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An analysis and treatment of chronic thumb sucking and chronic hair pulling

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**An Analysis and Treatment of Chronic Thumb Sucking
and Chronic Hair Pulling**

A Thesis Presented

By

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The Department of Counseling and Applied Educational Psychology

In partial fulfillment of the requirements

for the degree of

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An Analysis and Treatment of Chronic Thumb Sucking and Chronic Hair Pulling

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Abstract

Thumb sucking often occurs with other habit disorders such as hair pulling. There have been several suggested relationships between thumb sucking and hair pulling, including that thumb sucking is an establishing operation for hair pulling. In the current study a 12-year-old girl with Cri du Chat Syndrome engaged in chronic bi-lateral thumb sucking and chronic hair pulling. Classroom data suggested that thumb sucking and hair pulling occurred simultaneously, thus the purpose of the study was three-fold, 1) Identify the function of thumb sucking, 2) Identify the relationship between thumb sucking and hair pulling, and 3) Assess the direct effects of protective equipment (i.e., ThumbGuards®) on thumb sucking and indirect effects on hair pulling. Functional analysis results showed that the duration of thumb sucking was highest in low stimulation conditions suggesting an automatic function. Results of the relationship analysis suggested that thumb sucking functioned as an establishing operation for hair pulling. During the treatment analysis, implementation of the ThumbGuards® decreased thumb sucking to low levels and eliminated untreated hair pulling. Interobserver agreement was assessed on 30% of all sessions and averaged above 80% on all measures.

An Analysis and Treatment of Chronic Thumb Sucking and Chronic Hair Pulling

Thumb sucking is an adaptive and normative behavior during infancy and early childhood (Friman, Barone, & Christophersen, 1986). However, when thumb sucking persists into later childhood, it can lead to socially significant dental complications, skin deterioration, and sores. In some children, chronic thumb sucking may require treatment.

Often the occurrence of thumb sucking is observed concurrent with other behaviors. Attachment responses, such as mouthing and tracking, tend to increase with increases in development of the child. As this occurs, children begin to allocate attachment responses to inanimate objects, such as a blanket. Friman (2000) examined the effects of a transitional object on the thumb sucking of a 3 year-old boy. The boy was observed in two settings; in his crib and in the experimenter's lap. During baseline, the child's surgical cloth was removed from sight, while in the cloth present condition he was simply given the surgical cloth. Results from this study indicated that thumb sucking never occurred in the absence of the surgical cloth, however rapidly emerged when the cloth was present. These results suggest that the cloth may have functioned as a discriminative stimulus (S^D) or as an establishing operation (EO). These findings suggest that if a child uses a transitional object, it may be possible to treat thumb sucking by simply removing the transitional object.

Thumb sucking is often observed concurrent with a variety of other habit disorders, such as trichotillomania, or hair pulling. When responses covary it may be possible to change the frequency of one behavior by treating the other (Friman & Hove, 1987). For example, aversive taste treatment is one possible direct treatment for thumb sucking; however it has also been evaluated for the indirect effect on trichotillomania (Friman & Hove, 1987). During baseline, the childcare providers provided no consequence for either of the target behaviors. During

treatment, an aversive taste solution was applied to the thumbs in the morning and in the evening, as well as contingent on any instance of thumb sucking throughout the day. The application was slowly faded until the solution was applied only contingent upon any thumb sucking. This resulted in a decrease to near zero levels for both the treated thumb sucking and the untreated hair pulling. It is possible that the hair pulling was actually punished by the contingent application of the aversive solution. Typically when using aversive taste solutions to treat thumb sucking there is an initial decrease followed by some recovery. This study, however, introduced a fading procedure that was effective in producing a lasting decrease in both target behaviors.

Understanding the relationship between thumb sucking and hair pulling may help with treating the behaviors. The relationship between thumb sucking and other behaviors has been described by several suggested relationships. One possible explanation is that thumb sucking is a motivating operation. A motivating operation is an environmental variable that alters the reinforcing effectiveness of some stimulus object or event and alters the frequency of all behavior that has been reinforced by that stimulus, object, or event (Cooper, Heron, & Heward, 2007). Michael (1982) provided a distinction between the motivating and discriminating properties of these antecedent variables. A discriminating stimulus simply signals that reinforcement is available; whereas a motivating operation alters the reinforcing effectiveness of all behaviors that have been reinforced by that stimulus. Abolishing operations describe environmental variables which decrease the reinforcing effectiveness of some stimulus and decrease the frequency of all behaviors that had been previously reinforced by that stimulus (Michael, 1982). The term establishing operation is used to describe environmental variables which increase the reinforcing effectiveness of some stimulus and increase the frequency of all behaviors that have been previously reinforced by that stimulus. Friman (1987) suggested that

transitional objects increase the reinforcing effectiveness of thumb sucking, and therefore function as an EO. With or without the transitional object, a child has access to thumb sucking; however, the presence of the transitional object increases the reinforcing effect of thumb sucking. Similarly, thumb sucking may function as an EO for hair pulling. With or without thumb sucking, a child has access to hair pulling. However, if hair pulling doesn't occur without thumb sucking, it's possible that thumb sucking increases the reinforcing effect of hair pulling.

Another term used to describe the relationship between thumb sucking and hair pulling is complimentary reinforcers (Friman, 2000). That is the automatic reinforcement produced by thumb sucking may increase in value when paired with hair pulling. This is also true for the reinforcing value of hair pulling when paired with thumb sucking.

It is also possible that thumb sucking and other behaviors are part of a response class or response chain. Friman and Hove (2000) suggested that thumb sucking and hair pulling might have been paired in infancy and shaped by early reinforcing experiences such as feeding. By treating one behavior you disrupt the entire chain, which would account for the successful elimination of hair pulling by treating thumb sucking.

Yet another explanation for the relationship between thumb sucking and hair pulling is simply that the responses covary. That is the change in frequency of one behavior is correlated with changes in the frequency of another behavior (Friman & Hove, 2000). By directly treating thumb sucking, it is possible to indirectly treat hair pulling. A decrease in the frequency of one behavior results in the decrease in frequency of the other behavior, suggesting the two behaviors covary.

It is also possible that thumb sucking is a discriminative stimulus for other habit disorders such as hair pulling. That is, thumb sucking has come to signal that reinforcement for hair

pulling is available. During past pairing, hair pulling has been reinforced in the presence of thumb sucking, but has not been reinforced in the absence of thumb sucking. This history of differential reinforcement may explain the increase in hair pulling in the presence of thumb sucking (Cooper, Heron, & Heward, 2007).

