule & Rutter, 1974; Rincover & Koegel (1977); Schreibman & Carr, 1978). Whilst proving generally effective in quickly reducing inappropriate behaviour in the short term, negative side-effects do result from intrusive punishment techniques, such as escape from punishing situations, as well as elicited and imitative aggression (Vollmar & Iwata, 1991).

Response probability models of reinforcement and obsessional behaviour

A growing literature investigating the reinforcing properties of obsessional behaviour has demonstrated that these high frequency behaviours have motivating properties (e.g. Epstein, Taubman & Lovaas, 1985; Lovaas, Newsom, & Hickman, 1987). This is in sharp contrast with the general difficulty experienced in identifying effective reinforcers to motivate children with autism, and their general unresponsiveness to the environment. Therefore, rather than persisting in efforts to eliminate obsessional and other aberrant behaviour, it may be more pragmatic to identify reinforcing properties of these highly preferable and frequently occurring behaviours so they can be used as effective reinforcers (Charlop et al., 1990).

Application of the Premack Principle (Premack, 1959) has implications for utilising the high frequency obsessional behaviour observed in autism as a potent reinforcer. Furthermore, this principle would predict that effective contingencies would not only increase the desired behaviour but would also involve a relative decrease of the contingent obsessional behaviour. Premack noted that this variable was an "invariant concomitant" of the reinforcement effect. This could provide an alternative approach to standard educational and behaviour modification programmes for individuals working with autism. Such an approach could facilitate the development of tailored reinforcement procedures incorporating the child's interests and behaviours. A further aspect of the principle, noted by Premack (1959) is that "reinforcement results when an R of a lower independent rate coincides, within temporal limits, with the stimuli governing the occurrence of an R of a higher independent rate" (p.219). In other words, the stimuli associated with any behaviour that is occurring at a low rate can be reinforced by the stimuli associated with high-rate behaviour. This suggests that both high-rate behaviour and the stimuli associated with it should function as reinforcers. However, it is essential that the stimuli of the high frequency behaviour can be harnessed and delivered in a controlled way, and that there is a clear understanding of the instrumental requirement; failure to do so would restrict the operation of the Premack Principle. The main problem faced with such an approach is how to harness control of the behaviours in a way that they can be used in educational settings as reinforcers.

Stereotypy and self-stimulation as a reinforcer

Research has investigated using a range of highly preferable repetitive behaviour as potent reinforcers in children with autism. It is noted that earlier research focussed on using stereotypy and self-stimulation as reinforcers, whereas more recent research has addressed the use of obsessional behaviour. This perhaps reflects the development of methodology for harnessing and delivering such reinforcement.

A number of studies have hypothesised and provided support for the notion that the highly preferred stereotypy and object self-stimulation of children with autism may function as reinforcers. (Epstein et al., 1978; Lovaas et al., 1987; Sugai & White, 1986; Wolery, 1978; Wolery, Kirk & Gast, 1985). A review of these studies will now follow, highlighting the value of this approach and its potential use with a range of behaviours. Hung (1978) examined the effects of using self-stimulatory behaviour as reinforcement for spontaneous sentence utterances in two children with autism. The children earned tokens for the targeted response, which could then be traded for access to their favourite self-stimulatory activities. In one condition the children earned tokens for each spontaneous sentence, which could be used to buy time to engage in their stereotypic behaviour. The second condition afforded the children free access to time for stereotypic behaviour. Results indicated that a higher rate of spontaneous appropriate sentences occurred during the contingent self-stimulation condition, indicating the reinforcing properties of self-stimulatory behaviour. Hung recognised the potential value of providing controlled contingent access to such behaviours as a possible means of enlarging the reinforcement repertoire in children with autism. Wolery (1978) reported similar results from a study of two children with autism contrasting verbal praise and trainer applied sensory stimulation, duplicating each child's preferred self-stimulatory behaviour. Praise was presented contingent upon correct responses during the baseline conditions; during intervention, the children with autism received trainer-applied sensory stimulation, contingent upon correct task responses. The study indicated the potent reinforcing potential of contingent trainer-applied sensory stimulation. Finally, Wolery et al. (1985) rewarded correct responses in children with autism by modelling a preferred self-stimulatory behaviour that served as a cue for the subject to engage in self-stimulatory behaviour.

These studies share a common goal of attempting to expand the reinforcement repertoire of children with autism and control their undesirable aberrant behaviour that is recognised as a serious problem. Together, they demonstrate the reinforcing properties of self-stimulation and suggest it can be used as a potent reinforcer. A further study provided similar evidence although from a different perspective. Sugai and White (1986) examined the effects of continuous access to and contingent removal of object self-stimulation on the task-interrupting and self-stimulatory behaviour and prevocational work responses in a boy with autism. Again, access to self-stimulation proved to be reinforcing. However, this study allowed the child to access a specific self-stimulatory behaviour during the completion of the instrumental task, providing immediate reinforcement. This indicates the potential to shape self-stimulatory behaviour to facilitate performance proficiencies.

The majority of the early studies investigated the use of self-stimulatory and stereotypical behaviours as reinforcers in children with autism, using a range of methods for delivering reinforcement. None of these studies provides an empirical evaluation of the Premack Principle. Instead, the selection and use of highly preferred behaviours as reinforcers is based upon the implication of the Premack Principle. The review will now address literature examining the use of obsessional behaviour as a reinforcer.

Obsessional behaviour as a reinforcer

The work of Charlop, Kurtz, & Casey (1990), and Charlop-Christy and Haymes (1996, 1998) has examined the reinforcing properties obsessional behaviour in children with autism. Extending initial support for the notion that stereotypy may function as an effective reinforcer (e.g. Hung, 1978), the Premack Principle has been explored in these studies to understand the potential reinforcing function of highly preferred and frequent behaviours. In a series of three experiments, Charlop et al. (1990) compared the efficacy of using self-stimulation, delayed echolalia, and perseverative behaviours (obsessions) as reinforcers to increase correct task responding in a total of 10 children with autism. The children were allowed to engage in specific aberrant behaviour (e.g., self-stimulation, echolalia, obsession) for 3 to 5 seconds contingent upon correct responses. Three academic tasks were selected for each child from their curriculum for presentation during the experimental sessions (e.g., use of expressive pronouns and prepositions, shape matching, telling time, recall of previous actions and adding up coins). Following a baseline assessment of correct task performance, two experimental sessions were presented weekly to each child. A consequence corresponding to the particular reinforcer condition was provided with verbal praise immediately after each correct response. In the first experiment the potential use of stereotypy as a reinforcer was directly compared with both food and conditions of varied consequence (food or stereotypy). In the second experiment the use of delayed echolalia was compared as a potential reinforcer with both food and varied consequences (delayed echolalia or food). During conditions of varied consequence the child was permitted to choose either a food treat or the opportunity to engage in a specific aberrant behaviour. The third experiment compared the use of perseverative behaviour as a potential reinforcer with stereotypy and food and no varied consequence condition was included. An assessment of the potential increase in frequency of aberrant behaviour was conducted both during and after all three experiments. Results indicated that task performance was generally highest when the opportunity to engage in aberrant behaviour functioned as a contingent reinforcer. Specifically, conditions in which perseverative behaviour served as a reinforcer witnessed the highest percentage of correct task responding. Importantly, no increase in the overall frequency of obsessional and stereotypical behaviour was reported as an undesirable side effect, supporting similar findings by Wolery et al. (1985). This series of studies incorporated obsessional interests that were readily available and could be easily controlled (including toys, dolls, books, and miniature cars). Overall, this study confirmed the notion that high-frequency behaviours can function as reinforcers to increase low-frequency behaviours. Charlop et al. recognised that this pragmatic approach is limited to children with autism who display behaviours and have obsessional interests that are easily available.

In a study of four children with autism, Charlop-Christy and Haymes (1996) assessed the efficacy of using obsessions contingent upon periods of non-occurrence of inappropriate behaviour to decrease such behaviours. Three experimental conditions were assessed in a multi-element design. The first condition provided obsessions as reinforcers, the second provided obsessions as reinforcers in conjunction with mild reductive procedures, and the final condition incorporated food reinforcers with mild reductive procedures. The obsessions of the children with autism were successfully used as reinforcers to decrease inappropriate behaviours when provided in a contingent format, in contrast to traditional food reinforcers. Additional use of mild reductive procedures accompanying contingent access to the obsessional behaviour was the most effective condition. Charlop-Christy and Haymes extended the use of obsessional behaviours and demonstrated that the objects of these interests can be effectively used as token reinforcers to increase task performance in children with autism. A comparison of typical tokens (e.g. happy faces) was made with the use of obsessions as tokens (e.g. a picture of a train). Further agreement that the area of idiosyncratic obsessional behaviour offers a means of motivating these children with autism is evidenced in other studies. The activities and behaviours that have been reinforced include correct academic task performance (Charlop et al., 1990; Morrison & Rosales-Ruiz, 1997; Wolery et al., 1985), to decrease off-task, stereotypy, aggression and tantrum behaviours (Charlop-Christy & Haymes, 1996), non-occurrence of aberrant behaviour (Charlop-Christy et al., 1996, 1998), appropriate social interaction including sibling play and joint attention (Baker, Koegel, & Koegel, 1998; Baker, 2000; Koegel, et al., 1987), prevocational task performance such as packaging, and mail sorting (Sugai & White, 1986), spontaneous appropriate sentences (Hung, 1978), and initiation of social interactions (Gaylord-Ross, Haring, Breen, & Pitts-Conway, 1984). The reinforcing property of the aberrant behaviours and the potential to flexibly manipulate the application of them is evidenced in the results.

The application of stereotypic and self-stimulatory behaviour as a reinforcer in children with autism has raised concern for the effect on these behaviours in other situations (e.g. Wolery et al., 1985). Furthermore, concern for the potential negative side effects (such as tantrums and aggression and a generalised increase in obsessional behaviour) on withdrawal of the child's obsessional behaviour has been raised. Consistently, however, marked decreases in the rate of stereotypic behaviour and the absence of negative side effects have been reported from studies using obsessional behaviour as reinforcers (Devany, 1979; Wolery, et al., 1985). Furthermore, a concomitant decrease in inappropriate behaviours has been reported as a positive side effect both within and beyond experimental conditions (Wolery, et al., 1985; Charlop et al., 1990; Charlop-Christy et al., 1996). Specifically, Sugai and White (1986) suggest that favourable generalised responding had occurred, increasing compliance and engagement in residence based activities.

The saliency of obsessional behaviour

The literature on self-stimulation offers a possible explanation as to the saliency of obsessions as reinforcers (Charlop-Christy et al., 1996). Charlop et al., (1990) recognise that highly salient sensory or perceptual properties have been identified to maintain stereotypic behaviour in children with autism, referring to studies by Rincover (1978) and Rincover, Cook, Peoples and Packard (1979). Rincover and Newsom (1985) proposed that specific sensory or perceptual properties (auditory, visual or proprioceptive) are responsible for the reinforcing nature of stereotypy. More specifically the perceptual properties of stereotypy have been proposed to provide a form of stimulation to the central nervous system (Lovaas, Newsom, and Hickman, 1987). This stimulation is believed to serve a possible organic function analogous to eating and drinking (Lovaas et al., 1987) and may also maintain obsessional behaviour in a similar manner.

Obsessive behaviours have been hypothesised to be a more complex form of stereotypic behaviour because of their repetitive nature, the complex stimuli produced by them and the interference they create in acquiring desirable behaviour (Epstein et al., 1985; Lovaas et al., 1987). Charlop et al. (1990) review evidence in support of this supposition from long-term results of intensive treatment of children with autism, which shows that "low level" self-stimulatory behaviour changes to "higher level" behaviour typically seen as obsessions, as children learn speech and academic tasks (Epstein et al., 1985). Charlop et al. draw the conclusion that obsessional behaviours may be considered as primary reinforcers, accounting for the success of using aberrant behaviour as reinforcers. Consideration of stereotypy and obsessional behaviour as a continuum of primary reinforcer sophistication helps to explain the differences in the saliency of these behaviours. Importantly, no prior conditioning is required of primary reinforcers, making them highly suitable for use with children with autism.

Methodological Limitations

The results of these studies must be treated with some caution. Many studies have relied on the assumption of the Premack Principle that a high probability response can be used to reinforce a low probability response. However, these studies have failed to use methodology for producing the reinforcement effect according to the Premack Principle. In particular, the lack of an appropriate control group is a common fault among tests of the Premack Principle (Knapp, 1976) and among many studies using obsessional behaviour as reinforcement. Further, the studies that have been reviewed are predominantly single-case, which naturally limits the number of children that have participated and makes it difficult to generalise findings without further replication. Unfortunately, the design of previous studies, which have utilised stereotypy and obsessional behaviour as reinforcement, has not permitted identification of the effective components of the reported intervention effects (Hanley, Iwata, Thompson, & Lindberg, 2000). Charlop et al. (1990) and Wolery et al. (1985) provide an exception to this, by developing methodology with the inclusion of control conditions to determine whether prompting (independent of other components) accounted for the reinforcement effects. No long-term evaluation of the effect of using aberrant behaviours as reinforcers has been conducted. Indeed, variation in the potency of the reinforcers adopted in many of the studies draws attention to the saliency of the aberrant behaviours that are used. An extended investigation into possible satiation effects may be an important avenue to explore in understanding the reinforcing properties of obsessional behaviours that also serve to maintain them. However, the procedure adopted by Charlop et al. does enable individually tailored reinforcement programmes to be developed incorporating individual interests with the potential to reinforce a range of preferable behaviours and activities. This warrants further investigation.

Summary

The difficulty of motivating children with autism has been discussed. The identification and delivery of potent reinforcers in children with autism is restricted by their limited repertoire of interests. Often described as unmotivated or unresponsive (e.g. Koegel & Egel, 1979), children with autism are not motivated by typical reinforcers. Characteristically, children with autism demonstrate a high preference for engaging in aberrant behaviour, such as obsessional behaviour. These behaviours are largely resistant to traditional approaches of eliminating aberrant behaviour, but have been shown to possess motivating properties. The class of high-rate stereotyped and repetitive behaviour has been understood in terms of operant learning theory (Lovaas, et al., 1987). Conceptualising obsessional behaviour as operant behaviour has the advantage of providing increased control to clinicians and teachers over such behaviour. It is suggested that these behaviours are selected, strengthened and maintained by perceptual reinforcers, under close control by the individual.

The notion of the Premack Principle has helped the selection and identification of potent reinforcers in children with autism. The opportunity to engage in highly preferred obsessional and stereotyped behaviour has been used to reinforce a range of alternative behaviours in autism. Children differ greatly in their preferred activities, and through measurement of a child's relative probability of engaging in different activities, reinforcement procedures can be personalised to take advantage of each child's unique response preferences, utilising their obsessional behaviour as reinforcers. The success of this approach has been evidenced predominantly in an educational environment, but also in social and vocational settings.

The majority of the studies reviewed have focused on behaviours that are available to be easily harnessed or controlled experimentally. However, the content of obsessional behaviour in many children with autism is not available for use in educational environments, neither is it easily controlled using the range of current methodology. In order to make the approach accessible to a wider range of children with autism, the previously unavailable obsessions and preoccupations need to be harnessed for contingent application. Hanley et al. (2000) summarise the technical aspects required successfully to programme stereotypy as reinforcement. Within the context of reinforcing an alternative behaviour, several distinct components are included in the procedure. These include: the provision of access to relevant stimuli; prompting the desired response; restricting access to the stimuli until a criterion for reinforcement is met; and that access to stereotypy is provided contingent on the instrumental behaviour. These components, in addition to the inclusion of a control condition for non-contingent effects and appropriate baseline measures of behaviour, are essential in evaluating the Premack Principle and the effectiveness of using obsessional behaviour as reinforcement.

Future research

Studies demonstrating the effectiveness of providing brief, controlled periods of access to obsessional stimuli and stereotypy have largely incorporated objects and behaviours that could be easily controlled. These included toys, dolls, books, miniature cars, and puzzle pieces amongst others. However, there are many children with autism for whom the range and content of their obsessions involve objects or activities that cannot be easily delivered within a classroom environment (such as a preference for watching washing machines spinning). Consequently, it can be extremely difficult to harness such obsessions to motivate and reinforce children with autism. Therefore, not all children with autism are suitable candidates for these procedures (Charlop et al., 1990). In view of the reported success of using obsessional behaviour as contingent reinforcement, further research is required to extend this procedure to explore ways of harnessing the content of obsessional behaviours and activities that have previously been undeliverable in the classroom environment.

