Generalization and Maintenance

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Introduction

The past 20 years has seen a marked increase in the quantity of research literature investigating the effectiveness of interventions for people with autism spectrum disorders (ASD). Much of this research has been conducted in applied behavior analysis (ABA), however, many reported interventions do not include information or data on generalization and maintenance of behavior change. The importance of this is self-evident, as an intervention that increases or decreases a behavior is of little use if the behavior change is not observed in a variety of settings and continues after the intervention period has ended.

This chapter seeks to outline why generalization across settings, stimuli, people, and time can be particularly difficult for children with ASD and to review strategies for promoting generalization and maintenance. We did not conduct a comprehensive review of generalization and maintenance in published ASD intervention research. Instead, the available literature was sampled to provide examples of the various strategies that are used to promote generalization and maintenance. Recommendations are provided for practitioners on how to plan for generalization and maintenance.

What is Generalization and Maintenance?

As applied behavior analysis developed, generalization of behavior change was included as one of the field's defining characteristics (Baer, Wolf, & Risley, 1968). Behavior change was said to have generalized if it lasted over time, it occurred in many environments, or if it spread to related behaviors. These three aspects of generalized behavior change (i.e., across time, settings, and behaviors) were later stressed by Stokes and Baer (1977) when they defined generalization as

> "the occurrence of relevant behavior under different non training conditions (i.e., across subjects, settings, people, behaviors, and / or time) without the scheduling of the same events in those conditions as has been scheduled in the training conditions. Thus, generalization may be claimed when no extratraining manipulations are needed for extratraining changes; or may be claimed when some extra manipulations are necessary, but their cost or extent is clearly less than that of the direct intervention." (p. 350).

Generalization is an integral part in the development of any behavioral plan as it allows for the behavior that is being taught to occur (or not occur) under different, non-training conditions. It is clearly an advantage to take what we are taught and apply it appropriately in a novel situation. Indeed, our ability to generalize has been said to be crucial to our survival (Keller & Schoenfeld, 1950). If we were unable to generalize, every time we bought a new pair of shoes we would have to relearn how to tie our shoelaces.

Discrimination or Generalization?

When teaching a child to point to a picture of a cat upon hearing the word "cat" we are teaching discrimination. The child hears the word "cat", there is a picture of a cat in the book that is being read, the child touches the picture of the cat, and we praise or otherwise reinforce the child for touching the correct picture. The act of the child touching the picture of the cat is called a discriminated operant. The child has made a discrimination and the behavior of touching the picture of the cat, the discriminated operant, occurs more frequently under the antecedent condition of the adult saying "cat", than it does at any other time. Because the discriminated operant, touching the cat, occurs at a higher frequency when we say "cat", the response is said to be under stimulus control. The relationship of the stimulus to the discriminated operant comes from the three-term contingency – antecedent, behavior, and consequence. In the example above, the antecedent is the adult saying the word "cat", the behavior is the child touching the picture of the cat, and the consequence is the delivery of a reinforcer. If the child was to touch something else on the page the consequence would not be reinforcement, but error correction or extinction to decrease the likelihood of that behavior occurring again.

The adult has taught the relationship that when you see *this* cat in *this* picture book and I say "cat", your touching the cat will result in reinforcement. Touching the picture of the cat is more likely to occur in the presence of the discriminative stimulus, the spoken word "cat". This is a discrimination, however, it is limited to the adult saying "cat" in the presence of that picture of that cat in that book. Other people may say "cat" to the child in the presence of the same book in the same or other settings. Others may also say "cat" in the presence of other pictures or photos of cats, or actual cats in multiple settings. Cats come in many forms, big, small, fat, and furry and the adult may also say "cat" tomorrow or next week.

A successful program for socially significant behavior change requires more than that the individual performs exactly the same topography of behavior, in the identical stimulus context as in a tightly controlled training setting, and with the intervention program remaining in place. Real success will include that the intervention has produced generalization of change across a range of functional response forms in a wide variety of settings, and maintenance (i.e., generalization beyond the termination of the original training program).

Generalization

The occurrence of generalization without additional training manipulations is consistent with the historical understanding that generalization was a passive phenomenon. Generalization was not something that was trained. It was something that just happened. If generalization did not occur, it was assumed that the teaching processes had managed to maintain particularly good control of the stimuli and the responses involved, thus producing little variability in behavior.

Stokes and Baer (1977) questioned the view that generalization was a passive phenomenon by which behavior change in the training setting (e.g., one-to-one therapist-child teaching in a distraction-free room) with specified antecedent stimuli (e.g., particular materials and therapist's script) "naturally" transferred to other settings and stimulus contexts. Put another way, is generalization a desirable outcome that often (or ever) naturally comes with no extra effort on the part of the therapist or ABA programmer? From their review of ABA research to that time, Stokes and Baer (1977) concluded that behavior analysts should assume that socially important generalization never comes "for free". Baer et al. (1968) had made similar arguments several years earlier. They recommended that plans for generalization be incorporated in interventions rather than assuming generalization would occur and mourning if it did not. Thus, programming actively for generalization has long been encouraged.

The passive view of generalization is implicit in the following statements: "Children with autism learn OK, but don't generalize what they have learned" {oft-said by anonymous therapists (year dot to present)}; and, "It is sometimes assumed that application [of a behavioral intervention] has failed when generalization does not take place in any widespread form." (Baer et al., 1968, p. 96). In the first example, children are, and/or autism is, the implied source of failed generalization. In the second example, the blame is on the intervention. Sometimes these sources of failure are conflated, e.g., "... and inability [of children with autism] to use trained skills outside school are some of the shortcomings critics attribute to ABA" (Time, May 7, 2006).

A contrasting approach, consistent with proactive recommendations of Baer et al. (1968) and Stokes and Baer (1977), would attribute successful generalization to well-planned, well-designed, and well-implemented procedures to promote generalization. A failure of generalization would be blamed not on the child, or autism, or the intervention *per se,* but to inadequacies in generalization planning, design, and implementation.

Before further discussing how to promote generalized behavior change, it is necessary to understand the different terms used to describe generalization.
The following paragraphs define and provide examples of the three basic forms of generalized behavior change: stimulus generalization, response generalization and response maintenance, in addition to other types of generalized outcome.

Stimulus generalization. Stimulus generalization is said to have occurred when the likelihood of the behavior increases in the presence of a stimulus or setting as a result of being reinforced in the presence of a different stimulus or setting (Martin & Pear, 2003). In our example above, if the child was to touch the picture of the same cat in a different book upon hearing the word "cat", this would be stimulus generalization. Further examples would be touching the same cat on flash cards, or on computer screens. Touching similar cats (cats with physical similarity – similar colors, size) is also an example of stimulus generalization. As with animals, we (humans) have evolved such that when two stimuli have a large degree of physical similarity the more likely it is that stimulus generalization will occur between them. However, is the child likely to touch a lion, or a hairless cat? Perhaps not, as the child may not have learned the complete stimulus class 'cat'. A further example of stimulus generalization occurs when we teach a child to wash their hands. Stimulus generalization is very useful in this case as we want our learner to wash their hands in a new situation that is different in some way to the teaching setting (different bathrooms) and stimuli (different taps, soap dispensers, towels).

