

*RESPONSE ACQUISITION UNDER DIRECT AND
INDIRECT CONTINGENCIES OF REINFORCEMENT*

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We compared the effects of direct and indirect reinforcement contingencies on the performance of 6 individuals with profound developmental disabilities. Under both contingencies, completion of identical tasks (opening one of several types of containers) produced access to identical reinforcers. Under the direct contingency, the reinforcer was placed inside the container to be opened; under the indirect contingency, the therapist held the reinforcer and delivered it to the participant upon task completion. One participant immediately performed the task at 100% accuracy under both contingencies. Three participants showed either more immediate or larger improvements in performance under the direct contingency. The remaining 2 participants showed improved performance only under the direct reinforcement contingency. Data taken on the occurrence of “irrelevant” behaviors under the indirect contingency (e.g., reaching for the reinforcer instead of performing the task) provided some evidence that these behaviors may have interfered with task performance and that their occurrence was a function of differential stimulus control.

DESCRIPTORS: reinforcement, instruction, response–reinforcer relations, stimulus control

Most applied research on variables that contribute to the effectiveness of reinforcement procedures has had two main emphases—reinforcer identification and reinforcer usage. A large body of work has focused on the identification of stimuli that function as reinforcers (e.g., see recent reviews by Ivancic, in press, and by Lohrmann-O'Rourke & Browder, 1998). A smaller but growing number of studies have attempted to identify factors that enhance the effects of a given reinforcer or set of reinforcers. For example, it has been shown that reinforcer variation (Egel, 1981) and deprivation (Vollmer & Iwata, 1991), as well as response effort and the rate, quality, and delay of reinforcement (Neef, Shade, & Miller 1994), may be

altered to improve performance. In spite of these advances, clinicians and educators still encounter difficulties in establishing adaptive behaviors, particularly in individuals with profound developmental disabilities. Thus, additional research is needed to identify conditions that enhance reinforcement effects.

The present study focused on one aspect of reinforcer usage that has been examined in two previous investigations. Koegel and Williams (1980) made a distinction between two types of reinforcement contingencies. *Direct* contingencies were those in which the target response produced access to reinforcement with no intervening steps (i.e., procurement of reinforcement was part of the response chain or at least was topographically related to it). By contrast, *indirect* contingencies were those in which the target response did not produce immediate access to reinforcement; instead, a therapist delivered the reinforcer once the target response occurred. This distinction bears some resemblance to the differentiation between auto-

This research was supported in part by a grant from the Florida Department of Children and Families. We thank Juliet Conners, Gregory Hanley, Jeffrey Hickman, Eileen Roscoe, Jessica Thompkins, Michele Wallace, and April Worsdell for their assistance in conducting the research.

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matic (direct) and socially mediated (indirect) reinforcement. The authors suggested that direct contingencies may lead to better performance and examined this possibility in the context of skill acquisition by 3 individuals with autism. They observed low levels of behavior when an indirect contingency was used (e.g., when a piece of cracker was delivered by the therapist each time the participant lifted the correct box) but immediate and large increases in behavior when a direct contingency was implemented (e.g., when a piece of cracker was placed under the correct box). However, because the direct and indirect conditions usually were associated with either different tasks or different reinforcers, it was not possible to determine whether the results obtained were a function of task difficulty or reinforcer potency rather than the contingencies themselves.

In a subsequent study, Williams, Koegel, and Egel (1981) compared the effects of direct (referred to in that article as "functional") and indirect (referred to as "arbitrary") contingencies on skill acquisition by 3 autistic children when the two conditions were associated with identical tasks and reinforcers. Again, low levels of responding were observed under the indirect contingency, whereas large increases in responding were observed when the contingency was changed to a direct one. In addition, when the indirect contingency was reinstated for 2 participants following response acquisition under the direct contingency, high levels of responding were maintained. In discussing their results, Williams et al. suggested that one explanation for the superiority of direct contingency arrangements may have been that indirect contingencies promote the occurrence of "irrelevant" responses. For example, in the indirect condition, participants were required to engage in a target response (e.g., picking up the correct box) and then to procure reinforcement by emitting a different response (e.g., reaching over and ob-

taining the preferred item from the therapist). This arrangement may have resulted in strengthening the response most closely related to procuring reinforcement (reaching behavior), which might have then interfered with acquisition of the target response. However, data on the occurrence of these interfering behaviors were not collected during the experiment.

