Teacher-Conducted, Latency-Based Functional Analysis as Basis for Individualized Levels System in a Classroom Setting

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Abstract Latency-based functional analysis (FA) may be appropriate when stakeholders are concerned with safety or feasibility. We trained a first-year special education teacher to collect data while she implemented a latency-based FA and validated a function-based intervention. Treatment effects were generalized across paraeducators and were maintained during a 1-month follow-up.

Keywords Latency · Functional analysis · Levels system · School · Classroom

Having teachers conduct functional analyses (FAs) of problem behavior in their own classrooms can lead to practical and ecologically valid approaches to FA-informed intensive intervention. If it is possible for these teachers to conduct FAs without evoking high rates of problem behavior and to do so without depending on others to collect their data for them, then there may be fewer concerns about conducting the analysis than what might otherwise be the case.

Implications for Practitioners

- Latency-based functional analyses (FAs) may increase feasibility of assessment.
- Teacher-implemented FAs may increase validity of assessment.
- Individualized levels systems represent a streamlined approach to addressing multiply controlled challenging behavior.
- Modified pyramidal training can establish expertise in indigenous school personnel.

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Latency-based FAs meet the standard of experimental control while evoking a fraction of the problem behavior commonly observed during traditional FAs (Thomason-Sassi, Iwata, Neidert, & Roscoe, 2011). Furthermore, conclusions about treatment efficacy drawn from analysis of response latencies appear to correspond well with conclusions drawn from analysis of response rates, making latency-based FAs viable baseline measures for subsequent latency-based treatment evaluations (Caruthers, Lambert, Chazin, Harbin, & Houchins-Juárez, 2015).

Because collecting data on response latencies can be less effortful than collecting rate-based data, it may be possible for a single person to collect his or her own data while implementing latency-based FAs. If so, latency-based approaches to assessment and data analysis could decrease stakeholder concerns about safety and feasibility—commonly hypothesized barriers to school-based FA implementation (Lloyd, Weaver, & Staubitz, 2016). The purpose of this study was to highlight a model of intensive intervention for challenging behavior in which data-based decision making occurred in response to latency-based measures. Specifically, we eliminated multiply controlled problem behavior using an individualized levels system (Hagopian et al., 2002) informed by the results of a teacher-implemented, latency-based FA conducted in a public classroom setting.

Method

Subjects and Setting

Larry was an 8-year-old boy diagnosed with autism who attended second grade in a public elementary school. Most of his academic day was spent in a self-contained classroom with one-to-one paraeducator support. Larry was nonverbal,

used gestures to communicate, and often controlled classroom events through his disruptions. Mariah was a first-year special education teacher with a bachelor's degree and 4 months of teaching experience. This study took place in Larry's classroom.

Response Measurement

Mariah collected primary data on all dependent variables using a timer with a "lap" function. Specifically, she began the timer at trial onset and touched "lap" following the first instance of each dependent variable. Following trial termination, Mariah recorded her data. Dependent variables included latencies to the first instances of disruption (i.e., screaming, biting, or hitting), compliance (i.e., task completion prior to manual guidance), and independent mands (i.e., picture exchanges) for tangible reinforcement following completion of the green side of Larry's token board. If Mariah prompted a mand, the mand was not scored for that trial. Because mands for tangible reinforcement were only recorded (and reinforced) following completion of the green side of Larry's token board, the interaction between latencies to compliance and latencies to independent mands allows readers to deduce the time Larry spent satisfying specific response requirements (e.g., two, five, or 10 consecutive compliances with no challenging behavior) during each trial.

