

## THE NON EFFECTS OF USING MUSCLE MEMORY ACTIVITIES AND FADING WORKSHEETS TO TEACH TWO PRESCHOOL STUDENTS DIAGNOSED WITH DEVELOPMENTAL DELAYS HANDWRITING

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**Abstract:** *The purpose of this study was to evaluate and measure the effectiveness of muscle memory techniques and fading worksheets with handwriting on two preschool students diagnosed with developmental delays in both pre-academics and communication. Two students were selected from a self-contained special education preschool classroom in the Pacific Northwest. All the students in the classroom had special needs usually diagnosed with developmental delays but also included other health impairments, attention deficit hyperactivity disorder, and behavioral impairments age's three to five. The muscle memory activities intervention was used to teach both students how to write their first name. Then, a fading worksheets system was implemented for both students to provide extra practice. In baseline, both students were asked to, "Write your name. Just try your best." During baseline, both students were not able to write any letters of their name legibly. The final outcomes showed little improvement in handwriting ability. Muscle memory activities were engaging for the students but time consuming to implement, did not provide enough practice, and required an assortment of materials. Fading worksheets provided extra practice for the students but were not engaging. Suggestions for using muscle memory activities and fading worksheets with preschool children were not made. Reasons for the differential outcomes of muscle memory activities and fading worksheets were discussed.*

**Keywords:** *muscle memory, preschool, fading worksheet, single case research, developmental delay, handwriting,*

### Introduction

Handwriting is an essential skill in every student's school experience, but it is under taught in the classroom. Approximately 30% to 60% of a typical school day is devoted to fine motor related activities primarily involved with writing tasks. (Graham, 1999; McHale &

Cermak, 1992). Formal handwriting instruction can begin as early as the kindergarten year (Zaner-Bloser, 1994).

## Review of Literature

Intervention strategies for handwriting that incorporate prepositional, spatial, and temporal concepts should be made developmentally appropriate for the child. Verbal prompts are often used to encourage correct directional stroke formation with letters regardless of the child's age. Prompts include "on top of the line," "above the line," or "between the lines" are typically used in handwriting curriculum. (Benbow, 1995). The age at which the typically developing child begins to understand the term "in" is at 2 years. Additional concepts are learned as the child grows older with the most challenging term acquired by the typically developing child at 4 years and 8 months with "back/front" (Johnston 1988). The importance of understanding the developmentally appropriate concepts can help teachers monitor their own students to modify or adapt their handwriting instruction to best suit the needs of the classroom.

A classroom can incorporate handwriting instruction in a variety of opportunities. It is most beneficial for the learners to practice writing in a functional approach instead of solely through isolated practice (Graham, 1999). Providing functional techniques helps the child to generalize the skills learned. Handwriting instruction has also benefited from the use of free-play as a consequence. Hopkins Schutte, and Garton, (1971) conducted a study with kindergarten children and found that gradually decreasing work time and instead engaging in free-play in a playroom could increase the rate of letters formed per minute. There were no systematic increases in the rate of errors associated with the change of instructional and play time. Studies have also been conducted using various teaching strategies to improve the handwriting of students. Systematic instruction with prompts, tracing, praise, and task analysis has been shown to be effective for teaching children with disabilities to write their name (Caletti, McLaughlin, Derby, & Rinaldi, in press; LeBrun, McLaughlin, Derby, & McKenzie, 2012; Morris, McLaughlin, Derby, & McKenzie, 2012; Park, Weber, & McLaughlin, 2007). Token reinforcement strategies using the mean number of legible letters written by ten special education students with behavior disorders made significant gains in their handwriting as noted through teacher ratings, and for both frequency and legibility (McLaughlin, 1981). Comparisons were made between a two groups of students with behavior disorders and between general education and special education student legibility in handwriting.

The purpose of this study was to evaluate the effectiveness of the muscle memory activities paired with fading worksheets in a preschool setting with two students diagnosed with developmental delays in both pre-academics and communication. The goal of the study was to

have both students from the self-contained preschool classroom learn to write their first names using all uppercase letters independently.

## Methodology

### Participants and Setting

Two preschool students who were both diagnosed with developmental delays served as the participants for the study. Participant 1 was an adopted five-year-old boy with developmental delays who qualifies for both pre-academic and communication categories. Participant 2 was a five-year-old girl also with developmental delays in pre-academic and communication.