The studies by Koegel and Williams (1980) and Williams et al. (1981) illustrate the use of an interesting technique that may enhance the effectiveness of reinforcement, but it is one that is not encountered often and may be difficult to arrange. In addition, the basis for the superiority of direct over indirect contingencies remains somewhat speculative. The purpose of this study was to extend the research of Koegel and Williams and of Williams et al. by comparing the effects of direct and indirect reinforcement contingencies on the performance of individuals with profound developmental disabilities. In addition, we recorded occurrences of reaching behavior under the indirect contingency to determine whether this behavior might interfere with performance of the target response.

METHOD

Participants and Setting

Six individuals who lived at a state residential facility for persons with developmental disabilities participated. All participants were adults who had been diagnosed with profound mental retardation and who were referred to a day-treatment program for treatment of self-injurious behavior (SIB), although this behavior did not appear to have a disruptive effect on any participant's performance during the study. All participants required physical assistance with activities of daily living (e.g., toileting, dressing) and had very limited communication skills

(e.g., they could follow a few simple instructions and used idiosyncratic gestures).

All sessions were conducted in individual therapy rooms at the day-treatment center, which contained tables, chairs, and other materials needed to conduct sessions (see below). Sessions were approximately 10 min in duration and were conducted two to six times per day (with breaks of 10 min or more between sessions), 4 to 5 days per week, as individual schedules permitted.

Response Measurement and Reliability

Data were collected on three events. The initiation of a trial was recorded each time a therapist presented task materials to a participant and delivered a verbal prompt. A correct response was recorded when the participant opened the designated container at least halfway. For example, if the task was to unzip a plastic pouch, a correct response was scored if the participant pulled the zipper back so that the pouch was open at least halfway. Reaching was recorded (in the indirect condition only) when the participant extended his or her arm toward the reinforcer (located in the therapist's hand) *prior to* completing the task. Reaching was not scored during the baseline and direct conditions because reinforcers were either not present (baseline) or located only inside a clear container (direct condition). The number of trials that comprised a session was used as the basis for summarizing data on correct responses: The number of correct responses was divided by the total number of trials to determine the percentage of trials during which correct responses occurred. The percentage of trials during which reaching occurred was calculated in a similar manner.

Trained observers collected data on handheld computers (Assistant Model AST 102). Interobserver agreement was assessed by having a second observer simultaneously but independently record data during a mean of

41.2% of all sessions (range, 27.3% to 46.2%). Agreement percentages were calculated by dividing session time into continuous 10-s intervals and comparing observers' records on an interval-by-interval basis. The number of scoring agreements between the observers was divided by the total number of intervals and then multiplied by 100%. Mean percentage agreement across participants was 95.5% (range, 82.8% to 100%) for trial initiation, 97.5% (range, 85% to 100%) for correct responses, and 98.1% (range, 91.3% to 100%) for reaching.

Reinforcer Selection

Prior to the study, assessments were conducted with each individual to identify preferred edible or leisure items. The assessments for Samantha, Ralph, Biz, Deb, and Carmen were based on procedures described by DeLeon and Iwata (1996); for Lynn, they were based on those of DeLeon, Iwata, Conners, and Wallace (1999). The item identified as most highly preferred based on the results of the assessment was used during reinforcement conditions. The procedure was modified slightly for Biz because informal observations suggested that she became satiated by repeated presentation of a single food item. Therefore, the three items identified as most highly preferred were used with Biz. The stimuli selected for each participant during the study were popcorn (Samantha); chocolate chip cookies (Ralph); candies, chocolate bars, and chocolate chip cookies (Biz); fig bars (Deb); a string of plastic beads (Lynn); and chocolate chip cookies (Carmen).

