Combined Curricular Intervention with Brief Hands Down to Decrease Hand Mouthing and the Use of Arm Splints for a Young Boy with Profound Disabilities

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Abstract: Hand mouthing is highly prevalent in individuals with severe to profound developmental disabilities. Frequent hand mouthing may interfere with appropriate responding, have negative health impacts, and result in restrictive interventions, such as the application of arm splints, to prevent this challenging behavior. The continuous application of arm splints can have negative health outcomes and can interfere with daily activities. The purpose of this study was to replace arm splints with appropriate curricular activities in a 10-year-old boy with profound disabilities. An intervention package involving the provision of curricular activities and a brief hands down procedure was evaluated using a combined alternating treatments and reversal design across several hours of the school day to demonstrate the effectiveness of the intervention on the reduction of hand mouthing. The intervention was successfully implemented across several hours of the student’s school day within his natural school environments. Limitations, implications, and directions for future research are discussed.

The prevalence of hand mouthing, a form of stereotypic behavior, has been estimated to occur in up to 16% of individuals with severe to profound disabilities (Rast & Jack, 1992). Hand mouthing can be detrimental to an individual’s health, adaptive behavior, and social functioning (Pelios, Morren, Tesch, & Axelrod, 1999; Wallace, Iwata, Zhou, & Goff, 1999), because it can lead to tissue damage, hematoma, salivary dermatitis, scarring, and skin breakage (Ball, Campbell, & Barkemeyer, 1980; Fisher, Piazza, Bowman, Hanley, & Adelinis, 1997; Luiselli, 1989). It can also interfere with participation in daily educational and living activities, because the individual’s hands are consistently in his or her mouth (McChure, Moss, McPeters, & Kirkpatrick, 1986). Additionally, it is considered to be socially maladaptive because of the repulsive sights and smells it produces (Realon, Favell, & Cacace, 1995).

A variety of interventions have been used to reduce the occurrence of hand mouthing in individuals with severe to profound disabilities, including overcorrection (Foxx & Azrin, 1973), contingent sensory reinforcement (Barmann, 1980; Case-Holden & Hupp, 1989), differential reinforcement of other behaviors (Favell, McGimsey, & Schell, 1982; McClure et al., 1986), differential reinforcement in combination with punishment (Lockwood & Williams, 1994; Mazaleski, Iwata, Rodgers, Vollmer, & Zarcone, 1994; Minness, 1980), environmental enrichment (Realon et al., 1995), and response restriction via mechanical restraint, such as arm splints (Ball et al., 1980; Luiselli & Waldstein, 1994).
The use of arm splints has been successful at eliminating hand mouthing by preventing the individual from being able to move his or her hands to the mouth. While effective as a preventative strategy, the use of arm splints has several potential disadvantages, including possible negative impacts on health, adaptive behavior, and social functioning of persons who wear them (Fisher et al., 1997; Luiselli, 1989). Additionally, researchers have found that long-term wearing of arm splints can cause health problems such as bone demineralization, shortening of tendons, muscle atrophy, arrested motor development, contractures, and restricted circulation (Fisher et al.; Oliver, Murphy, Hall, Arron, & Leggett, 2003). These findings cast doubt on the ethical aspects of the long-term use of arm splints for reducing hand mouthing in individuals with severe to profound disabilities.

Due to the ethical issues raised by the use of arm splints as a preventative intervention, it is important to examine other antecedent interventions that can be implemented to prevent the occurrence of hand mouthing. Several studies have investigated the use of various forms of environmental enrichment to prevent the occurrence of hand mouthing. For example, Vollmer, Marcus, and LeBlanc (1994) provided three individuals with severe disabilities who engaged in hand mouthing and hand biting access to an array of highly preferred stimuli and noted decreases in challenging behavior and increases in appropriate behavior across 10 min sessions. For one participant, explicit reinforcement of appropriate behaviors and a brief (5 s) time out was required. Realon et al. (1995) found reductions in hand mouthing when preferred toys were consistently made available to one participant with profound mental retardation across 5 min sessions.

Although interventions have been successful at reducing challenging behavior, they often only examine the effectiveness of an intervention over a short period of time (e.g., 10 min) and within only one environment. One purpose of the present study was to evaluate the effects of an intervention package for eliminating the use of arm splints in a boy with profound disabilities who had a long history of wearing arm splints to prevent hand mouthing. The intervention package included the provision of curricular activities and a brief hands down procedure. A second purpose of this study was to examine the effectiveness of the intervention across the student's entire school day in his natural environments.