The study took place in the Pacific Northwest at an elementary school in a self-contained preschool special education classroom. The preschool day was split into the morning class with nine students and the afternoon class with eight students including the two participants. The afternoon class enrolled eight students at the start of data collection, then one student joined, and there were a total of nine students at the end of data collection. A majority of the students in the classroom were diagnosed with developmental delays. Although the diversity of the disability population within the classroom included autism spectrum disorder, attention deficit hyperactivity disorder, and behavioral impairments. The multidisciplinary team which included professionals such as speech pathologists, occupational therapists, and physical therapists all worked closely together within the classroom alongside the teachers and instructional aides. In the classroom there were individual cubbies with the names labeled for the students to hang up their backpacks and coats. There was also a sectioned off table area that faced a wall for one-on-one independent work with the teacher or assessment purposes filled with a large box with reinforcing toys. There was a carpet area used for circle, free play, physical therapy exercises, and gross motor activities. There were two large tables used for snack, art projects, play dough, kindergarten club, and free play table activities. In the corner of the classroom, there is a housekeeping area with a kitchen set, table, and chairs. There was a sensory area with a large birdseed box and two blue tables used to put sensory items and water in. There was a sink and makeshift kitchen area used for students to wash their hands in preparation for breakfast or snack and to assemble the food items. In the housekeeping area, there were dolls, pretend food, dog care, and birthday parties for free play options. The data was collected during kindergarten club, physical therapy exercises, or at the start of free play. The sessions lasted approximately 15 to 20 minutes in the classroom. At the start of the study, the sessions took place in the housekeeping area away from the kindergarten club and physical therapy exercise areas. However as the study continued, the sessions transitioned to the independent work table area. Both participants and the researcher were seated at a table facing the wall sectioned off from the rest of the classroom. The move was done to increase on-task behaviors while minimizing distractions from the peers and other activity in the classroom.

## Materials

There were a wide variety of materials used with the muscle memory techniques. The materials used with every session were blank sheets of plain white paper and a marker. There were different materials required depending on the muscle memory activity for the day. Materials necessary for muscle memory activities included: stickers, changeable/magic markers, play dough, glue-able items (i.e. old candy, marshmallows, beads etc.), bingo dot markers, finger-paint, sheet protectors, and vis-à-vis markers. Data was gathered using a data collection form (See Appendix A).

## Dependent Variable and Measurement Procedures

The purpose of the study was to increase Participant 1 and Participant 2's ability to write their names. Based on the baseline testing data, both students did not exhibit the knowledge or show any concept of how to write any letter of their first names. All data was scored using the same measurement procedure. Two points were awarded for each letter learned of the student's name. One point was given for the appropriate slant and the second point was for formation regarding how legible the letter was. For Participant 1 and 2 there were a total of eighteen sessions conducted after baseline. The data was scored using the permanent products that the students independently completed using all uppercase letters at the end of every session. The permanent product contains letters learned in previous sessions in addition to the current letter that the student is working on.

## Experimental Design and Conditions

The effects of using muscle memory techniques and fading worksheets were evaluated in changing criterion designs. For Participant 1, the experimental design was a changing criterion A-B-A-C design (Kazdin, 2010). With Participant 2, the experimental design was a changing criterion plus an A-B-C-D-E-F design. Baseline data were taken for each student. Then, for both Participant 1 and 2 a muscle memory activity was implemented. For Participant 1, it was then paired with a fading worksheet, and then a reversal back to simply muscle memory activities alone, which finally led to muscle memory activities in conjunction with a separate fading worksheet. With Participant 2, the muscle memory activities were paired with a tracing worksheet followed by four implemented fading worksheets.

**Baseline.** Baseline was taken for each student separately. During baseline, every student was given a marker, a blank piece of plain white paper, paired with the same verbal prompt to, "Write your name. Just try your best." This condition lasted for one session for both participants.