Response generalization. Response generalization is shown when the learner emits a new, untrained behavior that is functionally equivalent to the behavior that was trained (Cooper, Heron, & Heward, 2007). For example, our child who learnt receptive identification of the cat by pointing to the picture of the cat, now responds to the adult saying "cat" by handing over the correct picture. Pointing to and handing over a picture are functionally equivalent as they demonstrate receptive identification of the cat and will both result in reinforcement. In the example of our hand washer if they were to dry their hands by wiping them on their pants this would be response generalization. Drying ones hands on ones pants is not necessarily desirable. However, drying hands on ones pants does have the same function as using a towel, as it results in getting ones hands dry.

Response maintenance. Response maintenance occurs when the learner continues to perform the behavior trained after the intervention responsible for the behavior has ceased. How long a newly learned behavior maintains in a person's life depends on how useful it is to them and whether natural contingencies in the environment continue to reinforce it. Our learner should be able to point to a picture of a cat in response to the word "cat" years after it has been taught, and the presence of dirty hands should result in the response of hand washing for the rest of the person's life. In addition to stimulus and response generalization and response maintenance other generalized outcomes (e.g., generalization across subjects and stimulus equivalence) have been reported in the ABA literature. Having taught one child to wash their hands if another child in the same house, who was not directly taught, started washing their hands too, this would be an example of generalization across children.

Stimulus equivalence occurs when correct responding to untrained stimulus-stimulus relations occurs. Sidman (1971) provided the first example of an equivalence class among arbitrary stimuli in a boy with mental retardation. Prior to the study the boy could match pictures to their spoken names and name pictures. After being taught to match written names to spoken names the boy could, without additional training, match written names to pictures, match pictures to written names, and say the written words. The result of learning one stimulus-stimulus relation was the emergence of three other relations without direct training. Sidman and Tailby (1982) described this in the logical formulation: if A = B and B = C, then A = C. Potentially this would be advantageous in programming and curriculum design for children with ASD. In theory, if A is the spoken word "cat", B is the picture of a cat, and C the written word cat , we could train the stimulus relations spoken word "cat" to picture and picture to written word CAT, then spoken word "cat" to written word CAT would emerge without further training. Eikeseth and Smith (1992) found naming of visual stimuli (Greek letters) to enhance the development of three-member (name and two visual stimuli; Greek letters and their written name) equivalence classes for one preschool child and to have mixed benefits with three other children.

Desirability of generalized behavior change.

Is generalized behavior change always desirable? In teaching skills to a young child with ASD it is somewhat difficult to come up with an example of when generalization would be undesirable. However, following the establishment of the discrimination "cat", if our cat learner was to point to a dog in the presence of someone saying "cat" we would say they have over-generalized. Cats and dogs after all do have some physical similarities. If our learner was to touch every black and white object they saw, in response to the spoken word "cat", faulty stimulus control would have occurred. The target behavior has come under the control of an irrelevant feature of the antecedent stimulus. It just so happens that our learner was taught cat in the presence of picture of a black and white cat.

As practitioners, we should always assume there is no such thing as free generalization. This applies even more when working children with ASD who are often described as having difficulty in generalizing behavior change.

Generalization and ASD

In teaching a child with ASD to identify a cat upon hearing the word "cat" practitioners anecdotally report that when different adults present the same discriminative stimulus ("cat") or when a different pictorial example of a cat is shown, errors occur. This difficulty with generalization has been attributed to insistence to sameness (Horner, Dunlop, & Koegel, 1988; Lovaas, Koegel, & Schreibman, 1979; Rincover, & Koegel, 1975), stimulus overselectivity (Lovaas, Schreibman, Koegel, & Rehm, 1971), and/or lack of motivation (Horner et al., 1988).

One of the behaviors identified as being symptomatic of autism is "restricted, repetitive, and stereotypic patterns of behavior, interests, and activities" (APA, 2000, pp. 70-75). Insistence on sameness may hinder the child's success in generalizing the target behavior across settings, time, and people (Horner et al., 1988: Lovaas et al., 1979; Rincover et al., 1975). When aspects of the generalization setting are different in any form from the setting that the child was trained in, the change in stimuli can inhibit transfer of the skills. Thus, different pictures of cats or cats in different forms (e.g., photos on a television screen) would result in errors. The likelihood that the child will only ever see one representation of a cat is extremely low. Furthermore, even a slight change in the stimulus, such as the pictured cat being at a different angle, could also hinder generalization, as this seemingly trivial change can be significant to a child with ASD.

Stimulus overselectivity has also been identified as playing a role in the difficulty children with autism have in generalizing behavior. Stimulus overselectivity is best defined as when a learner selects particular aspects of the stimulus to make the discrimination that may, or may not, be relevant (Lovaas et al., 1971). For example, a child who only recognized cats when they had a white left front paw (the trained cat had a white left front paw) would be said to be overselective in making the discrimination cat or not-cat. Children with autism have been found be more likely to respond to selected aspects of a complex stimulus compared with typically developing children, who respond to multiple aspects (Lovaas et al., 1971). Schreibman and Lovaas (1975) found children with autism were able to discriminate between male and female dolls. However, when the clothes and other characteristics of the dolls were changed the majority of the children with autism were no longer able to make the discrimination. This was not the case for typically developing children. Further testing revealed that the reason for lack of generalization was due to the children with autism selecting irrelevant item(s), such as the doll's shoes, as the discriminative stimulus to determine gender. Stimulus overselectivity has been shown to affect a child's ability to generalize their target behavior(s). If the target behavior is only under the control of limited aspects of the antecedent stimuli during training, it is possible that these aspects will not be present in another setting (Lovaas et al., 1979).

Lack of motivation may also be a factor for children with autism failing to generalize (Horner et al., 1988; Koegel & Egel, 1979; Koegel & Mentis, 1985). It has been said that children with autism have low levels of responding when in contact with intermittent reinforcers (Horner et al., 1988; Koegel & Mentis, 1985). When in an environment that does not produce reinforcers for every instance of correct behavior, children with autism may become 'unmotivated' to emit the behavior, thus resulting in a decrease and extinction of the target behavior. Furthermore, learned helplessness has also been reported as a factor for children being unmotivated to respond (Horner et al., 1988; Koegel & Egel, 1979; Koegel & Mentis, 1985). A decreased level of responding is observed due to constant failure at new tasks. Children quickly learn that reinforcement is only available when a correct response is delivered, and not for every response. So when presented with a new task the learner with autism may become unmotivated as they are reinforced only for correct responses that are less likely to occur.

Although the research outlined above suggests that children with autism have some specific limitations with regard generalization, it does not mean that the behavior changes that occur within increasing or decreasing programs cannot be generalized. As stated in the earlier section, the failure to see generalization is not a failure of an intervention or a child and their diagnosis, but rather the failure of the person planning the intervention to program for generalization.

Current Practices

It is the purpose of this section to report on the current practice of generalization strategies with specific reference to research with children with autism. Intervention articles published in the *Journal of Applied Behavior Analysis* from 2003 to present (volume 36 – volume 41 issue 2 inclusive) with children with ASD as the participants were reviewed. Forty-three articles were identified. Generalization and maintenance were not measured in 42 % of the reviewed articles. This is a dismal finding given that the importance of generalization and maintenance has been emphasized for 40 years. Generalization was programmed for in 26 % of articles, with the techniques of programming common stimuli and multiple exemplar training (these terms are defined below) being the most popular. A further 32 % of articles measured generalization and/or maintenance. The measurement of generalization without programming for it has been described as “train and hope” (Stokes & Baer, 1977). Training and hoping is characterized by the measurement of generalization across responses, experimenters, settings and time after a behavior change has been effected due to intervention. Generalization is not actively sought; it is just welcomed should it occur.

