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A Comparison of Direct and Indirect Contingencies of Reinforcement for Teaching Advanced Receptive Skills

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A Comparison of Direct and Indirect Contingencies of Reinforcement for Teaching Advanced Receptive Skills

by

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Abstract

An important variable not often examined in the literature is the relationship between target behaviors and their reinforcers. Previous research has demonstrated faster acquisition rates of simple receptive and imitative skills when the reinforcer used was part of the behavior chain that it reinforced. The current study evaluated the effectiveness of a direct reinforcement contingency to teach pairs of advanced receptive skills with three children with autism. During the indirect reinforcement condition, the therapist reinforced correct responding by handing the child an edible reinforcer. During the direct reinforcement condition, the reinforcer was located under the container displaying the correct response. Results showed that no participant reached mastery criterion regardless of the reinforcement contingency, although slightly higher levels of correct responding were observed during the direct reinforcement phase for all three participants on one skill.

Introduction

Positive reinforcement is a key component of any good treatment plan designed to increase various skills of individuals with autism and other related disabilities (Cooper, Heron, & Heward, 2007; Sundberg & Partington, 1998). There are many factors that increase the effectiveness of a reinforcer including states of deprivation and satiation (Knutson & Harding, 2000; Vollmer & Iwata, 1991), reinforcer variation (Bowman, Piazza, Fisher, Hagopian, & Kogan, 1997; Egel, 1981), speed of delivery, response effort, rate of reinforcement, and magnitude of reinforcement (Horner & Day, 1991; Mace, Mauro, Boyajian, & Eckert, 1997; Neef, Shade, & Miller, 1994; Richman, Wacker, & Winborn, 2001). However, the relationship between the reinforcer and the behavior to be reinforced is not often considered. Direct reinforcement occurs when the target response occurs directly within the behavior chain that produces the reinforcer (Koegel & Williams, 1980). Direct reinforcement can be compared to indirect reinforcement, in which the target response does not result in immediate access to reinforcement but rather the reinforcer is delivered by a trainer after the target behavior has been exhibited (Thompson & Iwata, 2000). Only three known studies have evaluated the direct reinforcement contingency; they demonstrated faster acquisition rates during direct reinforcement conditions compared with indirect reinforcement conditions for teaching basic receptive and imitative skills (Koegel & Williams, 1980; Williams, Koegel, & Egel, 1981; Thompson & Iwata, 2000).

Koegel and Williams (1980) evaluated the use of direct reinforcement versus indirect reinforcement on the acquisition of various skills. Three children with autism ages 4, 5, and 6 participated in the study. These children were chosen as participants due to their slow acquisition rates during therapy sessions. All children were nonverbal and were unable to respond to most instructions. Each child was enrolled in a treatment program, and teaching occurred as follows: the child was given up to 4 s to respond to the S^D. If the child engaged in the correct response, he or she received reinforcement in the form of praise and tangible items. If the child did not respond correctly within 4 s, the therapist responded with "no", and every third incorrect response was followed by prompting (i.e. no-no prompt sequence).

A multiple baseline across behaviors design was used to evaluate the effects of direct and indirect reinforcement. During baseline (indirect condition) for all children, correct responding was reinforced by the therapist delivering an edible or tangible item. Three target behaviors were chosen for child 1: imitating the "wh" sound, imitating clapping, and receptively discriminating a book from an array of three objects. During the direct reinforcement condition for imitating the "wh" sound, reinforcement occurred when the air expelled from the production of the "wh" sound spun a pinwheel that was held in front of the child. During direct reinforcement of imitating clapping hands, cymbals were placed in the child's hands such that an audible reinforcer was produced when the child correctly imitated clapping. During direct reinforcement of book discrimination, a flat cracker was placed under the cover of the book. All incorrect responses resulted in the therapist blocking the child from contacting the reinforcer, if necessary, during the direct reinforcement condition (Koegel & Williams, 1980).

The target behavior for child 2 was to discriminate a white box from a green box. During the direct reinforcement condition, the cracker was located under the correct box. The target behaviors for child 3 consisted of discriminating a circle from a square and selecting his printed name from an array of four names. During the direct reinforcement conditions, the child was allowed to drop the correct shape or name into a container, thus producing an auditory reinforcer (Koegel & Williams, 1980). Following the direct reinforcement phase, three matched tasks were taught using the same reinforcers for both the direct and indirect reinforcement conditions. In all indirect conditions, the therapist handed the child the reinforcer following correct responding. The first task consisted of selecting a red box from an array of two boxes. In the direct condition, the edible reinforcer was located under the correct box. The second task consisted of imitating bending over. In the direct condition, an edible reinforcer was placed on the ground, and the child was able to consume it if he imitated correctly. The third task consisted of imitating touching a spoon to the child's head. In the direct condition, the spoon was dipped in applesauce, and the child was able to consume it if he imitated correctly (Koegel & Williams, 1980).