Task Description

The target response for each participant was to open a clear plastic container. Specific containers were chosen for individual participants based on informal assessment of their motor abilities and the difficulty associated with opening a given container. The con-

tainers consisted of a pouch with a zipper (Samantha and Ralph), a bowl with a snap-on lid (Deb), or a box with a lid that fitted on top (Biz, Lynn, and Carmen). Each trial began with the container closed (e.g., the pouch was zipped). To initiate a trial, the therapist delivered a verbal prompt (e.g., "open it") and, if the participant did not complete the task within 5 s, the therapist modeled the task (e.g., unzipped the pouch) while simultaneously repeating the verbal prompt. If the participant did not complete the task within 30 s of the initial prompt, a new trial was initiated. During reinforcement conditions, correct responses resulted in 1-min access to a preferred leisure item (Lynn) or one small piece of an edible item. No other consequences were provided for correct responses. All sessions consisted of 20 trials initiated at 30-s intervals (18 or 19 trials were conducted during a few sessions due to therapist error).

Experimental Design

The effects of no reinforcement, a direct reinforcement contingency, and an indirect reinforcement contingency were compared in a multielement design with Ralph and Lynn. We initially attempted to use the same design with Biz but observed that the three-condition multielement comparison resulted in apparent carryover effects between baseline and reinforcement conditions. Therefore, the comparison was modified for Biz and the remaining participants (Samantha, Deb, and Carmen) to one in which only the direct and indirect contingencies were alternated in a multielement design. These two reinforcement conditions were alternated with baseline in a reversal design.

Baseline. The therapist initiated trials as described above but did not deliver any consequences following correct responses. If the participant did complete the task, the materials were removed until the beginning of the next trial.

Direct reinforcement. Prior to each trial, the therapist placed the reinforcer in the container (within the participant's view) and closed the container. If the participant exhibited a correct response, he or she was allowed access to the reinforcer. For example, prior to each of Ralph's trials, the therapist placed a piece of cookie in the plastic pouch and zipped the pouch closed. To initiate a trial, the therapist presented the pouch to Ralph and asked him to open it. If Ralph unzipped the pouch, he was allowed to reach inside and consume the cookie. During this condition, the only reinforcer visible to the participant was the one located in the container.

Indirect reinforcement. The therapist initiated a trial by presenting an empty container to the participant and delivering a prompt, while holding the reinforcer in such a way that it was visible to the participant (and within the participant's reach). If the participant exhibited a correct response, the therapist immediately placed the reinforcer in the participant's hand. Attempts to obtain the reinforcer by grabbing it from the therapist prior to completing the task were blocked and were recorded as reaching.

RESULTS

Figure 1 shows results obtained for Samantha and Ralph. Samantha displayed very few correct responses during the initial baseline. When reinforcement was introduced, her correct responses increased immediately to 100% in both the direct and indirect conditions. When reinforcement was withdrawn, her performance became more variable; when reinforcement was reintroduced, her correct responses again increased immediately to 100% in both the direct and indirect conditions. Samantha rarely attempted to obtain the reinforcer by reaching for it in the therapist's hand.