**Muscle memory activities.** After baseline, muscle memory activities were implemented working with the initial uppercase first letter of the participants' names. The researcher would present the muscle memory activities to the participants along with the necessary materials. The researcher would model how to write the letters with the correct directional strokes by using her finger to trace on top of the letter paired with the verbal directions. For instance with the letter "G" the researcher would verbally state, "First we start at the top. Then we go around. Then we stop. And then we go in the garage." The researcher would then instruct the participant to copy the motions with the verbal prompt, "now you do the same" while the researcher reiterated the correct directional strokes out loud to re-emphasize with the movements. Next, the researcher would model and verbally state the directions on how to complete the muscle memory activity itself. Then the participants would follow the directions stated previously while the researcher verbally restated the correct directional strokes out loud while reinforcing the participant with specific praise. After the first half of the study, the researcher would then put away all the materials from the activities leaving only a blank piece of plain white paper and a marker on a blank table. When the researcher instructed "now write me the letter (insert letter of the day)", the student would then use the marker of his/her choice to write the letter of the day independently from memory. Similarly, the researcher would take away all traces of the written letter away from the table. Finally, the researcher would instruct "now write me the letter(s) (previous letters learned from the study) and the letter (insert letter of the day)." After session eight for Participant 1 and after session seventeen for Participant 2 there were black lines on the plain white paper given to the participant where they were expected to write the uppercase letters on the line. The researcher would then examine the permanent products of both participants and assign the total number of correct letters written based on the number of letters assigned for that day.

**Fading worksheets.** Based on the results of the muscle memory activities alone, the researcher incorporated fading worksheets for extra practice with the letters. In the beginning, Participant 1 and 2 had different fading worksheets to emphasize different areas that the students needed improvement on initially. By the end of the study, both participants had similar fading worksheets which When the researcher presented the fading worksheet and said "trace and copy the letters on the page. At the end, write the letters all by yourself." The fading worksheets were not used for scoring data purposes. The fading worksheets were just supplemented for extra practice. Through observation by the researcher, it became clear that the fading worksheets alone would not be motivating enough for the students. As a result, the researcher continued to pair the muscle memory activities which were more reinforcing for the students with the fading worksheets for extra supplementary practice.

### **Interobserver Agreement and Fidelity of Implementation of Experimental Conditions**

At the end of every session permanent product data were collected for both Participant 1 and 2. Each student was given a marker and a blank white piece of paper with a line for every letter learned previously with the study in addition to a line for the letter that the student is currently working on. The researcher instructs the student to, “write your name and try your best. First write me a (first letter of the student’s name), then a (second letter of the student’s name), and finally (third letter of the student’s name).” The student would then independently write the uppercase letters on the specified line using the given materials. The researcher along with the cooperating teacher would score the student’s work independently. After the permanent products have been scored then the data for the number of correct letters written was compared among the two scorers. Interobserver agreement was taken 100% of the time across 19 sessions for both Participant 1 and Participant 2. Interobserver agreement was calculated by dividing the number of agreements by the sum of the agreements and disagreements and multiplying by 100. Agreement between the researcher and instructional assistant for Participant 1 was 74% and for Participant 2 was 84%.

### **Findings**

The number of correct uppercase letters written during baseline and across the muscle memory activities and fading worksheets study implementation were shown in the graphs for each student.

### **Participant 1**

For baseline, Participant 1 scored a zero with a possible score of 14 points total for correct number of letters written in his first name.

During the implementation of the muscle memory activities alone, Participant 1’s scores had initially increased and later acquired maintenance for the first letter over four consecutive sessions. He had a mean of 1.8 out of a possible two points for the first letter with a range from 1 to 2. However when the second letter was implemented the data had initially increased, then decreased, later increased, and finally decreased again before the implementation of fading worksheets were put in place. His scores for muscle memory activities alone lasted over 11 sessions. Participant 1 had a mean of 2.6 out of a possible four points for the first two letters with a range from 2 to 4. During session 16, only a muscle memory activity was implemented because the researcher and Participant 1 ran out of time in the allotted schedule in which he scored a four out of a possible six points.

When muscle memory activities and fading worksheets were paired and implemented together, Participant 1’s scores resulted in a slight upward and downward trend for the first two letters over three consecutive sessions with fading worksheet one. He initially increased and ultimately

decreased. Participant 1 had a mean of 3.3 out of a possible four points for the first two letters with a range from 3 to 4. Participant 1's scores with the first three letters over three consecutive sessions with fading worksheet two resulted in a downward and upward trend. He decreased first and then increased. Participant 1 had a mean of 3.0 out of a possible six points for the first three letters with a range from 2 to 4. Collectively over the last seven sessions, six of those utilized both muscle memory activities and fading worksheets paired together.

## Participant 2

For baseline, Participant 2 scored a zero out a possible score of 16 points total for correct number of letters written in her name.

