Functional Analysis and Treatment of Chronic Hair Pulling in a Child with Cri du Chat Syndrome: Effects on Co-Occurring Thumb Sucking

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ABSTRACT

The relation between hair pulling and thumb sucking in a child with Cri du Chat syndrome was evaluated during the assessment and treatment of hair pulling. A functional analysis suggested that both behaviors were maintained by automatic reinforcement and possibly by attention. Treatment combining differential reinforcement (praise), response interruption, and access to toys decreased hair pulling. A corresponding decrease in thumb sucking was observed even though it was not directly treated. After an initial evaluation in a controlled setting, the treatment was extended to the participant's classroom setting. A 1-year follow up revealed that hair pulling, but not thumb sucking, remained at near-zero frequency. Clinical and research-to-practice implications are discussed.

Descriptors: Cri du Chat syndrome, functional analysis, hair pulling, trichotillomania, response covariation

Some children with developmental disabilities pull their hair excessively, producing bald spots, scalp irritation, and possible disfigurement (Long & Miltenberger, 1998; Rapp, Miltenberger, Galensky, Ellingson, & Long, 1999). This severe behavior disorder may lead to a clinical diagnosis of "trichotillomania" based on the criteria outlined in the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2000). However, a function-based approach to problem behavior presumes that chronic hair pulling is a learned response like many other behavior disorders. That is, hair pulling may continue to occur because of the consequences that follow it (Rapp et al., 1999).

Common consequences that maintain problem behavior include attention, access to preferred tangible items, and escape from demands. In some cases, problem behavior is maintained by consequences that are directly produced by the behavior (e.g., sensory stimulation, pain attenuation). This form of reinforcement is often referred to as "automatic reinforcement." The functional analysis approach to assessment provides a methodology for identifying the consequence(s) that maintain an individual's problem behavior (see Iwata

& Dozier in this issue). By isolating the function of problem behavior, treatment is more likely to be effective because it can be matched to confirmed sources of control (Hanley, Iwata, & McCord, 2003).

Nonetheless, only one study included a functional analysis before treating hair pulling in a child with developmental disabilities (Rapp et al., 1999). The functional analysis conducted by Rapp et al. indicated that the child's hair pulling was maintained by automatic reinforcement. The authors then compared two treatments based on this finding. They either gave the child continuous access to pulled hair or required her to wear gloves. Both procedures were equally effective but could not be implemented over the long term. Allowing the child continuous access to pulled hair would be impractical and wearing gloves would hinder learning of fine motor skills. These findings and the limited research that has been conducted suggest the need for further research on hair pulling with this population.

Several studies on hair pulling exhibited by typically developing children found that the treatment of a different behavior problem – thumb sucking – produced corresponding decreases in hair pulling. In other words, hair pulling and

thumb sucking appeared to co-vary in this population. For example, Friman and Hove (1987) used an aversive taste treatment for thumb sucking in two children who also pulled their hair. Although left untreated, hair pulling was eliminated simultaneously with a reduction in thumb sucking. In another evaluation, Watson, Dittmer, and Ray (2000) found that an aversive taste treatment applied to the thumb only when it followed hair pulling decreased thumb sucking and eliminated hair pulling in an 18-month old boy.

These findings suggest that, in some cases, hair pulling and thumb sucking may naturally co-vary, meaning that the behaviors will respond similarly when treatment is applied to only one of them. The identification of behavior problems that decrease simultaneously in this manner can help maximize the efficiency and practicality of individualized, function-based interventions. Functional analyses, in particular, may be useful for identifying behaviors that are likely to co-vary during treatment.

The purpose of this study was to further examine the assessment and treatment of hair pulling in children with developmental disabilities. More specifically, the relation between hair pulling and thumb sucking

was explored by conducting a functional analysis of hair pulling while simultaneously measuring thumb sucking in a child with developmental disabilities. A treatment that was based on the results of the assessment yet practical for classroom staff was then implemented for hair pulling. Thumb sucking was not directly treated. Eventually, treatment was extended from a controlled setting to a more naturalistic arrangement within the child's classroom.