Reliability and Fidelity

Researchers collected reliability data for 100% of FA trials and 37.7% of intervention trials. We calculated reliability scores by comparing latencies to each dependent variable across observers. If latencies fell within ± 10 s, we scored an agreement. Otherwise, we scored a disagreement. Then, we divided agreements by the sum of agreements and disagreements. Mean FA reliability was 98.3%. Mean intervention reliability was 96.2%. We evaluated procedural fidelity by dividing correct environmental manipulations (e.g., presentation of establishing operations [EOs], consequence delivery, and so on) by opportunities to make them during each trial and multiplying by 100. Mean fidelity to FA was 97.8% across 100% of trials, and mean fidelity to intervention was 96.8% across 40.6% of trials.

General Procedures

One week before the FA, a researcher visited Larry's classroom to conduct an informal observation and an open-ended interview. Because of the severity of Larry's disruptions, the amount of time in intervention we projected he would require, and limitations to our own availability (due to the distance we needed to travel for each appointment), we requested permission from Larry's principal and parents to conduct his FA and

initial treatment evaluation over the course of a weekend, when his classroom was empty.

On a Friday from approximately 1:30 to 3 p.m., a researcher played with Larry and conducted a tangible preference assessment. Concurrently, Mariah received behavior skills training and helped researchers define Larry's disruptions. From approximately 3 to 5 p.m., Mariah conducted all conditions of an FA that was designed by researchers while they provided in vivo coaching (e.g., instructions, corrective feedback).

Researchers designed Larry's intervention and prepared relevant training materials (e.g., flowcharts) for approximately 3 h on Friday night. Because Mariah reported that Larry had previously been served by two behavior specialists who had ineffectively attempted a number of different reinforcement- and extinction-based interventions (e.g., contingent praise, planned ignoring, noncontingent escape, picture exchange systems, first-then boards, token systems), we opted to incorporate function-based punishment into an individualized levels system. On green, attention, escape, and tangible reinforcers could be earned. Disruptions sent Larry to red, where only escape was available. Transition from red back to green was contingent upon the absence of disruptions.

From 7 a.m. to 1:30 p.m. on Saturday (after a brief training) and from 7:30 a.m. to noon on Monday, Mariah implemented Larry's intervention and then trained both of her paraeducators to implement it under typical classroom conditions. Although researchers attempted to minimize interactions with Larry, they helped Mariah block disruptions and redirect elopement during intense bouts of disruption on Saturday (between Trials 4 and 10).

Latency-Based FA

Mariah implemented an FA with attention, play, tangible, and escape conditions. Test trials with no disruptions (and all play trials) lasted 5 min. Otherwise, Mariah terminated test trials after delivering prescribed consequences following the first instance of disruption and did not initiate a new trial until at least 1 min passed *without disruptions*. During intertrial intervals, Mariah abolished the consequence targeted for the next experimental trial. For example, she provided continuous attention prior to initiating attention, access to high-preferred items prior to initiating tangible, and no demands prior to initiating escape. Prior to initiating play, Mariah provided continuous attention and high-preferred items.

During attention, Mariah turned away from Larry. Disruptions produced statements of concern and trial termination. During play, Mariah did not attend to disruptions and provided continuous attention and preferred tangibles. During tangible, Mariah removed tangibles and responded to bids for attention. Disruptions produced 30-s access to tangibles and trial termination. During

escape, Mariah delivered academic demands using a three-step prompt hierarchy (vocal, model, and manual guidance [5-s interprompt interval]). Compliance produced neutral praise and a new demand. Disruptions produced a 30-s break and trial termination.

Individualized Levels System

Following the FA, we implemented baseline, intervention, schedule leaning, generalization, and maintenance conditions.

Baseline To evaluate the effect of our intervention against a single baseline, we synthesized relevant EOs (e.g., denied tangible access, demand presentation) and consequences (e.g., attention, tangible access, and demand removal) into a single sequence similar to the one observed in Larry's classroom. Prior to trials, Mariah provided preferred tangibles and continuous attention. At trial onset, Mariah removed tangibles and presented academic demands. Disruptions produced statements of concern, demand removal, 30-s access to tangibles, and trial termination.