It is clear that the majority of researchers do not report planning for generalization. Even though researchers do not always attend to generalization, it can never be ignored by responsible practitioners.

Strategies to Promote Generalization

As previously discussed, if we are to increase the likelihood of generalized behavior change, it is necessary to plan systematically for the desired outcome. This requires selecting target behaviors that are functional and will come under naturally occurring reinforcement contingencies in the environment, specifying all environments where the target behavior (stimulus generalization) should occur, and in all forms that it should occur (response generalization). Returning to our example of cat identification, the desired outcome is for our learner to recognize all cats in all forms (e.g., pictures, photos, live, textual) in all settings (e.g., home, grandparents' house, school, outside) – stimulus generalization – and to be able to receptively identify cats, expressively identify cats, and sort cats into categories – response generalization. Identifying all the behaviors that need to be changed and all the settings and situations in which the behavior should occur requires a fair amount of planning. However, without a *systematic* plan the practitioner will be relying on the train-and-hope approach and generalization that does occur may not be desired. Furthermore, if we are going to all the bother of changing behavior, we should ensure that it will maintain in the natural environment and that it will occur in all forms and relevant environments.

Strategies for promoting generalized behavior change were categorized under nine general headings by Stokes and Baer (1977).

1. Train and Hope
2. Sequential Modification
3. Introduce to Natural Maintaining Contingencies
4. Train Sufficient Exemplars
5. Train Loosely
6. Use Indiscriminable Contingencies
7. Program Common Stimuli
8. Mediate Generalization
9. Train "To Generalize"

Other authors have extended and re-categorized the nine proposed approaches generalization (e.g., Cooper et al., 2007; Stokes & Osnes, 1989). However, we will use Stokes and Baer's original terminology due to its clarity and inclusiveness.

The following sections explain and provide examples of each generalization strategy with reference to children with autism. Despite train-and-hope being common practice it will not be discussed further as it is not a strategy to promote generalization.

Sequential Modification

As with train-and-hope sequential modification addresses generalization only after behavior change has occurred (Stokes & Baer, 1977). That is, an intervention is conducted, behavior change occurs, generalization is probed for and then, if generalization has not occurred to the desired, settings, stimuli and/ or behaviors it is trained. This would be akin to teaching a child to receptively identify a cat by pointing to one flashcard of a cat in one setting. After the desired response is being emitted, pointing to the cat in response to the instructor saying “cat”, generalization probes would be conducted with different cats in flashcard and other forms in the same and different settings.

Kamps, Potucek, Lopez, Kravits, and Kemmerer (1997) used a multiple probe design across activities to measure the effects of introducing peer networks and reinforcement of social interaction for three young boys with autism. The intervention was introduced in a sequential fashion across four activities for each student while baseline conditions remained in effect for two activities. For two of the participants generalization of social interactions was observed in at least one untrained activity. The authors do not report whether the intervention was introduced to the activities or for participants for which generalization did not occur. Generalization was more likely to occur in similar social settings, when the generalization activity was scheduled soon after the trained activity, and when the materials between activities were similar.

Introduce to Natural Maintaining Contingencies

In order for behavior to continue to occur outside the training environment, it must continue to make contact with its maintaining contingencies. Therefore, when planning for generalization, a practitioner must work to *maximize* the contact the behavior will have with natural contingencies. The practitioner, therefore, should consider the target behavior, the possible natural contingences, and alternative strategies if the natural contingencies are not strong enough (Baer, 1999).

One way of achieving this is to ensure that there are natural contingencies in the generalization setting that the behavior will contact. When selecting a target behavior a practitioner should consider what the learner would achieve for emitting the behavior in the natural setting. If the behavior is not going to result in reinforcement at a high enough rate, or is going to require too much effort to emit, then it is unlikely that the behavior will occur in the natural setting (Baer, 1999).

In conjunction with ensuring that the target behavior has a natural consequence, the practitioner must also ensure that the behavior occurs in a manner that allows it to make contact with reinforcement. This requires the practitioner to consider the most appropriate topographical form of the behavior. Harchick, Harchick, Luce, and Sherman (1990) found that although the phrase "check it out", to gain attention, was appropriate and received praise in the home setting, it did not receive praise in the school setting and, instead, often lead to a reprimand. In addition to considering the topography of the behavior, a practitioner must also ensure that the behavior is trained until it is accurate and occurring often enough, long enough, fast enough, and with enough magnitude to obtain reinforcement (e.g., Tiger, Bouxsein, & Fisher, 2007). For example, it is unlikely that a peer's greeting behavior will be maintained if following their "good morning" greeting the second child takes 30 seconds to respond. The peer, who made the initial greeting, will have probably left by this time, thus removing the opportunity for either child to receive reinforcement. For those behaviors that do have a natural consequence but do not occur often enough, long enough, fast enough and with enough magnitude to obtain reinforcement, it may be beneficial to start training with a contrived reinforcer (e.g. Jones et al. 2007).

Baer and Wolf (1970) used the term behavior trap to describe how natural contingences can result in significant and efficient behavior change that maintains over time without intervention. Despite there being little research on behavior traps it is worthwhile to describe the concept. A behavior trap has four essential features. First, it is necessary that the consequence for initially entering the behavior trap is something the individual wants. The second is that the individual has, in his/her repertoire, the response required to enter the behavior trap, and the response does not require much effort to emit. The third feature is that once in the trap there are a number of contingencies that interact with each other to ensure that the individual acquires, extends, and maintains the targeted skills. Finally, a behavior trap will continue to reinforce behavior change without an intervention because the individual will show minimal satiation effects (Alber & Heward, 1996).

Some behavior traps occur naturally, (e.g., the challenging behavior shown by a child with conduct disorder, while in the presence of other peers with conduct disorder), and some are created. Alber and Heward (1996) provided five steps for developing effective behavior traps. First, the practitioner must identify an appropriate target behavior. This means a behavior that is important, has natural consequences, is able to be practiced frequently, and is easily emitted. Second, the practitioner must identify the reinforcer for entering the behavior trap (e.g., look at the individual's interests). Third, the practitioner must now create or set the behavior trap. This requires making sure the child will emit the behavior and therefore come into contact with the initial reinforcer. Fourth, the practitioner should maintain the trap by gradually increasing the work requirement and ensuring that there is new material, items, and activities for the child. Fifth, the practitioner should continually be assessing the behavior change to ensure that the trap is effective.

Alber and Heward (1996) provide a number of examples of how to create behavior traps within a classroom. For example, the teacher identifies that her student is having difficulty interacting socially with her peers. Increased and generalized peer interaction is sought. The student is very good on computers and enjoys playing games on them. The teacher asks the student to teach one of the other children how to play a game based on a topic that is mutually liked by both children. Once both are competent in the game the teacher asks the two students to work together to find out other information on the game. During this time the teacher assesses the children's amount and type of interaction during prescribed learning time and outside of this time.