Rather than attempting to harness the high-rate behaviour itself, one possibility may be to harness the stimuli associated with the behaviour. The stimuli associated with high-rate behaviour have been shown to successfully function as reinforcers (Premack, 1959), which would enable the obsession to be harnessed more easily, and delivered with greater control. Depending on the presenting nature of the obsessional stimuli it would be necessary to harness stimuli across several modalities. The stimuli may involve sound (e.g. a favourite song or word), movement (e.g. a washing machine or train), and static objects (e.g. toys or buildings), each requiring a different mode of presentation. Therefore, investigation into computer delivered reinforcement is an important direction for further research, which would allow a range of different stimuli to be harnessed and delivered under controlled conditions. First, it is important to establish an effective method for computer delivered reinforcement, and for harnessing stimuli associated with obsessional behaviour.

Conclusion

This review has addressed the problems associated with motivating children with autism, and the inadequacy of standard reinforcement assessments and use of common reinforcers. It has also addressed the difficulty of eliminating the high rate obsessional behaviour in children with autism, which are typically resistant to standard intervention techniques. This review considered the limitations of traditional models for identifying potent reinforcers. The application of the Premack Principle, to utilise the high frequency obsessional behaviours as reinforcers, was discussed as a pragmatic approach to motivating children with autism. The potential value of this approach for identifying reinforcers was raised and discussed. However, methodological weaknesses have prevented a comprehensive evaluation of the use of the Premack Principle. This review further discussed the importance of individually tailored intervention approaches incorporating the obsessions and interests of children with autism. Autism is a heterogenous disorder with a vast topography of obsessional and repetitive behaviours, which are not easily defined and must be considered on an individual basis. The need and value of extending this approach to incorporate previously unavailable obsessions that are highly intrusive was discussed. It has been suggested that a system to harness and contingently deliver these behaviours is necessary to permit their application in a controlled manner within educational settings.

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Empirical Paper

A computer-delivered reinforcement package, harnessing obsessional behavior, for young children based on Premack's Principle of reinforcement: A preliminary Investigation.

Prepared as if for submission to the Journal of Applied Behavior Analysis

(see Appendix 6 for instructions for authors)

A computer-delivered reinforcement package, harnessing obsessional behavior, for young children based on Premack's Principle of reinforcement: A preliminary Investigation.

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Running Header:

Obsessional Behavior and Reinforcement in Autism

A computer-delivered reinforcement package, harnessing obsessional behavior, for young children based on Premack's Principle of reinforcement: A preliminary investigation.

Abstract

Identifying reinforcers to motivate children with autism is a difficult task. This study investigated a new method for harnessing previously unavailable obsessional behavior for use as a reinforcer. The key development of this study was that it used the Premack Principle to determine reinforcers, which states that high probability behavior can be used to reinforce low probability behavior. It was predicted that instrumental behavior would increase when access to the contingent behavior was restricted through a contingent arrangement. An ABCA design was replicated across four children. In condition A, a free-choice operant baseline assessed the response probabilities of academic activity and obsessional behavior. In condition B, obsessional behavior (contingent behavior) was made contingent upon academic behavior (instrumental behavior), using a reinforcement schedule determined from the ratio of baseline responding. Condition C was a matched control condition in which contingent behavior was restricted in the absence of an instrumental response requirement. Participants were two children with autism and two non-autistic children (aged 5.1-6.4 years). Results showed that instrumental behavior increased during the contingent condition across all children; however, this increase was not due to a contingent effect. A decrease in contingent behavior was also observed across all children, which was greater in the non-autistic children. Overall, the results predicted by the Premack Principle were not observed. Results are discussed in terms of recommendations for replication and further research.

Introduction

Three main diagnostic criteria for autism are highlighted in the International Classification of Diseases (ICD-10) (World Health Organisation, 1992) and the Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) (American Psychiatric Association, 1994). The first criterion highlights qualitative impairments in social interaction. The second criterion focuses on qualitative impairments in communication, including stereotyped idiosyncratic language. The third criterion involves restricted, repetitive, and stereotyped patterns of behaviors. Of the core diagnostic features, behavioral impairments have been viewed as particularly problematic in autism for some time (Smith & Van Houten, 1996). However, the understanding of obsessional and repetitive patterns of behavior has received little research in comparison to the social and communication deficits (Jones, Walsh, & Sturmey, 1995). Despite little consensus on terminology and topographical descriptions of behavior, a broad range of abnormally restricted, repetitive and stereotyped behavior has been associated with autism. Turner (1999) suggests repetitive behavior can present as either low-level behavior (such as stereotyped movements, repetitive manipulation of objects, and repetitive forms of self-injury) or high-level behavior (such as object attachments, insistence on sameness, repetitive language and obsessional preoccupation with stereotyped or restricted objects or patterns of behavior). Obsessional behavior and obsessional interests are described as the highest level behaviors in autism, which can incorporate interests with unusual objects (e.g., washing machines) or more common interests (e.g. train engines). The range of problems shown within the fundamental diagnostic areas of deficit can be highly variable. Age, and cognitive and linguistic ability can all have a major impact on the way in which the condition and other deficits manifest (Howlin, 1999). Thus, the obsessional behavior of an autistic child with a severe learning disability will be more limited and stereotyped than that evidenced by a child with a higher IQ.

Motivating developmentally disabled children is typically a difficult task, particularly so in autism (Egel, 1981; Charlop, Kurtz & Casey, 1990). These children can appear unresponsive or lacking in motivation to respond to educational activities, placing them at risk of a negative perception or reduced teaching efforts to work with them (Koegel & Egel, 1979). Considerable emphasis is placed on the selection of suitable reinforcement schedules and contingencies in attempting to apply operant techniques to modify behavior (Pace, Ivancic, Edwards, Iwata, & Page, 1985). In the development of operant behavior, reinforcement is considered by Vollmar and Iwata (1991) as the essential tool for motivating and teaching children with autism. Thus, the identification of salient reinforcing stimuli is an essential prerequisite to motivating children with autism and effecting behavior change.

The success of motivational techniques and attempts at using reinforcement systems with children with autism in their natural environment has been met with varied success (Schreibman, 1988), and continues to present a major challenge to both clinicians and researchers. Several factors make the identification of reinforcers problematic in children with autism. First, these children fail to respond to typical stimuli that motivate other children (e.g., toys) or to social reinforcers (e.g., approval) (Schreibman & Charlop-Christy, 1998). Second, the range of reinforcers that can be used is naturally limited by the restricted repertoire of interests that defines autism. Third, autistic preferences for tangible objects can vary on a regular basis, creating the need for a flexible and regular assessment (Farmer-Dougan & McGee, 1986). These limitations and restrictions on the availability of reinforcers may result in the overuse of tangible reinforcers, to which children may eventually habituate. Whilst primary reinforcers (i.e. food) have shown some success in motivating children with autism (Howlin, 1999), the difficulties in administration and rapid satiation limits their effectiveness.

Many standard techniques of reinforcer selection are based upon the empirical law of effect (Skinner, 1935; Spence, 1956). Such techniques involve determining the effect of a stimulus upon behavior before it can be classed as a reinforcer. A major disadvantage of this post-hoc approach is its inability to predict and identify reinforcing stimuli without an empirical demonstration (Aeschleman & Williams, 1989). Furthermore, this method of reinforcer selection can be time consuming and is not always effective. Thus, the process of reinforcement selection may be taken for granted in applying operant techniques. Consequently, failed attempts to effect behavior change can be considered a result of poor reinforcer selection, rather than mismanagement of operant contingencies (Repp, Barton, & Brulle, 1983). The need for more potent reinforcers to motivate and contingently modify behavior in children with autism suggests a new method of reinforcer selection should be investigated. This needs to identify behaviors that are more stable and preferred by children with autism, given the relative ineffectiveness of typical reinforcers.

An alternative approach for identifying more salient stimuli for use as reinforcers is to explore the application of the Premack Principle (Premack, 1959). This approach makes predictions about potential reinforcers on the analysis of free operant response rates of several behaviors and the subsequent schedule manipulation of those behaviors (Aeschleman & Williams, 1989). The principle states that any high probability behavior (i.e., highly preferred) can be used to reinforce low probability behavior (i.e., less preferred), if and only if the independent rate of the high probability behavior is greater. An assessment of response probability is essential to measure the relative free performance levels of behaviors. A second principle noted by Premack (1959) is that stimuli associated with any behavior that is occurring at a low rate can be reinforced by the stimuli associated with high-rate behavior. These reinforcement principles suggest that not only may high frequency behavior function as a reinforcer itself but the associated stimuli should function as reinforcers as well. Early research has demonstrated that the most preferred behaviors of children with autism are often aberrant behaviors such as stereotypy, self-stimulation and obsessional preoccupations (e.g., Lovaas, Koegel, Simmons & Long, 1972). Studies assessing the reinforcing properties of these behaviors for children with autism have demonstrated that these behaviors are highly preferred and generally occur at a high frequency (Lovaas, Newsom, & Hickman, 1987). This notion is further supported by anecdotal clinical evidence confirming the excessive preoccupation and narrow interest that children with autism have in their obsessional behaviors, often at the expense of academic and daily activities. Traditionally, these behaviors have been regarded as pathological in nature (Ollendick & Matson, 1978), and reductive procedures have attempted to eliminate them. These range from milder forms of punishment (e.g., over-correction) through to more intrusive procedures (e.g., physical restraint). Whilst generally proving effective in quickly reducing inappropriate behaviors, the difficulty of eliminating aberrant behavior in autism is well documented (e.g., Favell, McGimsey & Jones, 1978; Schreibman & Carr, 1978; Vollmar & Iwata, 1991). Studies demonstrating the interfering and negative consequences of repetitive behavior establish a rationale for intervention to decelerate their occurrence. Obsessional, stereotypical and repetitive behaviors have been reported to interfere with the acquisition of new skills (Lovaas, Litownick & Mann, 1971); the development of spontaneous appropriate play (Koegel, Firestone, Kramme & Dunlap, 1974); positive social interaction (Jones, Wint, & Ellis, 1990); and finally, significant comorbidity is reported between repetitive behavior and self-injurious behavior (Guess & Carr, 1991).

The relatively stable and highly preferred repetitive behavior observed in autism lends itself to the application of the Premack Principle. Accordingly, stereotypy and self-stimulatory behaviors may function effectively as reinforcers. Initial support for this notion is found in the results of several early studies (Epstein, Taubnam, & Lovaas, 1985; Hung, 1978; Lovaas et al., 1987; Sugai & White, 1986; Wolery, 1978; Wolery, Kirk & Gast, 1985). This is in sharp contrast to the general difficulty experienced in identifying effective reinforcers to motivate children with autism (Schriebman, 1988). These results have prompted further studies investigating the reinforcing properties of other highly preferred behaviors displayed by children with autism. A variety of distinct obsessional behavior, stereotypy and self-stimulation have been successfully incorporated into many reinforcement programmes. These have reinforced a range of desired responses, including: increasing correct academic performance (Charlop et al., 1990; Morrison & Rosales-Ruiz, 1997; Wolery et al., 1985), the non-occurrence of aberrant behavior (Charlop-Christy & Haymes, 1996, 1998), appropriate social interaction including sibling play and joint attention (Baker, Koegel, & Koegel, 1998; Baker, 2000; Koegel, Dyer & Bell, 1987), prevocational task performance such as packaging, and mail sorting (Sugai & White, 1986), spontaneous appropriate sentences (Hung, 1978), and initiation of social interactions (Gaylord-Ross, Haring, Breen, & Pitts-Conway, 1984). In a series of three experiments, Charlop et al. (1990) compared the efficacy of using self-stimulation, delayed echolalia, and perseverative behaviors (obsessions) as reinforcers to increase correct task responding in children with autism. The tasks presented during the experimental sessions were selected from each child's current curriculum (e.g., use of expressive pronouns and prepositions, shape matching, telling time, recall of previous actions and adding up coins). The children were allowed to engage in specific aberrant behavior (e.g., self-stimulation, echolalia, and obsession) for 3 to 5 s contingent upon correct responses. A consequence corresponding to the particular reinforcer condition was provided after each correct response. Results indicated that conditions in which aberrant behaviors were used as reinforcers were more successful than conditions in which edible reinforcers were used. Specifically, conditions in which perseverative behavior served as a reinforcer showed the highest percentage of correct task responding, which were better than self-stimulation and echolalia as reinforcers for the children. Additionally, no undesirable side effect, such as increases in obsessional and stereotypical behavior, and off-task behavior was reported, supporting similar findings by Wolery et al. (1985). This series of studies incorporated obsessional interests that were readily available and could be easily controlled (including toys, dolls, books, and miniature cars). However, the availability of some obsessional interests can be problematic (e.g., watching washing machines spin) and may not be easily harnessed for contingent application in academic settings. Consequently, not all children with autism are suitable candidates for these procedures.

This study extends the line of research taken by Charlop et al. by further exploring the use of obsessional behavior as reinforcement. It aimed to pilot a computer-delivered reinforcement package, providing contingent access to obsessional behavior that is not easily controlled for practical reasons, unavailability, and safety issues. The effective application of computers as an engaging educational tool for children with autism and children with learning disabilities is developing (Chayer-Farrell & Freedman, 1987; Dube & McIlvane, 2001; Moore, Sweeney, & Butterfield, 1993; Neef & Lutz, 2001). With the ongoing evolution of computer technology, this developing area should be considered for use with children with autism.

The overall aim of this study is to examine the effectiveness of using stimuli associated with highly preferred (i.e., high probability) obsessional behavior to increase the duration of less preferred (i.e., low probability) academic activity in young children (including two children with autism), through the application of the Premack Principle. Many studies have relied on the assumption of the Premack Principle that high probability behavior can be used to reinforce low probability behavior. However, these studies have failed to use methodology for producing the reinforcement effect according to the Premack Principle. Since it is about the issue of response probability assessment that Premack's theory revolves, the method by which response probability is determined is critically important. In order to evaluate the Premack Principle, it is necessary to first measure the probability of at least two behaviors (one being the desired instrumental behavior) under a free-choice operant baseline condition. This consists of allowing unrestricted choice of responding without any contingency arrangements in order to measure the relative probabilities. The behavior that is allocated the largest amount of time is designated the contingent behavior (Domjam, 1998). According to Premack, duration of time (measured in seconds) is the optimal measure for the between-response comparison, necessary for determining relative probabilities. A contingent phase then follows, in which the baseline ratio of high probability (contingent) responding and low probability (instrumental) responding is calculated. This ratio is then increased and the instrumental and contingent requirements are determined. An effective reinforcement contingency arrangement, as defined by the Premack Principle, exists when the programmed schedule requirements restrict the high probability behavior below its free-operant baseline duration in a fixed time period. This results in an increase in low probability behavior in order to reinstate the high probability behavior back to its baseline level. Operationally, an effective reinforcement schedule exists if $I/C>L_{pb}/H_{pb}$, where I and C are the schedule requirements for the instrumental and contingent behaviors, respectively, while L_{pb} and H_{pb} represent the respective paired-operant levels of low probability behavior and high probability behavior. The inclusion of a matched control condition is also necessary for demonstrating an effective reinforcement contingency arrangement. Timberlake (1979) notes that it is difficult to determine whether a reinforcement effect is due to the contingency arrangement, or due to the restricted access to the high probability behavior. Put another way, if an individual is deprived of a large portion of available responding within the confines of an experimental time constraint, an increase may occur in some other behavior. Thus, a matched control condition assesses the effects of restricting the high probability behavior in the absence of a low probability response requirement. This ensures whether any increase in low probability behavior occurred independently of the contingency arrangement. The methodology of the present study will adapt a controlled experimental design described by Aeschelman and Williams (1989).

It is hypothesised that low-probability behavior (i.e., academic activity) will increase more when it is contingently reinforced by the opportunity to engage in high-probability behavior (i.e., obsessional behavior), than with a matched control. Premack also stated that effective reinforcement contingencies not only increase instrumental behavior but also involve a reduction in the amount of contingent responding relative to its baseline level. Therefore, the frequency of obsessional behavior was predicted to decrease.

