

*FUNCTIONAL ANALYSIS AND TREATMENT OF  
BREATH HOLDING MAINTAINED BY  
NONSOCIAL REINFORCEMENT*

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A functional analysis showed that breath holding exhibited by a 16-year-old boy with mental retardation occurred independent of social consequences. Assessment results of the existing treatment procedure—a verbal reprimand—were used to design a treatment package that reduced the behavior to low levels across 7 months.

DESCRIPTORS: breath holding, hypoxia, functional analysis, developmental disabilities

Breath holding, which is characterized by an arrest of breathing that may result in cyanosis and loss of consciousness, is an unusual and potentially harmful behavior. For example, loss of consciousness could result in concussion and tissue damage due to falling. Despite the importance of understanding and treating breath holding, few studies have examined the possible functions of this behavior. Kern, Mauk, Marder, and Mace (1995) demonstrated that 1 individual's breath holding was maintained by contingent attention and that a function-based treatment decreased occurrences of the behavior. The purposes of the current study were (a) to apply functional analysis methodology to the assessment of breath holding, (b) to identify variables responsible for reducing breath holding, and (c) to determine if treatment effects would be maintained after the research team discontinued consultation with caregivers.

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#### METHOD

Ray was a 16-year-old boy who had been diagnosed with severe mental retardation and cerebral palsy. A neurologist referred Ray to an outpatient clinic for treatment of breath holding, which occasionally resulted in brief periods of unconsciousness (5 s to 10 s). *Breath holding* was defined as arching the back with the absence of audible inhalation sounds followed by an audible slow exhalation. Numerous evaluations ruled out possible medical causes for breath holding (e.g., seizure disorder). Caregivers reported that Ray engaged in this behavior when he was not closely monitored by a caregiver and that a verbal reprimand was currently effective for managing the behavior at home. Ray's parents requested consultation to confirm that attention was not a reinforcer for the behavior and to determine how to make the reprimand effective at school such that the teacher could move away from Ray during instructional activities. Data on breath holding were collected using 10-s partial-interval recording. A second observer collected data

during 69% of all sessions, distributed evenly across conditions. Interobserver agreement, calculated on an interval-by-interval basis, was 96% (range, 83% to 100%). All sessions lasted 5 min (see exception below).

Caregivers implemented sessions for the initial functional analysis with coaching from a therapist. Initially, a series of four conditions (toy play, attention, ignore, and alone) were conducted in an outpatient clinic observation room using a multielement design (Northup *et al.*, 1991). Ray's parents remained within close proximity (1 m to 3 m), and the same toys were available during all conditions except alone. The parents took turns delivering a loud verbal reprimand contingent on breath holding ("Ray no!") during the attention condition. The ignore condition consisted of his parents ignoring all behaviors while he played with toys. Demand and tangible conditions were not conducted because descriptive interview information suggested that escape and access to tangible items were irrelevant to breath holding.

We hypothesized that the volume of the reprimand and the proximity of the caregiver while delivering the reprimand influenced its effectiveness. The effects of therapist-delivered loud or soft reprimands on a fixed-ratio (FR) 1 schedule were evaluated via a reversal design. The therapist sat approximately 3 m away from Ray. Both conditions were similar to the attention condition of the functional analysis except that reprimands were delivered either above (loud) or at (soft) normal conversational tone. An ignore session also was conducted during this analysis.

The effects of loud reprimands were then evaluated in two conditions (close and far) within a multielement design at Ray's public school. During both conditions, Ray was seated at a table, and his teacher delivered verbal prompts to complete a towel-folding task every 30 s to 60 s while reprimanding breath holding on an FR 1 schedule. The teacher either delivered reprimands while she

was approximately 1 m away from him (close) or while she was approximately 9 m away from him (far).

Assessment results then were used to modify the existing treatment to allow the teacher to move approximately 9 m away from Ray during instructional activities. The initial treatment analysis involved comparing two conditions within a multielement design. The first condition was identical to the far condition of the previous analysis. The second condition consisted of the teacher moving approximately 9 m away during demand situations and rapidly approaching Ray and delivering a loud reprimand on an FR 1 schedule for breath holding.

After the approach plus reprimand condition was shown to reduce breath holding, differential reinforcement of other behavior (DRO) was added to the treatment, and its effects on breath holding were evaluated via a withdrawal design. For the DRO procedure, Ray was given 30-s access to a preferred activity (swinging or playing the piano) for the absence of breath holding for 30 s. The DRO schedule was yoked to the interresponse time of breath holding during the alone sessions of the functional analysis. The length of the DRO interval was increased to 60 s (Session 18), to 2.5 min (Session 20), and to 5 min (Session 22), and the reinforcement interval was increased to 1 min. Sessions were 5 min with reinforcement time excluded. Follow-up sessions were conducted at Ray's home-school placement 6 and 7 months after the research team discontinued consultation with caregivers.