Some treatment options for thumb sucking include aversive taste treatments, awareness enhancement devices, and response blocking (Ellington, Miltenberger, Garlinghouse, Roberts, & Galensky, 2000; Friman & Hove, 1987; Stricker, Miltenberger, Garlinghouse, Deaver, & Anderson, 2001; VanHouten & Rolider, 1984). Contingent reading has also been used to treat night time thumb sucking (Knight & McKenzie, 1974). During baseline the experimenter read continuously to the child whether or not thumb sucking occurred. During treatment, however, the experimenter stopped reading and was silent contingent on thumb sucking. When the child removed the thumb from his mouth, the experimenter immediately resumed reading. After several sessions, rates of thumb sucking decreased to near zero levels. The contingent withdrawal of the reinforcer punished thumb sucking and increased stable avoidance behavior, i.e. not thumb sucking. It is important to recognize that for this type of treatment to be successful, reading must function as a reinforcer.

An awareness enhancement device may also be used to effectively treat thumb sucking (Ellington, Miltenberger, Garlinghouse, Roberts, & Galensky, 2000; Stricker, Miltenberger, Garlinghouse, Deaver, & Anderson, 2001). Ellington et al.(2000) examined the effects of gloving a child's hand and using an awareness enhancement device (AED) to decrease finger sucking in two typically developing children. The awareness enhancement device was described as an electronic device that emits a tone when the child's hand gets within a specified proximity of their head. For one child, the use of a glove was immediately effective and for the other the

glove was ineffective. When an AED was introduced the other participant immediately reduced finger sucking. Implementation of the gloves provided sensory extinction for one of the participants; however, it is possible for the other participant the gloves provided only partial sensory reduction. It is possible that this participant still received some sensory reinforcement for sucking his fingers, so therefore it was necessary to use an AED to decrease the behavior.

Stricker et al. (2001) evaluated the effects of an awareness enhancement device alone on thumb sucking. The three experimental conditions were baseline, inactive AED, and active AED presented in an ABCBAC design. During baseline the participant was alone watching television during the videotaped observation. The inactive AED condition was the same as the alone condition except the child wore a disabled AED device. In the AED active condition, contingent on the hand coming within 25 cm of the child's mouth, two tones were emitted at 65 decibels. Results indicated a decrease to near zero levels during the active condition and high rates during baseline and the inactive condition, demonstrating a clear relationship between contingent delivery of a tone and levels of thumb sucking. Advantages of using an AED include that it does not require an individual to constantly monitor the behavior and an individual can wear it during various activities.

Thumb sucking can be self injurious if it leads to skin break down or damage to the mouth. Prolonged thumb sucking may lead to extensive orthodontic correction, as well as mucosal trauma and digital malformation (Friman, Barone, & Christophersen, 1986). Roscoe, Iwata, and Goh (1998) compared the effects of noncontingent reinforcement and sensory extinction on the self injurious behavior (SIB) of 3 individuals with developmental disabilities. During the noncontingent reinforcement (NCR) condition, the child was granted access to leisure items and received no attention from the experimenter. However, during the sensory extinction

condition, the experimenter placed designated equipment on the participant that masked or attenuated the sensory stimulation produced by the SIB. For example, one of the participants engaged in body rubbing and body picking, for her latex gloves were used to suppress the tactile feeling of rubbing her skin or picking with her fingernail. Both NCR and sensory extinction resulted in a decrease in rates for both conditions; however during the sensory extinction condition the decrease was not as great or as rapid as the NCR condition. For both NCR and sensory extinction the leisure items selected and the equipment used are very important. If the leisure item is to be effective at suppressing SIB, it must have reinforcing properties and the equipment must mask the sensory consequences of the SIB. Future research should examine the effects of noncontingent reinforcement and sensory extinction on the treatment of thumb sucking.

VanHouten and Rolider (1984) used response prevention to effectively treat nocturnal thumb sucking. In Experiment 1, two participants started with a baseline condition in which parents recorded the occurrence of thumb sucking during designated times. The parents then placed boxing gloves on the participants' hands. The participants were then shown a graph of their rates of thumb sucking. They were told that they could earn reinforcers for no thumb sucking and that they would lose television if they sucked their thumb or tried to remove the glove.

After a week of the boxing glove intervention, the glove was faded to an absorbent cotton restraint. Following two sessions, the cotton was faded to a finger tip bandage, which was then faded to no restraint. However, the reinforcement and television contingencies remained in effect. For one participant, the response prevention package reduced thumb sucking to zero. However, the other participant switched to sucking his other hand when only one glove was on.

As a result, the experimenter applied the treatment package to both hands. This produced zero levels of thumb sucking. In Experiment 2, the experimenters examined whether response cost and reinforcement alone would decrease thumb sucking. They assessed the effect of the contingencies alone, restraints and contingencies, restraints and no contingencies, and no restraints and no contingencies. Results indicated that the reinforcement and response cost alone were not effective in eliminating nocturnal thumb sucking. In experiment 3, the response prevention package used the cotton restraint rather than the boxing glove to determine if thumb sucking would be suppressed without the glove restraint. The results suggested an immediate decrease in thumb sucking behavior. Experiment 4 was designed to assess whether it was necessary to fade the restraints, or if implementing the cotton restraint and then removing it could still suppress responding. The experimental design consisted of baseline, cotton restraint with contingencies, and contingencies alone. Results indicated that for one participant responding decreased to near zero with the restraint and remained at zero with the abrupt removal of the restraint. However, results for the other participant suggested that nocturnal thumb sucking recovered following the abrupt removal of the restraint. Further analyses should be conducted on the fading of restraints for individuals with thumb sucking behavior.

The literature on thumb sucking and hair pulling is limited. There has been little direct research to identify the function and relationship between these two behaviors. Understanding the relationship between thumb sucking and hair pulling, may help with treating the behaviors. The purpose of this study was three-fold, first to identify the function of thumb sucking, then to identify the relationship between thumb sucking and hair pulling, and finally to assess the direct effects of protective equipment (i.e., ThumbGuards®) on thumb sucking and indirect effects on hair pulling.

General Method

Participant and Setting

Julie, a twelve-year-old girl diagnosed with Cri du Chat Syndrome participated. Cri du Chat Syndrome is a rare genetic disorder which is caused by a missing part of chromosome 5. Julie attended a small private school and neurorehabilitation center where all assessments were conducted. She followed simple directions and was able to communicate with a few words, modified signs, and a communication picture book.

Sessions were conducted in a small treatment room (3m by 4m) and in her regular classroom. Sessions in the treatment room were 5 min in length; this session length was extended to 10 min during classroom sessions. Session blocks consisted of 5-6 sessions per block.

Response Measurement and Interobserver Agreement

The target responses for all experimental conditions were thumb sucking and hair pulling. Thumb sucking was defined as any instance of placing either thumb in the mouth, past the plane of the lips, for at least 1s. Instances of thumb sucking were separated by at least 2s. Hair pulling was defined as any hair to finger contact paired with hand movements away from the head. Instances of hair pulling were separated by separation of finger and hair for longer than 2s.

During the functional analysis, relationship analysis, and treatment analysis all sessions were videotaped. An observer scored the tapes, recording the duration of thumb sucking by noting the time of insertion and removal of the thumb from the lips and the duration of hair pulling by recording the time of contact and separation of the finger and hair. Total duration of thumb sucking and hair pulling for each session was calculated by adding the duration of each instance of behavior. Appendix A contains a sample data sheet for thumb sucking and Appendix B contains a sample data sheet for hair pulling.