Method

Design

An ABCA[1] time-series design was replicated across four single-case studies. The experiment contained a free-choice baseline (A), a contingency condition (B), and a matched control condition (C). The matched control condition assessed the effects of restricting the contingent behavior in the absence of an instrumental behavior requirement (Bernstein & Ebbesen, 1978). These three conditions were presented in the following order: baseline, contingency, matched control, baseline. In this design, access to the obsessional behavior (to be defined as contingent behavior) was made contingent upon the academic activity (to be defined as instrumental behavior) in condition B, and was fixed in condition C. The duration of the instrumental behavior was the dependent variable. Presenting the matched control condition both before and after the contingent condition provided a control for the non-contingent effects of the experimental stimuli (Knapp, 1976) as well as potential carryover effects (Konarski, Johnson, Crowell, & Whitman, 1981).

Participants

Four boys between the ages of 5.1 years to 6.4 years old were recruited from a school for children with moderate learning disabilities, funded by the local education authority. Participants were selected based on distinct obsessional

[1] An ABCABCA design had been planned to provide both internal and external validity through replication, but had to be modified as a result of unanticipated and uncontrollable changes in the research context. The issues surrounding these changes are fully considered in the discussion and critical overview.

behaviors and preoccupations with specific activities and interests. Selection was based on reports from the children's parents and classroom teacher that the children were not motivated to engage in academic activity for extended periods, and engaged in off-task behavior (such as non-compliance, shouting, crying, and leaving their seat) during teaching periods. Exclusion criteria included aggressive or self-injurious behavior or known neurological problems (e.g. ADHD, impaired vision, impaired hearing or problems with motor co-ordination).

The presence, severity, and topography of abnormal repetitive behavior for each child were assessed using the Repetitive Behavior Scale (RBS; see Appendix 4) (Bodfish, Crawford, Powell, Parker, Golden, & Lewis, 1995; Bodfish, Symons, & Lewis, 1993). This clinical rating scale was completed by the classroom teacher who met the exposure criterion recommended by Bodfish et al. (1993), having known each child for more than three months. This measure was used to determine the presence of compulsive, stereotyped and self-injurious behavior, as well as any other apparently purposeless, repetitive behaviors, actions, or movements. The RBS also identified the frequency with which each child engaged in these behaviors, the effect of blocking the behavior, whether a preferred activity could stop the behavior, whether it was necessary for someone to do something to manage the behaviour, and the interfering effect of the behaviour on each child's school work. Descriptions of each child's obsessional behavior were further obtained from the classroom teacher, the parents of each child, and from classroom observations. Together with the obsessional behaviors identified on the RBS, stimuli associated with the obsessional behaviors of each child were used in the present study. A summary of the behaviors shown by each child is presented in Table 1.

Table 1&2 about here

Child 1 (chronological age, 5.4 years) had a primary diagnosis of autism (ICD-10, F84.0) (World Health Organisation, 1992) received through a regional autistic diagnosis centre in October 2000, and met the criteria for a secondary diagnosis of moderate mental retardation (ICD-10, F71) (World Health Organisation, 1992). He had limited language at a two-word utterance level, but frequently engaged in excessive indistinguishable vocalisations. Results of the RBS (see Table 2) indicated that he displayed only two stereotypical behaviors (about once every one to three hours), although management of them was necessary at times by the teacher. Stereotypical body movements were most often observed, although the opportunity to engage in a preferred behavior usually led to the cessation of the stereotypical behavior with no additional aggressive or inappropriate behavior. Child 1 also had a range of obsessional behaviors and interests (e.g., dinosaurs, toy animals, and shiny objects) which could be stopped with moderate distress when access to them was blocked. At school it was often necessary to manage his obsessional behavior. He rarely completed academic tasks without much assistance and rushed their completion, resulting in frequent mistakes. Off-task behavior included crying, shouting, and getting out of his seat.

Child 2 (chronological age, 5.5 years) had a primary diagnosis of autism received through a regional autistic diagnostic centre in June 2000. He was verbal but spoke very little. From the results of the RBS, he was estimated to display stereotypy once every 30 to 60 minutes, these involved high-pitched vocalisations and object manipulation. He was estimated to display obsessional behavior once every 15 to 30 minutes, which predominantly focussed on characters from the Wallace & Gromit television animation. When blocked, stereotypy and obsessional behavior could be stopped resulting in moderate distress. Sometimes, it was necessary for his stereotypy and obsessional behavior to be managed in the classroom, usually by offering a preferred activity. Child 2 engaged in academic tasks for relatively short periods appearing unmotivated to spend longer periods of time working. Off-task behavior involved getting out of his seat, non-compliance, gazing, crying, and high-pitched screaming.

Child 3 (chronological age, 6.4 years) had a primary diagnosis of Soto's Syndrome (a rare genetic disorder characterised by accelerated growth, cerebral gigantisms, and developmental delay). Results of the RBS indicated that although he did not display any stereotypical or compulsive behavior he had a range of obsessional behaviors. His main obsession was with children's television theme tunes. He had limited expressive language at a one-word utterance level and often exhibited disruptive behaviors (e.g., irritability, and non-compliance) with an apparent disinterest in learning. He was easily distracted and evidenced difficulty focussing on academic work for extended periods.

Child 4 (chronological age, 5.1 years) had a primary diagnosis of microcephaly and associated moderate learning disability. There were no stereotypical or compulsive behaviour, as measured by the RBS. However, he did demonstrate a range of obsessional behaviours indicated on the RBS (e.g., children's television programmes, and watching washing machines spinning). His expressive language was limited to a two-word utterance level. At school, he regularly got out of his seat, shouted, and was easily distracted by other activities in the classroom.

The obsessional interests and preoccupations of the children were reported to have been relatively stable over the last year, although the two children with autism (Child 1 and Child 2) showed greater desire for sameness and detail. Child 3 and Child 4 maintained their obsessional preoccupations. However, they allowed greater variation around the central themes.

Setting and Materials

Experimental sessions were conducted in the children's daily classroom and scheduled into their work routines, so as to simulate typical work sessions as closely as possible. The classroom was set up to allow a suitable area for the study to be conducted, which was screened off from the rest of the class. Closed-ended academic activities from each child's current curriculum were used in the study (see Table 3). The activities for each child were kept in separate boxes that were taken to the experimental sessions. This enabled the teacher to easily access them reducing the transition time between activities. The activities were consistently used across baseline and experimental sessions, and presented in a pseudo random order.

Table 3 about here

A computer programme was written using Borland C++ Builder 5, to enable stimuli associated with previously unavailable obsessional behavior to be controlled and delivered for contingent reinforcement. A library consisting of 85 different stimuli, presented randomly were created for each child and stored on a Sony PCG-FX503 laptop computer. This was intended to reduce the possibility of stimulus satiation that can occur with continued access to the same stimuli (Miltenberger, 1997). Stimuli that were associated with each child's obsessional behavior were collected in three formats: still picture (bitmap file), video clip (avi file), and audio clip (wav file). Where possible, stimuli were collected in more than one format for each obsessional behavior. The stimuli were selected from the obsessional behaviors identified by the Repetitive Behavior Scale, and from teacher and parent reports. A digital camera and digital video camera were used to capture the object of each child's obsessional behavior for use as stimuli (e.g., photographs of favourite toys, and video clips of different washing machines spinning). This enabled stimuli to be obtained from the context in which the obsessional behaviors occurred. The internet also provided a source for many of the stimuli, and some music was captured from a compact disk of children's theme tunes. All the images and video clips were re-sized to consistently appear in the centre of the computer monitor. The stimuli were presented via a 35.5 cm monitor, and the audio files were played via the internal speakers of the laptop. The maximum length of time that each stimulus was presented was specified in the computer programme, and a large button was used to enable the children to change the stimulus before this time had elapsed. The total length of time each child could access the stimuli was also specified, depending on their schedule requirements. During the baseline condition, the computer programme was specified to run continuously until it was manually cancelled. The computer displayed a blank screen when the contingent reinforcement was not available. The teacher and child sat opposite each other at a table measuring 60 cm in width, and the computer monitor was placed to the right of the teacher (Figure 1 shows a plan of the experimental setting). This was the optimal position to ensure the children remained facing the teacher, adopting a familiar teaching format.

Figure 1 about here

Procedure

Appropriate ethical approval was obtained for this study (see Appendix 1). An MLD school was identified within the local education authority and approached in order to identify the participants. Full details of the study and an information sheet were offered to the Headteacher and classroom teacher prior to receiving their agreement to proceed. An information sheet detailing the purpose and nature of the study and an appropriate consent form (see Appendix 2 and 3), was passed on to the parents of potential child participants by the classroom teacher. All four of the parents approached gave consent for their sons to be potential participants.

Free-choice Baseline. The aim of the baseline condition was to conduct a preference assessment in order to calculate the ratio between each child's high probability behavior and low probability behavior. This was conducted free from any contingent arrangements in a fixed time. Duration in seconds (secs) was used as the assessment measure of behavior probability, where a longer duration of responding reflected a greater behavior preference. Once the child was seated, the computer-delivered stimuli and the materials for the academic activities were simultaneously presented. The materials for the academic activity were placed on the table within easy reach of the child, and adjacent to the button enabling the stimuli to be changed. At the start of each baseline session the teacher started the computer programme to deliver the obsessional stimuli, and gave the child a free choice of activity. Baseline sessions continued until the session exceeded the duration of a typical teaching session for each child, as specified by the teacher. For all baseline conditions, a minimum of three baseline sessions was conducted for each participant, in accordance with Barlow and Hersen's (1973) recommendations. This number was deemed appropriate given the existing high preference for obsessional behavior. The mean length of baseline sessions for each child was calculated and used to determine the length of all proceeding experimental sessions.

Contingency Procedure. A reinforcement schedule that satisfied the Premack Principle requirement (i.e., $I/C>L_{pb}/H_{pb}$[2]) was calculated for each child. This was based on the ratio of each child's high probability behavior and low probability behavior, as determined by the duration allocated to either the academic activity or the computer delivered obsessional stimuli, during the free-choice baseline condition. Schedule requirements were not identical for each child since each had a different distribution of time and mean session length. Each child's reinforcement schedule, determining their instrumental behavior requirement value (I) and contingent behavior requirement value (C), was calculated based on the following criteria stated by Aeschleman & Williams (1989): (a) the schedule allowed each child to complete the contingency several times within each session, (b) the I and C values permitted a natural unit of interaction to be completed (e.g., completion of one puzzle, building a design of coloured blocks), (c) the I/C ratio was at least 2.5 times the L_{pb}/H_{pb} ratio, and (d) the total session I value was at least 3.5 minutes (reflecting the minimum mean baseline). The L_{pb}/H_{pb} ratios calculated for each child were designed to allow the detection of an instrumental effect (i.e. a clear increase in academic activity

[2] L_{pb} = operant baseline of low probability behaviour, H_{pr} = operant baseline of high probability behaviour, I= instrumental behaviour requirement of the contingency, C = contingent behaviour requirement of the contingency.

would be produced by an effective contingency). A summary of each child's schedule requirements is presented in Table 4.

Table 4 about here

Prior to each session in the contingency condition, the teacher instructed each child to remain seated until they were told it was the end of the session. A stopwatch was attached to the side of the computer monitor and each child's instrumental requirement was clearly displayed next to it. The first instrumental academic activity was placed on the table in front of the child and the stopwatch was started. The stopwatch was stopped when the child was not on-task. Once the child completed the instrumental requirement of the schedule, the academic materials were removed. The button controlling the contingent reinforcement was then placed within easy reach of the child and the teacher started the computer presentation of the contingent stimuli. After the contingent reinforcement had been available for the allotted time, the computer displayed a blank screen and the teacher removed the button, regardless of the duration of time the child responded to their obsessional stimuli. The academic activity was then repositioned in front of the child and this procedure was repeated until the session had reached its mean length, as determined from the baseline sessions. Throughout, the teacher used optimal language to communicate with each child, such as: "where does the lorry go?"; "(name of child) working now"; "(name of child) do his work"; "(name of child) watching". A minimum of four and a maximum of five contingency condition sessions were conducted for each participant. Child 1, 3 and 4 received 4 contingency sessions, Child 2 received 5.

Matched Control Procedure. The procedure for this condition was identical to the contingency condition, except that the contingent behavior was restricted to the level that it occurred at during the contingency condition. At times when the contingent behavior was not available, the academic tasks (instrumental behavior) were presented to each child for completion in the absence of an instrumental requirement. The frequency and duration of the presentations were identical to the mean occurrence in the first contingent condition. The teacher used a stopwatch to determine the inter-reinforcement intervals of instrumental behavior. Child 1, 3 and 4 received 4 matched control sessions, Child 2 received 5.

Recording and Reliability

All sessions were videotaped and analysed away from the classroom. During each experimental session, the total duration of instrumental behavior was measured for each child. A digital stopwatch was used throughout to record, to the nearest second, the time of the initiation of contact with the instrumental activity and the time at the end of such contact. In the contingent condition (B) the instrumental requirement determined the duration. An observer also measured the duration of each child's contingent behavior using a stopwatch as described. Times when the children engaged in neither instrumental nor contingent behavior were measured and recorded as undefined behavior. Interobserver reliability checks were conducted by having a second observer independently record the duration of instrumental and contingent behavior. The same procedure used by the primary observer was adopted. Reliability checks were conducted on a minimum of 29% of each child's sessions (across all conditions). Interobserver agreement for duration measures of each behavior was calculated by dividing the smaller duration by the larger duration and multiplying by 100 (Miltenberger, 1997). Interobserver reliability percentages are shown in Table 5 for each child. Across all children, interobserver agreement for duration of on-task behavior was recorded with a range of 90% to 100%.

Table 5 about here

Treatment Fidelity

Each child's instrumental requirement was constant across all sessions. The teacher's accuracy of timing when each child's instrumental requirement had been met was assessed in the contingent condition. A non-parametric Mann Whitney U Test was used to compare the required instrumental duration and the observed duration of the instrumental behavior across each contingent session in seconds. This non-parametric analysis provides a suitable method of testing for significant differences between two independent conditions in single-case research (Edgington, 1992). No statistical difference was found for Child 1 ($U_{(17, 17)} = 110.5$, $p = 0.170$) which suggested that the duration of instrumental behavior was accurately timed in accordance with the required duration. A significant difference between the required instrumental duration and the observed instrumental duration was found for Child 2 ($U_{(25, 25)} = 187.5$, $p < 0.05$), Child 3 ($U_{(21, 21)} = 84$, $p < 0.001$), and Child 4 ($U_{(23, 23)} = 138$, $p < 0.01$) which suggested some difference between the experimenter's timing of instrumental behavior and the required duration of instrumental behavior. Mean durations of required instrumental behavior and observed instrumental behavior for each child were 28/30, 23/18, 41/44, and 39/41, respectively. These mean differences are very small (except for Child 2); however, the schedule requirements were not materially affected by the inaccurate timing of the instrumental requirement, and the I/C ratio would still have established a contingency. It was not necessary to analyse the duration of contingent feedback for accuracy as the computer programme controlled the timing.

The frequency and duration of access to contingent reinforcement was also analysed for accuracy, during the matched control condition. A Mann Whitney U Test compared the duration of the required inter-reinforcement intervals with the duration of the observed inter-reinforcement intervals. No significant difference was found for Child 1 ($U_{(17, 17)} = 142.5$, $P = 0.944$) and Child 3 ($U_{(21,21)} = 128.5$, $p = 0.19$). A significant difference was found for Child 2 ($U_{(25, 25)} = 156.5$, $p<0.05$) and Child 4 ($U_{(23, 23)} = 68$, $p<0.001$), which suggested there was some difference in the timing of the inter-reinforcement intervals.

Results

Expected pattern of results

Figure 2 shows a pattern of results that would be expected from an effective reinforcement contingency arrangement, as defined by the Premack Principle. During the free-choice baseline condition, a response differential would be observed between two behaviors (of high probability and low probability). A decrease in high probability behavior below its baseline duration would then be expected in the contingent condition, as it is restricted and made contingent upon an increase in instrumental behavior, marking the reinforcement effect. In the matched control condition, this contingent behavior is expected to remain at a level similar to that in the contingent condition. In the absence of an instrumental requirement within the matched control condition, no increase in the instrumental behavior would be expected. Finally, the instrumental and contingent behaviors would be expected to return to their operant baseline levels.

Figure 2 about here

Visual analysis[3]

The children's total on-task academic behavior (as defined by instrumental behavior) and on-task obsessional behavior (as defined by contingent behavior) across experimental sessions are shown in Figure 3. A comparison of the mean on-task durations for these behaviors are made in Figure 4, and the total duration of undefined behavior is presented in Figure 5.

