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USING DIFFERENTIAL REINFORCEMENT TO DECREASE ACADEMIC RESPONSE LATENCIES OF AN ADOLESCENT WITH ACQUIRED BRAIN INJURY

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The present study investigated the effects of contingency-specifying rules and a token economy to decrease the latency to comply with academic instructions by a 16-year-old girl with acquired brain injury. Results showed that treatment was successful in reducing academic response latencies. These results replicate previous research in which differential reinforcement was used to decrease slow responding to academic tasks.

DESCRIPTORS: acquired brain injury, compliance, differential reinforcement, latency, token economy

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Brain injury can cause neurological and behavioral deficits that may lead to problems in the classroom. One such problem is the failure to respond to instructional requests within a reasonable period of time (Jantz & Coulter, 2007; Page, 2007). This problem has been addressed in two prior investigations. Fjellstedt and Sulzer-Azaroff (1973) used a token economy with contingency-specifying rules to reinforce differentially the short academic response latencies of an 8-year-old boy enrolled in a special education classroom. Tiger, Bouxsein, and Fisher (2007) replicated these findings in the first of two studies conducted with a 19-year-old man with Asperger syndrome by shaping short response latencies, also using a token economy with contingency-specifying rules. The purpose of the present study was to replicate these previous studies systematically by investigating the effects of a token economy with contingency-specifying rules to decrease academic response latency of an adolescent girl with acquired brain injury.

METHOD

Participant and Setting

Claire was a 16-year-old girl, 12 years postinjury, who had been diagnosed with a seizure disorder and acquired hydrocephalus. She was served by a postacute rehabilitation program for individuals with neurological impairment. She had been admitted for emotional and social regression, aggression towards family members and teachers, and suicidal threats. An additional goal was to increase her overall functional independence. Her psychotropic medications at the time of the study included fluoxetine, diazepam, divalproex sodium, and topiramate.

All sessions took place in a small therapy room in Claire's school that was located within

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the rehabilitation program site. During these sessions, Claire was to complete arithmetic, spelling, and grammar worksheets from her general education curriculum.

Session Structure and Data Collection

Sessions consisted of the experimenter (the first author) meeting with the participant for approximately 30 min outside of class, once per day, 5 days a week for a total of 21 sessions.

Sessions were structured as follows:

1. The experimenter went to Claire's classroom and asked her to come to the therapy room.
2. The experimenter instructed Claire to select a toy to play with during a 5-min play break.
3. A 5-min play break was presented (if earned).
4. The experimenter gave Claire instructions to put away the toy and return to the table.
5. The experimenter gave Claire a worksheet and instructed her to begin working on it.
6. A 5-min work period was presented.
7. The experimenter instructed Claire to turn in the worksheet and return to the table.
8. The experimenter instructed Claire to select a toy to play with during her second 5-min play break.
9. A 5-min play break was presented (if earned).
10. The experimenter instructed Claire to put away the toy and stand by the therapy room door to prepare to return to the classroom.
11. The experimenter asked Claire to return to her classroom and sit at her desk.

The dependent measure—latency to respond to Steps 1, 2, 4, 7, 8, 10, and 11—was measured in seconds by beginning a timer immediately after an instruction was delivered and stopping the timer when Claire complied with it. Latency to respond to Step 5 remained at an acceptable level throughout baseline, warranting no intervention. For Step 1, the timing began when the experimenter entered Claire's classroom and asked her to come to the therapy room and ended when both of her feet crossed the threshold of the room. Timing for Steps 2 and 8 began when the experimenter instructed Claire to select a preferred toy (identified via a preference assessment, described below) and ended when she was seated at the table with her toy. For Steps 4 and 10, the timing began when she was given the instructions to put away the toy. The timing ended for Step 4 when she put away the toy and was seated at the table, and the timing for Step 10 ended when she put away the toy and was standing at the therapy room door. For Step 7, the timing began when she was instructed to turn in her worksheet and ended when she turned in her worksheet and was seated at the table. Timing for Step 11 began when she was instructed to return to class and ended when she was seated at her desk in her classroom.