A 30-s partial interval recording system was used to collect data on thumb sucking and hair pulling during the classroom treatment analysis. Each session was divided into 30-s intervals. A plus sign was recorded for any instance of thumb sucking during each interval and a minus symbol was recorded if there was an absence of thumb sucking. The same was done for hair pulling.

Interobserver agreement (IOA) was collected by having a second observer independently record data. Agreement was calculated by dividing the lesser total duration by the greater total duration and multiplying by 100%. IOA was collected for 32% of all sessions during the functional analysis; mean agreement was 96% (range 77%-100%) for thumb sucking and 98% (range 98%-100%) for hair pulling. During the relationship analysis, IOA was collected for 35% of sessions for thumb sucking and averaged 81% (range 0%-100%). IOA was collected for 29% of sessions for hair pulling and averaged 92% (range 78%-100%). IOA was collected during 30% of treatment sessions in the small treatment room. For thumb sucking, IOA averaged 89% (range 43%-100%). IOA averaged 92% (range 61%-100%) for hair pulling. Agreement was calculated during classroom sessions by dividing total agreement by the number of intervals. IOA was collected for 20% of classroom sessions and averaged 99% (range 90%-100%) for thumb sucking and 98% (range 70%-100%) for hair pulling.

Treatment integrity was assessed for 25% of sessions during the functional analysis, relationship analysis, and the treatment analysis in the treatment room. Treatment integrity was 100%. Integrity was taken from a random sample of sessions, and included at least one session from each condition. Treatment integrity was in the form of a five question checklist, completed by an independent observer. Treatment integrity evaluated whether materials were present, whether the S^d was presented, whether the appropriate consequence followed the target behavior,

whether other behaviors had no programmed consequences, and whether the session length was precise.

Preference Assessment

A paired stimulus preference assessment (Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin, 1992) was conducted to identify highly and moderately preferred leisure items to be used in the functional analysis. All items were selected from the participant's classroom to ensure familiarity with all of the items. The items selected included; a small hula doll, pink dinosaur, peg board, playschool spinning gears toy, Legos, books, a dancing Elmo, and a teddy bear. The participant and experimenter were seated on a rug facing each other. An independent observer sat behind the participant and recorded approach responses. The experimenter held two items approximately .5m apart and .5m in front of the participant and instructed the participant to pick one. An approach response was defined as any hand movement toward an item. An approach response resulted in 15s access to the item approached and removal of the other item. If the participant attempted to touch both items simultaneously, the items were both removed briefly and then represented. If neither item was approached within 5s, both items were removed and were not represented. This was repeated for every possible pairing of potential reinforcers. IOA was collected by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100%. IOA was taken during more than 30% of sessions and averaged 100%.

The results of the preference assessment are displayed in Figure 1. The dinosaur and hula girl were selected most frequently and served as highly preferred, high stimulation items. The pegboard, Lego's, and playschool spinning gears toy were selected infrequently and served as low stimulation items, which were moderately preferred

Study 1 – Functional Analysis

Procedure

Prior to the study, Julie was observed in a naturalistic setting. These observations revealed that throughout the day Julie simultaneously sucked her thumb and pulled her hair; therefore, data was collected on both behaviors. Subsequently, a functional analysis was conducted for thumb sucking only in order to determine the variables which maintained it. Friman and Hove (2000) suggested that it might be possible to treat behaviors that are harder to target because of their limited, variable, or covert practice, such as hair pulling, by targeting overt and high rate behaviors such as thumb sucking. An alternating treatments design was used. Sessions were 5 minutes in length and were randomized across conditions.

Control. The experimenter, who sat approximately one arm length away from the participant, started the session by asking her, “What do you want to do?” The only items in the room were highly preferred toys, which were identified using the paired stimulus preference assessment previously described. Every 15s the experimenter delivered verbal attention in the form of a brief remark (e.g., “I like the warm weather today” or “I like your outfit”). If at the 15s mark the student was engaged in thumb sucking, verbal praise delivery was delayed approximately 5s or until the thumb was removed from the mouth. The experimenter responded to the participant’s mands, and the student was able to continuously interact with the toys. No consequences were delivered following thumb sucking, hair pulling, or any other problem behavior.

Academic demand. The experimenter sat approximately one arm length away from the participant and started the session by stating, “It’s time for work.” Using a three step prompting procedure (vocal, model, and physical), the therapist delivered continuous demands related to a

receptive number identification task. The experimenter would hold two number cards approximately 1 foot in front of the participant, and stated "Point to the number ____". Contingent on thumb sucking, the experimenter stated, "Ok you don't have to," turned away from the student, and removed the task materials for 15s. If at the end of the 15s break, the participant was engaged in thumb sucking the therapist stated, "Ok you don't have to," removed the materials, turned away from the student, and delivered a second 15s break. Praise was delivered for correct responses, and incorrect responses were followed by a prompt from the three-step promoting procedure on a 5-s schedule. There were no programmed consequences for hair pulling or other problem behaviors.

Attention. Prior to the session, the therapist interacted with the participant for three minutes. The experimenter sat approximately one arm length away from the participant and started the session by telling the participant, "Julie, you can play. I have to work now." The participant had continuous access to moderately preferred toys. The experimenter then assumed the appearance of working. Contingent on thumb sucking the experimenter delivered 3-5s of attention in the form of a verbal reprimand (e.g., "don't do that, you are going to hurt yourself" or "you know I don't like it when you do that"). When the duration of thumb sucking lasted longer than 15s, 3-5 s of attention was delivered every 15s. No consequences were delivered following hair pulling or other problem behavior and the experimenter did not respond to student mands.

Alone 1. The therapist started the session by stating to the student, "I will be right back," and leaving the treatment room. Julie had continuous access to moderately preferred toys, which were identified using the paired stimulus preference assessment. This condition was to reflect a

more naturalistic alone setting, one in which Julie did not have continuous access to all highly preferred toys.

Alone 2. This condition was identical to the Alone 1, except Julie had access to highly preferred toys. This condition was conducted to determine if highly preferred toys would compete with the thumb sucking.

Results and Discussion

The results of the functional analysis are displayed in Figure 2. Thumb sucking and hair pulling were never observed during the Alone 2 and Control conditions. Responding was variable in the Alone 1, Attention, and Demand conditions for both thumb sucking and hair pulling. In the Alone 1 condition, the duration of thumb sucking and hair pulling averaged 121.6s (range 9.0-247.0) and 63.2s (range 1.0-145.0), respectively. In the Attention condition, the duration of thumb sucking and hair pulling averaged 135.0s (range 4.0-251.0) and 55s (range 0-135.0), respectively. In the Demand condition the duration of thumb sucking and hair pulling averaged 124.5s (range 0-255.0) and 60.5s (range 0-209.0), respectively. These results suggest that thumb sucking is automatically maintained, that is not sensitive to socially mediated consequences. However, the low levels of responding during conditions with highly preferred toys suggests that access to these items may compete with the target behavior.