Results demonstrated that direct reinforcement was more effective than indirect reinforcement at increasing the rate of acquisition of each targeted skill. Baseline (indirect reinforcement) levels for all participants and targeted responses were low; when direct reinforcement was implemented, rapid acquisition of each response was observed. In addition, a similar result was shown for each of the three matched tasks, as acquisition of skills only occurred during direct reinforcement conditions regardless of the type of reinforcer being used. Because acquisition only occurred during direct reinforcement, the

direct reinforcement contingency was likely responsible for acquisition rates rather than differences in reinforcer effectiveness (Koegel & Williams, 1980).

In a similar study, Williams et al. (1981) extended the work of Koegel and Williams (1980) by comparing functional (direct) and arbitrary (indirect) reinforcers on the acquisition of six different behaviors. Three children with autism ages 4, 4, and 7 participated in the study. Each child was nonverbal and exhibited frequent self-stimulatory behavior. All could follow simple one-step directions. A multiple baseline across participants and behaviors was used, and teaching procedures were the same as those used by Koegel and Williams (1980). A predetermined number of baseline (indirect reinforcement) sessions was conducted for each target behavior.

Two tasks were chosen for child 1: imitating extending one arm outward with palm facing up and discriminating between two different colored boxes. Indirect reinforcement consisted of placing an edible reinforcer in the child's mouth. Direct reinforcement of imitating arm outward consisted of placing the reinforcer in the child's hand, and direct reinforcement for box discrimination consisted of placing the reinforcer under the correct box (Williams et al., 1981). Four tasks were chosen for child 2: imitating opening mouth, discriminating between a cup and spoon, imitating bending over, and imitating touching head. For indirect reinforcement, all tasks consisted of handing the child an edible reinforcer. Direct reinforcement of opening mouth consisted of placing the reinforcer in the child's mouth. Direct reinforcement of cup discrimination consisted of allowing the child to consume juice that was in the correctly selected cup. Direct reinforcement of imitating bending over consisted of placing a chip on the floor and allowing the child to consume it once he bent over. Direct reinforcement of imitating

touching head consisted of placing a chip on the child's head and allowing him to consume it once he correctly touched his head. The task for child 3 was the same as the cup and spoon discrimination task for child 2 (Williams et al., 1981).

After the direct reinforcement condition was completed for each participant, the indirect reinforcement condition was reinstated. In addition, several tasks were randomly alternated with already acquired behaviors to establish whether stimulus control under the appropriate discriminative stimulus had occurred. Correct responses were reinforced in the same manner as in the indirect reinforcement condition (Williams et al., 1981). Results demonstrated that the direct reinforcement condition resulted in acquisition of all targeted skills for all participants. Percentages of correct responding were low across all indirect reinforcement conditions. When the direct reinforcement contingency was added, all participants rapidly acquired the targeted skills, and the skills maintained during the return to indirect reinforcement. Stimulus control was demonstrated by the high rates of correct responding when the target behaviors and previously acquired behaviors were alternated (Williams et al., 1981).

Thompson and Iwata (2000) further extended the work of Koegel and Williams (1980) and Williams et al. (1981) by examining the effects of direct and indirect reinforcement on a task that involved opening a container. In addition, Thompson and Iwata (2000) recorded the frequency with which participants engaged in reaching behavior during the indirect reinforcement condition, as reaching was hypothesized to interfere with performing the target response during this condition. Six participants were involved in the study, all of whom attended a day treatment program for individuals with self-injurious behaviors (SIB). The SIB did not seem to interfere with the acquisition of

any of the targeted skills. All participants were nonverbal and required assistance with daily living skills. Data were collected on the percentage of correct responses (i.e., opening the container at least halfway). Data were also collected on the frequency of reaching for the reinforcer during the indirect reinforcement condition only, as the reinforcer was either not present during baseline or was inside a container during the direct reinforcement condition (Thompson & Iwata, 2000).

A multielement design consisting of baseline (no reinforcement), indirect reinforcement, and direct reinforcement was used for two participants. However, due to observed carryover effects, the design was modified to include only a comparison of the indirect and direct conditions for the remaining four participants. Target responses for all participants consisted of opening a clear plastic container. A zippered pouch was used for two participants, a bowl with a snap on lid was used for one participant, and a box with a fitted lid was used for three participants based on their skill set (Thompson & Iwata, 2000). During the indirect reinforcement condition for all participants, reinforcement for correct responding consisted of the therapist delivering an edible reinforcer. During the direct reinforcement condition for all participants, the reinforcer was placed inside the clear container and the participant was allowed to consume it following a correct response (i.e., opening the container; Thompson & Iwata, 2000).

Results demonstrated better acquisition rates during the direct reinforcement condition than during the indirect reinforcement condition. Four participants showed acquisition of the targeted skills during both conditions, although better performance was observed during the direct reinforcement condition. For the remaining two participants, skill acquisition only occurred during the direct reinforcement condition. In addition,

data for two participants demonstrated that when reaching behavior was consistently high during the indirect condition, skill acquisition was low, supporting the hypothesis that interfering behaviors during an indirect reinforcement contingency may prevent individuals from acquiring targeted skills. However, data on the other four participants were inconclusive (Thompson & Iwata, 2000).