Figure 3, 4, and 5 about here

Figure 3 suggests that all children allocated more time to their obsessional behavior (i.e., contingent behavior) than to their academic behavior (i.e., instrumental behavior) in each initial baseline session. This response differential met the necessary requirements of the Premack Principle indicating that each single case replication could continue accordingly. It was not possible to run the full design for each child as they were simultaneously recruited from the same class, the teacher from which ran the study. Therefore, the unanticipated and uncontrollable changes that were encountered in the research context affected all the children. The results for each child will now be reported separately.

[3] The reader is referred to Appendix 7 for a discussion of the debate between visual analysis and statistical analysis in analysing single-case research.

Child 1

Apart from variation in the baseline data points for contingent behavior, data for Child 1 varied very little across conditions. During the initial baseline there was a large response differential, where the mean duration of contingent behavior (489 seconds) exceeded the mean duration of instrumental behavior (75 seconds). This indicates that in this context, the obsessional behavior of Child 1 was preferred to the academic work. During the contingent condition, the duration of contingent behavior decreased and became more stable. An increase in instrumental behavior was also observed, from the preceding baseline condition, as expected. In the matched control condition the instrumental behavior increased a little from the contingent condition and the contingent behavior decreased slightly. A further increase in instrumental behavior was observed across the return to baseline condition and the contingent behavior remained unchanged from the preceding matched control condition. Although the response differential in the second baseline condition was not as large as in the initial baseline condition, the duration of the contingent behavior remained higher. This indicates it was still preferred under free-choice conditions. Furthermore, although the duration of instrumental behavior increased in the contingent condition, no effect of the matched control condition was observed because the instrumental activity increased rather than decreased. Across the return to baseline condition, duration of instrumental behavior remained relatively stable and greater than the mean initial baseline duration. The mean on-task duration of instrumental behavior increased across the experimental conditions, exceeding the duration in each immediately preceding condition. A comparison of the mean duration for contingent behavior indicates a general decrease across conditions from the initial baseline. The highest duration of undefined behavior (Figure 5) was observed during the matched control condition. This duration exceeded the level observed in the preceding contingent condition, which itself had increased from a minimal baseline level. A decrease in undefined behavior was then observed in the return to baseline condition.

Child 2

Child 2's baseline duration of instrumental behavior averaged 186 seconds, exceeding the average duration of 74 for contingent behavior. This shows that he allocated more time to his contingent behavior than the instrumental behavior, under free choice conditions. The duration of instrumental behavior increased in the contingent condition and exceeded the preceding baseline, although there was a decrease on session six. Also, as expected, the contingent behavior decreased from baseline during the contingent condition. During the matched control condition, data varied very little for the instrumental behavior, except for session 13 where a decrease was observed. Consequently, the mean duration of instrumental behavior decreased slightly from the contingent condition. A similar pattern was observed for the contingent behavior during the matched control condition, with a final decrease at session 13. The observed decrease in instrumental and obsessional behavior duration across session 13 and 14 coincided with the redecoration of the classroom, and a two-week period in which Child 2 screamed excessively on arrival in the classroom. Interestingly, gradual cessation of the screaming was observed during the experimental sessions at times when Child 2 was engaged in his contingent behavior. Following session 14 (return to baseline condition), Child 2 showed a steady increase in the on-task duration of instrumental behavior, and the mean duration was recovered. The baseline duration of obsessional behavior was not recovered, against predictions, and the mean duration varied very little from the two preceding conditions. Therefore, the response differential in the initial baseline condition was greater than that observed in the second baseline condition. Child 2 demonstrated a low baseline duration of undefined behavior that remained stable (Figure 5). During the contingent condition, the duration of undefined behavior increased until session 6 before decreasing to baseline level. During the matched control condition, there was a similar mid-point increase in the duration of undefined behavior. Session 13 and 14 showed a larger increase across into the second baseline condition; this coincided with the redecoration of the classroom. The duration of undefined behavior then decreased rapidly across session 15 and 16 during remaining baseline sessions.

Child 3

During the baseline, Child 3 allocated more time to contingent behavior than to instrumental behavior (Figure 3). The difference in distribution was evident where the mean on-task duration of 305 seconds for the contingent behavior exceeded the mean on-task duration of 145 seconds for instrumental behavior. This response differential was as expected. The duration of instrumental behavior increased and remained relatively stable in the contingent condition, exceeding the baseline duration. A decrease in contingent behavior was also observed, falling below the duration of instrumental behavior on session six and seven. Data points for the instrumental behavior decreased a little in the matched control condition, again remaining stable. The mean duration of instrumental behavior in the matched control condition fell between its mean on-task duration in the baseline and contingent conditions. A decrease in contingent behavior was observed during the matched control condition at session 10, increasing a little over session 11. The mean duration of contingent behavior in the matched control condition did not change from the preceding contingent condition. Unfortunately, this pattern of results is not consistent with the expected pattern that indicates a matched control effect. During the second baseline condition, instrumental behavior increased again to mean duration comparable with the contingent condition, whereas obsessional behavior continued to decrease. This suggests that under free-choice conditions, the instrumental behavior was now preferred to the contingent behavior. Overall, the mean duration of instrumental behavior was greater than the mean duration of contingent behavior across experimental conditions, following the initial baseline where the duration of contingent behavior was greater. Child 3 demonstrated a minimal duration of undefined behavior during the initial baseline condition (Figure 3). This duration increased across conditions with the greatest variation in the Matched Control condition. The duration in the return to baseline condition stabilised and was greater than the initial baseline.

Child 4

Following a minimal response differential in session one of the baseline condition, the duration of contingent behavior appeared to increase across baseline (mean of 242 seconds), exceeding the duration of instrumental behavior, which appeared to decrease across baseline (mean of 143 seconds). Thus, contingent behavior was preferred as expected. Immediately following the baseline condition, the instrumental behavior is observed to increase above the duration of contingent behavior, despite a baseline trend in the opposite direction. Throughout the contingent condition the duration of the instrumental behavior remained stable. The duration of contingent behavior remained stable and unchanged across the matched control condition. Also, following a decrease on session eight at the start of the matched control condition, the duration of instrumental behavior remained stable. After the initial increase in mean duration of instrumental behavior in the contingent condition there is no matched control effect for Child 4 as the duration remained high. These findings are not as expected in order to demonstrate that the observed increase in instrumental behavior in the contingent condition was due to the reinforcement contingency. Under free-choice conditions in the second baseline, the duration of instrumental behavior exceeded the duration of contingent behavior, which was particularly low on the final session. This indicates that the response differential had reversed from the initial baseline condition, as Child 4 was allocating more time to the instrumental behavior. Figure 3 shows clearly that the duration of instrumental behavior exceeded the duration of contingent behavior across all conditions following baseline. The duration of undefined behavior for Child 4 was inconsistent, evidencing a slight increase in duration across conditions (Figure 5). The duration of undefined behavior during the second baseline condition was higher than the duration across the initial baseline.

Discussion

The aim of this study was to explore a new method of harnessing and using obsessional behavior that was previously unavailable as reinforcement in children. The key development of this study was that it used the Premack Principle to determine reinforcers and contingencies for increasing instrumental activity. Although it is not possible to draw firm conclusions regarding the long term utility of the intervention procedure developed here, because of the design restrictions imposed by the naturalistic conditions of the study, the findings will be discussed in respect of the limitations and need for future research.

Summary of main findings

A comparison of the mean duration for instrumental and contingent behavior across the children suggests seven general trends. First, the mean baseline duration of contingent behavior exceeded the mean baseline duration of instrumental behavior across children. Second, the duration of instrumental behavior increased in the contingent condition, compared to the preceding baseline condition for all children. Third, the mean duration of contingent behavior decreased across the experimental conditions after initial baseline in all children. This trend is clearly observed in Child 3 and 4 whereas Child 1 and 2 show an initial decrease before the durations stabilise. Fourth, three of the four children (Children 1, 3, and 4) demonstrated a mean durational increase in instrumental behavior between the initial baseline condition and the return to baseline condition. Comparable mean durations of instrumental behavior were observed between the two baseline conditions for Child 2, indicating a return to baseline duration following removal of the contingent reinforcement. However, this child did not show a baseline level of the contingent activity as required by the theory. Fifth, an effect of the matched control condition on the on-task duration of academic activity was not uniform across children. Sixth, the duration of undefined behavior generally increased across the experimental conditions for each child. Child 1, 3 and 4 demonstrated a general increase in undefined behavior across experimental conditions where the duration across the return to baseline condition was greater than the initial baseline duration. Data for Child 2 were confounded by the period of excessive screaming across session 13 and

14. Seventh, the duration of contingent behavior in the two children with autism (Child 1 and 2) remained higher across the experimental conditions than the non-autistic children (Child 3 and 4).

These findings suggest that academic activity (instrumental behavior) increased when the children's access to their obsessional behavior was made contingent. In addition, there were concomitant decreases in the children's obsessional behavior (contingent behavior), and an increase in undefined behavior was observed. Overall, there was not a contingent effect consistent with the Premack Principle.

Discussion of results

From the results of the present study it is not clear whether contingent access to the obsessional behavior was the controlling variable for the increase in instrumental behavior, that was replicated across each case study. The observed increase could be due to the unavailability of the contingent reinforcement for periods of time during the schedule condition, rather than due to a probability differential between the behaviors. Specifically, the children may have increased their instrumental behavior because it was the only behavior available rather than because it gains them access to the contingent reinforcement. In order to determine a clear contingent effect, consistent with the Premack Principle, a lower duration of academic activity was necessary in the matched control condition than in the contingent condition, whilst the contingent behavior was restricted. Thus, contingent access to the obsessional behavior does not appear to be the controlling variable for the children's durational increase in academic activity. Without the inclusion of such a control it would be difficult to draw any firm conclusion about the reinforcing value of the harnessed obsessional behaviors used in the present study. Thus, this study does not support previous findings that obsessional behavior and other forms of repetitive behavior can be used as reinforcers (Hung, 1978; Sugai & White, 1986; Wolery et al., 1985; Charlop et al., 1990; Charlop-Christy & Haymes, 1996, 1998). However, it is difficult to draw comparisons with previous research employing the assumption of the Premack Principle to identify reinforcers. This is because many studies have failed to provide a matched control condition ensuring that any increase in low probability behavior occurred as a result of contingency arrangement.

Premack stated that effective reinforcement contingencies not only increase instrumental behavior but also necessarily involve a relative decrease in contingent behavior. The observed reduction in the amount of contingent responding relative to its baseline level was consistent with previous findings (Eisenberger, Karpman & Trattner, 1967; Premack, 1965). Konarski et al. (1981) suggest that the contribution of this relative reduction of contingent responding during the contingency has received little attention. There are potential implications for using the Premack Principle as a clinical tool for decelerating highly preferred undesirable behavior in children with autism. Despite the absence of a conclusive contingent effect, the lack of reversal back to baseline levels for Child 1, 3 and 4, suggests carryover effects of the intervention (Barlow & Hersen, 1984). In particular, these three children were able to maintain an increased duration of academic activity even when the reinforcer was no longer available.

Encouragingly, observations of the children during the study indicated that they quickly learned the association between instrumental behavior and gaining access to contingent reinforcement. Initial interest and motivation to engage in the study was high. All the children were observed attempting to access their stimuli from the equipment at times when the study was not in progress; this occurred at some point following the first experimental session. The attempts, however, made by each child to engage in their contingent behavior during the study declined across the sessions (such as reaching for the button and pointing at the computer monitor), and the duration of undefined behavior increased.

Consistent with previous findings (Charlop et al, 1990; Wolery et al., 1985), there was no evidence of resistance or excessive obsessional responding when access to the obsessional stimuli was restricted. All the children engaged in their contingent behavior in a controlled manner and the teacher did not report any increase in inappropriate behaviors in nontreatment settings, again consistent with previous research (Charlop-Christy & Haymes, 1996). No child engaged in excessive obsessional behavior, although, without extended observations beyond the experimental setting, it is impossible to determine any generalised changes in each child's obsessional behavior. Furthermore, the children often appeared eager to continue with their instrumental academic behavior once the contingent reinforcement had been presented.

The present study ruled out that the accuracy of timing of each child's instrumental requirement had a material effect on the results. However, the possibility that other factors or variables could have been reinforcing or could have influenced the results, cannot be ruled out. These include the reinforcing value of the contingent stimuli, the novelty of the stimuli, and stimulus satiation effects. A discussion of these will now follow.

The observed decrease in contingent behavior across all children may be explained in terms of the potency of the reinforcing stimuli. Although a large number of obsessional stimuli were collected for each child, the variations of stimuli may not have been potent enough to induce a contingent effect. This explanation may be borne from the literature on stimulus satiation (Miltenberger, 1997; Wolery et al., 1985). It is possible that repeated exposure to the stimuli served to make the reinforcement less potent. Indeed, Charlop et al. (1990) discussed whether a satiation effect would have been encountered with extended use of the obsessional stimuli in their study. Satiation effects are always stimulus specific, however, some generalisation of the effects may have also occurred amongst the obsessional stimuli, or may have lacked the reinforcing value of the obsessional behavior in its pure form. Furthermore, the obsessional stimuli may not have introduced enough novelty required to prevent stimulus satiation. This highlights the importance of stimulus variation when attempting to identify and use potent reinforcers to increase motivation in autism.

Issues of satiation are somewhat paradoxical in autism. Whilst Egel (1981) notes that a repetitive presentation of stimuli with no variation will typically result in stimulus satiation, children with autism are observed to repeatedly engage in the same repetitive and obsessional behavior over time. Why then are these behaviors not subject to satiation effects when repeatedly performed by children with autism, and are there differences when these behaviors are controlled externally as in the present study? The type of reinforcement gained by each child may explain the differences in the duration of contingent behavior observed between the children with autism and non-autistic children. The contingent behavior of the children with autism remained more preferred and stable across experimental conditions than that of the non-autistic children, suggesting a difference in the nature and function of obsessional behavior. Lovaas et al. (1987) proposed that the perceptual reinforcement provided by stereotypy in autism was primary, serving an internal organic function. Additionally, obsessive behaviors have been hypothesised to be a more complex form of stereotypy (Epstein, et al., 1985; Lovaas, et al., 1987). The results of long-term intervention demonstrated that as children learn speech and acquire academic skills, their "low level" stereotypy (e.g. hand flapping) becomes replaced by increased "higher levels" (i.e., obsessional behavior) (Epstein et al., 1985). Charlop-Christy and Haymes (1996) proposed therefore that obsessional behaviors may also be primary reinforcers. In contrast, the obsessional behavior observed in the non-autistic children is not reported to develop in a similar way, and is not likely to serve an internal organic function. Instead, it is possible that the obsessional behavior provides a source of secondary reinforcement. This could account for the difference observed in the duration of obsessional behavior between the autistic and non-autistic children. Furthermore, one may assume that the potency of obsessional behaviors as reinforcers would be greater in children with autism due to the internal function organic function they provide. There is, however, no firm evidence documenting that obsessions are primary reinforcers.

The application of stimulus satiation techniques deserves consideration as a paradigm for controlling the obsessional behavior of autistic and non-autistic children, and warrants further investigation. For example, the technique of satiation could be used to reduce obsessional behavior whereby the behavior maintained by the reinforcer is weakened through externally controlled presentation (Ayllon, 1963; Ayllon & Michael, 1959).

Limitations and recommendations for future research

The present study could be developed in a number of ways. Of most importance is the need to get better experimental control. This necessarily means repeating the study with more children with autism who present with more highly intrusive obsessional behaviors. Due to recruitment difficulties, the present study included non-autistic children with obsessional behaviors in order evaluate the method of delivering reinforcement. It is therefore difficult to make comparisons with previous research, which primarily used children with autism with highly intrusive obsessional behaviors. It would also be vital to extend the study with the inclusion of an internal replication over a longer period, as proposed in the original design. This would provide a larger data set and enable firmer conclusions to be reached about the efficacy of the current method of delivering reinforcement and the presence of a contingent effect.

An absence of negative side effects has been reported in previous research (e.g., Wolery et al., 1985). Therefore, it would have been useful to quantitatively measure the occurrence of obsessional behaviors outside the experimental session and at each child's home, in order to replicate this finding and extend the support for the line of research using obsessional behavior as a reinforcer. It would also be of interest to consider why negative side effects are not observed in using obsessional behavior as reinforcers. Further investigation into the pathology of obsessional behavior may provide a source of information. Although not directly assessed in the present study, negative side effects (such as increased obsessional behavior) were not reported or observed to have occurred during study.