Method

Participant, Settings, and Materials

Matthew was a 10-year-old, Caucasian boy with profound mental retardation, cerebral palsy, and hydrocephalus. He did not speak or use any alternative form of symbolic communication. At the beginning of this study, Matthew would respond to one-sentence requests by pointing to the correct answer or his choice when presented with an array of items and/or photographs. He was non-ambulatory and spent the majority of his school day seated in a wheelchair or on a bean bag or mat on the floor. Matthew was completely dependent on others for all of his daily functioning (e.g., toileting, feeding, washing, etc.). He attended a functional life skills classroom at a school for individuals with severe to profound developmental disabilities. When he engaged in hand mouthing, his teachers would give him one verbal warning. After the warning, he would often stop hand mouthing for approximately 30 s while looking at the teacher, then begin hand mouthing again if no further direction or engagement was provided. If he continued to engage in hand mouthing, his teachers would put arm splints on both arms. Once the arm splints were placed on Matthew, they were generally not removed until the end of the school day when he left the school.

All intervention sessions were conducted in Matthew’s natural school environments, which included his classroom, the library, the gymnasium, and an outdoor playground. Materials for the curricular activities included picture books, non-interlocking puzzles, and various pieces of gym equipment, such as balls.
**Target Behavior**

Hand mouthing was defined as the insertion of any part of the hand into the mouth or the protrusion of the tongue out of the mouth onto the hand. For a new occurrence of hand mouthing to be recorded, Matthew's hand had to be completely removed from his mouth then reinserted or the tongue completely removed from the hand and then reapplied to the hand.

**Data Collection and Interobserver Agreement**

Data were collected in real time using a scatterplot data collection system (Touchette, MacDonald, & Langer, 1985). Data were collected during two different time blocks during the day. Time Block A (i.e., 11:30–1:00) was broken into six 15 min intervals, and Time Block B (i.e., 1:00–2:45) was broken into seven 15 min intervals. During each interval, the occurrence of hand mouthing was indicated for the first three occurrences for ease of data collection and interpretation (Touchette et al.). Therefore, hand mouthing could be scored 18 times in Time Block A and 21 times in Time Block B.

To determine inter-observer agreement, two observers (i.e., the first author and a graduate student) independently scored data on the target behavior for at least 30% of all sessions. Data from the two observers were compared for agreements and disagreements. An agreement was scored if both observers recorded the occurrence or non-occurrence of hand mouthing within each 15 min interval. In the intervention, an agreement was scored if each observer recorded the same number of occurrences of hand mouthing within each 15 min interval. Any discrepancy between the two observers was counted as a disagreement. Interobserver agreement on the dependent measure was calculated on an interval-by-interval basis using the formula: Agreements/(Disagreements + Agreements) × 100%. Inter-observer agreement data were collected for 33% of the sessions and overall agreement was calculated to be 96.7% (range 83.3–100%).

**Experimental Design**

A combination reversal and alternating treatments design across two time blocks was used (Kazdin, 1982). During Time Block A, the reversal design utilized an ABAB reversal pattern, while Time Block B utilized a non-reversal ABC pattern.

**Intervention**

During baseline, Matthew’s arm splints were removed and occurrences of hand mouthing were recorded within his natural settings (e.g., classroom, gymnasium, library, etc.). His teachers were asked to do what they would normally do, but were asked not to put his arm splints on. The first author sat in a corner of the room and observed Matthew. During each 15 min interval, the first three occurrences of hand mouthing were recorded on the scatterplot data sheet. Once three occurrences of hand mouthing occurred in an interval, no further data were collected during that interval, and data recording resumed at the beginning of the next 15 min interval. Baseline data were collected from 11:30 a.m. to 2:45 p.m. (i.e., Time Blocks A and B). During most baseline sessions, Matthew was placed in a bean bag or on a mat on the floor and provided either free access to the television or switch activated access to the radio or a book on tape. Very little interaction typically occurred with Matthew.