One of the factors that may play a role in the direct reinforcement contingency is the possibility of automatic reinforcement. Automatic reinforcement is reinforcement in the absence of a socially mediated reinforcer (Vaughn & Michael, 1982; Vollmer, 1994). For example, singing aloud while driving alone may be an example of an automatically reinforced behavior because the behavior of singing itself may be reinforcing. In addition, there is no other person present providing a reinforcer. Behaviors that are maintained by automatic contingencies can be especially resistant to change because it is difficult to identify the particular aspect of the behavior or stimulation produced by the behavior that is reinforcing (Piazza, Adelinis, Hanley, Goh, & Delia, 2000). Furthermore, even if the reinforcer is identified, it is often difficult to manipulate the contingency because the reinforcer is inseparable from the behavior itself. The automatic reinforcement contingency may explain why the direct reinforcement contingency has been shown to be more effective than indirect reinforcement.

Research shows that direct reinforcement may be more effective than indirect reinforcement on the acquisition of various skills (Koegel & Williams, 1980; Thompson & Iwata, 2000; Williams et al., 1981). However, research has only evaluated the use of direct reinforcement when the skills taught were simple receptive or imitation skills such as opening a container, imitating clapping hands, or selecting a colored box from an array

of two boxes. No known studies have evaluated the effect of direct reinforcement on more complex skills such as selecting prepositions, selecting a quantity that has more or less compared to a sample, or selecting by function, feature, or class. The purpose of the current study was to examine the effectiveness of using direct reinforcement on the acquisition of more advanced receptive skills. In addition, the current study expanded on the previous literature by prompting the correct answer after each error rather than using a no-no prompt sequence (Williams et al., 1981; Koegel & Williams, 1980).

Method

Participants

Three children with autism ages 8-10 participated in the study. All children were receiving Verbal Behavior therapy (ABA/VB) from a small, local therapy center that focuses on the acquisition of language and the reduction of disruptive behavior in young children with autism. All children were able to speak in 3-5 word sentences and follow basic receptive directions.

Ricky was an 8-year-old male. He could answer at least 40 "wh" questions, request at least 100 items, label at least 150 items, complete block designs, patterns, seriation (i.e., putting pictures of an activity in order), and sequencing tasks, select at least 250 items on demand, select items based on shape, color, prepositional location, and pronoun, and select and label any number up to 10.

Jack was an 8-year-old male. He could answer at least 40 "wh" questions, request and label at least 750 different items, complete block designs, patterns, seriation, and sequencing tasks, select at least 1200 different items on demand, select by color, shape, and adjective, select and label any number up to 10, receptively identify at least 6 comparisons involving measurement (i.e. more/less, big/little, etc.), and label and receptively identify the days of the week on a calendar.

Joey was a 10-year-old male. He was able to answer at least 25 "wh" questions, request and label at least 750 different items, complete patterns, sequences, or seriation

tasks, select at least 1200 different items, select by color and shape, and select and label any number up to 10.

Inclusion and Exclusion Criteria

Participants were included in the study if they had mastered the necessary prerequisite skills for one of the more advanced receptive programs outlined in the Assessment of Basic Language and Learning Skills-Revised (ABLLS-R; Partington, 2010) but had not met the mastery criteria for that program. The ABLLS-R is an assessment tool and skill tracking system used primarily to teach language to children who have autism. It assesses skills in 26 different overarching categories including receptive language, imitation, requesting, labeling, intraverbal, academic, self-help, and motor skills. Participants were also included in the study if they had mastered the necessary prerequisite skills for one of the agency's academic programs but had not yet met the mastery criteria for that program. Participants were chosen based on a history of failure to master one of these programs, such as selecting more and less, using indirect reinforcement. Participants were excluded in this study if they exhibited rates of disruptive behavior high enough to interfere with teaching.

Setting

All of Ricky's sessions and 8 of Joey's sessions took place at the therapy center at a small table in a 1:1 therapy room approximately 3.5m by 4m. Sessions at Joey's home took place either at a dining room table, kitchen breakfast bar, or desk in his room. Sessions at Jack's home occurred in a playroom consisting of a small table and two chairs along with various toys and games used for teaching and reinforcement.

Data Collection

A correct response during indirect reinforcement was defined as the participant naming the correct number or day in response to the S^D. A correct response during direct reinforcement was defined as the participant selecting the correct container in response to the S^D. Ten trials of each skill were conducted during each session to yield an overall percentage correct score during the first three phases for Ricky and during the first two phases for Jack and Joey. Ten trials of one skill were conducted during each session to yield an overall percentage correct score during the last phase for Ricky, the last three phases for Jack, and the last four phases for Joey. Mastery criterion consisted of three consecutive sessions of the participant scoring 90% or above on a skill. Sessions were run either by the principal investigator or by one of the participants' primary therapists. One to eight sessions were conducted per day with no more than five sessions conducted in a row.