Ralph exhibited few correct responses

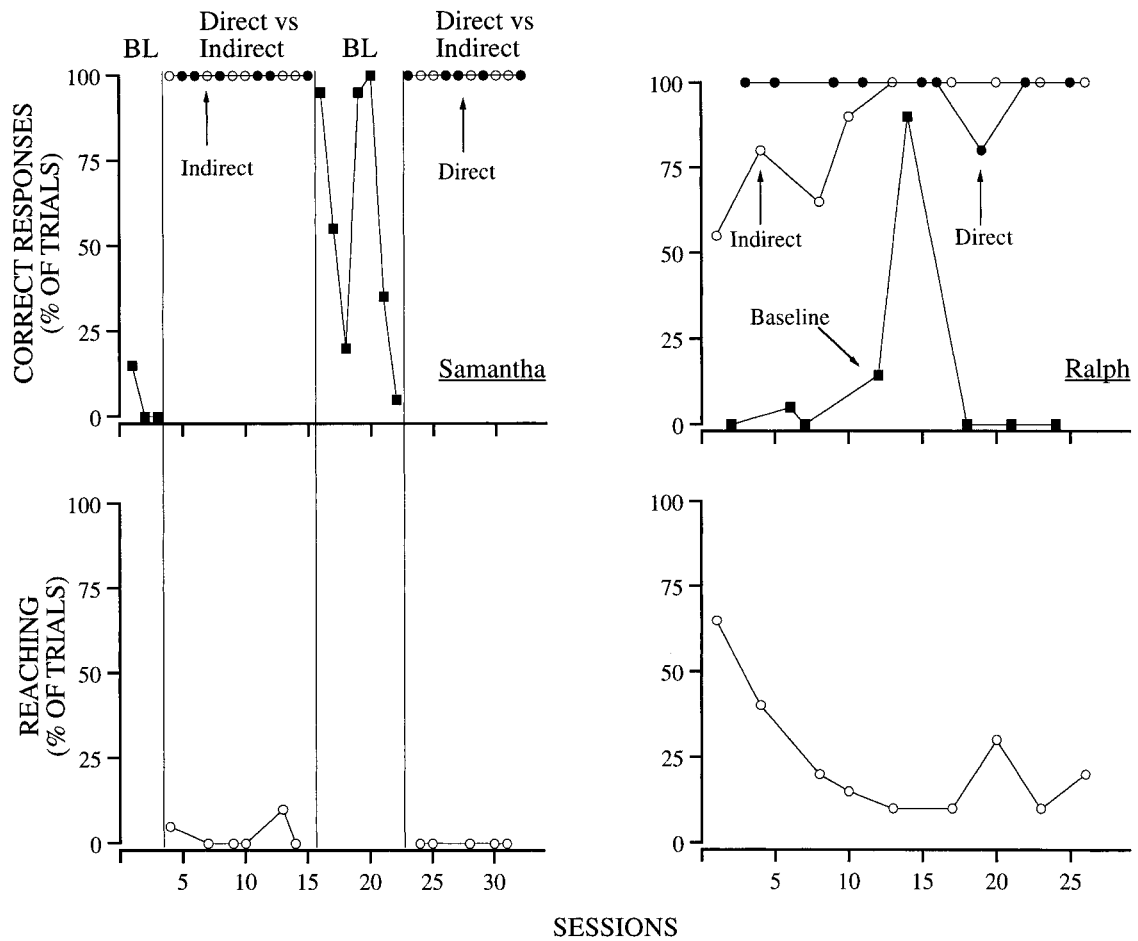


Figure 1. Percentage of trials with correct responses during baseline (BL) and direct (closed circles) and indirect (open circles) conditions for Samantha (top left panel) and Ralph (top right panel); and percentage of trials with reaching during the indirect condition for Samantha (bottom left panel) and Ralph (bottom right panel).

during baseline, except in one session. His percentages of correct responses were high during both the direct and indirect reinforcement conditions, although his acquisition was slightly delayed during the indirect condition. Ralph was also observed to engage in high levels of reaching at the outset of the indirect condition; however, this behavior decreased as the indirect condition continued.

Figure 2 shows the results obtained for Biz and Deb. Biz rarely exhibited correct responses during the initial baseline. During

the first direct and indirect comparison, Biz's correct responding increased to almost 100% during the direct condition, whereas her performance remained low during the indirect condition except in one session. Biz's correct responding decreased during the return to baseline and then immediately increased during the direct condition of the second direct and indirect comparison. Her performance during the indirect condition of that second comparison was initially low but abruptly increased to 100% after several sessions. Biz exhibited varying levels of