An alternative when the natural reinforcement is low is to 'wake up' any potential natural reinforcement in the environment (Baer, 1999). This is especially important if the schedule cannot be thinned to a point that the natural contingencies will take effect (e.g., Tarbox et al. 2002). One way to increase the natural reinforcement that is available in the generalization setting is for the practitioner to recruit others to help generalize and maintain the behavior. The techniques vary from merely drawing people's attention to the intervention and/or behavior to more explicit instructions and training. Tarbox et al. (2002) used parent training to ensure continued treatment gains obtained with an intervention that was designed to decrease object mouthing by a child with autism. The treatment involved the provision of prompted toy play in conjunction with response blocking. Initial attempts by therapists to thin the schedule of response blocking in the natural setting were somewhat successful. However, this success was not maintained when the schedule was thinned further. In response to this outcome, the mother was trained to implement the initial procedure at home. The training consisted of explanations of the rationale, descriptions, and modeling of the procedure and feedback based upon actual implementation. This training resulted in near zero levels of the behavior. As well as parents, research has also been conducted where peers (e.g., Kamps et al. 2002) and staff (e.g., Arco & Millet, 1996) have been recruited to maintain the behavior in the natural environment.

Where possible, it is often more advantageous to teach the child to recruit reinforcement. For example, Durand and Carr (1992) found that teaching children to gain attention in an appropriate manner (e.g., "Am I doing good work?") was equally as effective as timeout in decreasing behavioral excesses maintained by access to attention. However, the results of a generalization test to a naive trainer showed that the communicative response groups' behavior remained low, while the timeout groups' behavior increased. Although it would be possible to train the naive trainer to implement the timeout procedure, it is much more cost effective to train the children and have them assist in generalizing the behavior. Harchick et al. (1990) taught four boys with autism to ask questions and make requests in order to increase the amount of praise that they received from adults. All the children learnt to ask the questions and make requests and used these skills over a number of different settings and activities. A review of the maintenance data showed that the original levels were maintained for at least three weeks, at which time data collection stopped. One limitation that was noted with this research was that there was no corresponding decrease in attention-seeking behaviors. This may have been because the children's requests for praise did not always result in praise. This limitation draws attention to the need to consult all interested parties when considering target behaviors to maximize the chances of the behavior contacting the natural contingencies and generalizing.

There appears to be consensus (e.g., Baer, 1999; Cooper et al., 2007; Stokes & Baer, 1977; Stokes & Osnes, 1989) on the need for practitioners to program to capture natural contingencies when designing interventions to change both behavioral excesses and deficits. Indeed, it is possible that a number of interventions that have shown generalization and/or maintenance without any programming will have done so because the behavior has inadvertently come into contact with natural contingences (e.g., Carr & Darcy, 1990).

Train Sufficient Exemplars

Training sufficient exemplars was described by Stokes and Baer (1977) as the most prominent generalization strategy in the literature. In teaching a generalizable lesson often only one exemplar is taught to mastery with no generalization beyond what has been specifically taught. Training sufficient exemplars involves teaching another and another and another exemplar of the same generalizable lesson until generalization occurs on its own sufficiently to teach the lesson. For example, when teaching the receptive identification of cats, we may teach with a picture of one cat. After this has been mastered and there is no evidence of generalization to other cat pictures another cat exemplar would be taught, then another, and another until the learner can identify cats of all different forms e.g., photos of cats, live cats, different colored cats, cats standing in different positions and different species of cat. Laushey and Heflin (2000) conducted a study to increase the social skills in two kindergarten children with autism. Each child attended a mainstream kindergarten class where a buddy system was developed in which each student with autism was paired with a typical peer to engage in play and conversation. As part of the generalization training, multiple stimulus examples were provided by rotating the pairing so that the participants were with a different peer each day. The pairing of the participant with multiple peers provided them with opportunity to respond correctly to different peers. Results showed that the participants increased their social skills significantly with many of their peers. A generalization probe conducted at follow up showed that the social skills had generalized across settings also, as one participant maintained a high level of interaction with peers in his first grade class.

Fiorile and Greer (2007) programmed for generalization among four children with autism after it was found that tact training, experimenter presentation of item, and vocal tact (name), did not result in a naming repertoire. Fiorile and Greer provided multiple examples of the stimuli (pictures of and actual objects), alternating between match, point, and tact for a set of objects during instruction. Once mastery was met, generalization probes showed the children had acquired naming of stimuli in trained sets as well as the capability to name from tact instruction alone.

When promoting generalization by training with multiple stimulus and response examples it is necessary to conduct a generalization probe in an untrained setting or with untrained people following initial training. If the child is successfully able to emit the target behavior in untrained examples, then generalization has occurred. However, if the child does not, training should then be conducted in the probe setting or with more examples. Generalization probes should again follow with further untrained examples until the child is able to emit the target behavior proficiently with untrained examples (Stokes & Baer, 1977).

Train Loosely

In training loosely the behavior analyst plans to randomly alters irrelevant aspects of the training setting that may inadvertently acquire stimulus control over the child's newly learned behavior (Campbell, 1982). When training the receptive identification of a cat the practitioner will randomize the position of the correct picture, teaching will occur with many different teachers, in many different rooms and at a desk, as well as when sitting on the floor. Stokes and Baer (1977) recommended that practitioners use loose teaching by varying random stimuli in the training setting such as; temperature, tone of voice, trainers, and noise level in addition to further examples. One of the aims of teaching loosely is that the participant's target behavior is not controlled by unwanted stimuli. Rincover and Koegel (1975) found that their participants' behavior did not generalize to an untrained setting due to the children responding to unintended stimuli (hand movements) instead of the planned discriminative stimuli (verbal commands). Teaching loosely is also useful for avoiding any 'surprises' that the child may encounter in the generalization setting (Cooper et al., 2007; Horner et al., 1988). By varying the different stimuli in the training setting, there is a high possibility that the child may experience some, if not all, of these stimuli in other untrained settings. When training loosely it is important during planning to take note of the different irrelevant antecedent stimuli and vary them at different times of the day and as unpredictably as possible (Baer, 1999).

Use Indiscriminable Contingencies

It has been identified that practitioners should strive to select behaviors that have naturally occurring contingencies although these contingencies are sometimes weak (i.e., lean schedules of reinforcement or delayed reinforcement). In situations such as this, the chances of generalization occurring is enhanced if the contingencies that mark the presence or absence of the availability of reinforcement for the behavior are unclear, i.e., indiscriminable. Practitioners should program indiscriminable contingencies once the behavior has been mastered and before the intervention is removed from all settings. When an indiscriminable contingency is in place, the child should not receive immediate reinforcement for every response but only for some responses. This is called intermittent reinforcement and is obtained through a process known as schedule thinning. Research shows that behavior that is reinforced on an intermittent schedule is more resistant to extinction, and as such should be more likely to generalize (Stokes & Baer, 1977).