Study 2 – Relationship Analysis

Procedure

The results of the functional analysis indicated that thumb sucking and hair pulling occurred during the demand, attention, and alone condition with moderately preferred toys, even though only consequences for thumb sucking were manipulated. These results suggested that thumb sucking is automatically maintained, and that high preference toys may compete with

these target behaviors. These results also suggested that thumb sucking and hair pulling covaried. An understanding of the relationship between thumb sucking and hair pulling was needed to identify the most effective treatment procedure.

Baseline. This condition was identical to the Alone 1 condition from the functional analysis. The only items in the room were moderately preferred toys. The therapist stated to the student, “I will be right back”, and left the treatment room. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time and recording of the session. Julie had continuous access to moderately preferred toys, which were identified using the paired stimulus preference assessment. This condition was to reflect a more naturalistic alone setting, one in which Julie did not have continuous access to all highly preferred toys.

Block thumb sucking. The only items in the room were moderately preferred toys. The experimenter stated, “You sit and play”, and then sat approximately 1m from the student. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time and the recording of the session. Contingent on Julie bringing her thumb within approximately 3 inches of her mouth, the experimenter would block her hand and prompt it to her lap. There were no programmed consequences for hair pulling.

Block hair pulling. The only items in the room were moderately preferred toys. The experimenter stated, “You sit and play”, and then sat approximately 1m from the student. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time and the recording of the session. Contingent on Julie bringing her hand within approximately 3 inches from her head, the experimenter would block her hand and prompt it to her lap. There were no programmed consequences for thumb sucking.

Results and Discussion

The results of the relationship assessment are displayed in Figure 3. The duration of thumb sucking was high during the baseline and block hair pulling conditions. The duration of hair pulling was high during the baseline condition only. During baseline the average duration of thumb sucking was 207.5s (range 120.0-291.0) and the average duration of hair pulling was 48.8s (range 4.0-89.0). During the block hair pulling condition, the duration of thumb sucking averaged 141.7s (range 77.0-257.0) and the duration of hair pulling averaged .5s (range 0-2.0). During the block thumb sucking condition, the duration of thumb sucking and the duration of hair pulling was zero. When thumb sucking was blocked, hair pulling never occurred. However, when hair pulling was blocked, thumb sucking persisted. These results suggest that thumb sucking functions as an establishing operation for hair pulling, but that hair pulling is not an establishing operation for thumb sucking. That is, thumb sucking increases the reinforcing properties of hair pulling, but hair pulling does not increase the reinforcing properties of thumb sucking. In that thumb sucking increases the reinforcing value of hair pulling, by preventing thumb sucking, hair pulling no longer occurs.

Study 3 – Treatment Analysis and Follow up

Procedure

The results of the relationship analysis suggested that hair pulling did not occur in the absence of thumb sucking. Therefore, during the treatment analysis and follow up, intervention occurred on thumb sucking only. One possible treatment for thumb sucking is response prevention (VanHouten & Rolider, 1984). During the treatment analysis, Julie wore flexible plastic ThumbGuards® on each thumb. The ThumbGuards® covered the base of the thumb and left the tip exposed. The guards were secured using plastic wristbands. An alternating treatments

design was used, and sessions were randomized across conditions. A treatment package which combined blocking of thumb sucking and access to highly preferred toys was also assessed following the follow up.

Baseline. The participant was brought to the treatment room by the experimenter and was seated on a beanbag. The only items in the room were moderately preferred toys. The therapist stated to the student, “I will be right back”, and left the treatment room. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time and the recording of the session.

Probe. Prior to the start of each session, a plastic wristband was placed on the student’s wrist. The participant was brought to the treatment room by the experimenter and was seated on a beanbag. The only items in the room were moderately preferred toys. The therapist stated to the student, “I will be right back”, and left the treatment room. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time and the recording of the session. This condition was included to determine if the plastic wristbands alone could decrease thumb sucking.

ThumbGuards®. Prior to the start of each session, flexible plastic ThumbGuards® were secured to both of the student’s thumbs using a plastic wristband. The participant was brought to the treatment room by the experimenter and was seated on a beanbag. The only items in the room were moderately preferred toys. The therapist stated to the student, “I will be right back”, and left the treatment room. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time and the recording of the session.

Follow up. Eight months after the completion of the initial treatment analysis a follow up analysis was conducted. It was identical to the treatment analysis.

Block thumb sucking/highly preferred toys/ThumbGuards®s. Prior to the start of each session, flexible plastic ThumbGuards® were secured to both of the student's thumbs using a plastic wristband. The participant was brought to the treatment room by the experimenter and was seated on a beanbag. The participant had access to highly preferred toys. The experimenter stated, "You sit and play", and then sat approximately 1m from the student. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time and the recording of the session. Contingent on Julie bringing her thumb within approximately 3 inches of her mouth, the experimenter would block her hand and prompt it to her lap.

Results and Discussion

Results of the treatment analysis and follow up can be seen in Figure 4. During the baseline condition the mean duration of thumb sucking and hair pulling was 152.3s (range 0-258.0) and 85.0s (range 0-151.0), respectively. During the probe condition the mean duration of thumb sucking and hair pulling was 156.0s (range 86.0-238.0) and 31.0s (range 25.0-132.0), respectively. During the ThumbGuards® condition the mean duration of thumb sucking and hair pulling was 23.5s (range 0-176.0) and 4.0s (range 0-44.0), respectively. Results of the probe sessions showed that the wristband alone was not effective in reducing the duration of thumb sucking or hair pulling in that both behaviors occurred at similar durations as that of baseline. Results of the ThumbGuards® sessions revealed that the ThumbGuards®s were effective at directly decreasing thumb sucking, and indirectly eliminating hair pulling.

The results of the follow up study showed a slight decrease in thumb sucking, and a small increase in hair pulling during the treatment condition when compared to the initial analysis. During the baseline condition the mean duration of thumb sucking and hair pulling was 162.9s (range 0-241.0) and 96.5s (0-138.0), respectively. During the probe condition the mean duration

of thumb sucking and hair pulling was 162.2s (range 62.0-256.0) and 100.8s (range 4.0-131.0), respectively. During the ThumbGuards® condition the mean duration of thumb sucking and hair pulling was 19.1s (range 0-64.0) and 31.8s (range 0-87.0), respectively.

The treatment package which combined ThumbGuards®, blocking of thumb sucking, and access to highly preferred toys resulted in a return to zero levels of responding for both thumb sucking and hair pulling. During the baseline condition the mean duration of thumb sucking and hair pulling was 196.3s (range 138.0-256.0) and 125s (range 102.0-154.0), respectively. These results suggest that use of the ThumbGuards® is an effective procedure to reduce thumb sucking and hair pulling. However, it may be necessary to include a blocking procedure or use of highly preferred toys.