It was a disadvantage of the present study that the reinforcing value of each child's obsessional stimuli was not formally assessed. Despite a great deal of time spent collecting each child's library of obsessional stimuli, time constraints prevented a systematic evaluation of their saliency prior to using them. To investigate further the reinforcing value of using stimuli associated with obsessional behavior, it would be of use directly to compare the functional properties of computer delivered obsessional stimuli with the actual object of the obsession. It is impossible to determine from the present study whether the children were obtaining the same perceptual reinforcement from the obsessional stimuli as they would from engaging in the obsessional behavior in vivo; perhaps merely seeing or hearing the associated stimuli out of context did not provide adequate reinforcement. This could highlight whether computer-harnessed stimuli, associated with the object of a child with autism's obsession, is as reinforcing as engaging in the actual obsessional behavior. However, one reason for developing a new method was to harness obsessions that are not readily available and easily controlled. So even if the reinforcing value is less when the associated stimuli are used, it could still provide a valuable reinforcer.

Procedures for identifying and assessing the reinforcing properties of obsessional behavior are required. Gaining further insight into the nature and function of obsessional behavior in autism is important to understand the relationship between obsessional behavior, learning, daily functioning, and social acceptability. Certainly, not all children with autism are suitable candidates for this procedure. However, a substantial body of research has demonstrated the effectiveness of using obsessional behavior as reinforcement.

A further limitation of the present study was the failure to collect information regarding task accuracy, which has stronger educational implications. Although an increase in the duration of on-task academic activity was observed, it was not possible to determine whether actual academic progress was obtained. Nonetheless, increased on-task duration is conducive to developing task performance. This is applicable to children starting school who have difficulty sitting at a table in an educational format.

Development of the computer programme

A new method of harnessing and delivering obsessional behavior as reinforcement was investigated in the present study. This method enabled obsessional behaviors that were previously unavailable or difficult to control, to be harnessed and used as reinforcement in an educational environment. Charlop et al. (1990) provided participants with brief access to an object of their obsessional interest. While this procedure was effective at increasing task performance, it was limited to children with autism with obsessions that were easily controlled and available. The computer delivery system developed in the present study may be more effective in harnessing a broader range of obsessional behaviors, which has implications for expanding the reinforcement repertoire of some children with autism.

Future developments of the computer system are required to tighten up the procedure and timing of the schedule requirements. The statistically significant difference between the required and observed durations for three of the children is best explained by inaccurate timing of the schedule requirements. Therefore, placing these under the control of the computer may serve to eliminate unnecessary human error. A further potential development of the computer delivery system may be to run the entire session through the computer. A procedure for administering the academic activities via the computer monitor may serve to develop a more comprehensive educational software package. This should ideally include the capability of timing and delivering reinforcement following different time intervals, in the matched control condition, to provide a more accurate assessment of the contingent effect. In the present study this was manually timed during the matched control condition and the accuracy has been questioned through reliability checks. This would allow reinforcement to be offered on immediate completion of an instrumental requirement and could provide an indication of task performance and progress, unlike the present study that measured on-task duration. This study also provides some insight into the potential use of this approach with children without autism but who present with intrusive obsessional behaviors.

Conclusion

It is well documented that eliminating aberrant behavior in children with autism is difficult (e.g., Favell et al., 1978; Foxx & Azrin, 1973; Rincover & Koegel, 1977; Schreibman & Carr, 1978). This study endorses Charlop et al.'s (1990) proposition that continued efforts should be made to identify the reinforcing properties of these behaviors and use them as reinforcers in children with autism. Such a pragmatic approach could provide teachers and clinicians with an alternative to standard behavioral intervention programmes.

Speculatively, there are implications for extending research to further understand the reinforcing properties of obsessional behavior, in order to assist in identifying more salient stimuli. The method investigated in the present study could provide an approach to behavior modification programmes for use in educational settings or within a non-ABA friendly environment. It could help to reduce the demand placed on teachers to complete one-to-one work, if the computer programme could be developed as a comprehensive teaching aid.

In summary, in spite of the limitations and practical problems encountered in the present study, a new method of harnessing previously unavailable obsessional behaviors and delivering them as reinforcement has been investigated. Applied use of the Premack Principle has great potential value: it provides a mechanism with which to identify potential reinforcers and to arrange contingencies to increase desirable behaviors. Obsessional behaviors may be considered as intrinsically reinforcing agents for positive change and development in children with autism. This points to the possibility of enlarging the reinforcement repertoire for working with children with autism, whilst simultaneously increasing the control over their obsessional behaviors, rather than attempting to eliminate them. If indeed obsessional behavior does function as a primary reinforcer, the control rather than the elimination of it is arguably the better option.

A final note of caution is appropriate. Although an increasing number of studies have addressed the issue of using obsessional and repetitive behaviors as reinforcers in autism, the number of children who have participated still remains small, as is characteristic of single-case research. Thus, the use of obsessional and repetitive behaviors as reinforcers should be applied with some caution, and the effects and side effects should be carefully monitored. This field of research, however, offers an encouraging development for helping to shape a better life for children with autism.

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Table 1

Stereotypy, Obsessional, and Off-task behaviors Displayed by each Child

	Child 1	Child 2	Child 3	Child 4
Stereotypy	Waving arm	High-pitched vocalisations	Nil	Nil
	Flicking fingers	Object manipulation		
	High-pitched vocalisations			
	Body rocking			
	Head rolling			
Obsessional interests	Running water	Wallace & Gromit	Children's TV characters & theme tunes	Washing machines
	Shiny/soft objects	Toy cars	Cake & biscuits	Tumble dryers
	Dinosaurs	Balls	Pictures of himself	Children's TV programmes
	Toy animals	Garden swings	Thomas the Tank Engine	Thomas the Tank Engine
	Sticks	Water at the sink		
	Painting	Thomas the Tank Engine		
	Music (TV theme tunes)	Teletubbies		
		Soft toys		
Off-task behavior	Non-compliance	Non-compliance	Non-compliance	Out of seat
	Shouting	Shouting	Gazing	Shouting
	Out of chair	Out of chair	Irritability	
		Gazing		

Table 2

Summary of Scores from the Repetitive Behavior Scale for each Child

	Number of Behaviors			
Subscale	Child 1	Child 2	Child 3	Child 4
Stereotyped Behavior	2	2	0	0
Self-injurious Behavior	0	0	0	0
Compulsive Behavior	3	2	2	2
Other Repetitive Behavior	2	2	1	1
Overall Score	7	6	3	3

Table 3

Academic Activities for each Child

Child 1	Child 2	Child 3	Child 4
Picture matching	Shape & picture puzzles	Join the dots	Picture matching
Block building	Wooden puzzle	Block building	Block building
Wooden puzzle	Shape matching	Wooden puzzle	Wooden puzzle
Counting	Balancing objects on scales	Counting	Counting
Colouring geometric shapes		Picture recognition	Balancing objects on scales
		Following “where is ?” requests	Colour puzzle

Table 4

Schedule Requirements

	Phase 1	
	L_{PB}/H_{PB}	I/C
Child 1	0.40	1
Child 2	0.15	0.40
Child 3	0.59	1.5
Child 4	0.46	1.14

Note: L_{PB} = operant baseline of instrumental response, H_{PB} = operant baseline of contingent response, I= instrumental response requirement of the reinforcement contingency, C = contingent response requirement of the contingency.

Table 5

Interobserver Reliability Percentages for duration of on-task behavior across experimental conditions

	Experimental Condition[a]			
	Baseline	Contingent	Matched Control	Baseline
Child 1	97/100	98/98	99/99	98/99
Child 2	94/98	96/98	90/93	93/94
Child 3	98/99	97/99	93/96	94/98
Child 4	96/99	99/99	97/99	98/97

<u>Note.</u> [a] Percentage of agreement, Instrumental activity/Contingent behavior

Figure 1. Plan of Experimental Setting and Seating Arrangement

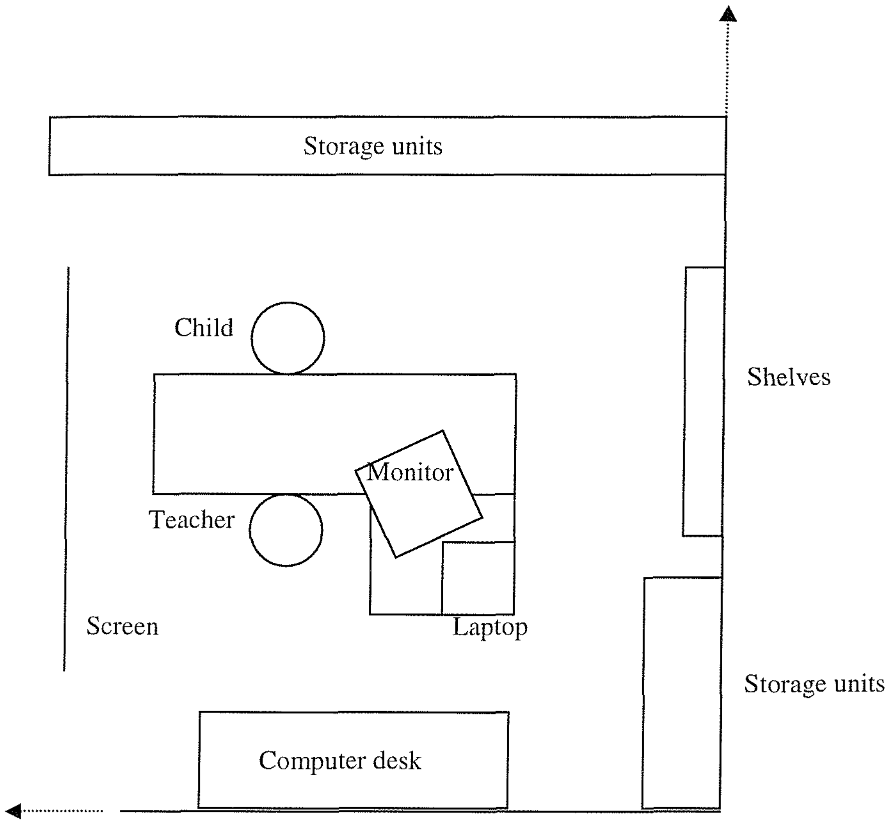


Figure 2. Example data pattern expected with the Premack Principle across necessary conditions

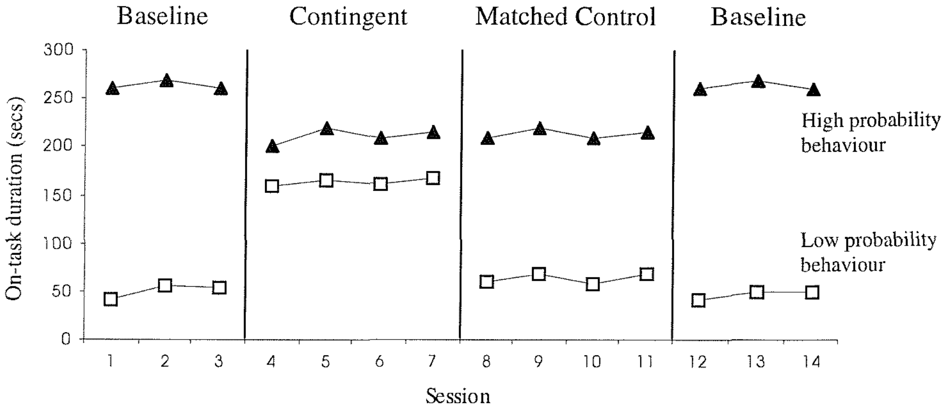


Figure 3. On-task duration of instrumental behavior and contingent behavior in the baseline (BL), contingency (CON), and matched control (MC) conditions

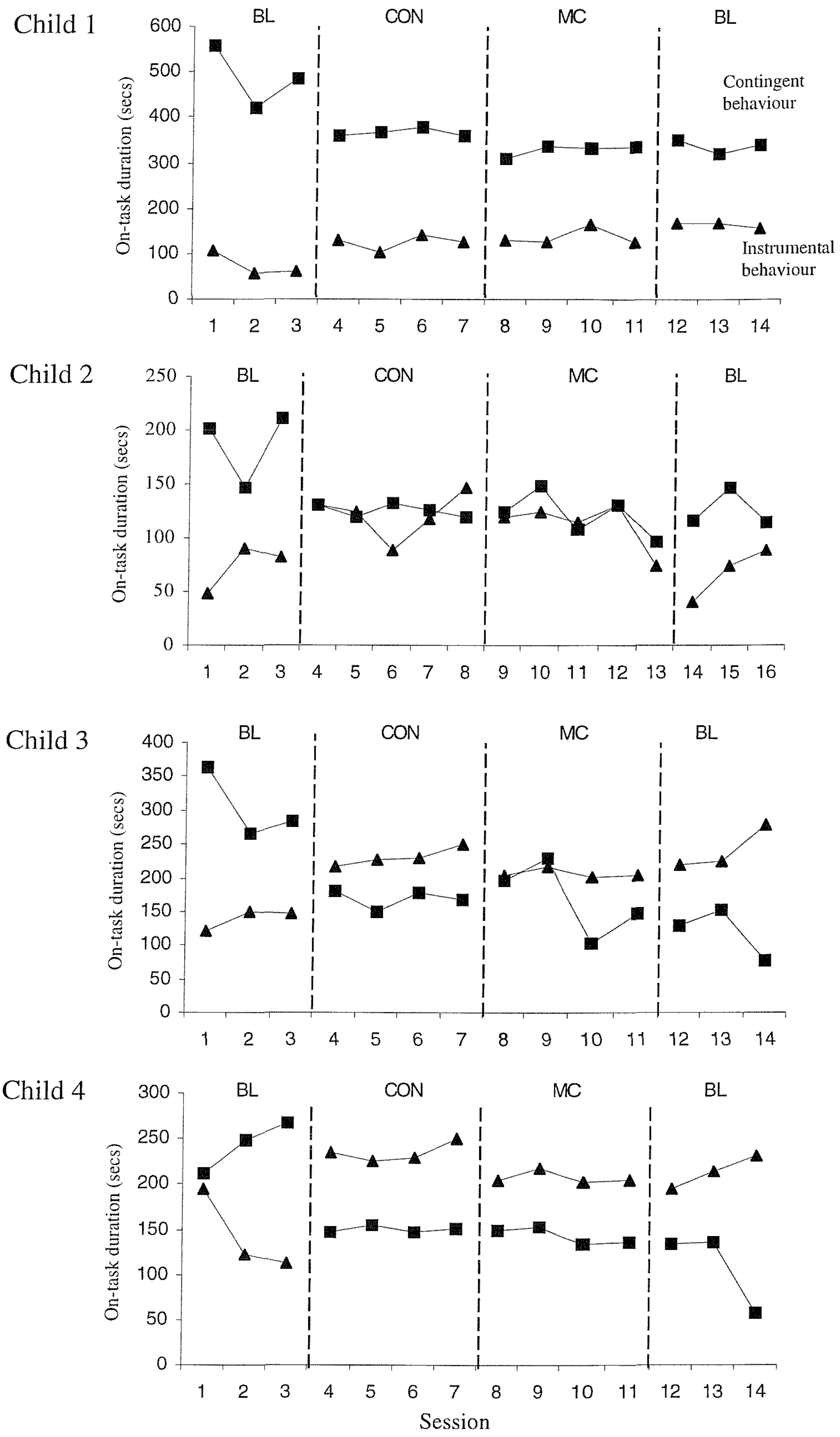


Figure 4. Mean on-task duration across baseline (BL), contingent (CON), and matched control (MC) conditions