## RESULTS AND DISCUSSION

Ray engaged in high levels of breath holding during the alone and ignore conditions of the functional analysis (Figure 1). Substantially lower levels of breath holding occurred in the attention and toy play conditions. Thus, results indicated that breath

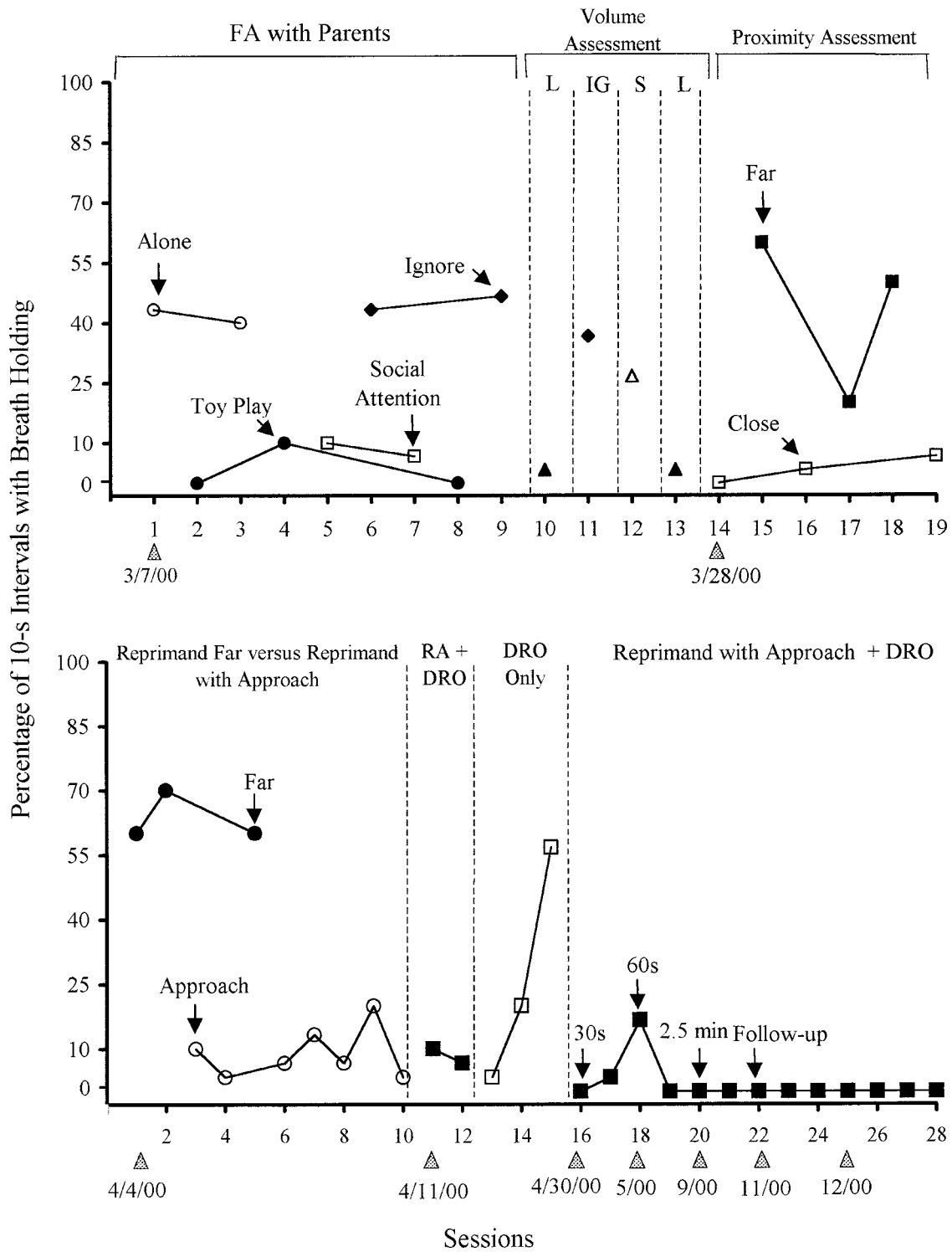


Figure 1. Percentage of 10-s intervals with breath holding during the functional analysis, reprimand volume assessment, and reprimand proximity assessment (top panel). Percentage of 10-s intervals with breath holding during the treatment analysis (bottom panel). FA = functional analysis, L = loud reprimand, S = soft reprimand, IG = ignore, RA = reprimand with approach.

holding occurred independent of social consequences and was not reinforced by caregiver attention. The relevance of social reinforcers other than attention, however, could not be ruled out.

Percentage of 10-s intervals with breath holding was much lower when a loud reprimand was delivered than when a soft reprimand was used. Levels of breath holding also were substantially lower when the teacher delivered a loud reprimand from a close proximity than from a far proximity. The teacher approach plus reprimand condition resulted in lower levels of breath holding than the teacher far plus reprimand condition. Results of the DRO analysis suggested that differential reinforcement alone would not maintain the treatment effects. After the verbal reprimand was reintroduced, breath holding remained low as the length of the DRO interval was increased to 2.5 min, and the behavior did not occur during any of the follow-up probes.

Although results of the functional analysis suggested that breath holding was maintained by nonsocial reinforcement, the specific reinforcing properties of the behavior were not isolated. Reduced oxygen to the brain (hypoxia) may cause a variety of physical sensations such as lightheadedness and auditory or visual hallucinations (Brugger, Regard, Landis, & Oelzo, 1999). We hypothesized that one or more of these sensations maintained Ray's breath holding via

automatic positive reinforcement. Caregivers reported that previous treatments for Ray's breath holding included the contingent delivery of an aversive physical stimulus (pressing on his anterior larynx) while a reprimand was delivered. The pairing of a verbal reprimand with the aversive physical stimulus may explain why loud verbal reprimands presented within close proximity functioned as a punisher. A procedural limitation of this study was the lack of a formal preference assessment prior to implementing the DRO component. Ray's caregivers reported that playing the piano, swinging, and walking were the only leisure activities that he engaged in on a regular basis. In conclusion, results of this study suggest the need for further research on the possible functions of breath holding and the effects of less intrusive interventions.

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