METHOD

Participant

Jamie was an 8-year-old girl diagnosed with Cri du Chat syndrome. Children with Cri du Chat syndrome (also known as "chromosome 5p deletion syndrome") have a distinct, cat-like cry and exhibit problem behavior, such as self-injury, hyperactivity, stereotypy, and aggression. The disorder affects between 1 per 20,000 to 50,000 live births and is characterized by low birth weight, microcephaly, facial abnormalities (hypertelorism, micrognathia), incomplete motor development, and mental retardation (Cornish & Munir, 1996; Niebuhr, 1978). Jamie communicated using approximately 15 single-word signs and completed routine one-step instructions (e.g., come here, sit down). Otherwise, she required physical assistance to perform more complex activities, including self-care and daily living skills.

Jamie's parents reported that her hair pulling had been a problem for the past 4 years. They tried unsuccessfully to prevent the behavior by cutting her hair, having her wear a bicycle helmet, and giving her dental floss to keep her hands occupied. At the start of the study, Jamie had several bald areas where she had pulled large sections of hair from her head. Her parents gave informed consent for the functional analysis and treatment evaluation.

Setting

Jamie attended a private school for children who had acquired brain injury and developmental disabilities. Functional analysis and treatment evaluation sessions were conducted weekdays in a therapy room at the school. The room had a one-way observation window that permitted unobtrusive visual monitoring and data

collection. Follow-up sessions occurred in Jamie's classroom. Both the therapy room and classroom contained a table and chairs, a "beanbag" chair that Jamie sat on, and the necessary session materials.

Response Measurement and Interobserver Agreement

Target behaviors were *hair pulling*, which was defined as fingers-to-hair contact with or without a pulling motion, and *thumb sucking*, which was defined as inserting the thumb past the plane of the lips. An observer recorded the behaviors through the one-way window during functional analysis and treatment evaluation sessions. Follow-up sessions were recorded by an observer positioned in Jamie's classroom. Each 10-min session was sequenced into 60, 10-s intervals. Using a partial interval recording measure, the observer marked a data collection form when Jamie pulled her hair or sucked her thumb at any time during an interval. Data for both behaviors then were converted to percentage of intervals scored. To prevent significant loss of hair, sessions were terminated when hair pulling was recorded during 18 consecutive 10-s intervals (signaled by the observer). The termination criterion was imposed during sessions 5, 11, 13, 18, and 23 of the functional analysis and during sessions 4, 6, and 22 of the treatment evaluation.

Interobserver agreement (IOA) was assessed by having a second person record data simultaneously and independently with the primary observer during 38% of the combined functional analysis and treatment evaluation sessions. IOA was calculated by dividing agreements between the observers by agreements plus disagreements and multiplying by 100. Agreement intervals were defined as both observers recording either the occurrence or non-occurrence of target behaviors. Disagreement intervals were defined as one observer recording occurrence and the other observer recording non-occurrence of the target behaviors. IOA averaged 93% (range, 86% to 100%) for hair pulling and 93% (range, 88% to 100%) for thumb sucking.

Preference Assessment

A paired stimulus preference assessment was conducted using procedures described

by Fisher et al. (1992) to identify potential reinforcers. Nine toys commonly found in Jamie's classroom were included in the assessment. Included among those toys were personal items (e.g., a mouse purse, a baby doll) that Jamie regularly transported to and from school and home. Items were presented to Jamie in pairs until each item was presented with every other item exactly once. The item approached by Jamie on each trial was recorded, and the total number of trials each item was chosen were summed. The three items chosen on the most number of trials were considered "highly preferred." These items included a button-press sound book, a baby doll, and a mouse purse. The three items chosen on the least number of trials were considered "low preferred" and included a regular picture book, a ball, and a stuffed animal. High and low preference toys were used in the subsequent functional analysis and treatment.