Interobserver Agreement

A second independent observer recorded response latencies to instructions during 19% of sessions to assess interobserver agreement. Agreement was calculated per response by dividing the shorter response latency by the longer response latency and multiplying by 100%. These scores were then averaged across steps for each session. Mean agreement was 98%.

Procedure

Experimental design. A multiple baseline design across behaviors was used to evaluate the effects of treatment, which was applied simultaneously to two to three steps at a time.

Baseline. The experimenter explained to Claire that each session was going to be divided into play and work periods. Instructions for each step were provided (e.g., "Claire, please pick out a toy to play with.") without information regarding timeliness of, or consequences for, compliance. The experimenter praised Claire for compliance with instructions, which was routine in her school environment.

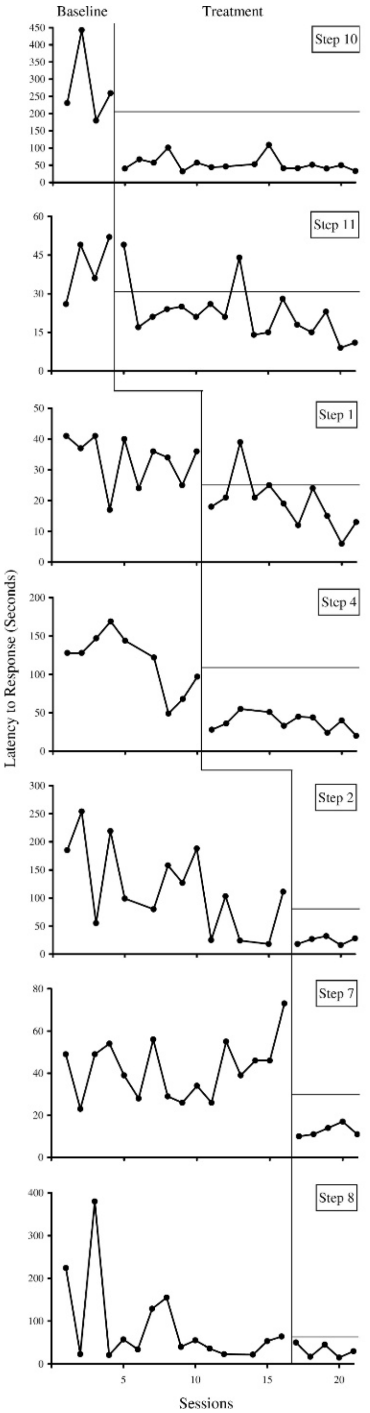
Treatment. Treatment included a token economy with contingency-specifying rules. After the fourth session, the experimenter explained to Claire that the first play break would no longer be free during the next session and that she would have to earn two tokens to purchase the play break for that and all subsequent sessions. She was explicitly told that she could earn the tokens by completing Step 10 within 207 s and Step 11 within 31 s. Criterion latencies were chosen to be 25% shorter than mean latencies in baseline. After Session 10, the experimenter explained to Claire that the second play break would no longer be free and that she would have to earn two tokens to purchase the second play break for all subsequent sessions. She was told she could earn two more tokens by completing Step 1 within 25 s and Step 4 within 107 s. The intervention was first applied to Steps 10 and 11 and then to Steps 1 and 4 based on the order in which previous research had implemented similar treatments (Fjellstedt & Sulzer-Azaroff, 1973). After Session 16, Claire was informed that she had the opportunity to earn three extra tokens to purchase preferred stimuli at the end of the sessions by completing Steps 2, 7, and 8 within 88, 32, and 66 s, respectively. These steps were targeted for intervention because their latencies remained high and variable even after the intervention had been applied to Steps 1, 3, 10, and 11. Although Claire received no additional training trials on the rules of the token economy, rules were reviewed prior to each session. Preferred stimuli were identified via direct observation and multiple-stimulus preference assessments (DeLeon & Iwata, 1996).