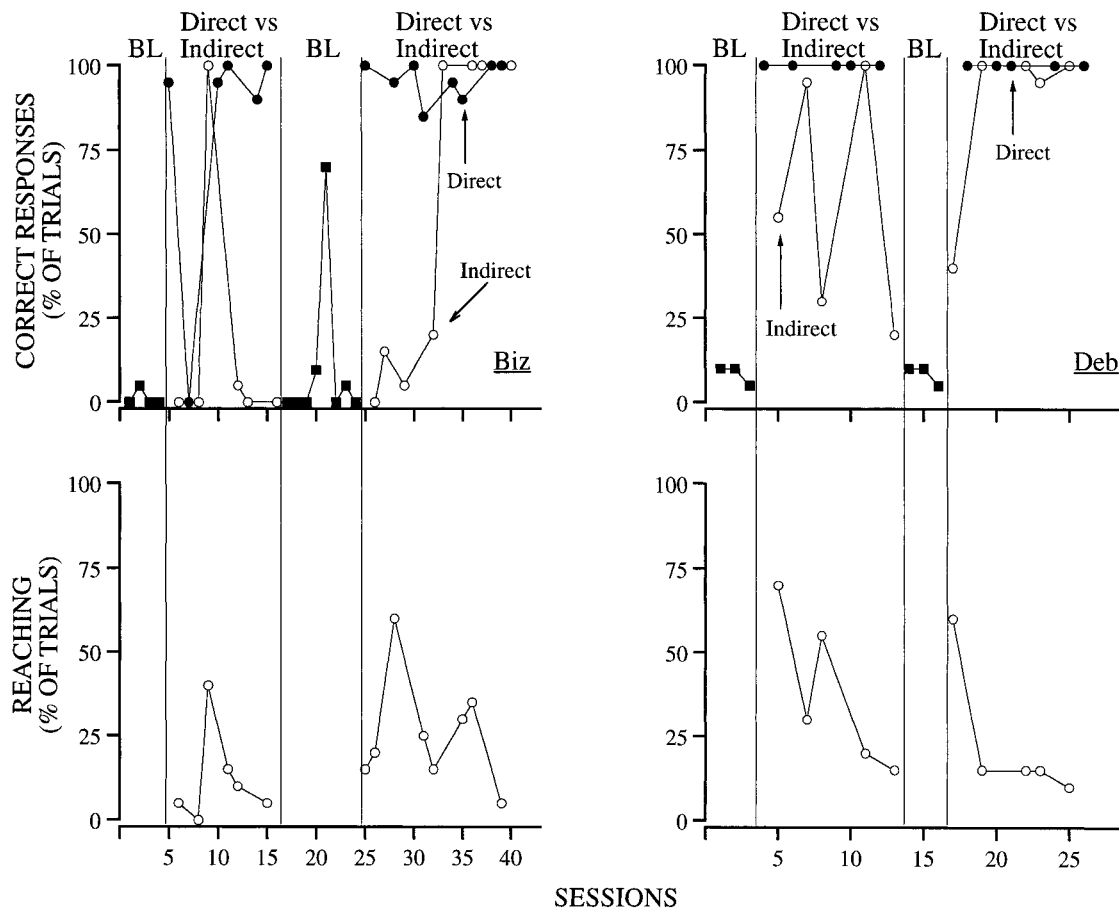


Figure 2. Percentage of trials with correct responses during baseline (BL) and direct and indirect conditions for Biz (top left panel) and Deb (top right panel); and percentage of trials with reaching during the indirect condition for Biz (bottom left panel) and Deb (bottom right panel).

reaching during the indirect conditions, which did not seem to be inversely related to her task performance.

Deb exhibited low percentages of correct responding during the initial baseline. When reinforcement was introduced, her task completion increased in both the direct and indirect conditions; however, her performance was consistently high in the direct condition (100% correct for all sessions) but was much more variable in the indirect condition. Deb's performance decreased during the return to baseline and increased to high levels during both the direct and indirect conditions when reinforcement was reinstated.

Deb's reaching behavior during the indirect condition showed a characteristic pattern in which reaching occurred on a high percentage of trials initially but decreased in subsequent sessions.

Figure 3 shows the results for Lynn and Carmen. Lynn's task performance was variable and appeared to show downward trends during both baseline and the indirect reinforcement condition. By contrast, she maintained 100% correct responses on every trial during the direct reinforcement condition. Lynn's reaching during the indirect condition initially occurred during most trials but progressively decreased across sessions.