Intervention Similar to baseline, trials began when Mariah removed tangibles and presented demands. However, disruptions did not produce reinforcement or terminate trials; rather, Mariah continued to enforce programmed contingencies for the remainder of the trial. Thus, similar to session-based approaches to data analysis, our measures represent behavior change following successive exposures to fixed temporal units of therapy (Caruthers et al., 2015). Progression through intervention phases was contingent upon three consecutive trials with no disruptions and mand independence.

Intervention consisted of noncontingent reinforcement, differential reinforcement, and response cost. Prior to trial onset, Mariah placed a two-sided 8.5" × 11" laminated token board in front of Larry. One side was green, and the other was red. The top of the green side contained 10 Velcro spaces for small tokens. The center contained a space for tangible picture cards (actual items were placed behind the board, but attempts to grab them were blocked). An adjacent space held a "break" card. Red contained three spaces for large check marks.

While on green, Larry did not have access to tangibles and was constantly presented with demands. However, Larry earned tokens for academic task completion (prompted or independent). Mariah always reinforced mands for breaks by removing demands for 30 s. Mariah did not allow Larry to leave his work area or access tangibles following mands for breaks. Although compliance produced tokens, Mariah did not stop presenting demands when Larry's token board was filled. Thus, Larry could only escape demands by manding. Once Larry both filled his token board and manded for a break, Mariah reinforced mands for tangibles with 5 min of tangibles and access to all classroom areas. Mariah signaled tangible access time using a green visual timer. Regardless of

token board status, Mariah provided Larry with attention at least one time every minute.

A researcher prompted mands following a progressive time delay. Specifically, the researcher immediately manually guided Larry to emit mands (while simultaneously saying "break" or "toys") when Larry filled his token board during the first intervention trial. During the second trial, the researcher waited 5 s before manually guiding break and then waited another 5 s before manually guiding toys. During subsequent trials, the researcher waited 10 s before manually guiding exchanges. Mariah ignored mands for tangibles when Larry's token board was incomplete. Similarly, when Larry's token board was filled, Mariah ignored mands for tangibles and continued to present demands until Larry manded for a break.

Contingent upon disruptions, Mariah immediately turned Larry's token board to red, said "You're on red," changed the color of the visual timer from green to red, and changed the cycle duration from 5 min to 10 s. When Larry did not disrupt for 10 s, Mariah placed a check mark on the red board. If Larry attempted disruption, Mariah blocked it, removed all earned check marks, and reset the timer. When Larry earned three check marks, Mariah turned the board back to green, praised him, and presented a demand. Larry was never allowed to transition directly from red to a full token board and was always required to complete tasks that preceded disruptions.

Schedule Leaning Initially, Larry's token board held eight tokens on green, and he was required to earn two. During subsequent phases, Larry was required to earn five and then 10 tokens (i.e., backward chaining). During "2a," Larry manded for tangibles but not breaks, and tantrums persisted. During "2b," researchers immediately manually guided mands for breaks and only required independent mands for tangibles. After increasing response requirements to five ("5") and then 10 ("10a") responses, Mariah prompted Larry to mand for two breaks ("10b"): once prior to filling the token board and once afterward. When Larry independently manded for breaks both before and after filling the token board and only manded for tangibles when the token board was full (after manding for a break), Mariah introduced additional demands ("10c") to more completely represent the range of tasks required of Larry throughout his school day.

Generalization and Maintenance Generalization trials were conducted with other students completing typical routines in the classroom. After instructing her paraeducators, Mariah provided in vivo coaching as each implemented the intervention. Concurrently, researchers coached Mariah on her coaching (modified pyramidal training; Kunnavatana et al., 2013). Each paraeducator continued until he or she reported feeling confident with the procedures. We conducted maintenance trials 1 month later.