Tokens (small laminated star icons) were delivered immediately along with verbal praise contingent on Claire completing an instruction within the specified time criterion. If a latency criterion was not met and a play break was not earned, the break was replaced with an additional 5-min work period that was identical to the work period in Step 6 (this occurred three times throughout the course of the study). Also, if Claire earned only one token and could not purchase a play break, the token was not allowed to be carried over to subsequent steps.

RESULTS AND DISCUSSION

As seen in Figure 1, the introduction of treatment resulted in an immediate reduction in latencies to comply for each instruction. The top two panels show that mean latencies to instructions in Steps 10 and 11 were reduced from 278 s and 40 s in baseline to 54 s and 22 s (81% and 45% reduction) during treatment, respectively. After the second treatment implementation (middle two panels), mean latencies to instructions in Steps 1 and 4 were reduced from 33 s and 117 s in baseline to 19 s and 38 s (42% and 68% reduction), respectively. After the final treatment implementation (bottom three panels) mean latencies to instructions in Steps 2, 7, and 8 were reduced from 118 s, 42 s, and 88 s in baseline to 24 s, 13 s, and 31 s (80%, 69%, and 65% reduction), respectively. Because the treatment immediately reduced response latencies to levels that were deemed acceptable by clinical staff who routinely worked with Claire, further decreases in response latencies were deemed unnecessary.

In the current investigation, the magnitude of latency reductions varied across steps, ranging from a mean of 42% to 81%. These variations might be a function of differential response effort across steps or the relative aversiveness of activity transitions that occurred when Claire left an activity to comply with an instruction. The latency reductions achieved in the current procedure might have been further decreased by successively lowering the criterion levels (latency shaping), using more potent reinforcers during play breaks and increasing the length of the play



Step	Behavior
10	Putting toy away after second play break
11	Returning to classroom
1	Going to therapy room
4	Putting toy away after first play break
2	Picking out toy for first play break
7	Turning in worksheet
8	Picking out toy for second play break

Figure 1. Latency to comply with academic instructions (in seconds). Horizontal lines represent the criteria for reinforcer delivery.

breaks. Furthermore, multiple components were used in the current intervention. Thus, additional investigation is required to identify its critical components.

The present article should be evaluated in light of at least three procedural limitations. First, treatment integrity was not assessed. Although the treatment can probably be considered low risk for failure of treatment integrity (Peterson, Homer, & Wonderlich, 1982), these data remain important in the demonstration of a functional relation. Second, data on response accuracy were not collected during work periods. Anecdotally, Claire consistently completed her worksheets accurately. However, other children might exhibit more variability in their academic performance, necessitating more comprehensive measurement of this behavior. Third, the current intervention was evaluated in an analogue environment. Although this approach is useful for facilitating internal validity, additional research is necessary to determine whether such treatment can be implemented in the face of challenges that may occur in common classroom settings. Such a naturalistic evaluation would also permit the assessment of maintenance via follow-up measures.

REFERENCES

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis*, *29*, 519–533.

Fjellstedt, N., & Sulzer-Azaroff, B. (1973). Reducing the latency of a child's responding to instructions by means of a token system. *Journal of Applied Behavior Analysis*, *6*, 125–130.

Jantz, P. B., & Coulter, G. A. (2007). Child and adolescent traumatic brain injury: Academic, behavioural, and social consequences in the classroom. *Support for Learning*, *22*, 84–89.

Page, T. (2007). Understanding and treating functional impacts of brain injury. In T. Antoinette, D. Braunling-McMorrow, M. Lash, L. Reyst, & H. Tyler (Eds.), *The essential brain injury guide* (4th ed., pp. 81–105). Vienna, VA: Brain Injury Association of America.

Peterson, L., Homer, A. L., & Wonderlich, S. A. (1982). The integrity of independent variables in behavior analysis. *Journal of Applied Behavior Analysis*, *15*, 477–492.

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.

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