Koegel and Rincover (1977) were among the first to investigate the effects of manipulating the contingencies within the intervention and natural setting to make them less discriminable. The participants were children with autism aged between 7 and 13 years of age. The intervention consisted of teaching the children non-verbal imitation and following verbal instruction. In the initial study, Koegel and Rincover found that two of the children showed generalization but failed to maintain their behavior and one failed to generalize at all. In the second experiment they found that children given continuous reinforcement for their behavior during treatment did initially generalize to the alternative setting. However, the behavior quickly extinguished. They found that the thinner the schedule during treatment (the more correct responses that were not reinforced) the more resistant the behavior was to extinction in the generalization setting. In addition, they found that if a schedule was thinned and paired with non-contingent reinforcement in the natural setting, generalization over time was further enhanced.

Program Common Stimuli

Generalization can also be promoted by making the training setting similar to the generalization setting. Programming common stimuli requires the training environment to contain stimuli comparable to those in the generalization setting (Stokes & Baer, 1977). For example, in teaching the receptive identification of cats, our goal may be for the child to point to pictures of cats in a book during circle time in their preschool class. If we were promoting generalization through the programming of common stimuli, we would create a similar environment for training purposes. This may involve using the teacher as the instructor, simulating circle time by having peers present during training, turn-taking responses, and using the same materials as those in the classroom. If the common stimuli are well chosen, functional, and salient during training the likelihood of generalization will be enhanced (Stokes & Baer, 1977).

Petursdottir et al., (2007) used programming common stimuli to increase social interactions for a 5-year-old preschool child with autism with his peer tutoring partners following a tutoring session. Their intervention involved scripted peer tutoring in a reading activity with and without programming common stimuli. Three classmates were selected as peer tutors for the reading activity and observations were carried out to determine the frequency of social interactions between the participant and his tutoring partners during free play. Common stimuli were programmed by incorporating the same play activities into the peer tutoring reading activity sessions as were used in free play sessions. Results showed that the social interactions in the reading activity generalized to the free play when common stimuli were programmed compared to when they was not.

Before programming common stimuli, it is important to determine the significant stimuli. When teaching children with multiple handicaps to order food at a fast food restaurant van den Pol et al. (1981) determined that the significant stimuli could include one or multiple stimuli such as; the menu board, price of items, and the person at the counter. The practitioner would program common stimuli by placing models of the menu board and price of items in the training setting to increase the probability of facilitating generalization of fast food ordering from one setting to another (Cooper et al., 2007; Horner et al., 1988; van den Pol et al., 1981).

Mediate Generalization

Generalization may be facilitated by arranging a mediating stimulus (e.g., a person or object) to ensure generalization of behavior change from the instructional setting to the generalization setting. This may be done by contriving a mediating stimulus that prompts or aids the child's performance of the target behavior (Stokes & Baer, 1977). A mediating stimulus may be added to the instructional setting or may be naturally present in the generalization setting. The stimulus must reliably prompt the target behavior during instruction and must be transportable to all important generalization settings (Baer, 1999). Examples of mediating stimuli used with children with autism include people (e.g., Goldstein & Wickstrom, 1986), cue cards (e.g., O'Neill & Sweetland-Baker, 2001), photographic activity schedules (e.g., MacDuff, Krantz, & McClannahan, 1993), and the Picture Exchange Communication System (PECS; Bondy & Frost, 1994).

People are highly successful as mediating stimuli as they move from setting to setting and often provide reinforcement for many behaviors (Cooper et al., 2007). Goldstein and Wickstrom (1986) used a peer-mediated intervention to increase interactions among three preschoolers who displayed autistic-like behaviors. Two typical preschoolers were taught strategies to facilitate interactions with the target participants (e.g., gaining eye contact and prompting requests). The peers were then also present as mediating stimuli in non-training sessions. During maintenance sessions, all teacher prompts were removed, and results showed interactions to remain at levels higher than baseline.

O'Neill and Sweetland-Baker (2001) used functional communication training to reduce escape-maintained disruptive behavior with two students with autism. During instruction (e.g., writing), students were prompted to touch a small "BREAK" card for a 30-second break from task demand. In generalization settings (other tasks such as cleaning and putting items away) the card was present but no prompting occurred. Generalization was demonstrated across most untrained tasks, with reductions in disruptive behavior and increases in unprompted break requests.

A further method to mediate generalization is to teach the child self-management skills. Self-management involves the child themselves applying behavior change tactics to produce a desirable change in the target behavior (Cooper et al., 2007). Self management can involve the child observing and recording their own behavior (self-monitoring or self-recording), comparing their performance to a pre-determined criterion (self-evaluation), and administering reinforcement (self-reinforcement).

Self-management has been used with children with autism to decrease off-task behavior (e.g., Coyle & Cole, 2004), improve social responses (e.g., Koegel, Koegel, Hurley, & Frea, 1992), teach daily living skills (e.g., Pierce & Shreibman, 1994) and increase appropriate play in unsupervised settings (e.g., Stahmer, & Schreibman, 1992). Some mediating stimuli, such as photographic activity schedules (e.g., MacDuff et al., 1993), may also include self-management techniques.

Coyle and Cole (2004) evaluated the effect of video self-modeling and self-monitoring on off-task behavior in three boys with autism. During the intervention, children were first required to watch a video that showed them engaging in on-task behavior. Children were then trained in self-monitoring and were required to record behavior in the classroom as ‘working’ or ‘not working’ at the end of 30-second intervals. The teacher provided reinforcement (including colored stickers and popcorn) for appropriate behavior. Results showed a large decrease in off-task behavior during the intervention that was maintained during follow-up sessions.

As well as a mediating stimulus, a photographic activity schedule also allows for self-management, as it allows children to administer their reinforcement after completing a series of tasks. A photographic activity schedule depicts activities that a child must complete, in order, before having access to a reinforcer. The schedule serves as a prompt to complete the tasks and is easily transportable as it is typically kept in a small binder. MacDuff et al., (1993) used photographic activity schedules with four boys with autism aged 9 to 14 to increase on-task and on-schedule behavior. The children were required to complete three activities (including Lego™, games, and handwriting worksheets) before having access to reinforcers (snack, puzzle, and TV). Generalization was assessed by replacing two of the original tasks with similar tasks in the boy’s schedules. Results showed sustained on-task and on-schedule behavior across lengthy response chains that generalized to novel tasks. Photographic activity schedules have also been used to teach daily living skills e.g., getting dressed, making lunch, and doing laundry; (Pierce & Shreibman, 1994).

Train to Generalize

Possibly the most simple way to attempt to obtain generalization is to ask the child to generalize. Stokes and Baer (1977) suggested that practitioners could obtain cost-effective generalization by using systematic instructions to inform the learner on what is required in other situations. In order to generalize in this manner an individual would require prerequisite skills, such as listening skills and the ability to follow rules. However, despite many children with ASD having these skills, there does not appear to be any literature as to the effectiveness of the intervention with this population.

Another way of training to generalize may be reinforcing response variability, (Stokes & Baer, 1977) discussed. The idea is that that if practitioners can increase variability in responding, they would obtain response generalization. In addition, the increase in variations should then create more contact with natural reinforcement, and thus the response class will be more likely to be maintained in the natural environment. The basic and applied literature has a number of articles that show that response variability can be increased using either extinction and/or direct reinforcement (Lee, Sturmey, & Fields, 2007). Despite this, the research with children with autism, especially in applied situations, is not as extensive. Two studies (Lee, McComas, & Jawor, 2002; Lee & Sturmey, 2006) have investigated the effects of lag schedules on variability in children with autism.