Participant 2 made minimal progress throughout the first twelve sessions using muscle memory activities intervention alone for the first letter of her name. There was no progress made from baseline until session six and seven. However, at the start of session eight the data remained stagnant from baseline data. For the first four sessions of the intervention, Participant 2 scored a 0/2. Then during session six and seven, Participant 2 scored a 2/2. However, from session eight to session twelve, Participant 2's score remained consistent at 0/2. For the muscle memory activities intervention alone, Participant 2 had a mean of 0.33 out of a possible two points for the first letter with a range from 0 to 2. A total of twelve sessions were completed using muscle memory activities alone before an additional intervention was utilized.

When the second intervention involving fading worksheets were implemented together, Participant 2's scores started to gradually increase. First tracing worksheets were utilized during session thirteen; Participant 2 continued to score 0/2 with a mean of 0 and no range. Similarly, when fading worksheet one was implemented in session fourteen, Participant 2 scored a 0/2 again with a mean of 0 and no range. For session fifteen, fading worksheet two was implemented and Participant 2's trend increased to 1/2 with a mean of 1. For fading worksheet three during session sixteen and seventeen, Participant 2's trend continued to increase and scored a 2/2 with a mean of 2 and no range. During session eighteen and nineteen, the second letter of Participant 2's name was implemented and she continued to make progress. Participant 2 score a 3/4 for both sessions using fading worksheet four with a mean of 3 and no range. Ultimately, the last seven sessions the intervention consisted of both muscle memory activities and fading worksheets paired together.

Figure 1. Data collection sheet for Participant 1 used for baseline and intervention.

Handwriting Data Collection Sheet

Name: Gabriel Date: \_\_\_\_\_ Session: \_\_\_\_\_ Phase: \_\_\_\_\_ Data Collector: \_\_\_\_\_

Letter	Slant	Formation	Total
G			
A			
B			
R			
I			
E			
L			

Figure 2. Data collection sheet for Participant 2 used for baseline and intervention.

Handwriting Data Collection Sheet

Name: Kaedynce Date: \_\_\_\_\_ Session: \_\_\_\_\_ Phase: \_\_\_\_\_ Data Collector: \_\_\_\_\_

Letter	Slant	Formation	Total
K			
A			
E			
D			
Y			
N			
C			
E			

Figure 3: The number of correct letters with handwriting for Participant 1 during baseline (session 1) using Muscle Memory & Fading Worksheets (sessions 2-19).