The intervention consisted of the provision of curricular activities and a brief hands down procedure. During intervention, the first author placed curricular materials within Matthew's reach and waited 10 s for him to initiate appropriate engagement with the materials. If he did not engage in the activity within 10 s, a least-to-most prompting hierarchy was used to prompt engagement. Specifically, the therapist would first provide a verbal prompt (e.g., “Ok Matthew, let’s work on the puzzle.”), then a gestural prompt (e.g., pointing to the puzzle), then a model prompt (e.g., placing one puzzle piece in place), and finally a physical prompt (e.g., guiding his hand to pick up and place a puzzle piece). Curricular activities presented to Matthew included reading books to him while he turned the pages, having him complete his choice of non-interlocking puz-
zles, going for walks while he pushed himself in his wheelchair, and playing games in the gymnasium. Matthew was provided a choice of what activity he wanted to engage in by showing him the activities in an array of photographs and having him point to the activity he wanted. All activities were part of his individualized educational plan.

When the class engaged in group activities, the first author provided one-on-one assistance to Matthew as needed within the group setting. When the class engaged in center activities, the first author provided Matthew with an array of curricular activities to choose from and followed the previously described procedures. If Matthew engaged in hand mouthing, the first author immediately removed Matthew’s from his mouth, said “hands down”, and held his hands in his lap for 10 s. Following the 10 s, Matthew was prompted to engage with the curricular materials.

In the reversal back to baseline in Time Block B, the teachers began to interact with Matthew in a manner different than in all other baseline phases. Therefore, this phase was relabeled as the teacher intervention. During this phase, the classroom teacher and her teaching assistants began to include Matthew in regular small group (SG) and one-to-one (1:1) instruction, which they had not done in any of the other baseline sessions. While the teachers did provide curricular activities, they did not implement the brief hands down procedure. Additionally, he was not placed in a beanbag or on a mat during this phase, and he was no longer given free access to the television or switch-activated access to the radio or books on tape. During 10 of the 31 intervals, Matthew was given an independent task and was not engaged with the teacher, her assistants, or his peers. The teachers shifted their instruction independently and without prompting from the researcher. As in all other baseline conditions, the teachers did not apply Matthew’s splints, even when he did engage in hand mouthing.

**Results**

Figure 1 shows the number of occurrences (up to three per interval) of hand mouthing for the two time blocks in which daily sessions

![Figure 1. Intervention results for Matthew across Time Blocks A and B.](image-url)
were conducted. During the initial baseline phase in Time Block A (sessions 1–12), Matthew engaged in hand mouthing an average of 11.4 times (range 2–18) per session. When the intervention was introduced in Time Block A (sessions 13–15), occurrences of hand mouthing decreased dramatically to 0–2 occurrences. Upon a return to baseline (sessions 16–18), hand mouthing increased to an average of 13.7 times (range 6–18) per session. In the final return to intervention (sessions 19–21), hand mouthing did not occur once over three sessions.

During the baseline phase in Time Block B (sessions 1–6), hand mouthing occurred an average of 9 times (range 6–15) per session. When the intervention was implemented (sessions 7–12), an immediate decrease in the occurrence of hand mouthing to an average of 1.3 times (range 0–2) per session was observed. When the intervention was removed in session 13 and the teachers began to intervene, the average occurrence of hand mouthing increased to an average of 5.8 times (range 3–9) per session in the remaining five sessions. During this last phase in Time Block B, Matthew was out of the classroom (na) for four full sessions and the final 15 min interval for all but the first session.

Discussion

By prompting engagement with curricular materials and implementing a brief hands down procedure, we were able to remove Matthew’s arm splints and maintain low levels of hand mouthing across a two hour and forty five minute period in several school environments. Because Matthew was not in arm splints and was provided with curricular activities, he engaged in higher levels of appropriate behavior. Additionally, with no training, the teachers in the classroom began to independently implement the curricular component of the intervention successfully during Time Block B.

While these results are promising, several issues should be considered. First, we were only able to complete this study with one participant. Although this intervention was successful with our participant, it is not known if this procedure would have similar effects with other students. This study should therefore be replicated within natural contexts with other participants who have severe to profound disabilities and engage in hand mouthing.

A second consideration is that the intervention utilized both a curricular intervention and a brief hands down component. One might argue that, even though both procedures were in effect, the decrease in hand mouthing might have been due to only one component of the intervention (i.e., curricular intervention or brief hands down). Based on all of the intervention data in both Time Blocks A and B, the use of the brief hands down procedure was only utilized in 10% of the intervention intervals, and implemented only 14 times out of 234 possible opportunities. This might suggest that the brief hands down component of the intervention could naturally be faded out as hand mouthing continued to decrease. This data also suggests that the curricular intervention had a significant impact on hand mouthing, as 85% of the intervals in the intervention phases had no occurrences of hand mouthing.