Study I: Functional Analysis

We performed a functional analysis to identify the antecedent and consequence conditions responsible for Jamie's hair pulling. Our functional analysis included four conditions similar to those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). Two of Jamie's teachers served as the therapists for all functional analysis sessions. During the *attention* condition, Jamie was given "low preferred" toys, and a therapist was present with Jamie in the therapy room, reading a book or magazine. When Jamie pulled her hair, the therapist provided 30 s of continuous attention by making comments such as "No, don't pull your hair." The purpose of this condition was to identify whether Jamie's hair pulling was sensitive to contingent attention. In the *demand* condition, the therapist presented Jamie with instructional tasks selected from her Individualized Educational Program (picture identification, one-step instruction following, motor imitation). Contingent on hair pulling, the therapist removed the task, turned away from Jamie, and resumed instructions 30 s later. The purpose of this condition was to determine whether Jamie's hair pulling was sensitive to contingent removal of demands. During the *alone* condition, no one was present in the therapy room with Jamie, and she was

Figure 1: Percentage of 10-s intervals with hair pulling (top panel) and thumb sucking (bottom panel) during the functional analysis.

given “low preferred” toys. Toys were made available in the alone condition because staff and parents typically did not leave Jamie by herself without providing her access to toys. Low preference items were used to limit the possibility that toys would compete with stimulation produced by hair pulling. The purpose of this condition was to determine whether hair pulling would persist in the absence of any social consequences. Levels of hair pulling during the attention, demand, and alone conditions were compared to those in a condition called *toy play*. During the toy play condition, Jamie had access to three “highly preferred” toys. The therapist delivered a neutral social comment to her every 30 s (e.g., “That’s a nice shirt.”) and did not provide any social consequences for hair pulling. During all functional analysis sessions, the therapist did not deliver any consequences when Jamie sucked her thumb (i.e., the therapist acted as though the behavior had not occurred).

The four conditions were randomly alternated. Three to five sessions were conducted each day, 2 to 5 days a week. Session blocks lasted approximately 1 hour

with 1 min to 5 min between sessions.

Results of Functional Analysis

Figure 1 shows the percentage of intervals with hair pulling (upper panel) and thumb sucking (lower panel) across all sessions and conditions of the functional analysis. For both behaviors, the highest percentage of intervals was recorded during the alone condition, followed by the attention condition. Lower and less variable percentages were documented in the demand and toy play conditions. These results suggested that hair pulling was maintained by automatic reinforcement and possibly by attention. Furthermore, thumb sucking appeared to co-vary with hair pulling. That is, when levels of hair pulling were higher relative to the other sessions, correspondingly high levels of thumb sucking were observed. During sessions with lower levels of hair pulling, correspondingly less thumb sucking occurred. As discussed above, previous research has shown that treatment applied to only one behavior may result in a corresponding decrease in the other, untreated behavior (e.g., Friman

& Hove, 1987; Watson, Dittmer, & Ray, 2000). In Study 2, we further examined this possibility.

Study 2 - Treatment Evaluation

Treatment was evaluated in an ABAB reversal design. The design is comprised of an initial baseline phase (A), followed by a treatment phase (B), a withdrawal of treatment (return to baseline) phase (A), and a second treatment phase (B). Staff assisting with these sessions were fully informed about the rationale of the study and the fact that a potentially successful treatment would be withdrawn temporarily to better understand its influence over Jamie’s hair pulling. Three to five 10-min sessions were scheduled each day, 2 to 5 days a week. Jamie’s teachers again served as the therapists during all sessions.

Baseline. This condition was identical to the alone condition of the functional analysis. That is, Jamie was alone in the therapy room for the duration of the session, and she had access to “low preference” toys identified during the pre-study preference assessment. There were no

arranged consequences for hair pulling or thumb sucking. This condition simulated what occurred in Jamie's classroom where she sometimes was expected to play by herself. Staff reported and observation verified that hair pulling and thumb sucking were frequent during independent play. By conducting an initial baseline phase, we were able to establish a pre-treatment level of problem behavior that served as a comparison for intervention.