Therapist Training

A training protocol (see Appendix A) was adapted from the therapy center's therapist competency evaluation for use in therapist training and treatment integrity. Behavioral skills training (BST), consisting of instructions, modeling, rehearsal, and feedback, was used to train the therapists on the correct indirect and direct reinforcement procedures. Each therapist scored at least 90% on the protocols three consecutive times for both indirect and direct reinforcement before performing the procedures independently. Furthermore, certain areas integral to the reinforcement contingency were graded separately (i.e., appropriate S^D was stated, reinforcement was provided appropriately based on the reinforcement contingency, and appropriate trial by trial data

were collected), and therapists scored 100% on those areas in addition to scoring 90% on the protocol overall. The first therapy session that a therapist had with a child was monitored by the principal investigator in person, and feedback was delivered as necessary until the therapist was performing the procedures correctly.

Treatment Integrity

All sessions were videotaped with the exception of 16 session with Ricky, three sessions with Jack, and 15 sessions with Joey. The training protocol was also used as treatment integrity measures for 33% of sessions for all participants. Treatment integrity for sessions carried out by the principal investigator was assessed by research assistants (RA) that also worked at the therapy center. Because they were familiar with the treatment integrity protocol, training consisted of reviewing each of the items on the protocol and subsequently having the RA independently score two trials, one in which the participant made a correct response and one in which the participant made an incorrect response. All RA's scores matched the principal investigator's for all trials reviewed.

Each item on the protocol was scored to identify whether the therapist performed the step correctly or incorrectly. Some items on the protocol were evaluated once (i.e., materials are organized and ready), while other items on the protocol were evaluated on a trial by trial basis (i.e., reinforcement was delivered immediately after a correct, independent response). The number correct was divided by the total number of items on the protocol to yield an overall percentage correct. If treatment integrity fell below 90% overall on the protocol on two consecutive occasions, the therapist would have been retrained using BST procedures before the next session takes place. In addition, if the treatment integrity fell below 100% on two consecutive occasions for the steps integral to

the reinforcement contingency stated above, BST would have also been used to retrain the therapist before the next session takes place. Treatment integrity never fell below these criteria so retraining did not occur. Treatment integrity for Ricky was 98%, Jack was 99.8%, and Joey was 99.8%.

Interobserver Agreement

Observers were trained in the data collection procedure (i.e., discrimination between correct and incorrect responses) in the same way as they were trained in the treatment integrity measures. Interobserver agreement (IOA) was calculated for 33% of sessions for all participants. A trained observer reviewed the videotaped sessions and independently scored each targeted response as correct or incorrect. Agreement was defined as the observer recording the same response (i.e., correct or incorrect) as the recorded data on the data sheet. Percentage agreement was calculated by dividing the number of agreements by the total number of trials multiplied by 100 for each session. IOA for Ricky was 100%, Jack was 99.6%, and Joey was 98.5%.

Reinforcer Selection

Edibles were used as reinforcers because they are used most frequently during therapy sessions and could be easily placed under containers during the direct reinforcement condition. A preference assessment was conducted with each child before each session involving asking the child to choose which reinforcer he would like to earn from an array of edibles. If participants indicated that they wanted a different reinforcer during any point in a session, that reinforcer was used instead for the remainder of the session. Access to edibles was restricted during the therapy session until the direct or indirect reinforcements sessions were run.

Task Selection

For Ricky and Joey, the task chosen was to select a number that was more or less than the comparison number in the presence of the appropriate S^D. For example, if the numbers 5 and 8 were shown on different containers, the participant would select the container that displayed the number 8 when asked, "Which one is more?"

For Jack, the task chosen was to select the day that comes before or after the day presented in the S^D. For example, if the days "Tuesday" and "Thursday" were shown on different containers, the participant would select the container that displayed "Tuesday" when asked, "What day comes before Wednesday?"

Experimental Design

A non-concurrent multiple-baseline-across-participants design was used. Two pairs of skills were targeted for Ricky in the first three phases and for Jack and Joey in the first two phases. In all subsequent phases, only one skill was targeted for all participants. A minimum of five baseline (indirect reinforcement) sessions were conducted for each participant to assess whether they learned the skill during the indirect reinforcement condition. All participants entered into the indirect reinforcement phase within a month of each other.

Procedure

Indirect reinforcement. Two containers were placed in front of the child displaying different stimuli. The order of the stimuli was randomly changed throughout the session to safeguard against a side bias. For the more/less task, two numbers were randomly chosen out of a container for each trial. For the before/after task, a day of the week was randomly chosen out of a container. For both tasks, the target skill (more/less

or before/after) was randomly chosen out of a container, and no more than five trials of the same skill were run in a row.

During the indirect reinforcement phase, the participants were given up to 3s to respond to the S^D. Correct responses were reinforced with praise in conjunction with the therapist giving the participant an edible reinforcer. Following incorrect responses, the S^D was presented again and was immediately followed by an echoic prompt to say the correct response in addition to a physical prompt to touch the correct container (hand-over-hand prompting). After the participants responded correctly with the prompt, the S^D was presented again, and the participant was given 3s to respond correctly in order to transfer stimulus control from the prompt to the S^D (transfer trial). Correct responses on the transfer trial were reinforced with praise in conjunction with the therapist giving the participant an edible reinforcer.