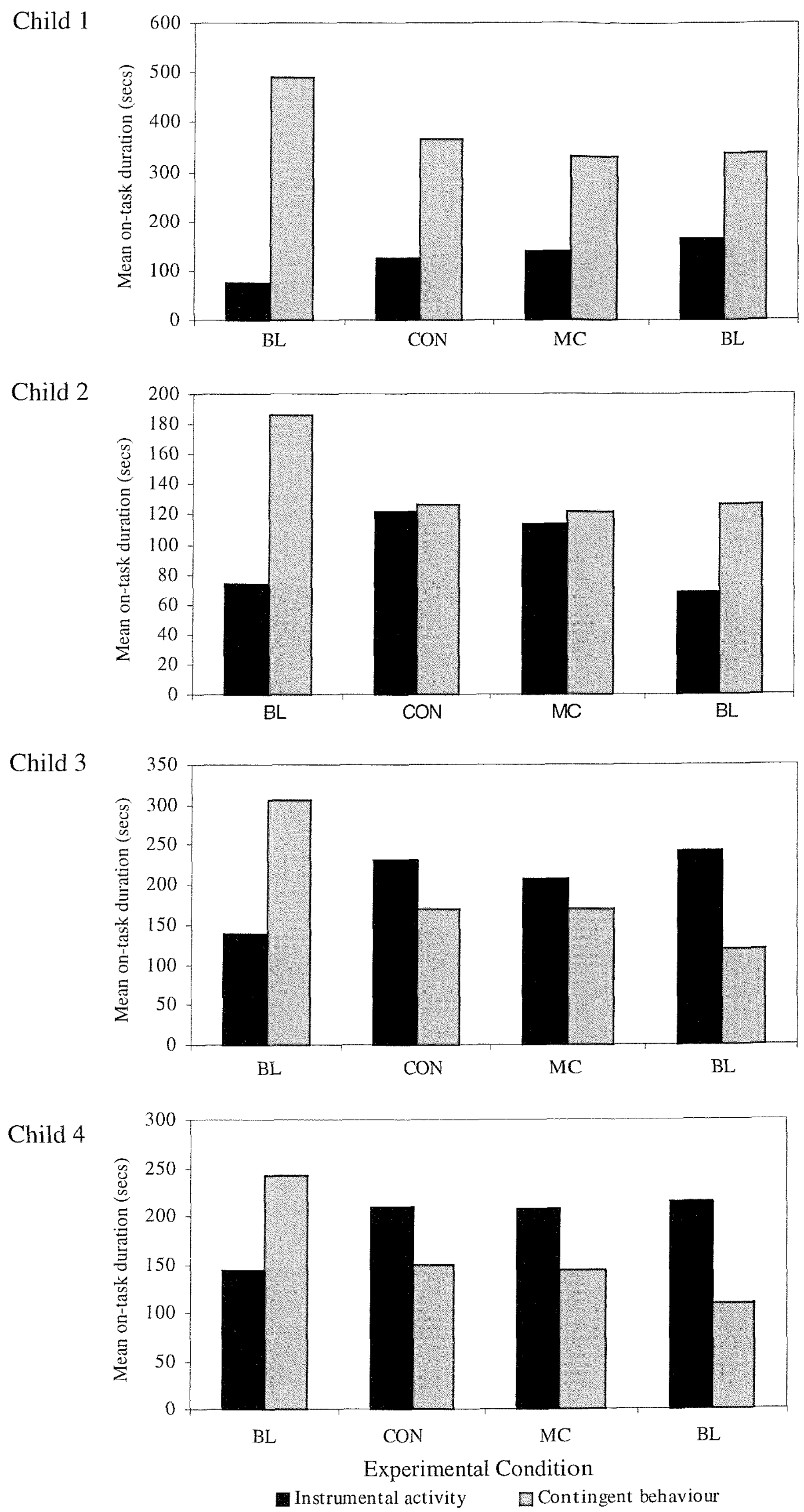
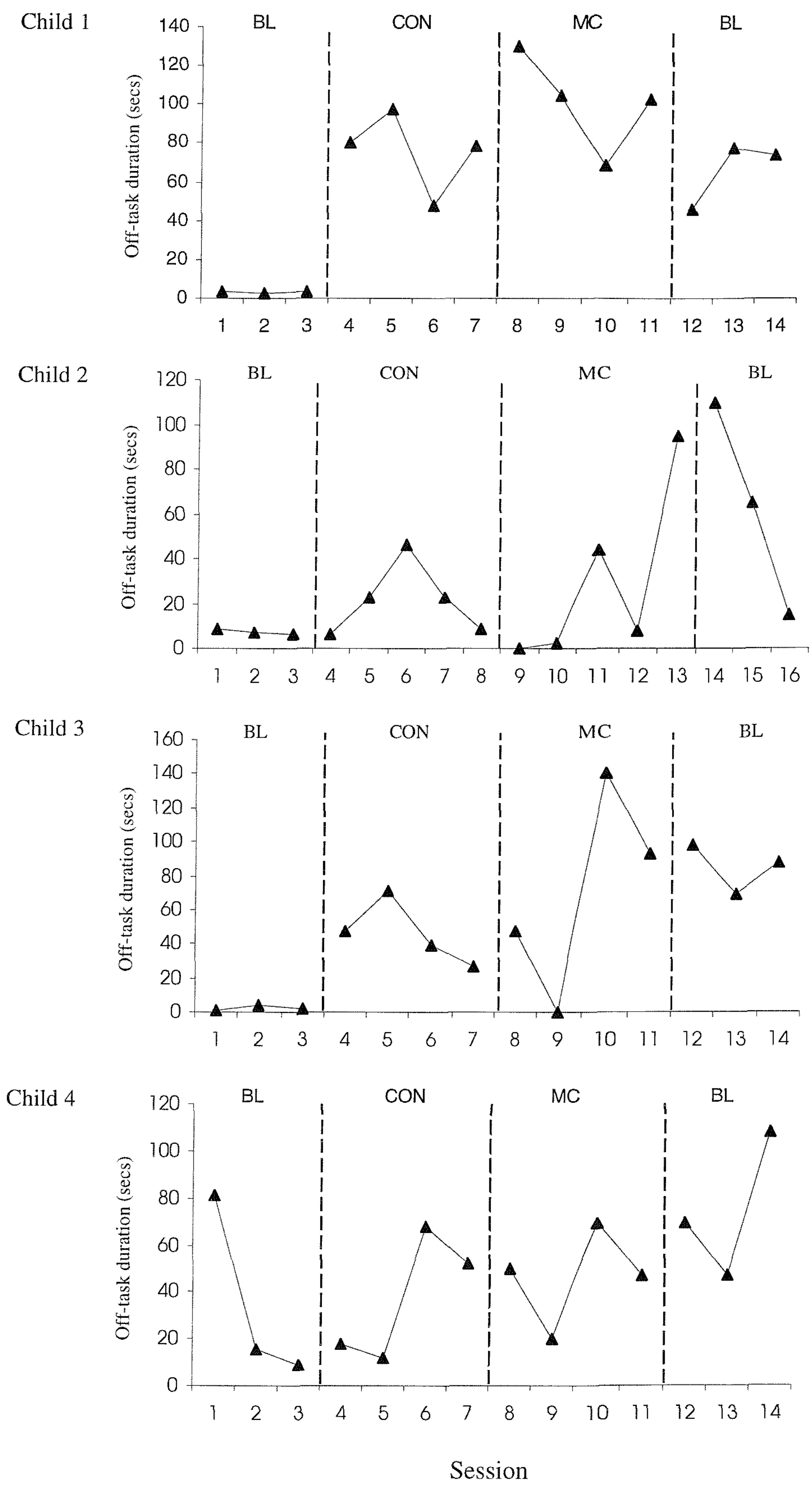


Figure 5. Total duration of undefined behavior in the baseline (BL), contingent (CON), and matched control (MC) conditions



Appendices

Appendix 1

Ethical Approval from Southampton University

UNIVERSITY OF SOUTHAMPTON

Doctoral Programme in Clinical Psychology
Building 44 (Shackleton)
Highfield
Southampton
SO17 1BJ

Direct Line: 023 8059 5321

Direct Fax: 023 8059 2588

Mr T Salzman
10 Caernarvon Gardens
Chandlers Ford
Hants
SO53 4NG

01/10/2001

Dear Tim

Re Dissertation Response to Feedback

I am pleased to tell you your response has been passed, but you are asked to ensure that the computer program to be written by Martin Hall will be available in time.

Best wishes

Janet

Janet Turner
Research Secretary

Appendix 2

Information Sheets

University of Southampton

Department of Psychology

Doctoral Programme in Clinical Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone +44 (0)23 8059 5321
Fax +44 (0)23 8059 2588
Email

Dear Teacher/Support Assistant,

<u>Information regarding a clinical research study investigating the use of obsessional behaviour as reinforcement in children with autism.</u>

I am carrying out a research study as part of my doctoral degree in Clinical Psychology, which looks at the effect of using the obsessional behaviour of autistic children as reinforcement. This study is to investigate a computer system for harnessing and delivering access to obsessional behaviour as reinforcement. Specifically, it will assess whether obsessional behaviour can be used to increase academic activity in autistic children. This information will enable us to look at whether the obsessional interests of autistic children can also be used as reinforcement, using the computer system, in an educational setting. This information will help to develop ways of motivating children, and understand the nature of obsessional behaviours. This project will be supervised by Dr Tony Brown from the University of Southampton.

I am writing to inform you about the research study and ask if you would give your permission for the study to be conducted in your classroom. The study would involve four children and be incorporated into their daily teaching sessions using a range of activities from their current curriculum. Over a minimum four-week period, you would be required to work with the children and provide them with access to their obsessional behaviour as reinforcement, using the computer system. The study will be run on a daily basis, lasting between 5-10 minutes for each child. The study will compare different conditions of reinforcement to examine how effective it is at increasing the amount of academic activity they complete. The children are under no obligation to complete the tasks and will receive no consequence for failure to engage in the task or for repeatedly engaging in obsessional behaviour. Full parental consent would be requested prior to conducting the study.

If you require any further information or have any questions or queries, please do not hesitate to contact me at the University.

Thank you for your time and consideration.

Tim Salzman
Trainee Clinical Psychologist
University of Southampton

Dr Tony Brown
Chartered Clinical Psychologist
University of Southampton

University of Southampton

Department of Psychology

Doctoral Programme in Clinical Psychology

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Telephone +44 (0)23 8059 5321
Fax +44 (0)23 8059 2588
Email

Dear Parent/Guardian, (of autism participants)

Information regarding a clinical research study investigating the use of obsessional behaviour as reinforcement in children with autism.

I am carrying out a research study as part of my doctoral degree in Clinical Psychology, which looks at the effect of using the obsessional behaviour of autistic children as reinforcement. This study is to investigate a computer system for harnessing and delivering access to obsessional behaviour as reinforcement. Specifically, it will assess whether obsessional behaviour can be used to increase academic activity in autistic children. Your son will enable us to look at whether the obsessional interests of children who do not have autism can also be used as reinforcement. This information will help to develop ways of motivating children, and understand the nature of their obsessional behaviours. Dr Tony Brown will supervise this project from the University of Southampton.

I am writing to inform you about the research study and ask if you would be prepared to give your permission for your child to be included in the study. If you allow your child to participate in this study he will be given a range of academic activities to complete, reflecting his current curriculum, and will be given access to his obsessional behaviour as reinforcement. Over a minimum four-week period, your child will complete the academic activities on a daily basis, lasting between 5-10 minutes. The study will compare different conditions of reinforcement to examine how effective it is at increasing the amount of academic activity your son completes. Your child is under no obligation to complete the tasks and will receive no consequence for failure to engage in the task or for repeatedly engaging in obsessional behaviour.

All information regarding your son will be strictly confidential. To allow me to analyse your child's obsessional behaviour I will need to videotape the study. Videotapes will be kept safe and at no point will any names, addresses or personal details be associated with them. On completion of the study you are free to request that the videotapes be destroyed. Permission for involvement in this study can be withdrawn at any time. Withdrawal from the study would not require justification. Participation in this study would be anonymous and a copy of the findings would be available for your information. I would be most grateful if you would give your permission for your child to participate in this study. Please indicate whether you are willing for your child to participate in this study by signing and returning the enclosed consent form.

If you require any further information or have any questions or queries, please do not hesitate to contact me at the University.

Thank you for your time and consideration.

Tim Salzman
Trainee Clinical Psychologist
University of Southampton

Dr Tony Brown
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Dear Parent/Guardian, (of non-autistic participants)

Information regarding a clinical research study investigating the use of obsessional behaviour as reinforcement in children with autism.

I am carrying out a research study as part of my doctoral degree in Clinical Psychology, which looks at the effect of using the obsessional behaviour of autistic children as reinforcement. This study is to investigate a computer system for harnessing and delivering access to obsessional behaviour as reinforcement. Specifically, it will assess whether obsessional behaviour can be used to increase academic activity in children. Your son will enable us to look at whether the obsessional interests of children who do not have autism can also be used as reinforcement. This information will help to develop ways of motivating children, and understand the nature of their obsessional behaviours. Dr Tony Brown will supervise this project from the University of Southampton.

I am writing to inform you about the research study and ask if you would be prepared to give your permission for your child to be included in the study. If you allow your child to participate in this study he will be given a range of academic activities to complete, reflecting his current curriculum, and will be given access to his obsessional behaviour as reinforcement. Over a minimum four-week period, your child will complete the academic activities on a daily basis, lasting between 5-10 minutes. The study will compare different conditions of reinforcement to examine how effective it is at increasing the amount of academic activity your son completes. Your child is under no obligation to complete the tasks and will receive no consequence for failure to engage in the task or for repeatedly engaging in obsessional behaviour.

All information regarding your son will be strictly confidential. To allow me to analyse your child's obsessional behaviour I will need to videotape the study. Videotapes will be kept safe and at no point will any names, addresses or personal details be associated with them. On completion of the study you are free to request that the videotapes be destroyed. Permission for involvement in this study can be withdrawn at any time. Withdrawal from the study would not require justification. Participation in this study would be anonymous and a copy of the findings would be available for your information. I would be most grateful if you would give your permission for your child to participate in this study. Please indicate whether you are willing for your child to participate in this study by signing and returning the enclosed consent form.

If you require any further information or have any questions or queries, please do not hesitate to contact me at the University.

Thank you for your time and consideration.

Tim Salzman
Trainee Clinical Psychologist
University of Southampton

Dr Tony Brown
Chartered Clinical Psychologist
University of Southampton

Appendix 3

Parental Consent Form

University of Southampton

Department of Psychology

Doctoral Programme in Clinical Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone +44 (0)23 8059 5321
Fax +44 (0)23 8059 2588
Email

CONSENT FORM

The use of obsessional behaviour as reinforcement in children with autism.

Participant's full name: ………………………………………….

Parent/Guardian full name: ………………………………………….

Please complete the following:

	Please circle as necessary
Have you read the information sheet?	Yes / No
Have you had an opportunity to ask questions and discuss this study?	Yes / No
Have you received satisfactory answers to all your questions?	Yes / No
Have you received enough information about this study?	Yes / No
Who have you spoken to?	____________
Do you understand that you are free to withdraw from the study: - At any time. - Without having to give a reason for withdrawing. - Without affecting your child's future education	Yes / No
Do you agree for your child to take part in this study?	Yes / No

I ………………………………….. HEREBY CONSENT for my child, as named above, to take part in a clinical research investigation about which I have received written information.

Signed:______________________________ Date:______________

Appendix 4

Measure: RBS

Compulsive Behavior

(DEFINITION: repetitive behavior that takes the form of a ritual / routine, or involves insistence on things being done "just so" or remaining "just so".)

nstructions: Read each item carefully. Place a "checkmark" next to each behavior type that this person has displayed within the past month. Be sure to check all that apply.

____ ORDERING
(Arranges certain objects in a particular pattern or place; Insists on a certain routine of events or activities; Insists on dressing, grooming, or cleaning in a certain order)

____ COMPLETENESS
(Must have doors opened or closed; Takes all items out of a container or area; Insists on doing a particular chore; Puts on / takes off garments; Insists on wearing certain clothes; Repeats rising up/down from chair; Repeats going in /out of door)

____ CLEANING / HOARDING
(Excessively cleans certain body part; Picks at lint or loose threads; Has certain bathroo... outine; H.des, collects or hoards objects)

____ CHECKING / TOUCHING
(Repeatedly opens and closes or checks doors or drawers; Touches / taps items)

____ COUNTING
(Counts items or objects, Counts to a certain number or in a certain way)

his person is *not currently* engaging in any of the above compulsive behaviors, skip to the next page. Otherwise, please continue answering the questions below.

Instructions: Circle the number next to the answer that you feel best describes this person. Base your answer for each question on your interactions with, and direct observations of, him or her over the past month.

(1) How often does this person engage in compulsive behavior?

0 = Less than once every 3 hours..
1 = Once every 1 to 3 hours.
2 = Once every 30 minutes to 1 hour.
3 = Once every 15 to 30 minutes.
4 = more than once every 15 minutes.