Treatment. Three treatment components were implemented based on the results of the functional assessment. The treatment was designed to be effective yet practical for classroom staff to implement. First, Jamie was given access to "high preference toys" (as identified via the pre-treatment preference assessment) to increase the likelihood that she would engage in toy play instead of pulling her hair. Previous research has shown that access to alternative sources of stimulation (i.e., an "enriched environment") may reduce behavior maintained by automatic reinforcement (e.g., Ringdahl, Vollmer, Marcus, & Roane, 1997). Second, response interruption (briefly removing Jamie's hands from her hair) was used to prevent or reduce the automatic consequences of hair pulling (Lindberg, Iwata, & Kahng, 1999). Third, praise was delivered for the absence of hair pulling to address the possible attention function (Lindberg, Iwata, Kahng, & DeLeon, 1999). As in baseline, Jamie was alone in the therapy room during the sessions; however, the therapist entered the room at regular intervals, which were initially 30 s. If Jamie was pulling her hair when the therapist entered the room, she interrupted the behavior by guiding one of Jamie's hands to her lap and placing one of the toys in her other hand. However, no other form of attention was delivered. If Jamie was not pulling her hair when the therapist entered the room, she praised her ("Good job!"), ensured that all toys were within Jamie's reach, and reminded her of the availability of the toys. After briefly interacting with Jamie, the therapist exited the room and waited for the next scheduled interaction. Thus, the treatment did not require continuous monitoring of behavior. The scheduled time for the therapist to enter the room was increased by 15 s or 30 s following 2 consecutive sessions with

at least a 75% decrease in the average baseline percentage of hair pulling. As in the functional analysis, the therapist did not provide any consequences for thumb sucking. That is, if Jamie was sucking her thumb when the therapist entered the room, she still received praise for the absence of hair pulling.

Follow-up. After treatment was evaluated and found to be successful in the controlled setting, it was extended to Jamie's classroom. During this process, the teachers who served as therapists continued to implement the treatment, and a consultant assisted them with fading the scheduled time for approaching Jamie to 300 s. Subsequently, the remaining classroom staff were taught to implement the procedures with Jamie during independent play periods. The staff were trained by having them watch the therapist apply treatment. Staff then implemented the procedures while they were coached and directed. Eventually, they assumed responsibility for Jamie's treatment; however, the consultant continued to provide ongoing assistance to the classroom staff including conducting periodic integrity checks. Treatment integrity varied during this time. Approximately 1 year later, 9 follow-up observations were conducted in the classroom during independent play. The teachers were not explicitly told to implement the treatment procedures, and, in fact, they did not implement all components of the treatment during the follow up sessions.

Results – Treatment Evaluation and Follow-up

Figure 2 shows the percentage of intervals with hair pulling (upper panel) and thumb sucking (lower panel) across all baseline, treatment, and follow-up sessions. Hair pulling and thumb sucking occurred during 30% to 100% of the intervals during the first baseline phase. Treatment was associated with a dramatic decrease in hair pulling, along with a corresponding decrease in thumb sucking. At the end of the first treatment phase, the therapist was entering the room every 45 s.

Both behaviors increased when treatment for hair pulling was withdrawn during the reversal to baseline and then decreased immediately with the

reintroduction of treatment. During the second treatment phase, however, the schedule for entering the room was not advanced beyond 210 s because Jamie began to pull her hair more frequently and played with the toys less frequently. As a result, the interval was reduced to 180 s for the remainder of this phase. When levels of hair pulling and toy play did not appreciably change following this modification, novel and more stimulating toys (e.g., items producing pleasant visual and auditory stimulation and items that could be spun) were added to the other available toys. These items were selected from among a group of items approached by Jamie when presented in a single stimulus preference assessment format (Pace, Ivancic, Edwards, Iwata, & Page, 1985). Hair pulling did not occur during 4 of the first 5 sessions after these new toys were introduced.

Very little hair pulling occurred during the follow-up observations, suggesting that the effects of treatment maintained over the long run in the natural environment. Thumb sucking, however, appeared to have returned to baseline levels.

Conclusions and Guidelines for Best Practice

A functional analysis, controlled treatment evaluation, and long-term follow up were conducted with a child who exhibited chronic hair pulling. Throughout the study, data were collected on another problem behavior that was not directly targeted in either the assessment or treatment (thumb sucking). Results of the functional analysis suggested that hair pulling was maintained by automatic reinforcement and possibly by attention, leading to a treatment comprised of differential positive reinforcement (praise), response interruption, and continuous access to preferred toys. The treatment, designed to be as practical as possible for classroom staff to implement, required brief periodic interactions with Jamie rather than continuous monitoring of behavior. Treatment was associated with a clinically significant decrease in hair pulling.