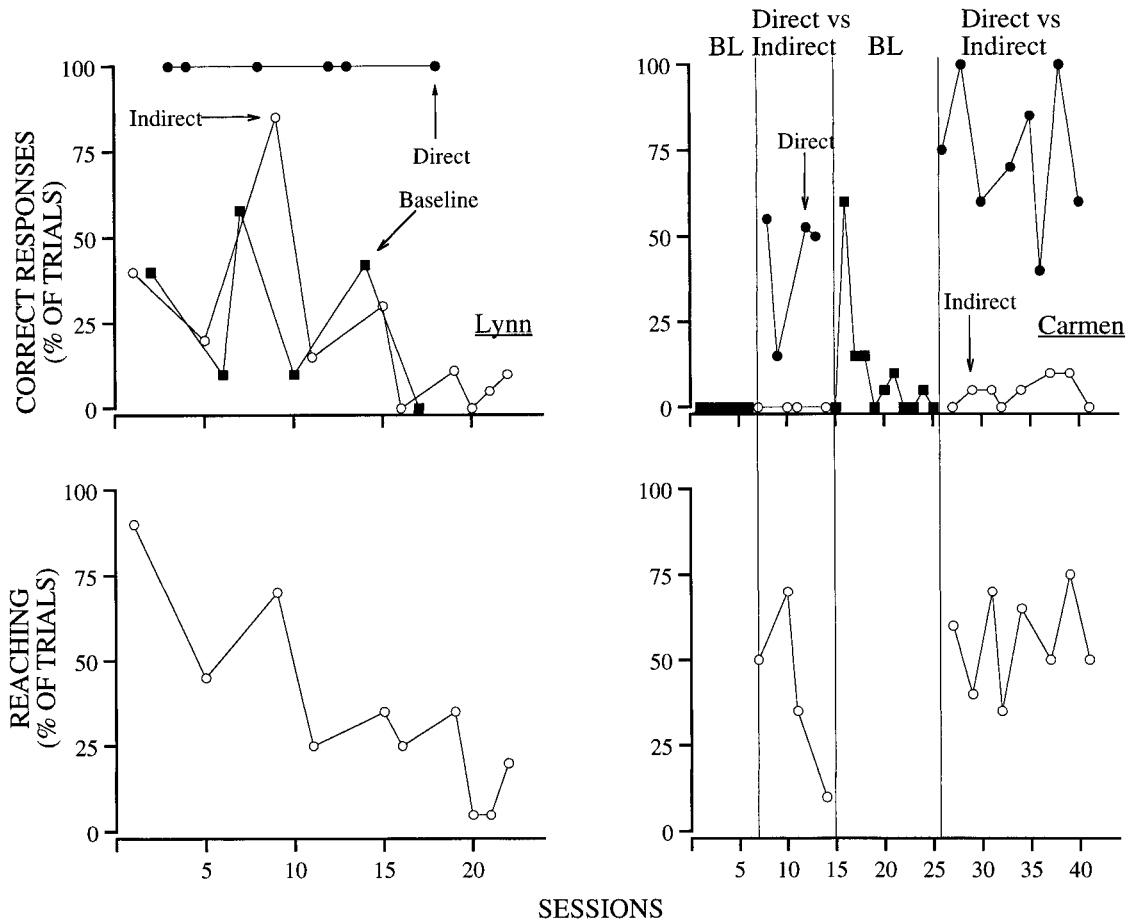


Figure 3. Percentage of trials with correct responses during baseline (BL) and direct and indirect conditions for Lynn (top left panel) and Carmen (top right panel); and percentage of trials with reaching during the indirect condition for Lynn (bottom left panel) and Carmen (bottom right panel).

Carmen never responded correctly during the initial baseline. During the first direct and indirect reinforcement conditions, her correct responses remained at zero in the indirect condition but increased to approximately 50% in the direct condition. Carmen's correct responses decreased when baseline was reinstated. During Carmen's final reinforcement phase, her performance remained at baseline level in the indirect condition and increased to above 50% in the direct condition. Carmen's reaching behavior occurred at moderate levels during both indirect conditions.