On the other hand, when the teachers implemented the intervention without the brief hands down component, the decrease in hand mouthing was not as significant as during intervention sessions conducted by the researcher. One reason for the decreased effectiveness of the teacher intervention might be that the teachers did not implement the brief hands down component. A second reason may be due to the fact that the teachers were not trained to implement any component of the intervention, but simply began to include Matthew in curricular activities. The data do indicate that when the teachers were working with Matthew, he only engaged in hand mouthing four times out of 63 possible opportunities, which is an average of less than one occurrence per session. This might suggest that by the time the teachers began to independently implement the curricular aspect of the intervention, the brief hands down procedure was no longer necessary. A final reason for the increased occurrence during the teacher intervention might be that Matthew was more likely to engage in high levels of hand mouthing when given independent tasks that did not involve any engagement with an adult. Matthew was given such tasks in 10 of the 31 teacher intervention sessions. In these 10 ses-
sions, he engaged in hand mouthing an average of 83% of the time, which indicates that the teachers were able to implement the intervention effectively when working with Matthew, but that independent seatwork led to a return to baseline levels of hand mouthing.

The above data suggests another limitation to this study in that when we did not address times when Matthew would be given independent tasks to complete. During the majority of the baseline conditions, Matthew was allowed free access to television or switch activated access to the radio or books on tape. During these times, his hand mouthing occurred at high rates. Although we were able to reduce his hand mouthing by incorporating significantly more activity into his day, it may not be possible, or beneficial, for a student to have no independent or free time during the day. It is possible that a traditional use of environmental enrichment using items that would keep the hands occupied would be effective during these independent times during the day. Future research should examine the effectiveness of targeting challenging behavior within the context of group work, one-on-one work, and independent work.

Another limitation to this study is that there was no clear reversal in Time Block B. This likely occurred because the teachers began including Matthew in the small group and one-on-one activities in Time Block B, which they did not do during Time Block A. The teacher intervention phase in Time Block B did indicate an increase in hand mouthing from an average of 1.3 times per session in intervention to an average of 5.8 times per session in the teacher intervention, though this was a decrease from the initial baseline phase (average 9 times per session). The possible reasons for this data were explained above. Although the independent change in teacher behavior did reduce the level of experimental control in Time Block B, the change in their behavior was meaningful for Matthew and we did not want to instruct them to discontinue their change. Additionally, a very clear reversal was seen in Time Block A, suggesting that the intervention was effective for Matthew.

Two final considerations are that, due to time constraints, we were unable to collect maintenance data within Matthew’s classroom with his teachers to examine whether the reduced levels of hand mouthing would maintain over time as well as determine if the teachers would be able to maintain the intervention. We were also unable to transfer the role of data collection to the teachers during this study, so it is not known if they would be able to both implement the intervention and maintain accurate data collection. However, because we used a scatterplot to collect the data, teachers would only need to collect data on the first three occurrences of a behavior during an interval, rather than on each occurrence of the behavior. Research should also consider the use of scatterplot data collection in natural environments to monitor the effectiveness of interventions across the entire day. While some might consider the use of the scatterplot as a limitation because it is less sensitive to behavior change than interval recording, this method is more amenable to collecting data over the course of several hours and is likely to be more feasible for teachers to implement than 10 s interval recording systems. Additionally, in Time Block A, clear changes in behavior were observed from baseline to intervention phases. Finally, using scatterplot data, we were able to examine the effectiveness of the intervention across several hours, rather than over 10 min sessions, which enhances the social validity of this study.

While a clear reversal was not observed in Time Block B, there are several advantages to this study that compensate for the reduced level of experimental control. First, because the intervention was conducted within Matthew’s natural environments, he was able to remain in his classroom and participate in activities with his peers. In line with that, the teachers were able to observe the intervention being implemented and the changes in Matthew’s behavior. Although the teachers were never trained to implement the intervention, they independently began implementing the curricular intervention with Matthew in Time Block B, suggesting that the ease of implementing the intervention was such that it could be implemented within the natural context of a classroom. Future research should continue to examine the effectiveness of interventions implemented by teachers and their
assistants within the natural contexts of a participant’s daily schedule.

References


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