Lag schedules involve reinforcing a response if it is different from the preceding responses. For example, a Lag 1 response schedule would require that the current response be different from the previous response, but not necessarily different from the response that had occurred two responses ago. In comparison, a Lag 2 response schedule would require that the current response be different from the two previous responses, but not different from the third previous response. Lee et al. (2002) investigated the effects of a Lag 1 schedule on responding to social questions. They found that two 7-year-old boys with autism had an increase in the percentage of trials with varied and appropriate responding when given the questions “what do you like to do?”. These results generalized across people and settings, even though reinforcement was not contingent upon variations in responding in these sessions. However, the generalization was not maintained when the Lag 1 schedule was not in place in the alterative setting. The authors suggested that the teaching situation might have been serving as a cue for varied behavior. A third participant, a 27-year-old male with autism, failed to show similar results in response to the questions "how are you?". The researchers suggested that this was due to the question failing to occasion varied responding or the ineffectiveness of reinforcement. Interestingly, of the two boys who achieved varied responding, one of the boys used 19 novel responses while the other only used four novel responses. Despite this difference the second boy was able to obtain similar levels of reinforcement to the first boy, because he merely alternated between responses.

Lee and Sturmey (2006) replicated these results with three teenagers who had a diagnosis of autism. They found that two of the three participants showed increased variations when a lag-1 schedule was in place irrespective of the presence of preferred items in the environment (a suspected confound from the previous research). In addition, they also found that while one participant showed a variety or responses, the other alternated between responses. The research by Lee and colleagues has demonstrated that variability can be increased in individuals with autism; however, they acknowledge that more research is needed into the clinical utility of these procedures.

Extinction occurs when reinforcement is no longer provided for a behavior that previously resulted in reinforcement. One of the known side effects of extinction is increased variability in behavior. There appears to be little research on this topic with children with autism. Grow, Kellt, Roane, & Shillingsburg, (2008) placed problem behaviors on extinction to induce response variability in functional communication training (FCT) responses in three children with autism. Typically, when problem behaviors are put on extinction, the functional alternative that is reinforced is either an existing response or an instructor-selected alternative. The results showed that placing problem behavior on extinction was effective in producing alternative behaviors during FCT.

Stokes and Baer (1977) state that although training an individual to generalize may be an effective tool to ensure generalization, ideally we would want the learner to generalize not only their behavior but also the ability to generalize. They labeled individuals who had been taught this skill as “generalized generalizers”. Both the techniques outlined above have received very little research, especially with children with autism, and there does not appear to be any research on “generalized generalizers”.

Planning for Generalized Outcomes

In this section we make recommendations to practitioners regarding *planning* for generalization. The planning is undertaken as part of the development of any plan for behavior change at the outset, not as an afterthought. An intervention plan for a referred behavior should include consideration of desired generalization across behaviors, stimuli, settings, and time, with the last being maintenance of behavior change in the future beyond the intervention. In our experience of planning for generalization in clinical and/or educational applications of ABA or teaching others how to plan, we have previously relied on the “generalization map” designed by Drabman, Hammer, and Rosenbaum (1979). The map presented a conceptual model for categorizing domains of generalization addressed in the ABA research literature. Studies were categorized by the presence or absence of generalization across participants, behaviors, settings, and time and all the combinations thereof: 16

categories in all. The generalization map may be most helpful for designing research studies concerning generalization, which was its developers' purpose. We have found it helpful as a conceptual model, but less so as a practical tool in planning generalization in individual applied (or clinical) applications. Hence, we have designed a "generalization planner" for applied use (see Figure 1).

The top panel in Figure 1 explains recommended domains of generalization to be considered when planning interventions at a relatively conceptual level. The middle panel shows a generalized schema for planning. The bottom panel shows a hypothetical example of the use of the planner for teaching receptive identification of the noun cat. From left to right, the planner first prompts the behavior analyst to write in a name for the class of behaviors to be changed. Second, to plan for generalization across the variety of response forms that are functionally equivalent, a list is made of all the topographies (forms) of referred behavior that are to be changed. If the intervention aims to teach new desirable forms of behavior that are related, these will be listed as exemplified in the bottom panel. If the intervention also aims to reduce problem behaviors, they will be listed. Third, in planning for generalization across stimuli, the range of materials required to perform the desired generalized behavior are listed. The naturally occurring antecedent stimuli for appropriate performance of the desired behavioral responses need to be considered here. What can be predicted to be naturally maintaining reinforcers (consequent stimuli) following withdrawal of arbitrary or contrived instructional reinforcers are included conceptually in considering generalization across stimuli. Fourth, the range of settings in which behavior change is to occur is listed. For children with ASD, obvious examples are home, school, and community settings. However, in planning for generalization for an individual child's behavior change program, these settings need to be specified.

For example, in which particular classrooms at which particular school does raising hand to obtain attention need to occur to replace screaming? Another example might be: What is the name of the health center where the child needs to sit still while her ears are examined for otitis media? Fifth, under the heading of "social generalization", we recommend that the program designer list the names of people in whose presence the changed behavior is to occur, e.g., which family members, teaching staff, and/or health care providers.

From where are the lists of response class members, stimuli, settings, and people typically obtained? From post-referral (but pre-intervention) interviews with the child with ASD where possible, all those who care about and for the child, and from direct observations by the behavior analyst in the child's natural environments. Interviews may be guided by the "generalization planner" (Figure 1). Observations of the child's behaviors is likely to add information about forms of response to be targeted, e.g., what form of verbal behavior the child uses (verbal, vocal, signs, gestures, PEC, etc.). Observations in the child's natural current and likely future environments, including of peers, will enhance information about instructional and naturally occurring stimuli surrounding the desired behaviors.

At this point in planning, like any good planner, the analyst has exhaustive lists to place in the boxes as in Figure 1. Before intervention commences, however, prioritization among response class members, stimulus materials, settings, and people is a complex task that needs to be undertaken. Prioritization is best negotiated, with guidance from the behavior analyst, with those informants who contributed to the lists during the interviews. The inclusion of the child, if possible, and parents in decision-making procedures of this type may be required by law in some jurisdictions. With regard to generalization planning for a particular intervention, a starting point has to be decided, e.g., what is the best setting in which to determine if the proposed intervention is effective and perhaps fine-tune it before generalizing to a new setting? In addition, at what point does the intervention end? Though we have planned for and measured behavior change in new settings what would we expect to happen when an unidentified setting occurs a year after the intervention? Intervention should end when the reinforcing contingencies that naturally occur in the environment take over, thus the behavior should transfer to the new setting a year later without any need for reintroduction of the intervention. To provide further guidance in the use of the planner a case example from clinical practice is provided below.

Case Example

Client information.

James is an 18-year-old male who attends a school for children with special needs. He has previously been diagnosed with autism and moderate mental retardation. He resides in a group home and spends every other weekend in his family home. James has presented with a number of challenging behaviors over the years including; swearing, hitting others, enuresis, tearing own clothing and throwing objects.

Referral question.

James was referred to a behavior analyst due to an increase in disruptive behavior in the classroom. Classroom staff reported the group home was also having difficulty managing James' behavior.

Behavior assessment.