Study 4 – Classroom Analysis

Procedure

During the treatment analysis, the ThumbGuards® condition was effective in decreasing both thumb sucking and hair pulling. The purpose of this study was to extend the results obtained during the treatment analysis to the classroom setting. A reversal design was used. In the morning a BAAB design was used and in the afternoon a ABAB design was used.

ThumbGuards®s on. Prior to the start of each session, flexible plastic ThumbGuards® were secured to both of the student's thumbs using a plastic wristband. The student was brought to a large area rug in her classroom, and had access to toys she used throughout the day. She was told by the experimenter that it was time to play. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time.

Weekly Probe off. After the ThumbGuards®s on condition, Julie's parents shaved her head. Weekly probes were conducted to determine when her hair was long enough for her to be

able to pull it out. The student was observed in her classroom. She had access to toys and did not wear her ThumbGuards®s.

ThumbGuards®s off. The student was brought to a large area rug in her classroom, and had access to toys she used throughout the day. She was told by the experimenter that it was time to play. Once the therapist delivered the instruction, the data collector would count down from 3 and start the session time.

Results and Discussion.

The results of classroom analysis indicated that the ThumbGuards® were effective at directly treating thumb sucking while also indirectly treating hair pulling. During the morning analysis, when the ThumbGuards®s were on, thumb sucking averaged 8% of intervals (range 0%-30%) and hair pulling was 0% of intervals. During the classroom analysis, Julie's head was shaved, making hair pulling impossible. While waiting for her hair to grow long enough to make hair pulling possible, weekly probes were conducted. During the weekly probes, ThumbGuards® were not worn. Thumb sucking averaged 20% of intervals (range 0%-85%) and hair pulling averaged 11% of intervals (range 0%-45%). Once Julie began thumb sucking and hair pulling during two consecutive probe sessions, the reversal to ThumbGuards® off condition was started. Thumb sucking averaged 57% of intervals (range 0%-100%) and hair pulling averaged 41% of intervals (range 0%-95%). During the reversal back to treatment, thumb sucking averaged 10% of intervals (range 0%-15%) and hair pulling occurred during 0% of intervals.

During the afternoon analysis, the reversal design began with the ThumbGuards® off condition. Thumb sucking averaged 75% of intervals (range 30%-100%) and hair pulling averaged 44% of intervals (range 5%-75%). During the first ThumbGuards® on condition, thumb sucking averaged 9% (range 0%-20%) and hair pulling averaged 0% (range 0%-5%). This

was then followed by the weekly probes with the ThumbGuards® off. During the probe condition, thumb sucking averaged 46% of intervals (range 20%-100%) and hair pulling averaged 20% of intervals (range 0%-60%). During the reversal back to ThumbGuards® on, thumb sucking averaged 11% (range 0%-40%) and hair pulling averaged 2% of intervals (range 0%-45%).

Discussion

The results from the functional analysis showed that the duration of thumb sucking was highest in low stimulation conditions, suggesting an automatic function. During the functional analysis, consequences were manipulated for thumb sucking only, however, it appeared that thumb sucking and hair pulling covaried. The next analysis conducted was a relationship assessment, to determine the relationship between thumb sucking and hair pulling. When thumb sucking was blocked, hair pulling never occurred. When hair pulling was blocked, the thumb sucking persisted. These results suggested that thumb sucking may best be described as an establishing operation for hair pulling, but that hair pulling is not an establishing operation for thumb sucking. That is, thumb sucking increases the reinforcing properties of the hair pulling, but hair pulling does not increase the reinforcing properties of thumb sucking.

Previous research has suggested that the relationship between thumb sucking and hair pulling can be described as a two-response chain (Friman & Hove, 2000). In a response chain, when the terminal response is interrupted or placed on extinction, the initial response rate also decreases (Kuhn, Lerman, Vondran, & Addison, 2006). However, in the current study, rates of the initial response remained high when the terminal response was interrupted, suggesting an establishing operation rather than a response chain. Julie had access to hair pulling even in the absence of thumb sucking, yet only engaged in hair pulling in the presence of thumb sucking.

These results support the suggested relationship of an establishing operation. In that thumb sucking increases the reinforcing value of hair pulling, by preventing thumb sucking, hair pulling no longer occurs. These results helped determine which behavior would be directly treated during the treatment analysis. By treating the thumb sucking only, it was possible to eliminate both thumb sucking and hair pulling.

Two other suggested explanations for the relationship between thumb sucking and hair pulling are covariation and complimentary reinforcers. Covariation refers to the change in frequency of one behavior that is correlated with changes in the frequency of another behavior (Friman and Hove, 2000). This does not describe the relationship, but rather simply describes a change in data. Friman (2000) described the relationship between thumb sucking and hair pulling as complimentary reinforcers. That is the automatic reinforcement produced by thumb sucking may increase in value when paired with hair pulling. This is also true for the value of hair pulling when paired with thumb sucking. This definition suggests that the relationship goes both ways, however this is not consistent with the findings of the current study. When hair pulling was blocked thumb sucking continued, but when thumb sucking was blocked hair pulling decreased. This suggests that automatic reinforcement produced by hair pulling may increase in value when paired with thumb sucking, but not vice versa.

In order to treat the automatically maintained thumb sucking, plastic ThumbGuards® were used. Results of the ThumbGuards® sessions revealed that the ThumbGuards®s were effective at directly decreasing thumb sucking, and indirectly eliminating hair pulling. One possible explanation for why the Thumbguards® were effective in decreasing thumb sucking is that they prevented Julie from creating suction. The Thumbguards® blocked the response, and prevented Julie from getting the reinforcing consequence from sucking her thumb.

The results of the 8 month follow up suggested that rates of thumb sucking and hair pulling had increased since the initial treatment. This was likely due to the shaping of a new behavior. It is possible that over time Julie learned to suck her thumb while wearing the Thumbguards®. Another treatment package was implemented which incorporated the plastic ThumbGuards®, access to highly stimulating toys, and a response blocking procedure. The results of this treatment package were a return to zero levels for both thumb sucking and hair pulling. These results indicate that although the ThumbGuards® may be effective alone, a blocking procedure may be needed in very low stimulating environments or Julie should be given access to highly stimulating toys.

The Thumbguards® were introduced in the classroom setting, and they were effective at decreasing both thumb sucking and hair pulling. In the classroom, Julie had access to a variety of toys, which may have been competing with thumb sucking. Since Julie's preference for toys changes frequently and she becomes satiated on toys, for clinical purposes she is given access to different toys on alternating days. The results from the treatment analysis suggest that in the classroom setting, levels of thumb sucking and hair pulling may increase during very low stimulation activities, this may require response blocking or access to a highly stimulating toy. For clinical purposes, Julie is given access to toys during group and is seated near a staff at all times.