Indirect reinforcement with no error correction. For Jack, an indirect reinforcement phase without error correction was run after the second indirect reinforcement phase due to a lack of increased percentage correct. This phase was identical to the indirect reinforcement phase, except incorrect responses were no longer followed by an error correction procedure. Following incorrect responses, the trial immediately ended and the next one began.

Direct reinforcement. The direct reinforcement phase involved the same procedures as the indirect reinforcement phase with the addition of the direct reinforcement contingency. In this phase, the reinforcer was located under the container that displayed the correct answer. If the participant made a vocal response but did not pick up the corresponding container, he was prompted to pick up the container (i.e., "Pick

it up.”). Participants always picked up the container after the verbal prompt and no additional prompt was necessary.

Direct reinforcement with no error correction. For Ricky, a direct reinforcement phase without error correction was run after the direct reinforcement phase due to a lack of increased percentage correct. This phase was identical to the direct reinforcement phase, except incorrect responses were no longer followed by an error correction procedure. Following incorrect responses, the trial immediately ended and the next one began.

Results

Figure 1 represents the percentages of correct responding across all phases for all participants. None of the participants reached mastery criterion during any of the phases. Correct responding during the initial indirect reinforcement phase ranged between 10% and 80% and averaged between 29% and 54% across all participants on all skills, demonstrating low to moderate percentages correct. Correct responding during all direct reinforcement phases ranged from 0% to 80% and averaged between 38% and 60% across all participants and skills. Additionally, variability was consistently high during all phases for all participants.

Table 1 presents the mean percentages correct for Ricky. Ricky's mean scores during indirect reinforcement were 32% correct for more and 54% correct for less. When the direct reinforcement contingency was put in place, his correct responding increased to an average of 59% for more but decreased to 50% for less. When indirect reinforcement was reinstated, his correct responding fell to an average of 40% for more. The data suggest that correct responding on more was highest during the direct reinforcement phases; however, correct responding on less was lower during the direct reinforcement phases.

Table 2 presents Jack's mean percentages correct. Jack's mean scores during the initial indirect reinforcement phase were 29% correct for before and 53% correct for after. When the direct reinforcement contingency was put in place, correct responding increased to an average of 38% for more before but decreased to 49% for after. No

substantial difference was observed when the indirect reinforcement contingency was reinstated. During the final direct reinforcement phase, correct responding rose to 42% for more. These data suggest that for one skill (more), correct responding did not increase until each direct reinforcement phase was put in place, and that increase was maintained into the indirect reinforcement phases. Lower percentages of correct responding were observed during the direct reinforcement phase for the other skill (less).

Table 3 presents Joey's mean percentages correct. Joey's mean scores during the initial indirect reinforcement phase were 49% correct for more and 45% correct for less. Correct responding increased to 51% for more and 60% for less during the direct reinforcement phase. Correct responding dropped to 38% on more when the indirect reinforcement contingency was reinstated. After a return to direct reinforcement, average correct responding on more increased to 54% but dropped to 51% and 48% during the following indirect and direct reinforcement phases, respectively. Data suggest that for one skill (less), direct reinforcement was more effective at increasing percentage correct. However, for the other skill (more), no consistent pattern of responding was observed in either phase.

There was no substantial difference between phases that used error correction and phases that did not use error correction. Ricky averaged 59% correct on more and 50% on less during the direct reinforcement with error correction and averaged 58% correct on more and 43% correct on less during direct reinforcement without error correction. Jack averaged 38% correct on indirect reinforcement with error correction while targeting more and 37% correct using indirect reinforcement without error correction on the same skill.