Results and Discussion

FA results are shown in the top panel of Fig. 1 and demonstrate attention, tangible, and escape functions. During intervention (bottom panel of Fig. 1), disruptions eventually subsided, and compliance and manding emerged. Vertical separation between latencies to compliance and manding indicates how much time Larry spent completing tasks during trials with no tantrums and shows a steady increase across phases. By noon on Monday, treatment effects had generalized across paraeducators and were maintained during the 1-month follow-up appointment.

Through e-mail, Mariah reported consistently implementing the intervention during school hours and experiencing multiple bouts of disruptions during the first week following FA. When the bouts subsided, Mariah reported that Larry was completing more work than ever before and that her classroom environment had improved considerably (Larry's screaming made

some question their job commitments). Consequently, Mariah formally reported perfect satisfaction scores on a social validity questionnaire administered upon discharge. Researchers spent approximately 21.5 h (nonoverlapping) working with Mariah (including e-mails and report writing).

Because concerns over ecological validity emerge when FAs are not conducted in typical settings (e.g., Conroy, Fox, Crain, Jenkins, & Belcher, 1996) and because therapists familiar to subjects are likely to evoke higher rates of problem behavior across more functional classes during FAs than are novel therapists (Huete & Kurtz, 2010; however, see Thomason-Sassi, Iwata, & Fritz, 2013), this study represents a much-needed demonstration of FA-informed intensive intervention implemented with fidelity in a public school setting (Lloyd et al., 2016; Solnick & Ardoin, 2010) and extends individualized levels systems (Hagopian et al., 2002) to a nonverbal child with autism.

Fig. 1 Results of latency-based functional analysis and results of intervention (bottom panel). Bx = behavior; BL = baseline; PB = problem behavior (i.e., disruptions)

TRIALS

Some limitations should be noted. First, we did not establish experimental control of treatment effects. Second, Mariah and Larry spent approximately 10 h working under nontraditional circumstances (i.e., over the weekend). Thus, the FA context did not overlap perfectly with the context in which disruptions typically occurred (e.g., during school with other children present). Although not always necessary (as was demonstrated for Larry) nor appropriate (e.g., when other children could be harmed), additional research demonstrating that such overlap is possible in public school settings is still needed (Lloyd et al., 2016).

A final limitation is that we incorporated punishment into Larry's intervention. During treatment design, we weighed the benefits of implementing a reinforcement-only intervention against the costs of doing so. Based on Larry's previous experience with behavioral programming and the inadequacy of the interventions we saw attempted during our observation, we concluded that the probability of success would be too low to justify attempting differential reinforcement without including additional intervention components. Likewise, when considering the cost of programming punishment into the intervention, we reasoned that reinforcement paired with punishment was not necessarily more aversive than reinforcement paired with extinction but could be more effective under certain circumstances (Hanley, Piazza, Fisher, & Maglieri, 2005). This fact played prominently into our decision-making process because we anticipated many challenges to effectively implementing extinction of multiply controlled problem behavior.

After considering the details of the proposed intervention, we concluded that our function-based punishment procedure was no more intrusive than extinction and represented an ethical alternative to it. Specifically, we did not introduce new or noxious stimuli. Rather, we took stock of variables already at play in Larry's environment, assumed that disruption's EOs were likely to function as punishers for whatever behavior preceded their presentation, and attempted to capitalize on this fact through the intentional programming of their onset and offset. This was justifiable because Larry was already likely to contact these EOs multiple times each day (regardless of programming). Simply accounting for and capitalizing on the potential punishing effects of EO onset presented us with an opportunity to maximize the probability of treatment effects. These facts, paired with the magnitude and nature of the programmed punishers (i.e., stimulus change and token removal followed by 30 s of differential reinforcement of other behavior to transition back to green), led us to conclude that our intervention met acceptable standards of punishment use in our field and fell within the ethical boundaries of practice.

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Compliance with Ethical Standards This manuscript is not under review, nor has it been published elsewhere. This submission has been approved by all authors and by the responsible authorities where the work was carried out.

Informed Consent The participant's guardian provided informed consent before the authors initiated study-related activities.

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