The decision to use duration data collection was made due to the low instance and high duration of Julie's thumb sucking. In order to get a precise measurement of the target behavior duration data was taken. There is a limitation the way that data was collected. There is no evidence that the two behaviors actually occurred together. Given that sessions were recorded, future research could calculate the conditional probability of hair pulling given thumb sucking

and thumb sucking given hair pulling or recollect data using partial intervals to demonstrate that the two behaviors were occurring simultaneously. However, it should be noted that anecdotal evidence suggests that the behaviors did occur together. Another limitation of the current study is the failure to establish control in the home environment. At the beginning of the treatment analysis, ThumbGuards® were sent home for use at Julie's parents' discretion. No data were taken in the home setting, and it is unclear if they were used consistently and properly. It is also possible that a new behavior was shaped, and Julie learned to suck her thumb with the guards on. Another limitation of the current study is that no data was taken on Julie's toy manipulation during any of the analyses conducted. In order to provide clinical support to the claim that Julie should be given access to manipulatives during low stimulation activities, it is important to know whether or not she is engaging with these manipulatives. It would be beneficial to look at the relationship between thumb sucking and toy manipulation. Also the current study made no attempt to fade the use of the ThumbGuards®.

Future research should look at the extent possible the ThumbGuards® could be faded and maintain their effect of reducing thumb sucking and hair pulling. Two possible ways that fading could be done would be the fading of the actual size of the protective equipment, or fading the amount of time the ThumbGuards® are worn. It is possible that thumb sucking is a discriminative stimulus for hair pulling, however this would suggest that hair pulling has not been reinforced in the absence of thumb sucking. Since Julie has access to hair pulling even in the absence of thumb sucking, this study supports the idea that thumb sucking is an establishing operation for hair pulling. In order to support the findings of this study, future research should also look at what effect satiation and deprivation of thumb sucking have on hair pulling.

Protective equipment has been shown to be effective at decreasing both thumb sucking and hair pulling. The current study adds to the literature on thumb sucking and hair pulling and uses direct manipulation to identify the function and relationship between these two behaviors.

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Figure Captions

Figure 1. Percent selection of individual stimuli for a paired-stimulus preference assessment for Julie.

Figure 2. Duration of thumb sucking and hair pulling across Alone 1, Alone 2, Attention, Demand, and Control conditions.

Figure 3. Duration of thumb sucking and hair pulling across baseline, block hair pulling, and block thumb sucking conditions.

Figure 4. Duration of thumb sucking and hair pulling across treatment, follow up, and block thumb sucking with highly preferred toys conditions.

Figure 5. Percentage of intervals containing thumb sucking and hair pulling during classroom analysis.