(2) When the compulsive behavior is blocked, can it be stopped?

0 = Yes, with no distress.
1 = Yes, with mild distress.
2 = Yes, with moderate distress.
3 = Yes, with severe distress.
4 = No

(3) Will he or she stop a compulsive behavior when a preferred activity is available?

0 = Always.
1 = Usually.
2 = Sometimes.
3 = Rarely.
4 = Never

(4) How often is it necessary for someone to do something to manage his / her compulsive behavior?

0 = Never.
1 = Sometimes.
2 = Often.
3 = Physical intervention is necessary.
4 = Strenuous physical intervention with struggling is needed.

(5) Does compulsive behavior cause problems at his or her school, work, or other activities?

0 = No. School / work is never missed due to repetitive behaviors.
1 = Yes. He/she is often late for school / work because of repetitive behaviors.
2 = Yes. He/she is often late completing school / work tasks
3 = Yes. He/she is unable to complete school / work tasks, or leaves activities prematurely.
4 = Yes. He/she is unable to attend school / work.

(6) Does compulsive behavior cause problems with self-care / personal hygiene tasks or training?

0 = No.
1 = Yes. Hygiene is occasionally poor.
2 = Yes. There are frequent delays in self-care tasks.
3 = Yes. There is decreased participation in self-care tasks.
4 = Yes. He / she does not participate in self-care tasks.

(7) Does compulsive behavior affect leisure time or time spent with others?

0 = No.
1 = Yes. He / she has sometimes given up opportunities for socializing or leisure.
2 = Yes. He / she has often refused to interact with others or engage in leisure activities.
3 = Yes. He / she needs to be constantly urged to take part in any social or leisure activity.
4 = Yes. He / she is unable to take part in any social or leisure activity.

Stereotyped Behavior

(DEFINITION: apparently purposeless movements or actions that are repeated over and over again in bouts or periods of activity)

nstructions: Read each item carefully. Place a "checkmark" next to each behavior that this person has isplayed within the past month. Be sure to check all that apply.

____	WHOLE BODY	(Body rocking, Body swaying)
____	HEAD	(Rolls Head, Nods Head, Turns Head)
____	EYE / VISUAL	(Covers eyes, Looks closely or gazes at hands or objects)
____	EAR / HEARING	(Covers ears)
____	MOUTH	(Grinds teeth, mouths or chews objects, Puts hand(s) in mouth)
____	LOCOMOTOR	(Turns in circle(s), Whirls, Jumps, Bounces)
____	VOCALIZATIONS	(Repetitive verbalization or vocalization, Echolalia)
____	HAND / FINGER	(Flaps hands, Wiggles or flicks fingers, Claps hands, Waves or shakes hand or arm)
____	OBJECT USAGE	(Spins or twirls, Twiddles or slaps or throws objects, Lets objects fall out of hands)
____	OTHER	(Maintains a set body posture, Walks on tip-toes, Breathes forcefully, Smells or Sniffs unusually, Rubs surfaces, Taps, touches, or rubs body part(s), Twirls hair) Other (*describe*): ____________

his person is *not currently* engaging in any of the above stereotyped behaviors, skip to the next page.
Otherwise, please continue answering the questions below.

istructions: Circle the number next to the answer that you feel best describes this person. Base your answer for each question on your interactions with, and direct observations of, him or her over the past month.

(1) How often does this person engage in stereotyped behavior?

0 = Less than once every 3 hours.
1 = Once every 1 to 3 hours.
2 = Once every 30 minutes to 1 hour.
3 = Once every 15 to 30 minutes.
4 = More than once every 15 minutes.

(2) When the stereotyped behavior is blocked, can it be stopped?

0 = Yes, with no distress.
1. = Yes, with mild distress.
2 = Yes, with moderate distress.
3 = Yes, with severe distress.
4 = No.

(3) Will he or she stop a stereotyped behavior when a preferred activity is available?

0 = Always.
1 = Usually.
2 = Sometimes.
3 = Rarely.
4 = Never.

(4) How often is it necessary for someone to do something to manage his / her stereotyped behavior?

0 = Never.
1 = Sometimes.
2 = Often.
3 = Physical intervention is necessary.
4 = Strenuous physical intervention & struggling is needed.

(5) Does stereotyped behavior cause problems at his or her school, work, or other activities?

0 = No. School / work is never missed due to repetitive behaviors.
1 = Yes. He/she is often late for school / work because of repetitive behaviors.
2 = Yes. He/she is often late completing school / work tasks.
3 = Yes. He/she is unable to complete school / work tasks, or leaves activities prematurely.
4 = Yes. He/she is unable to attend school / work.

(6) Does stereotyped behavior cause problems with self-care / personal hygiene tasks or training?

0 = No.
1 = Yes. Hygiene is occasionally poor.
2 = Yes. There are frequent delays in self-care tasks.
3 = Yes. There is decreased participation in self-care tasks.
4 = Yes. He / she does not participate in self-care tasks.

(7) Does stereotyped behavior affect leisure time or time spent with others?

0 = No.
1 = Yes. He / she has sometimes given up opportunities for socializing or leisure.
2 = Yes. He / she has often refused to interact with others or engage in leisure activities.
3 = Yes. He / she needs to be constantly urged to take part in any social or leisure activity.
4 = Yes. He / she is unable to take part in any social or leisure activity.

Self-Injurious Behavior

(DEFINITION: repetitive behavior that has the potential to cause redness, bruising, or other injury to the body)

nstructions: Read each item carefully. Place a "checkmark" next to each behavior that this person has isplayed within the past month. Be sure to check all that apply.

____ HITS SELF WITH BODY PART (e.g. slaps head or face)
____ HITS SELF *AGAINST* SURFACE OR OBJECT (e.g. bangs head on floor or table)
____ HITS SELF *WITH* OBJECT (e.g. bangs head or face with toys)
____ BITES SELF (e.g. bites hand or wrist or arm)
____ PULLS (e.g. pulls hair or skin.)
____ RUBS OR SCRATCHES SELF (e.g. rubs or scratches marks on arm or leg)
____ INSERTS FINGER OR OBJECT (e.g. eye-poking)
____ OTHER form of self-injury (*describe*): ____________________

this person is *not currently* engaging in any of the above self injury behaviors, skip to the next page. *Otherwise, please continue answering the questions below.*

Instructions: Circle the number next to the answer that you feel best describes this person. Base your answer for each question on your interactions with, and direct observations of, him or her over the past month.

(1) How often does this person engage in self injury behavior?

0 = Less than once every 3 hours.
1 = Once every 1 to 3 hours.
2 = Once every 30 minutes to 1 hour.
3 = Once every 15 to 30 minutes.
4 = More than once every 15 minutes.

(2) When the self injury behavior is blocked, can it be stopped?

0 = Yes, with no distress.
1 = Yes, with mild distress.
2 = Yes, with moderate distress.
3 = Yes, with severe distress.
4 = No

(3) Will he or she stop a self injury behavior when a preferred activity is available?

0 = Always.
1 = Usually.
2 = Sometimes.
3 = Rarely.
4 = Never

(4) How often is it necessary for someone to do something to manage his / her self-injury?

0 = Never.
1 = Sometimes.
2 = Often.
3 = Physical intervention is necessary.
4 = Strenuous physical intervention & struggling is needed.

(5) Does self injury behavior cause problems at his or her school, work, or other activities?

0 = No. School / work is never missed due to self injury behaviors.
1 = Yes. He/she is often late for school / work because of repetitive behaviors.
2 = Yes. He/she is often late completing school / work tasks
3 = Yes. He/she is unable to complete school / work tasks, or leaves activities prematurely.
4 = Yes. He/she is unable to attend school / work.

(6) Does self injury behavior cause problems with self-care / personal hygiene tasks or training?

0 = No.
1 = Yes. Hygiene is occasionally poor.
2 = Yes. There are frequent delays in self-care tasks.
3 = Yes. There is decreased participation in self-care tasks.
4 = Yes. He / she does not participate in self-care tasks.

(7) Does self injury behavior affect leisure time or time spent with others?

0 = No.
1 = Yes. He / she has sometimes given up opportunities for socializing or leisure.
2 = Yes. He / she has often refused to interact with others or engage in leisure activities.
3 = Yes. He / she needs to be constantly urged to take part in any social or leisure activity.
4 = Yes. He / she is unable to take part in any social or leisure activity.

Other Repetitive Behaviors

(DEFINITION: other apparently purposeless behaviors, actions, or movements that are repeated in a similar manner over and over again in bouts or periods of activity)

Instructions: Read each item carefully. Place a "checkmark" next to each behavior that this person has displayed within the past month. Be sure to check all that apply.

____ EXCESSIVE DRINKING / POLYDIPSIA
(frequently consumes fluids, strives to consume fluids)

____ EATING INEDIBLE MATERIALS / PICA
(frequently eats inedible materials - e.g. paper, string, dirt, etc)

____ BIZARRE / DEVIANT GROOMING
(unusual dress or grooming; wears inappropriate or excessive clothing, inappropriately cuts body hair, checks hair, teeth, face, etc in mirror excessively)

____ HAIR-PULLING
(holds, strokes, twirls, pulls own hair)

____ NAIL-BITING
(frequently keeps finger or fingers in mouth & bites parts of nail off)

____ OVEREATING / BINGING / HYPERPHAGIA
(frequently eats excessive amounts of food, covertly eats food, steals food to eat later, stuffs food into mouth)

____ VOMITING / RUMINATION
(frequently vomits for no apparent reason; vomits / purges food eaten recently; frequently regurgitates, re-chews & re-swallows food)

____ PACING / EXCESSIVE WALKING
(frequently walks or runs for no purpose back & forth across room or into / out of rooms)

____ POSTURING / MAINTAINING A SET POSTURE
(holds odd & purposeless facial or body positions for extended periods)

____ REPETITIVE / OBSESSIVE SPEECH PATTERNS
(frequently repeats a sentence verbatim & in same tone; engages in a fixed dialogue; repeats a question to evoke a fixed reply; excessive talking about certain people, objects or events)

____ PECULIAR LIP OR TONGUE MOVEMENTS
(repetitive odd, unusual, purposeless movements of lip or tongue)

____ RESTLESS, NERVOUS MANNERISMS
(frequently unable to sit still; repetitive, purposeless movements of hands, arms, feet, or legs while trying to sit still or while trying to stand still)

SCORING SECTION:

Subscale	Topography Score (# endorsed, excluding any endorsed as "other")	Severity Score (sum of items 1-7)
Stereotyped Behavior		
Self-Injurious Behavior		
Compulsive Behavior		
Other Repetitive Behavior		XXXXXXXXXXXXXXXXXX

OVERALL SCORE:	Total # of Topographies =	Total Severity Score =

Appendix 5

Instructions for Authors

(Journal of Child Psychology and Psychiatry)

Notes for Contributors

General

1. Submission of a paper to the Journal will be held to imply that it represents an original contribution not previously published (except in the form of an abstract or preliminary report); that it is not being considered for publication elsewhere; and that, if accepted by the Journal, it will not be published elsewhere in the same form, in any language, without the consent of the Editors. When submitting a manuscript, authors should state in a covering letter whether they have currently in press, submitted or in preparation any other papers that are based on the same data set, and, if so, provide details for the Editors.

Ethics

2. Authors are reminded that the Journal adheres to the ethics of scientific publication as detailed in the *Ethical principles of psychologists and code of conduct* (American Psychological Association, 1992). These principles also imply that the piecemeal, or fragmented publication of small amounts of data from the same study is not acceptable.

3. Papers should be submitted to the Joint Editors, care of:

   The Journal Secretary,
   St Saviour's House,
   39/41 Union Street,
   London SE1 1SD, U.K.
   Telephone: +44 (0)20 7403 7458
   Faxline: +44 (0)20 7403 7081 E-Mail: jcpp@acpp.co.uk

   Alternatively, papers may be submitted directly to any of the Corresponding Editors whose addresses are shown on the first page. Upon acceptance of a paper, the author will be asked to transfer copyright to the ACPP.

Manuscript Submission

1. Manuscripts should be typewritten, **double spaced throughout including references and tables**, with wide margins, on good quality A4 paper, using one side of the page only. Sheets should be numbered consecutively. **Four** copies should be sent. The author should retain a copy of the manuscript for personal use. Fax and electronic mail should **not** be used for initial submission of manuscripts.
2. Papers should be concise and written in English in a readily understandable style. Care should be taken to avoid racist or sexist language, and statistical presentation should be clear and unambiguous. The Journal follows the style recommendations given in the *Publication manual of the American Psychological Association* (4th edition, 1994), available from the Order Department, APA, PO Box 2710, Hyattsville, MD 20784, USA.
3. The Journal is **not** able to offer a translation service, but, in order to help authors whose first language is not English, the Editors will be happy to arrange for accepted papers to be prepared for publication in English by a sub-editor.
4. Authors whose papers have been given **final acceptance** are encouraged to submit a copy of the final version on computer disk, together with two hard copies produced using the same file. Instructions for disk submission will be sent to authors along with the acceptance letter. Do **not** send a disk with initial submission of paper.

Layout

1. *Title*: The first page of the manuscript should give the title, name(s) and address(es) of author(s), and an abbreviated title (running head) of up to 80 characters. Specify the author to whom reprint requests should be directed. The covering letter should clearly state the name and address of the person with whom the Editors should correspond, giving also if possible a fax and email address. Authors requesting **masked review** should provide a first page with the title only and adapt the manuscript accordingly.
2. *Abstract*: The abstract should not exceed 300 words.
3. *Acronyms*: In order to aid readers, we encourage authors who are using acronyms for tests or abbreviations not in common usage to provide a list to be printed after the abstract.
4. *Headings*: Original articles and research reports should be set out in the conventional form: Introduction, Materials and Methods, Results, Discussion, and Conclusion. To save space in the Journal, the Method will be printed in smaller typeface. Descriptions of techniques and methods should be given in detail only when they are unfamiliar.
5. *Acknowledgements*: These should appear on a separate sheet at the end of the text of the paper, before the References.

Referencing

The Journal follows the text referencing style and reference list style detailed in the *Publication manual of the American Psychological Association*.

(a) *References in text.*

References in running text should be quoted as follows: Smith and Brown (1990), or (Smith, 1990), or (Smith, 1980, 1981a, b), or (Smith & Brown, 1982), or (Brown & Green, 1983; Smith, 1982).

For up to five authors, all surnames should be cited the first time the reference occurs, e.g. Smith, Brown, Green, Rosen, and Jones (1981) or (Smith, Brown, & Jones, 1981). Subsequent citations should use "et al." (not underlined and with no period after the "et"), e.g. Smith et al. (1981) or (Smith et al., 1981).

For six or more authors, cite only the surname of the first author followed by "et al." and the year for the first and subsequent citation. Note, however, that **all** authors are listed in the Reference List.

Join the names in a multiple author citation in running text by the word "and". In parenthetical material, in tables, and in the Reference List, join the names by an ampersand (&).

References to unpublished material should be avoided.

(b) *Reference list.*

Full references should be given at the end of the article in alphabetical order, and not in footnotes. **Double spacing** must be used.

References to journals should include the authors' surnames and initials, the full title of the paper, the full name of the journal, the year of publication, the volume number, and inclusive page numbers. Titles of journals must not be abbreviated and should be italicised (underlined).

References to books should include the authors' surnames and initials, the full title of the book, the place of publication, the publisher's name and the year of publication.

References to articles, chapters and symposia contributions should be cited as per the examples below:

Kiernan, C. (1981). Sign language in autistic children. *Journal of Child Psychology and Psychiatry*, *22*, 215–220.

Jacob, G. (1983a). Development of coordination in children. *Developmental Studies*, *6*, 219–230.

Jacob, G. (1983b). Disorders of communication. *Journal of Clinical Studies*, *20*, 60–65.

Thompson, A. (1981). *Early experience: The new evidence*. Oxford: Pergamon Press.

Jones, C. C., & Brown, A. (1981). Disorders of perception. In K. Thompson (Ed.), *Problems in early childhood* (pp. 23–84). Oxford: Pergamon Press.

Use Ed.(s) for Editor(s); ed. for edition; p.(pp.) for page(s); Vol. 2 for Volume 2.