DISCUSSION

We evaluated the effects of direct and indirect contingencies of reinforcement on the performance of 6 individuals with profound developmental disabilities. Four participants (Samantha, Ralph, Biz, and Deb) exhibited high percentages of correct responses during both reinforcement conditions, although 3 of these participants (Ralph, Biz, and Deb) showed better performance during the direct condition. The remaining 2 participants (Lynn and Carmen) exhibited high and moderately high percentages of correct responses, respectively, during the direct con-

dition but failed to show acquisition during the indirect condition.

Our results are consistent with those reported by Koegel and Williams (1980) and by Williams et al. (1981) in that the direct arrangement enhanced performance for 5 of the 6 participants. These results suggest that clinicians and researchers may, in some cases, obtain better performance (i.e., either more rapid acquisition or more consistent maintenance) when they teach skills that produce reinforcement directly. When conditions permit, it may be beneficial to begin skill training by teaching functional skills (e.g., pouring a beverage into a glass) whose performance directly results in access to reinforcement (e.g., the opportunity to consume the drink).

All of the participants in the Koegel and Williams (1980) and Williams et al. (1981) studies showed uniformly poor performance under indirect contingencies. By contrast, 4 of our 6 participants showed evidence of response acquisition or maintenance under indirect contingencies. This finding should not be altogether surprising because the indirect arrangement is the most common format used in instructional research and is emphasized in most textbooks on behavior analysis (e.g., Cooper, Heron, & Heward, 1987; Miltenberger, 1997). In fact, given the ubiquity of indirect contingencies in research and practice and the highly positive results obtained with such procedures, the more interesting question raised by the present data and those reported by Koegel and colleagues is the basis for any observed superiority of direct contingencies over indirect ones.

We attempted to answer this question in the present study by collecting data on what Williams et al. (1981) described as irrelevant behaviors that might be strengthened under indirect contingencies because of their position in the response–reinforcer sequence. Balsam and Bondy (1983) described the

process as one in which the presence of reinforcers elicits appetitive responses that are incompatible with the target response. To examine this possibility, we recorded the occurrence of disruptive reaching behavior (extending a hand toward the reinforcer before completing the target response) on each trial during sessions in which indirect contingencies were in effect. These data are somewhat difficult to interpret because of variability in both correct responding and reaching across participants and trends observed during some conditions. Nevertheless, examination of these data allows some tentative conclusions. Samantha exhibited uniformly high percentages of correct responses during the indirect condition and also showed little evidence of reaching behavior. Although these data do not directly support the irrelevant behavior hypothesis, they are consistent with it in that Samantha exhibited a high percentage of correct responses in the absence of reaching. Ralph's correct responses increased throughout the indirect condition, while his reaching showed a corresponding decrease. This apparent inverse relation between the two responses suggests initial interference by reaching followed by an increase in correct responding as reaching was extinguished (recall that attempts to grab reinforcers were blocked). The findings for Biz, Deb, and Lynn were more difficult to interpret. No clear relation between reaching and correct responding in the indirect reinforcement condition was apparent for these participants. Finally, Carmen showed little evidence of acquiring the target response during both of the indirect conditions and engaged in moderately high levels of reaching during both conditions, suggesting that reaching may have interfered with her task performance.

It is possible that an arrangement different from the one used in the present study might yield results that would be more easily interpreted. More specifically, if reaching, in

fact, functioned as a competing behavior whose initial occurrence was more likely under the indirect contingency, its maintenance should be dependent on reinforcement. Thus, reinforcement (rather than extinction) of reaching behavior during the indirect condition may have yielded more consistent results and could be explored in future research.

In addition to the presence of irrelevant behaviors that interfered with task performance, Williams et al. (1981) provided two other possible explanations to account for the superiority of direct reinforcement contingencies. First, they suggested that direct contingencies may produce shorter delays to reinforcement than those produced by indirect contingencies. However, latency to reinforcement in that study was sometimes longer in the direct conditions, suggesting that performance differences under the direct and indirect contingencies could not be attributed solely to differences in delay to reinforcement. In the present study, we attempted to equate reinforcement latency between the two conditions by giving the reinforcer to the participant immediately following a correct response during the indirect condition. Although data were not taken on latency to reinforcement, it appeared that placing a reinforcer in a participant's hand (during the indirect condition) required no more time than did reaching into a container to get the reinforcer (during the direct condition).