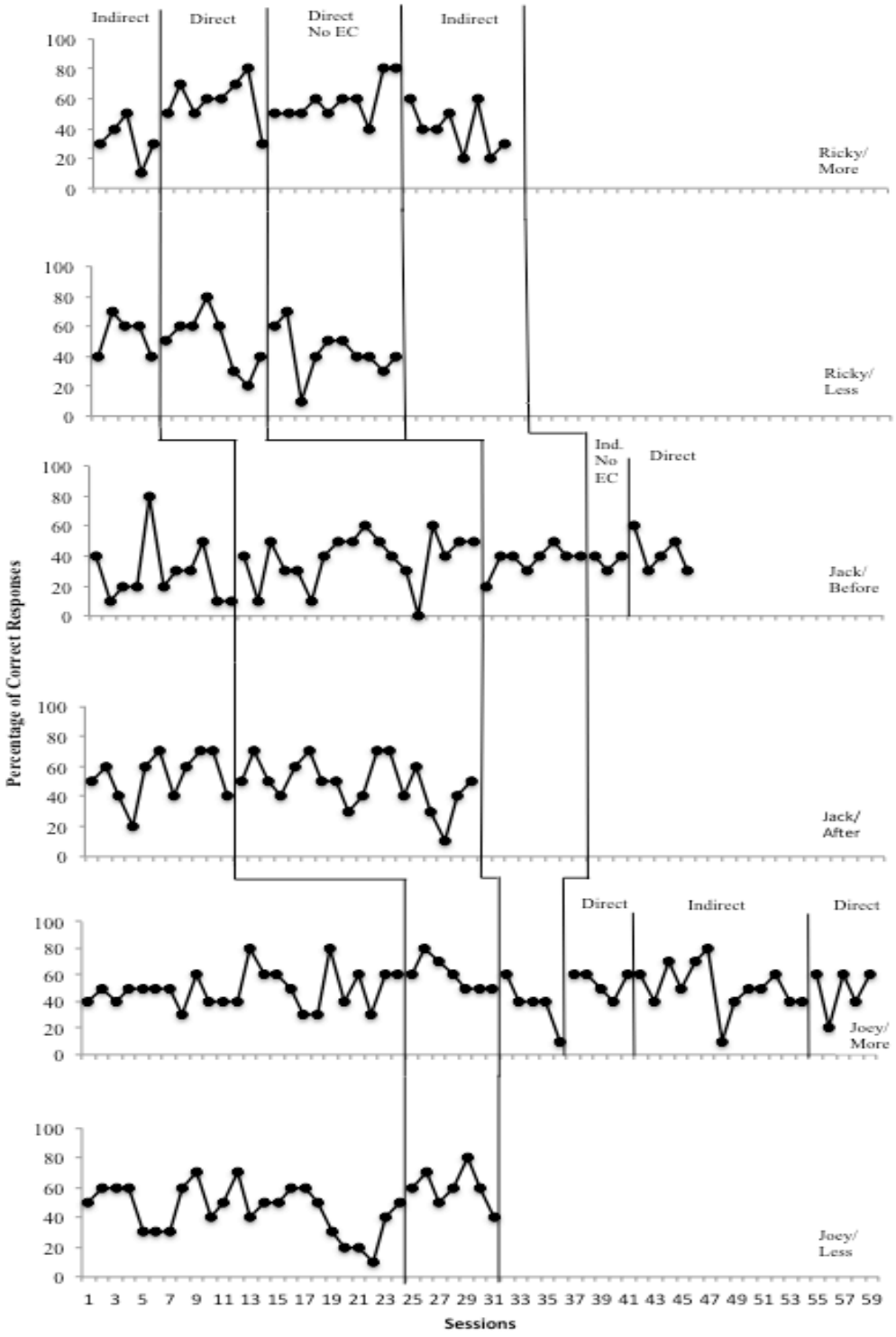

Figure 1. Percentage of correct responding during each session.

Table 1

Ricky's Mean Percentage Correct

Phase	More	Less
Indirect Reinforcement	32%	54%
Direct Reinforcement	59%	50%
Direct Reinforcement- No EC	58%	43%
Indirect Reinforcement	40%	

Table 2

Jack's Mean Percentage Correct

Phase	More	Less
Indirect Reinforcement	29%	53%
Direct Reinforcement	38%	49%
Indirect Reinforcement	38%	
Indirect Reinforcement- No EC	37%	
Direct Reinforcement	42%	

Table 3

Joey's Mean Percentage Correct

Phase	More	Less
Indirect Reinforcement	49%	45%
Direct Reinforcement	51%	60%
Indirect Reinforcement	38%	
Direct Reinforcement	54%	
Indirect Reinforcement	51%	
Direct Reinforcement	48%	

Discussion

The current study examined the effectiveness of using a direct reinforcement contingency on the acquisition of pairs of advanced receptive skills. All three participants exhibited higher percentages of correct responding on at least one targeted skill during the direct reinforcement conditions (Ricky on more, Jack on before, Joey on less). However, two participants exhibited lower percentages of correct responding (Ricky on less and Jack on after) and one participant exhibited variable responding (Joey on more) on the opposite targeted skill during the direct reinforcement conditions in comparison to the indirect reinforcement conditions. Overall, the results of this study do not suggest that direct reinforcement produces substantially better acquisition than does indirect reinforcement.

Previous studies have hypothesized several reasons as to why a direct reinforcement contingency may be more effective than an indirect reinforcement contingency (Koegel & Williams, 1980; Williams et al., 1981; Thompson & Iwata, 2000). First, it is proposed that direct reinforcement may strengthen the relationship between the behavior and the reinforcer because the target behavior is the last behavior in the chain to occur prior to reinforcement (Koegel & Williams, 1980; Williams et al., 1981; Thompson & Iwata, 2000). Because the reinforcer is part of the behavior chain, no other irrelevant or competing behaviors can be adventitiously reinforced.

Previous research has speculated that automatic reinforcement plays a large role in direct reinforcement contingencies (Koegel & Williams, 1980). The automatic

reinforcement contingency may explain why the direct reinforcement contingency had been shown to be more effective than indirect reinforcement in previous research. Additionally, direct reinforcement may have been more effective due to the immediacy of the reinforcement (Koegel & Williams, 1980; Williams et al., 1981). Because the reinforcer is part of the response chain, obtaining the reinforcer during direct reinforcement may be more immediate than obtaining the reinforcer during indirect reinforcement.