Tables and Figures

These should be constructed so as to be intelligible without reference to the text. The approximate location of figures and tables should be clearly indicated in the text. Figures will be reproduced directly from the author's original drawing and photographs, so it is essential that they be of professional standard. Computer generated figures must be laser printed. Illustrations for reproduction should normally be twice the final size required. Half-tones should be included only when essential, and they must be prepared on glossy paper and have good contrast. All photographs, charts and diagrams should be referred to as "Figures" and numbered consecutively in the order referred to in the text. Figure legends should be typed on a separate page.

Nomenclature and Symbols

No rigid rules are observed, but each paper must be consistent within itself as to nomenclature, symbols and units. When referring to drugs, give generic names, not trade names. Greek characters should be clearly indicated.

Refereeing

The Journal has a policy of anonymous peer review and the initial refereeing process seldom requires more than three months. Authors may request that their identity be withheld from referees and should follow the procedure for masked review, as above. Most manuscripts require some revision by the authors before final acceptance. Manuscripts, whether accepted or rejected, will not be returned to authors. The Editor's decision on the suitability of a manuscript for publication is final.

Proofs

Proofs will be sent to ther designated author. Only typographical or factual errors may be changed at proof stage. The publisher reserves the right to charge authors for correction of non-typographical errors.

Offprints

Fifty offprints of each paper will be provided free of charge to the senior author. Additional offprints may be purchased according to a set scale of charges if ordered using the offprint order form supplied with the proofs. Offprints are normally despatched by surface mail two weeks after publication.

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Whilst every effort is made by the publishers and editorial board to see that no inaccurate or misleading data, opinion or statement appear in this journal, they wish to make it clear that the data and opinions appearing in the articles and advertisements herein are the sole responsibility of the contributor or advertiser concerned. Accordingly, the publishers, editorial board and editors, and their respective employees, officers and agents accept no responsibility or liability whatsoever for the consequences of any such inaccurate or misleading data, opinion or statement.

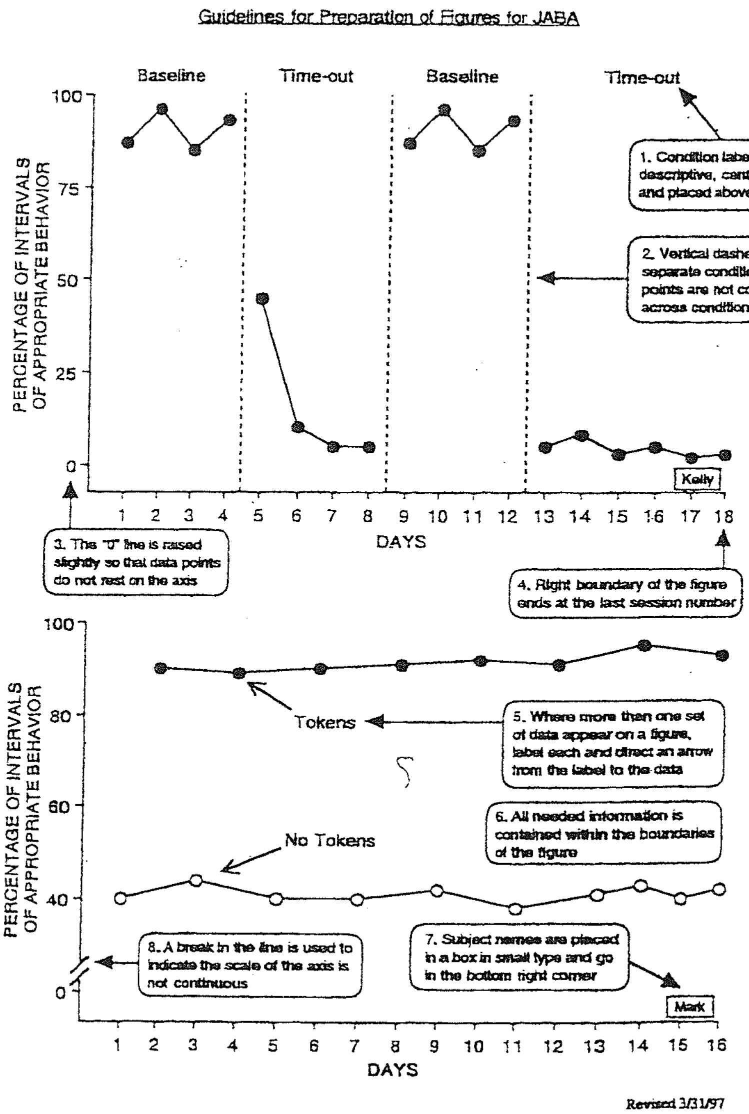
Appendix 6

Instructions for Authors

(Journal of Applied Behavior Analysis)

☐ Submitted manuscripts must contain the following:

- Five high-quality copies of the entire manuscript; the original typescript is not required.
- Copies of figures (with figure captions on a separate page) and tables for each manuscript being submitted; do not send letter-press, glossy prints, photographs, or original artwork. Figures should be numbered in pencil on the back and prepared according to the following guidelines:



(*continued on p. 400*)

(*continued from p. 399*)

- A letter to the Editor containing the following:
  - (a) A request for review and possible publication of the manuscript.
  - (b) A statement indicating the manuscript has not been previously published and has not been nor will be submitted elsewhere during the *JABA* review process.
  - (c) A classification of article into type (refer to "Types of Articles").
  - (d) The corresponding author's business address and telephone number as well as any upcoming address change. (This individual will receive copies of the editorial correspondence from the Editor and Associate Editor.)
- A title page including the following:
  - (a) The title of the paper.
  - (b) The first and surname of all authors.
  - (c) The affiliations of each author during the time the research was conducted. The names of the authors should not be listed on subsequent pages. (Refer to the *APA Manual* for appropriate affiliation listings for the title page and author notes.)
  - (d) The name, address, and telephone number of the corresponding author.
- Masked Review

  JABA will now routinely use masked review of manuscripts. Instructions for preparation of manuscripts for masked review appear on page 305 of the *APA Publication Manual* (4th ed.). Authors are responsible for concealing their identities in manuscripts by placing the author's note on the manuscript's title page, which will be removed prior to sending the manuscript out for review. Authors who do not want a masked review should place the author's note in the body of the manuscript.

☐ Manuscripts must be prepared according to APA format:

American Psychological Association, *Publication Manual of the American Psychological Association*, 4th ed., Washington, DC: Author, 1994.

☐ Send manuscripts to the Editor at the following address:

F. Charles Mace
School of Psychology
University of Wales
Bangor, Gwynedd LL57 2DG
United Kingdom

The U.S. Postal Service offers Global Priority mail service to the United Kingdom. A large envelope can accommodate up to 300 manuscript pages and will arrive in 3 to 4 days for the price of $6.95. Submissions in excess of 300 pages can use the Global Priority Box at a cost of $22.00. First Class Airmail will normally be less expensive than Global Priority service and can be expected to arrive in 5 to 7 days.

Questions regarding manuscript submission requirements or journal reviewing practices are welcome. The editorial office E-mail address is f.c.mace@bangor.ac.uk.

Appendix 7

Statistical versus Visual Analysis

Statistical versus visual analysis

The Journal of Applied Behaviour Analysis predominantly publishes single case research that uses visual analysis to interpret data. However, the decision to use visual analysis or statistical analysis to interpret single-case research has received considerable attention and debate in recent years (Kazdin, 1984). A brief overview of the debate will follow to contextualise the predominant use of visual analysis in the present study.

The use of statistical analysis to evaluate treatment effects in single-case research is widely disputed (e.g. Kazdin, 1982; Barlow and Hersen, 1984; Busk & Marascuilo, 1992; Parsonson & Baer, 1992), with data now being more frequently subjected to visual inspection as opposed to statistical evaluation. Jacobson and Traux (1991) highlight two limitations of using statistical significance. First, information concerning within-treatment variability of outcome is central to understanding the effects of a treatment and the variability of response to treatment cannot be inferred from the tests. Second, although statistical tests analyse real differences, very little information is given concerning the clinical significance of the treatment effects. Hersen and Barlow (1979) suggest that therapeutic change can not be suitably evaluated through statistical analysis, which may underestimate clinical effectiveness and encourage the acceptance of small effects (Parsonson & Baer, 1986). Statistical analysis seeks different sorts of effects and reaches decisions concerning intervention effects in a different manner to visual analysis. Therefore, the performance of the single subject may not be truly reflected through statistical analysis.

The use of statistical analyses should not be totally rejected. Barlow and Hersen (1984) suggest an appropriate use for statistical analysis in single-case research when visual inspection cannot adequately assess a particular pattern of data. Additionally, Morley and Adams (1989) suggest that statistical tests can aid the description of a series of data points, though agree they are not suitable for assessing treatment effects independently.

Several advantages are associated with the process of visual analysis (Gibson & Ottenbacher, 1988). Firstly, an overall temporal pattern of performance can be obtained when the repeated measurements of single-case research are plotted on a graph. This provides a comprehensive and clear summary of individual performance indicating the relationship between the dependent and independent variables. Secondly, single-case procedures involve repeated measurement of the dependent variable over time. When plotted graphically, this provides an ongoing indication of client performance that can inform necessary experimental alterations. Thirdly, in order to judge whether an intervention effect exists, the change between baseline and intervention must be of adequate size to rule out any ambiguity. Parsonson and Baer (1978) propose that failure to interpret a treatment effect through visual analysis suggests it will have questionable clinical value. Thus, visual analysis guarantees clinically relevant effects by ensuring that changes are sufficiently large, because of its relative insensitivity compared to more technically accurate statistical analyses.

Visual analysis of graphed data has been criticised for the absence of any formal criteria to guide inferences associated with visual inspections (Wampold & Furlong, 1981). Kazdin (1982) argues, specifically, that subjectivity and inconsistency in the inspection of intervention effects would be permitted through the process of visual analysis. Indeed, literature investigating the reliability of visual analysis has reported inconsistent and unreliable interpretations, marked by a low level of interrater reliability (Parsonson and Baer, 1992 provide a detailed review).

Although this literature has been criticised for poor methodology (Huitema, 1986), the use of additional quantitative analysis can be necessary to facilitate reliable interpretation of single-case data (Ottenbacher, 1990, 1986; Gibson & Ottenbacher, 1988), in view of the poor agreement associated with visual analysis. In summary, visual analysis can be rather an insensitive method of determining effective intervention, only capable of reliably detecting marked effects. However, visual analysis does avoid the limitations associated with statistical analysis that are of greater concern in evaluating clinical effects. Finally, whilst visual analysis enables a clear method of communicating experimental results consistent with an exploratory approach, the use of formal statistical analysis is often mandatory to confirmatory-research studies. Furthermore, external pressure to use statistical analysis is often yielded to because of publication requirements.

Appendix 8

Critical Overview

Critical Overview

The purpose of this critical overview is to highlight and reflect upon the process of completing this dissertation, and to draw attention to the practical problems that were encountered and which are perhaps inherent to applied single-case research. The challenge of conducting single-case research within the time constraints of the training course will be given particular attention.

The inspiration for this study came from working with children with autism, where it became apparent that they were not easily motivated; this was a particular problem I encountered whilst on clinical placement. In order to extend my understanding of this difficult issue in autism, I was keen to undertake an applied piece of research that could investigate a practical solution to the clinical problem and contribute to the literature base about autism. I chose to use the opportunity to further my applied research skills using single-case methodology, which is applicable to my chosen career path in learning disabilities. Applied behaviour analysis has provided an invaluable contribution to understanding and working with autism, and for developing ways of motivating children with autism. In particular, pragmatic approaches have established the reinforcing potential of a range of repetitive and obsessional behaviour. This study has provided a controlled method of harnessing and delivering contingent access to highly preferable obsessional behaviour as reinforcement. Although conclusions could not be reached regarding the effectiveness of the stimuli as potent reinforcers, it does have implications for expanding the repertoire of reinforcers that can be used to help shape the lives of children with autism.

It proved stimulating to be involved in an exciting and radical area of research generating innovative ideas to address real clinical problems. The literature review indicated the valuable two-way interplay between laboratory based research findings and the development of clinical intervention. In this study early laboratory research provided a framework for using obsessional behaviour as a reinforcer. A strength of this study was the identification of a clinical problem and the development of an original concept to address it. It provided a logical answer to the limitations of recent research within this field, by expanding the availability of obsessional behaviour for use as a reinforcer in an educational setting. It achieved this by developing a computer system that could harness stimuli associated with obsessional behaviours that were previously unavailable or beyond our control.

I have found the process of conducting an applied research project both exciting and enlightening, though it has proven to be a steep learning curve. It was vital to obtain an understanding of the behavioural laws of reinforcement and the methodological concepts of reinforcement schedules in the literature review from which to consider further research in this area. On reflection, the planning and preparation that went into this study and the development of the experimental procedure was critical to the running of the study. I became aware of the need to conceptualise the research question in a clear and logical way, and to consider the potential limitations and problems that might be encountered with the research and how best to address them.

During the course of this study I encountered a series of problems that a) delayed the start of the study, b) led to a change in the participants that were recruited, c) delayed data collection, and d) resulted in a change to the experimental design. These problems were largely unforeseen and beyond my control, but are reflective of the difficulties inherent to applied research and single-case methodology and will now be considered in more detail.

There was an important need to plan the study realistically within the time constraints of the training course. Unfortunately, I experienced several significant set backs that delayed the start of this study and significantly reduced the time I had available to complete the research. The first school I identified and began working with encountered problems that reduced the flexibility of the classroom environment, which was necessary to incorporate my study. These problems were largely political and were imposed following changes in the senior management at the school. Following identification of a second school, my study was again withdrawn after the school underwent an acute period of staff shortages and restructuring. This was in response to illness and the extreme challenging nature of some children. On both occasions I invested a great deal of time meeting with staff, visiting parents, and adapting procedures to the different school environments. These experiences informed me of the importance of considering the wider context of the system within which applied research is conducted. It is important to be aware of any specific rules, constraints or political issues of the applied context. In particular, there is a need to consider the stability of the environment and any factors that may prevent your requirements being met.

A substantial amount of time was spent visiting, observing and identifying potential participants for the study within schools and at their homes. This proved to be a lengthy part of the study although it was essential to ensure suitable children were recruited. In both the schools I withdrew my study from, I had identified suitable numbers of children with autism fitting the criteria of the study, which I was then unable to use. It then proved difficult to further identify enough children with autism with intrusive obsessional behaviour to participate in this study. Consequently, in view of the time constraints, the decision was made to include non-autistic children presenting with intrusive obsessional behaviours.

Finally, several factors affected the amount of data that was collected. This study placed a number of demands on the teacher. It was dependent upon him conducting regular sessions with all the children, taking time away from his class, adhering to different procedural instructions, completing measures, and liasing with the children's parents for information. Fortunately, the teacher was extremely supportive of the study and saw it as an opportunity to develop a potential teaching aid. Nevertheless, there were restrictions to being reliant upon someone else to collect the data. It was not possible to control for absence or sickness of both the teacher and children, neither was it possible to control for classroom disruptions or unexpected episodes of disruptive behaviour. Despite a realistic estimate taking into account the possible delay in data collection, data collection was far slower than expected. Due to the timing of the school term, the inconvenience caused by the overrunning of the study, the teacher's increasing lack of availability to run the study, and the time constraints of the course, it was felt necessary to end the study. Consequently, the design was changed eliminating the internal replication in order to meet the submission deadline. Although my original design had changed, it was important to remain flexible to allow the study to develop with the available resources.

Overall, a great deal of time, work and effort was invested in the development of the final project. However, a substantial proportion of this time was invested with little outcome because of the problems encountered in the school settings, which has felt extremely disheartening. On the other hand, I have valued the learning experience and feel that in conducting this study I have gained important insight and knowledge that accompanies the process of conducting research in an applied setting. This has increased my confidence for conducting further research and enabled a much broader consideration of the potential influential factors. This study has provided me with an important learning process of identifying and planning applied single-case research, and considering the implications it has for working with and understanding children with autism. I have experienced the potential fragility of using a single-case design, but also become aware of the efficacy of using this design to evaluate clinical intervention. Single-case design allows a continuous assessment of performance in an applied environment in which the participants act as their own control. Importantly, single-case procedures involve repeated measurement of the dependent variable over time, the temporal pattern of which can be obtained by graphing the repeated measurements (Gibson & Ottenbacher, 1988). This enables on-going adjustments to be made to intervention procedures. Unfortunately, the results are inconclusive due to the limitations that were encountered, but the potential implications of the study warrant replication and further research in this area.