Through the process of interviews with all caregivers and observation of James in all three key settings the behavior analyst was able to identify the following target behaviors; spitting, throwing objects (particularly food at meal times), hitting staff and others, poking staff and others, swearing, putting objects in own ear. A functional assessment revealed that all the target behaviors all occurred to provide James with attention in the form of reprimands, joking comments, cajoling to not misbehave, and other negative comments from staff.

Intervention

As high rates of target behaviors were observed, a schedule of non-contingent reinforcement (positive statements) on a fixed time 1-minute was the recommended intervention. Staff was also provided with information on the rate of praise and other positive statements made to James. Staff and family were consulted about the feasibility of this intervention, and as all the disruptive behaviors had the same function, it was agreed to work on them all at once. Measures of James engagement in school tasks and other activities were at low levels.

Planning for generalization

As a part of intervention development a generalization planner (Figure 2) was completed. Topographically different behaviors of the same function were grouped for intervention. The maintaining stimuli were identified and the locations of the targeted behavior were listed in the order of intervention. It was decided that generalization strategy sequential modification would be most effective in this case due to the differences between settings in which the behavior was observed. The classroom was targeted first as rates of behavior were high and fewer staff were involved. The family home was to be the second-to-last place of intervention as disruptive behavior showed low rates at baseline, possibility due to the high level of attention and greater choice of activities provided in that environment. Furthermore, the timer and the fading of the strict timing is an example of indiscriminable contingencies.

Results

At the time of writing a marked decrease in disruptive behavior in the classroom had occurred. This was accompanied with an increase in staff positive attention and a decrease in attention to disruptive behaviors. Furthermore, James became more engaged in school tasks and activities. During a follow-up observation the timer which prompted staff to reinforce was not in use, however, disruptive behaviors remained low and staff attention to positive behaviors high. Intervention was not required in the playground as a generalization probe showed a decrease in disruptive behavior in this environment. This was most probably due to the classroom staff, who had been trained in the intervention, always being present, thus mediating generalization. Other school staff had observed the intervention and engaged in it without training. It was necessary to introduce the intervention to residential staff and the NCR had resulted in a decrease in disruptive behavior in that environment as well. A probe conducted in the taxi showed disruptive behavior still to be occurring and this will be the next intervention area targeted. It is hypothesized that when a generalization probe is conducted during community outings that low levels of disruptive behaviors will occur there as James is always with caregivers (mediators).

Concluding Summary and Recommendations

Several hypotheses have emerged as to why children with autism appear to have difficulty generalizing skills learnt between settings, people, behavior and/or time. Insistence on sameness, stimulus overselectivity and lack of motivation in teaching environments are more reflective of inadequate teaching practices rather than inherent flaws of children with autism. There is a considerable volume of research available within the applied behavior analytic domain that provides us with strategies to address generalization and maintenance of behavior. The application of this technology has been sorely lacking. Our limited review of the current literature found 42% of intervention research articles not to measure generalization and maintenance, in fact many of these did not even mention it. The cause for considered and well planned generalization is not enhanced by ABA text books leaving discussion of this important topic to the final chapters when students' ability to absorb information is reduced (e.g., Cooper et al., 2007). It is our belief that if a behavior is worthy of modification then surely it is worthy of a little extra effort to ensure that it maintains in the learner's repertoire for years to come and that they are able to generalize the skill across settings, people, and behaviors as necessary. After all, very few of us remain in the same residence surrounded by the same people and same experiences all of our lives. Indeed, with regards to consideration to pivotal skills, one might consider being a generalized generalize an imperative skill. Given how long it takes children to learn some skills, taking the effort to ensure appropriate and ongoing generalization is necessary to create cost effective and socially valid results.

The section Strategies to Promote Generalization discussed eight strategies to promote generalization. This is the list originally provide Stokes and Baer's (1977) nine categories minus train-and-hope which is not a strategy to promote generalization. From this group of strategies it is helpful to consider which will be most effective in generalizing behavior change for the client. Furthermore, it is imperative that the natural maintaining contingencies be determined. Why should a child continue to brush their teeth after the backward chaining procedure, with most to least prompts and a contrived reinforcer, once the skill is learnt and the interventionists go away? We might continue to clean our teeth into adult-hood because the result of not doing so is bad breath, unhealthy and grimy teeth, which are hygienically and socially unacceptable. A child with autism may not be motivated by these factors so perhaps placing tooth brushing into a chain of morning behaviors that culminates in cartons on TV before school or work may be sufficient. In an environment devoid of positive naturally maintaining contingencies, it is the role of the behavior analyst to promote their establishment before withdrawing from the environment. As behavior analysts it is not sufficient for us to sit by and wait for generalization to occur, it is our goal to make meaningful and socially significant changes in the lives of children with autism.

References

Alber, S. R., & Heward, W. L. (1996). "GOTCHA!" Twenty five behavior traps guaranteed to extend your students' academic and social skills. *Intervention in School and Clinic, 31*, 285-289.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed. Text Revision.). Washington DC: Author

Arco, L., & Millet, R. (1996). Maintaining instructional behavior after on-the-job training with process-based performance feedback. *Behavior Modification, 20,* 300-320 .

Baer, D. M., & Wolf, M. M. (1970). The entry into natural communities of reinforcement. In R. Ulrich, T. Stachnik, & J. Mabry (Eds.), *Control of human behavior* (Vol. 2, pp. 319-324). Glenview, IL: Scott, Foresman

Baer, D. M. (1999). *How to plan for generalisation* (2nd ed.). Austin, TX: Pro-Ed.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*, 91-97

Bondy, A., & Frost, L. (1994). The picture exchange communication system. *Focus on Autistic Behavior*, 9, 1-19.

Campbell, C. R., & Campbell, K. S. (1982). Programming "loose training" as a strategy to facilitate language generalization. *Journal of Applied Behavior Analysis, 15,* 295–301.

Carr, E. G., & Darcy, M. (1990). Setting generality of peer modeling in children with autism. *Journal of Autism and Developmental Disorders, 20,* 45-59

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied Behavior Analysis (2nd ed.)*. Upper Saddle River, NJ: Pearson Education.

Cowan, R. J., & Allen, K. D. (2007). Using naturalistic procedures to enhance learning in individuals with autism: A focus on generalized teaching within the school setting. *Psychology in the Schools, 44*, 701 -715.

Coyle, C., & Cole, P. (2004). A videotaped self-modelling and self-monitoring treatment program to decrease off-task behaviour in children with autism. *Australia & New Zealand Journal of Developmental Disabilities*, 29, 3-15.

Drabman, R. S., Hammer, D., & Rosenbaum, M. S. (1979). Assessing generalization in behavior modification with children: The generalization map. *Behavioral Assessment, 1,* 203-219

Durand, V. M., & Carr, E. G. (1992). An analysis of maintenance following functional communication training. *Journal of Applied Behavior Analysis, 25,* 777–794.

Eikeseth, S., & Smith, T. J. (1992). The development of functional and equivalence classes in high-functioning autistic children: the role of naming. *Journal of the Experimental Analysis of Behavior, 58,* 123-133

Fiorile, C. A., & Greer, R. D. (2007). The induction of naming in children with no prior tact responses as a function of multiple exemplar histories of instruction. *The Analysis of Verbal Behavior, 23,* 71-87

Goldstein, H., & Wickstrom, S. (1986). Peer intervention effects on communicative interaction among handicapped and nonhandicapped preschoolers. *Journal of Applied Behavior Analysis*, 19, 209-214.