The other factor suggested by Williams et al. (1981) was that direct contingencies may be more effective because they focus greater attention on relevant aspects of the task. That is, the direct contingency may enhance stimulus control over responding by some feature of the antecedent condition. The antecedent stimuli associated with the direct and indirect contingencies in that study were often identical and therefore could not account for the consistent differences observed

in performance under the two conditions. By contrast, highly salient visual cues were associated with the two contingencies in the present study and may have allowed participants to readily discriminate between the direct and indirect reinforcement conditions. In the direct condition, the reinforcer could be seen inside the clear plastic container, whereas no other reinforcers were in view. In the indirect condition, the container was empty, and the reinforcer was visible in the therapist's hand.

Even though these visual cues were not differentially correlated with reinforcement (i.e., reinforcement was available for task completion in both the direct and indirect conditions), it is possible that participants' histories with such cues established stimulus control over responding. That is, in the direct condition, previously established approach responses to reinforcers would occasion manipulation of any container in which a reinforcer was visible. Evidence of such stimulus control can be seen in the performance of at least 4 of our participants (Samantha, Ralph, Deb, and Lynn), whose correct responding immediately increased to 100% during the direct condition and was maintained at that level during every session. In the indirect condition, a history of approach responses to reinforcers would occasion reaching toward the reinforcer. Similarly, performing the required response (opening a container) in the indirect condition would only be expected to occur given a history of instruction-following behavior. In the absence of such a history, reaching would either persist (see Carmen's data) or be extinguished (see Ralph's, Lynn's, and perhaps Deb's data). This stimulus control account of performance under direct and indirect contingencies by individuals whose histories of reaching for reinforcers were well established, but whose instruction-following histories were inconsistent, seems highly plausible in light of the current results. To ex-

plore this possibility further, one might arrange a series of conditions in which direct contingencies are and are not correlated with distinctive cues (e.g., reinforcers could be placed inside clear vs. opaque containers) and in which indirect contingencies are and are not correlated with both distinctive cues and reinforcement for other appetitive responses (e.g., reaching, as noted earlier).

In summary, the results of this study extend the research of Koegel and Williams (1980) and Williams et al. (1981) by demonstrating that some individuals may benefit during instruction when target responses directly produce access to reinforcement. Moreover, the methods used in this study, as well as the types of variability evident in our results relative to those reported previously, suggest specific manipulations that might identify the mechanisms by which direct contingencies enhance reinforcement effects. As noted earlier, however, direct contingencies may have limited application because it may be difficult to arrange such response-reinforcer relations for most typical training tasks (e.g., self-care, academic, or vocational activities). Thus, another line of research suggested by the present data would involve identification of those factors that inhibit performance under indirect contingencies (e.g., competing stimulus control) and ways to minimize their influence.

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Received August 3, 1999

Final acceptance November 15, 1999

Action Editor, David P. Wacker

STUDY QUESTIONS

1. Describe what is meant by the terms *direct* and *indirect* contingencies. Provide original examples of each type of contingency.
2. Describe the baseline, direct, and indirect conditions. Also, what was “reaching” and why was it recorded only during the indirect condition?
3. Describe the experimental design used with Ralph and Lynn. Why was the design altered with the remaining participants?
4. Briefly summarize the patterns of performance across the direct and indirect reinforcement conditions for all participants.
5. Why might indirect contingencies be less effective than direct contingencies in generating desired performances in typical training situations?
6. What types of performances suggested that reaching interfered with acquisition in the present study?
7. How might the authors have conducted a more thorough analysis of the influence of reaching?
8. How might differential stimulus control account for the occurrence of correct responding in the direct condition but reaching in the indirect condition?

Questions prepared by Jana Lindberg and Gregory Hanley, The University of Florida

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