Results of the functional analysis suggested that successful treatment of hair pulling might lead to corresponding decreases in thumb sucking. In fact, thumb sucking decreased during the

Figure 2: Percentage of 10-s intervals with hair pulling (top panel) and thumb sucking (bottom panel) during the treatment evaluation (closed symbols) and follow-up (open symbols) sessions. The numbers next to the arrows indicate the interval (in seconds) between scheduled room entries by the teacher; the arrows point to sessions in which this schedule was changed.

initial treatment evaluation even though it was not directly treated. These findings are similar to those found with typically developing children, in which treatment of thumb sucking produced reductions in untreated hair pulling (Friman & Hove, 1987; Watson et al., 2000). Thus, results of the current and previous studies suggest that identifying problem behaviors that co-vary might lead to more efficient and practical function-based interventions. The functional analysis approach to assessment appears to be a viable method for identifying these types of relations.

Data collected during the follow-up sessions nearly 1 year after the initial evaluation showed that a treatment implemented in a controlled setting could be successfully applied in the participant's natural setting. However, the associated effects of the treatment on thumb sucking were no longer observed. From a clinical perspective, the near-zero occurrence of hair pulling at follow-up was encouraging.

However, it would have been desirable to determine whether the treatment for hair pulling could have been applied successfully to thumb sucking or whether another intervention would have been required.

The reason that levels of thumb sucking corresponded with those of hair pulling during the functional analysis and initial treatment is unclear. However, Jamie often pulled her hair and sucked her thumb simultaneously. It is possible that these behaviors occurred as part of a response chain. Some studies have suggested that decreasing one behavior in a chain can disrupt the remaining behaviors in the chain (e.g., Friman & Hove, 1987; Rapp et al., 1999). Alternatively, the reinforcement produced by hair pulling and thumb sucking may have been "complementary" (Friman, 2000; Rapp, Vollmer, Dozier, St. Peter, & Cotnoir, 2004). That is, the automatic reinforcement produced by hair pulling may have been more valuable when Jamie was sucking her thumb and vice versa.

In other words, Jamie may have found it more reinforcing to suck her thumb when she was pulling her hair at the same time. Once the treatment reduced hair pulling, the reinforcement for thumb sucking may have been less valuable. Finally, the therapist's response interruption procedure, although applied to hair pulling only, may have also interrupted thumb sucking if it was occurring simultaneously with hair pulling.

Although functional analysis results suggested that Jamie's hair pulling was maintained by automatic reinforcement, the role of contingent attention was less clear. Hair pulling may have been high in the attention condition because the low preference toys available during these sessions were not sufficient to compete with the automatic reinforcement produced by hair pulling. Additional manipulations during the functional analysis would have been needed to clarify the role of attention relative to automatic reinforcement (see

Smith, Iwata, Vollmer, & Zarcone, 1993, for an example). Also, the contribution of each treatment component (access to preferred toys, response interruption, and differential reinforcement) to the reduction in behavior is unknown. Consequently, it is possible that a simpler treatment would have produced the same outcomes. This limitation could have been addressed by implementing each component separately.

Based on these results, the following guidelines for practice are recommended:

- Identifying problem behaviors that co-vary may lead to more efficient and practical treatment strategies. When these response patterns are not readily apparent through informal observation, a controlled functional analysis may be helpful.
- Treatment should be initially evaluated under controlled conditions with the assistance of a teacher, caregiver, or other staff. After the treatment has been shown to be effective, all caregivers and staff should be taught to implement the procedures in the natural context.
- Preference assessments should be conducted daily to ensure that the most highly preferred reinforcers are used in treatment. This will reduce the possibility of satiation affecting treatment efficacy. Data also should be collected on item engagement or reinforcer consumption to monitor shifts in preference.
- When treating problem behavior maintained by automatic reinforcement, practitioners should attempt to identify leisure items that produce reinforcement comparable to the pleasurable sensory effects produced by the targeted problem behavior. Successful use of this approach, however, requires knowledge of the source of automatic reinforcement produced by the behavior (for examples, see Piazza, Adelinis, Hanley, Goh, & Delia, 2000; Rapp, 2007).
- When consulting with teachers, practitioners should be mindful of issues affecting treatment acceptability, such as the schedule of reinforcer delivery. Continued support, training, and/or treatment modifications (e.g., variable schedules) may be necessary to decrease the demand on direct service providers.

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Author's Notes

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