Grow, L. L., Kellt, M. E., Roane, H. S., & Shillingsburg, M. A. (2008). Utility of extinction-induced response variability for the selection of mands. *Journal of Applied Behavior Analysis, 41,* 25-37.

Harchik, A. E., Harchik, A. J., Luce, S. C., & Sherman, J. A. (1990). Teaching autistic and severely handicapped children to recruit praise: Acquisition and generalization. *Research in Developmental Disabilities, 11,* 77-95.

Horner, R. H., Dunlap, G., & Koegel, R. L. (1988). *Generalization and Maintenance.* Baltimore: Paul H. Brookes Publishing.

Jones E. A., Feeley K. M., & Takacs J. (2007). Teaching spontaneous responses to young children with autism. *Journal of Applied Behavior Analysis, 40,* 565-570.

Jordan, R. (1999). *Autistic spectrum disorders: An Introductory Handbook for Practitioners.* London: David Fulton Publishers.

Kamps, D. M., Potucek, J., Lopez, A. G., Kravits, T., & Kemmerer, K. (1997). The use of peer networks across multiple settings to improve social interactions for students with autism. *Journal of Behavioral Education, 7,* 335-357.

Keller, E. S., & Schoenfelf, W. N. (1950). *Principles of Psychology: A systematic text in the science of behaviour.* New York: Appleton-Century-Crofts.

Koegel, R. L., & Rincover, A. (*1977*). Research on the difference between generalization and maintenance in extra-therapy responding. *Journal of Applied Behavior Analysis, 10,* 1-12

Koegel, L. K., Koegel, R. L., Hurley, C., & Frea, W. D. (1992). Improving social skills and disruptive behavior in children with autism through self-management. *Journal of Applied Behavior Analysis*, *25*, 341-353.

Koegel, R. L., & Egel, A. L. (1979). Motivating autistic children. *Journal of Abnormal Psychology, 88,* 418-426.

Koegel, R. L., & Mentis, M. (1985). Motivation in childhood autism: Can they or won't they*? Journal of Child Psychology and Psychiatry, 26,* 185-191.

Laushey, K. M., & Heflin, L. J. (*2000*). Enhancing social skills of kindergarten children with autism through the training of multiple peers as tutors. *Journal of Autism and Developmental Disorders*, *30*, 183-193.

Lee, R., & Sturmey, P. (2006). The effects of lag schedules and preferred materials on variable responding in students with autism. *Journal of Autism and Developmental Disorders, 36,* 421-428.

Lee, R., McComas, J. J. & Jawor, J. (2002). The effects of differential and lag reinforcement schedules on varied verbal responding by individuals with autism. *Journal of Applied Behavior Analysis, 35,* 391–402.

Lee, R., Sturmey, P., & Fields, L. (2007). Schedule-induced and operant mechanisms that influence response variability: A review and implications for future investigations. *Psychological Record, 57,* 429-455.

Lerman, D. C., Iwata, B. A., Shore, B. A., & DeLeon, I. G. (1997). Effects of intermittent punishment on self-injurious behavior: An evaluation of schedule thinning. *Journal of Applied Behavior Analysis, 30,* 187-201

Lovaas, O. L., & Schreibman, L. (1971). Stimulus overselectivity of autistic children in a two stimulus situation. *Behaviour Research and Therapy, 9,* 305-310.

Lovaas, O. I., Koegel, R. L., & Schreibman, L. (1979). Stimulus overselectivity in Autism: A review of research. *Psychological Bulletin, 86*, 1236-1254.

Lovaas., O. I., Schreibman, L., Koegel, R.L., & Rehm, R. (1971). Selective responding by autistic children to multiple sensory input. *Journal of Abnormal Psychology, 77,* 211-222.

MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. *Journal of Applied Behavior Analysis*, 26, 89-97.

Martin, G., & Pear, J. (2003). *Behavior Modification: What it is and how to do it (7th ed.)*. Upper Saddle River, NJ: Prentice Hall.

Matson, J. L. (1994). *Autism in Children and Adults: Etiology, Assessment, and Intervention.* California: Brooks/ Cole Publishing Company.

Miller, N., & Neuringer, A. (2000). Reinforcing variability in adolescents with autism. *Journal of Applied Behavior Analysis, 33,* 151–165

.

O'Neill, R. E., & Sweetland-Baker, M. (2001). Brief report: An assessment of stimulus generalization and contingency effects in functional communication training with two students with autism. *Journal of Autism and Developmental Disorders*, 31, 235-240.

Petursdottir, A., McComas, J., McMaster, K., & Horner, K. (2007). The effects of scripted peer tutoring and programming common stimuli on social interactions of a student with autism spectrum disorder. *Journal of Applied Behavior Analysis, 40*, 353-357.

Pierce, K. L., & Shreibman, L. (1994). Teaching daily living skills to children with autism in unsupervised settings through pictorial self-management. *Journal of Applied Behavior Analysis*, 27, 471-481.

Rincover, A., & Koegel, R. L. (1975). Setting generality and stimulus control in autistic children. *Journal of Applied Behavior Analysis*, *8,* 235-246.

Schopler, E., Yirmiya, N., Shulman, C., & Marcus, L. M. (2001). *The Research Basis for Autism Intervention.* New York: Kluwer Academic/ Plenum Publishers.

Schreibman, L., & Lovaas., O. I. (1973). Overselective response to social stimuli by autistic children. *Journal of Abnormal Child Psychology, 1,* 152-168.

Sidman, M. (1971). Reading and auditory-visual equivalences. *Journal of Speech and Hearing Research, 14,* 5-13

Sidman, M., & Tailby, W. (1982). Conditional discrimination vs. matching to sample: an expansion of the testing paradigm. *Journal of Experimental Analysis of Behavior, 37,* 5-22

Stahmer, A. C., & Shreibman, L. (1992). Teaching children with autism appropriate play in unsupervised environments using a self-management treatment package. *Journal of Applied Behavior Analysis*, 25, 447-459.

Stokes, T. F., & Osnes, P.G. (1989). An operant pursuit of generalization. *Behavior Therapy, 20*, 337-355.

Stokes, T. F., & Baer, D. M. (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10,* 349-367.

Tarbox, J., Wallace, M. D., & Tarbox, R. S. F. (2002). Successful generalized parent training and failed schedule thinning of response blocking for automatically maintained object mouthing. *Behavioral Interventions, 17,* 169-178.

Tiger, J. H., Bouxsein, K. J., & Fisher, W. W. (2007). Treating excessively slow responding of a young man with Asperger syndrome using differential reinforcement of short response latencies. *Journal of Applied Behavior Analysis, 40,* 559-563.

Time, May 7, 2006).

van den Pol, R. A., Iwata, B. A., Ivancic, M. T., Page, T. J., Neef, N. A., & Whitley, F. P. (1981). Teaching the handicapped to eat in public places: Acquisition, generalization and maintenance of restaurant skills. *Journal of Applied Behavior Analysis, 14,* 61-69.

Figure Captions

Figure 1. Generalization planner showing domains of generalization (top panel), generalization planning schema (middle panel) and hypothetical use of the planner in teaching identification of the stimulus class ‘cat’ (bottom panel).

Figure 2. Generalization planner for James’ disruptive behavior