Finally, previous studies have cited within-stimulus prompting as a reason why direct reinforcement was shown to be more effective than indirect reinforcement (Koegel & Williams, 1980; Williams et al., 1981; Thompson & Iwata, 2000). When a reinforcer is included in a response chain, the inclusion of the reinforcer may act as a within-stimulus prompt and highlight the relevant stimulus. Because the reinforcer was visible during most targeted skills in previous studies, within-stimulus prompting was very likely.

There are several factors that could have contributed to why no substantial difference was seen between direct and indirect reinforcement in the current study. First, the participants may have lacked a prerequisite or component skill needed to master the targeted skills. Skills were chosen only if the participants exhibited prerequisite skills outlined in the ABLLS-R or skills deemed prerequisite by the therapy center's Board Certified Behavior Analyst. For Ricky and Joey, these skills were tacting all numbers used during the study, selecting the numbers on command, and matching the numbers to pictures of quantities. It is possible that teaching participants to select quantities representing more and less would have facilitated the acquisition of selecting numbers.

For Jack, prerequisite skills included tacting and pointing the days of the week on a calendar and tacting and selecting the written days of the week on command. It is possible that teaching Jack to select a day that comes before or after a specified day using a calendar would have facilitated the acquisition of selecting days on a container.

A second factor is the reinforcer selection; edibles were used for several reasons. First, edibles were one of many types of reinforcers frequently used during these participants' normal therapy sessions. Second, edibles could be placed discretely under the containers during the direct reinforcement phase. Third, edibles could be consumed in seconds, allowing more time for teaching and a quicker pacing to the sessions. However, it is possible that other reinforcers such as access to activities or toys could have been more effective than edibles due to the high-functioning abilities of all of the participants as well as individual preferences.

Because edibles were used, it is possible that there may not have been a strong establishing operation (EO) during the study. Although participants expressed a preference for a particular edible, never refused an edible after it was given as a reinforcer, and access to edibles was restricted during other parts of the therapy session when the study was not being run, access to food items was not controlled outside of the therapy sessions. It is possible that participants had eaten prior to sessions, thus lowering the EO for any edibles. If the EO for edibles was low for any participant during any phase, the motivation to exhibit the correct response would also be low. In addition, stimulus control would be compromised.

It is possible that the S^Ds presented were not strong enough to evoke correct responding either due to weak EOs or because two behaviors were being trained at the

same time. As a result, later sessions with all participants only trained one behavior (more for Joey and Ricky and before for Jack). Although participants failed to reach mastery criterion even when only one behavior was being trained, Ricky and Jack showed slightly higher levels of correct responding when only one skill was being targeted. However, because the change from teaching two behaviors to teaching one behavior occurred later on in the study, it is unclear whether this higher level of correct responding was due to teaching only one behavior at a time or whether the participants were slowly learning the behaviors over the course of the study.

All participants exhibited either a side bias or consistent pattern of responding that was not related to the S^D exhibited during some portion of the study. For example, in most sessions, Ricky consistently selected the container on the right side regardless of the task presented. Joey also consistently selected the container on the right side in earlier sessions. Response effort may have influenced a side bias because both Ricky and Joey are right-handed. In later sessions, it was observed that Joey chose the container on the opposite side of the container that he chose in the previous trial. During early sessions, Jack selected the container that was on the side of the correct container in the previous trial. It is possible that other behaviors were being adventitiously reinforced on an intermittent schedule such as selecting only a certain side or switching sides after each trial. If another behavior was being adventitiously reinforced, the acquisition of the target behaviors may have been hindered.

Because of the nature of the targeted skills, there were only two containers presented during any given trial. As a result, there was a 50% chance of participants selecting the correct answer. It is possible that the response effort required to attend to

the S^D and stimuli then select the correct container was greater than the response effort involved in selecting a random container. Because the participant acquired the reinforcer after every trial, either through correct responding or through a short error correction procedure, it may have been more efficient for the participant to guess. Although, no differences in accuracy of responding were observed when incorrect responding resulted in the end of the trial rather than an error correction procedure, differences may have been seen if the phases were run out longer.

A seventh reason why direct reinforcement was shown to be less effective in the current study in comparison to previous research is due to immediacy of reinforcement. Previous research cited immediacy of reinforcement during direct reinforcement in comparison to indirect reinforcement as a primary reason why direct reinforcement was more effective (Koegel & Williams, 1980; Williams et al., 1981). The current study attenuated the difference in speed of delivery by delivering the reinforcer within three seconds after a correct response. Immediate reinforcement during the indirect reinforcement phase may be one explanation why no major differences in correct responding were observed during the phases.

Previous studies had suggested that within-stimulus prompting played a large role as to why direct reinforcement was shown to be more effective than indirect reinforcement (Koegel & Williams, 1980; Williams et al., 1981; Thompson & Iwata, 2000). Although this explanation may be true when the reinforcer is visible (i.e., if the participant were asked to touch his head and a reinforcer was located on his head), it is not true when the reinforcer is not visible, as in the current study (i.e., reinforcer located under correct container). The lack of a within-stimulus prompt during direct

reinforcement may explain why direct reinforcement was not effective in the current study.