Preference Assessment

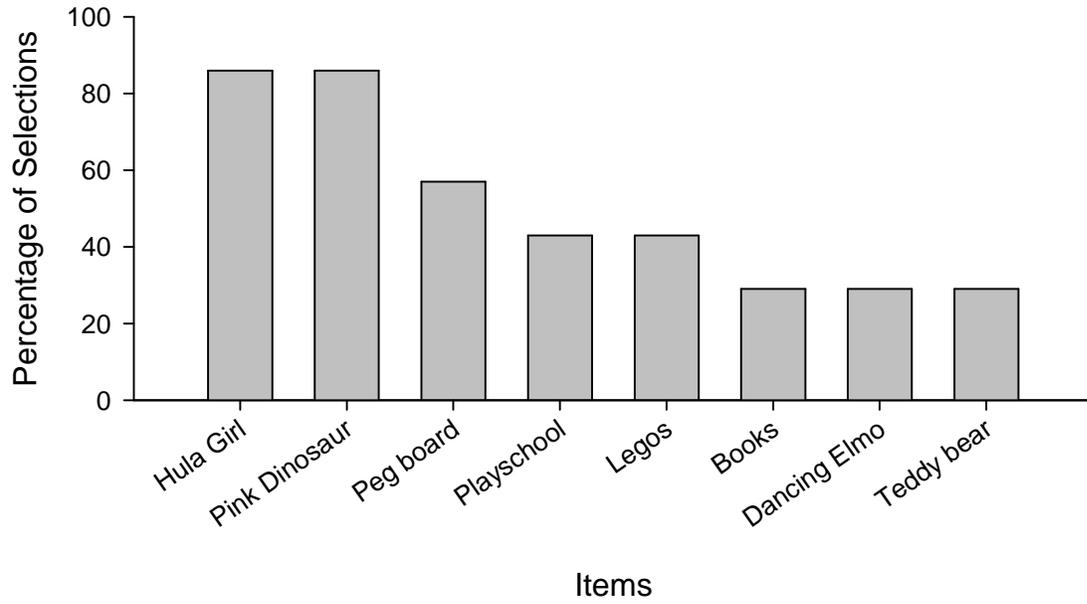


Figure 1

Functional Analysis of Thumb Sucking

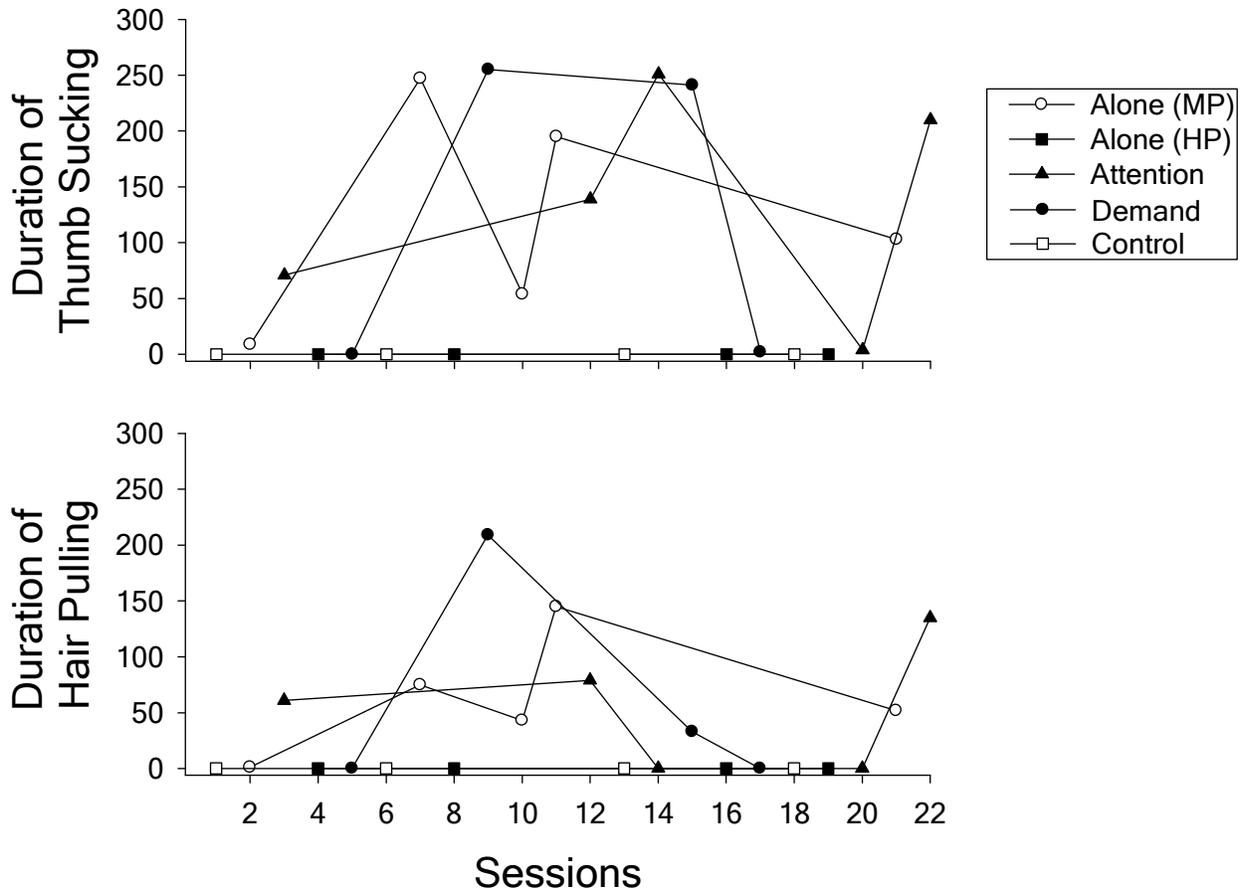


Figure 2

Relationship Analysis

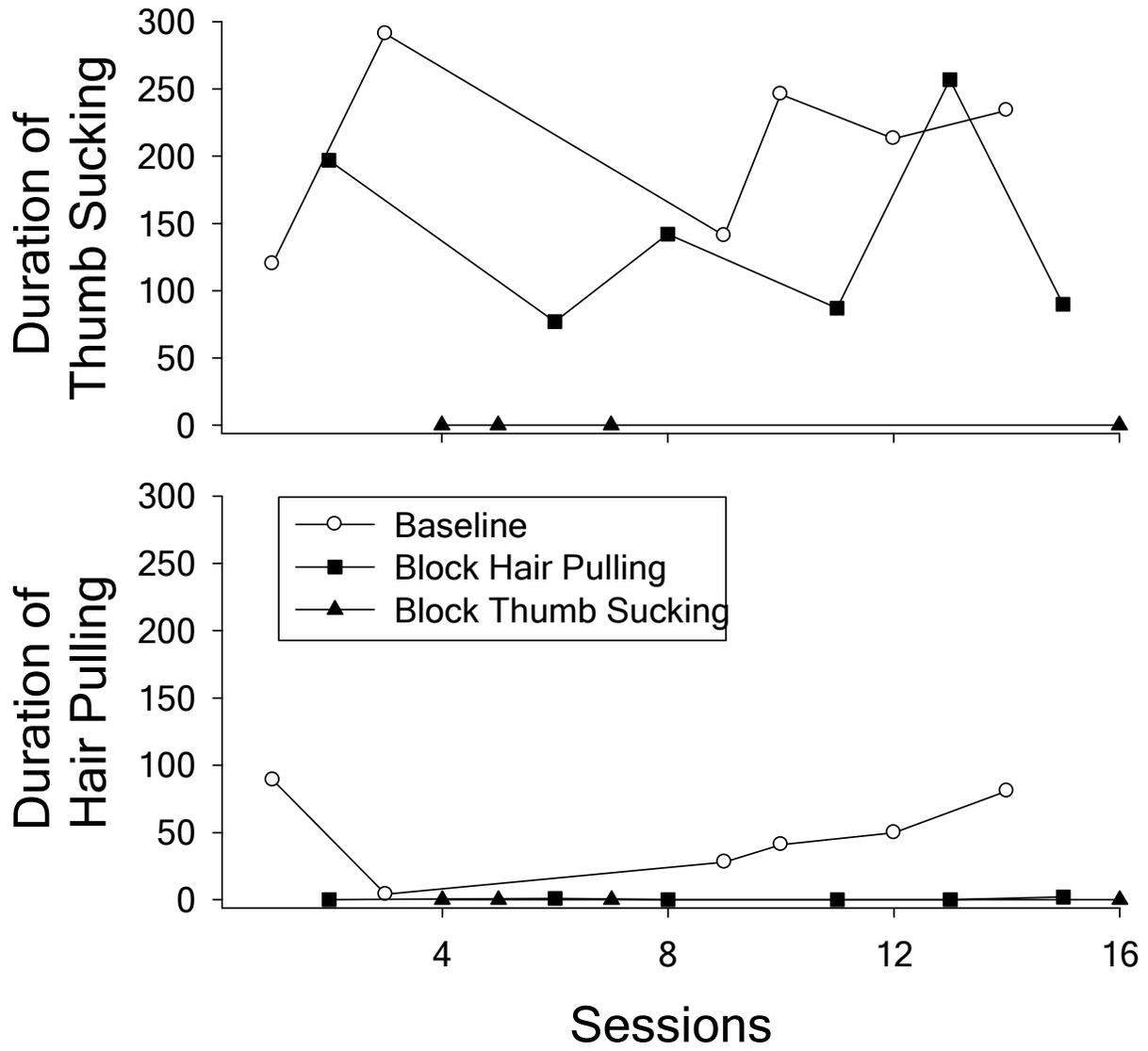


Figure 3

Treatment of thumb sucking

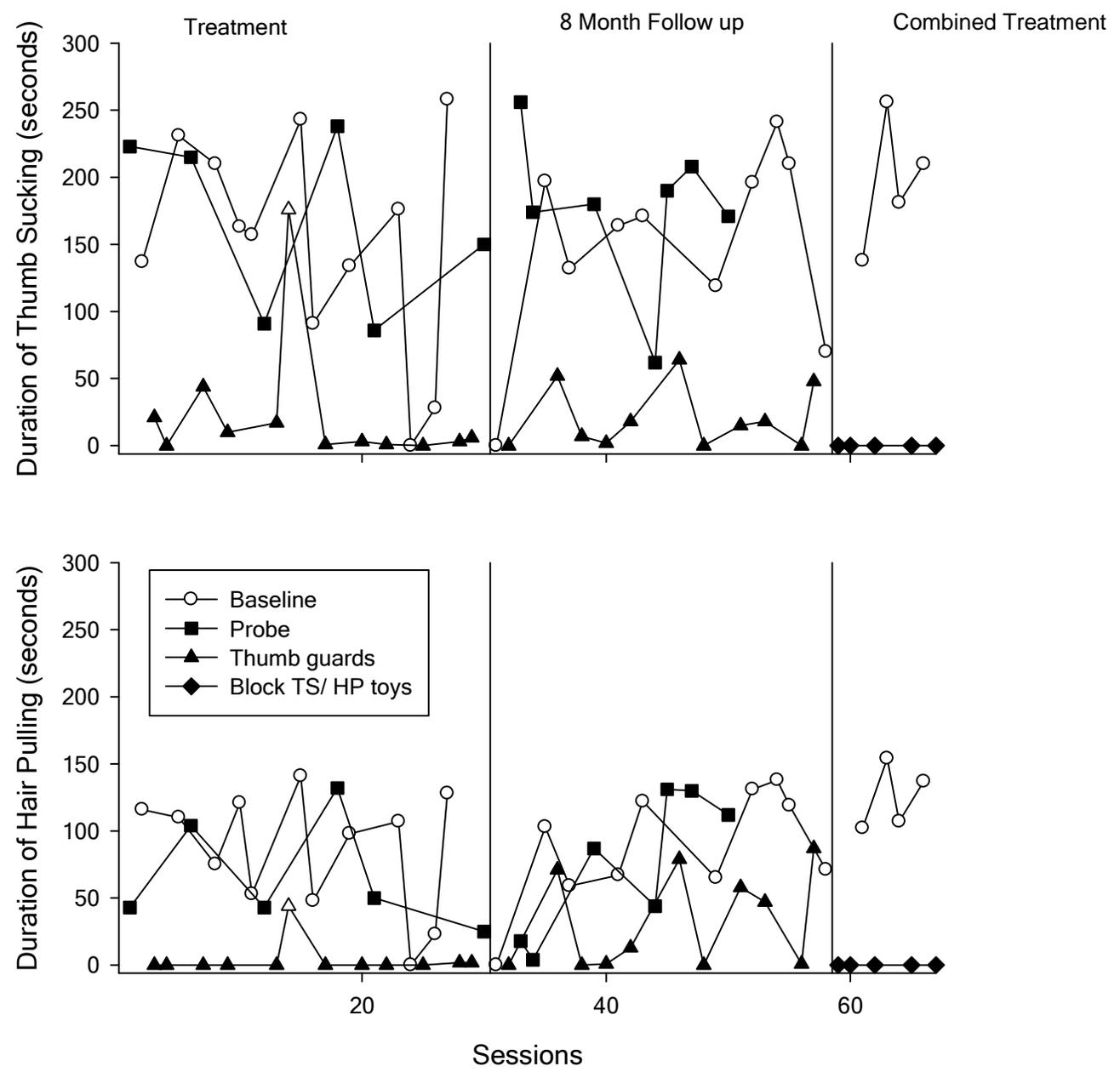


Figure 4

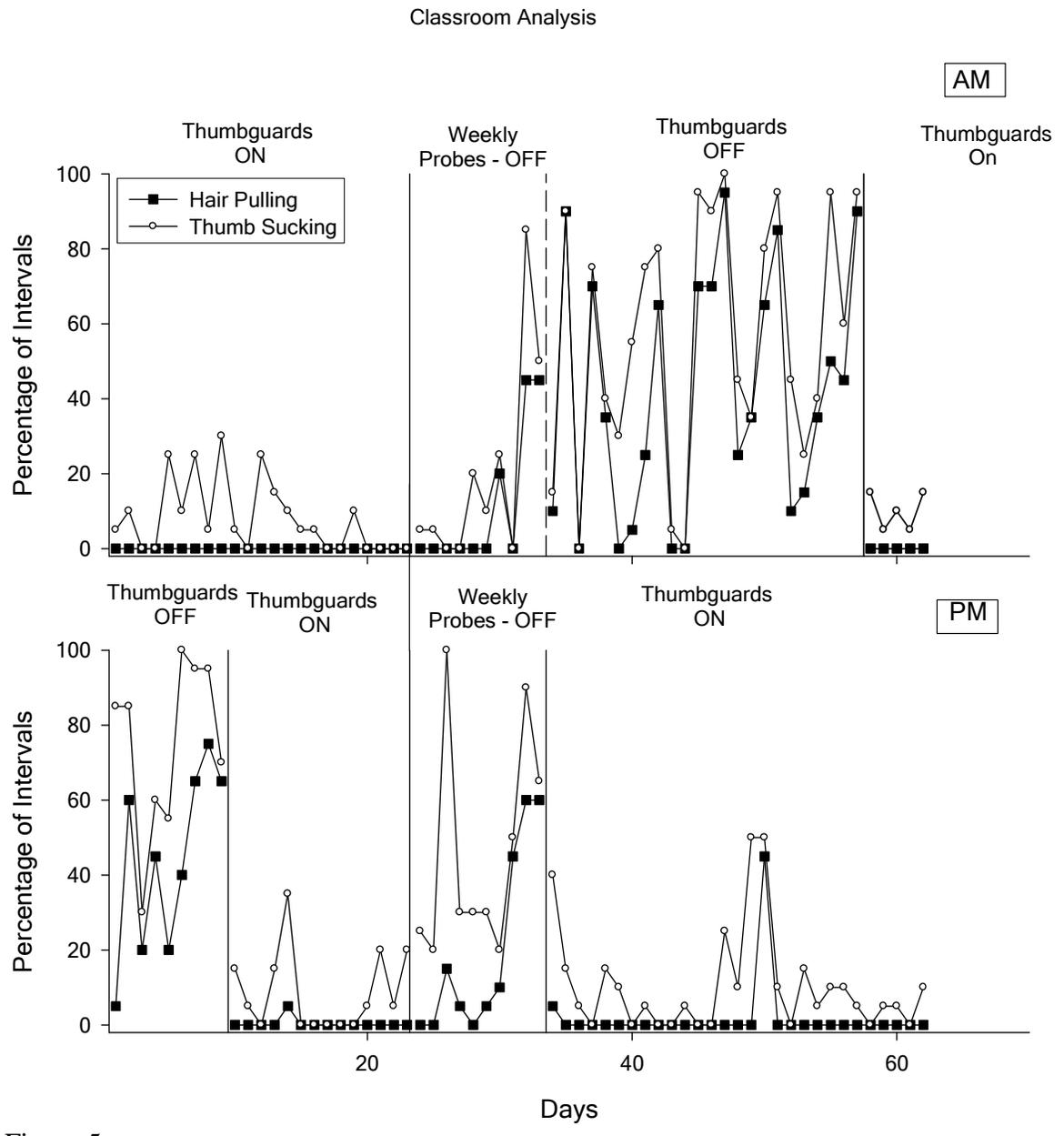


Figure 5

Appendix A

J.P. Functional Analysis

Observer _____ Reliability _____ Date _____
 Time _____ Session Number _____ Condition _____

Thumb Sucking – Any instance of placing thumb in the mouth for at least 1s, past the plane of the lips. Instances of thumb sucking are separated by at least 2s. Record time thumb enters the mouth and the time thumb is removed from the mouth.

Instance	In	Out	Duration
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

Total Instance _____

Total Duration _____

Appendix B

J.P. Functional Analysis

Observer _____ Reliability _____ Date _____
 Time _____ Session Number _____ Condition _____

Hair Pulling – Any finger to hair contact paired with hand movement away from the head. Instances of hair pulling are separated by any separation of finger and hair longer than 2s.

Instance	Contact	Separation	Duration
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

Total Instance _____

Total Duration _____