A final limitation is due to frequency of sessions. Jack was only seen by the principal investigator or research assistant once per week, Ricky was seen twice per week, and Joey was seen one to three times per week. Additionally, any cancellation of sessions due to illness or scheduling conflicts meant that some sessions were separated by weeks. Although several sessions could be conducted during any given therapy session, the large gaps in between blocks of sessions could have hindered maintenance of any gains made during the previous block of sessions, however small. It is possible that running a consistent schedule of sessions on multiple days during the week would have resulted in greater gains during those sessions.

Future research should run the direct reinforcement phase longer to evaluate whether the participants will acquire the skills over a longer period of time. It is possible that the participants would have reached mastery criterion if the direct reinforcement phase had been carried out for longer, as some participants exhibited higher percentages of correct responding during the direct reinforcement phase for some skills.

Future research should also evaluate whether using other reinforcers such as access to preferred items or activities is more effective than using edibles at increasing correct responding. Finally, because no substantial differences were observed between phases that used error correction after each incorrect response and phases that did not correct errors, future research should evaluate whether using the above described error correction procedure is a necessary component when teaching using direct reinforcement.

References

Bowman, L. G., Piazza, C. C., Fisher, W. W., Hagopian, L. P., & Kogan, J. S. (1997). Assessment of preference for varied versus constant reinforcers. *Journal of Applied Behavior Analysis, 30*, 451-458.

Brown, K. A., Wacker, D. P., Derby, K. M., Peck, S. M., Richman, D. M., Sasso, G. M., … Harding, J. W. (2000). Evaluating the effects of functional communication training in the presence and absence of establishing operations. *Journal of Applied Behavior Analysis, 33*, 53-71.

Cooper, J., Heron, T., & Heward, W. (2007). *Applied behavior analysis* (2nd ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Egel, A. L. (1981). Reinforcer variation: Implications for motivating developmentally disabled children. *Journal of Applied Behavior Analysis, 14*, 345-350.

Horner, R. H. & Day, H. M. (1991). The effects of response efficiency on functionally equivalent competing behaviors. *Journal of Applied Behavior Analysis, 24*, 719-732.

Koegel, R. & Williams, A. (1980). Direct versus indirect response-reinforcer relationships in teaching autistic children. *Journal of Abnormal Child Psychology, 8*, 537-547.

Mace, F. C., Mauro, B. C., Boyajian, A. E., & Eckert, T. L. (1997). Effects of reinforcer quality on behavioral momentum: Coordinated applied and basic research. *Journal of Applied Behavior Analysis, 30*, 1-20.

Neef, N. A., Shade, D., & Miller, M. S. (1994). Assessing influential dimensions of reinforcers on choice in students with serious emotional disturbance. *Journal of Applied Behavior Analysis, 27*, 575-583.

Partington, J. (2010). *The assessment of basic language and learning skills-revised.* Pleasant Hill, CA: Behavior Analysts, Inc.

Piazza, C. C., Adelinis, J. D., Hanley, G. P., Goh, H., & Delia, M. D. (2000). An evaluation of the effects of matched stimuli on behaviors maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 33*, 13-27.

Richman, D. M., Wacker, D. P., & Winborn, L. (2001). Response efficiency during functional communication training: Effects of effort on response allocation. *Journal of Applied Behavior Analysis, 34*, 73-76.

Sundberg, M.L. & Partington, J.W. (1998). *Teaching language to children with autism or other developmental disabilities*. Pleasant Hill, CA: Behavior Analysts, Inc.

Thompson, R. & Iwata, B. (2000). Response acquisition under direct and indirect contingencies of reinforcement. *Journal of Applied Behavior Analysis, 33,* 1-11.

Vaughan, M. E. & Michael, J. L. (1982). Automatic reinforcement: An important but ignored concept. *Behaviorism, 10*, 217-228.

Vollmer, T. R. & Iwata, B. A. (1991). Establishing operations and reinforcement effects. *Journal of Applied Behavior Analysis, 24*, 279-291.

Williams, J., Koegel, R., & Egel, A. (1981). Response-reinforcer relationships and improved learning in autistic children. *Journal of Applied Behavior Analysis, 14*, 53-60.

Appendices

Appendix A-Treatment Integrity Checklist

Therapist: _____ Date of Session: _____

Client: _____ Date Reviewed: _____

Environment										
Are the program materials organized and ready?	Y N									
Is the environment free from distractions?	Y N									
Are the reinforcers easily accessible?	Y N									
Preference Assessment										
Appropriate preference assessment was conducted.	Y N									
Task										
Are materials for the task ready?	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Instruction (S^D)										
*States appropriate S^D.	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
S^D was presented only 1 time before either a response or correction procedure.	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
There was only a 3-5 second delay between the S^D and response or correction procedure.	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Consequences										
Corrective procedures were implemented correctly (after incorrect response, wait a beat, and represent S^D with a 0 second delay physical prompt).	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Correct transfer trials were used following error correction procedures (immediately represent S^D and remove prompt).	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
*Reinforcement was provided within 3s of an independent, correct response.	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
*Reinforcement was provided appropriately based on reinforcement contingency (indirect or direct).	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Behavior Management										
Correctly implements escape extinction.	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Score										
IOA	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N