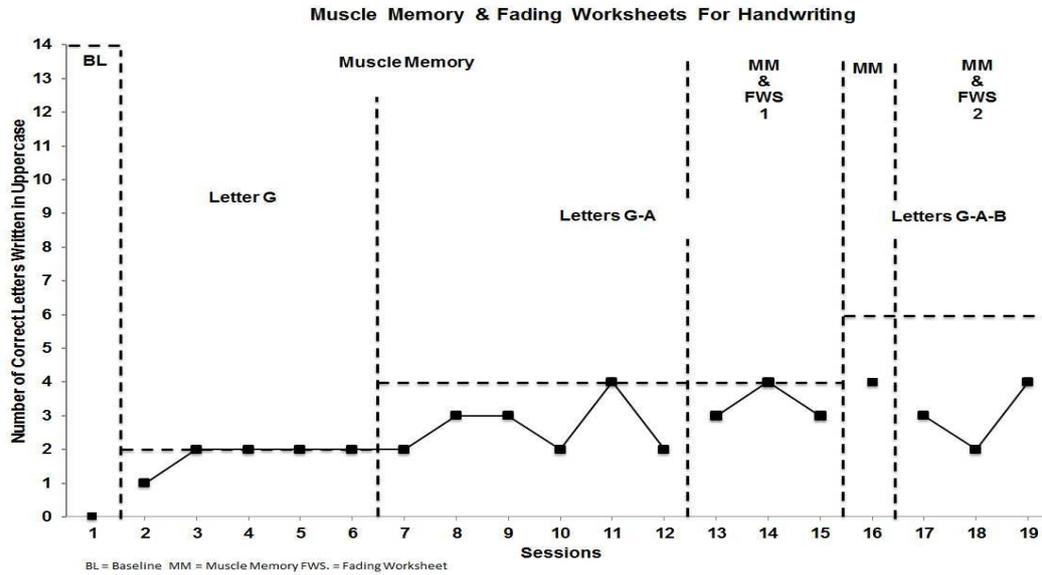
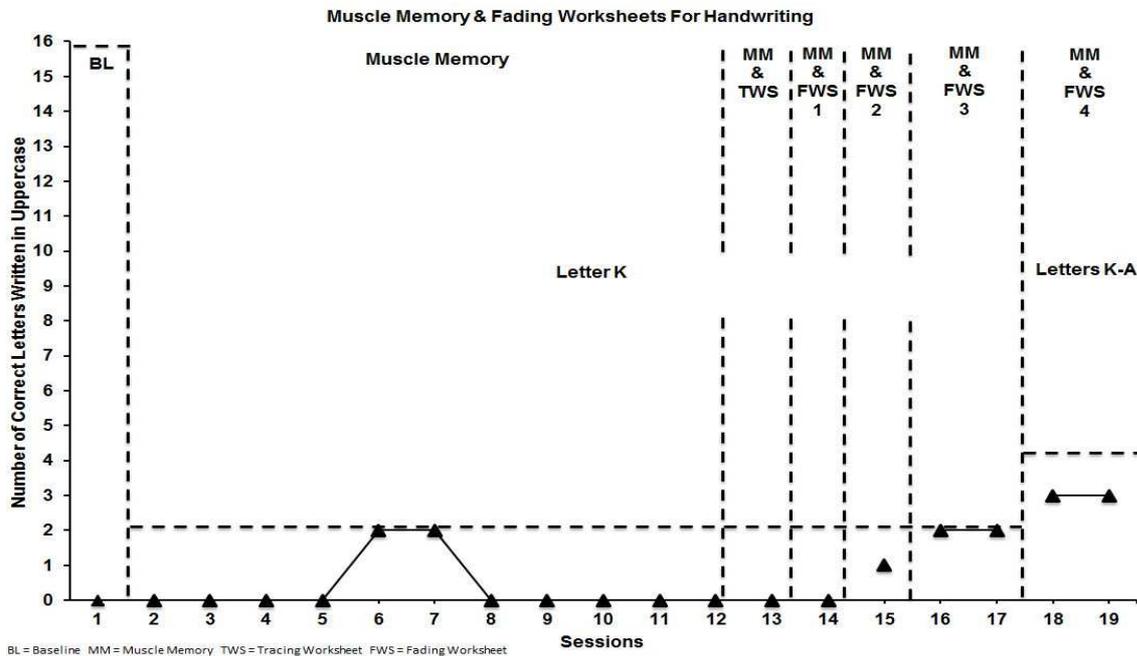


Figure 4: The number of correct letters with handwriting for Participant 2 during baseline (Session 1) using Muscle Memory & Fading Worksheets (sessions 2-19).



## Conclusion

The purpose of the study was to teach Participant 1 and Participant 2's to write the uppercase letters of their first name using muscle memory activities paired with fading worksheets system. Both students made improvements from baseline, however there did not appear to be a direct functional relationship between the numbers of correct uppercase letters written and muscle memory activities paired with fading worksheets. But a number of factors may have attributed to the results of the study.

When the researcher approached the cooperating teacher and occupational therapist for input with a handwriting intervention, the muscle memory activities came highly recommended by both from personal experiences. The first author initially wanted to use a Handwriting without Tears (HWT) Olsen, 1998) curriculum and materials to demonstrate and replicate our earlier work (Carlson, McLaughlin, Derby, & Blecher, 2009; McBride, Pelto, McLaughlin, Barretto, Robison & Mortensen, 2010) suggesting that HWT is very effective to teach legibility and name writing with preschoolers. However the cooperating teacher did not feel the approaches with that curriculum was developmentally appropriate due to the time consuming tasks required. As a result, the muscle memory intervention was implemented not because of the researcher's initial choice but through outside recommendations. In retrospect, the first author would have preferred to do the HWT curriculum for the intervention to provide more built in practice for the students to write the letters of their name using paper and a writing device that could generalize more effectively to their handwriting. We have noted this in our prior research with the cooperating teacher (McBride et al., 2010).

After 11 sessions with the implementation of muscle memory activities, Participant 2 had made minimal progress. The researcher grew concerned early on with Participant 2's lack of progress given the amount of time spent working on one letter, but the cooperating teacher and the occupational therapist told her not to rush the process. They explained that the formation of letters was a tedious process that does not occur in a matter of days. Also, the occupational therapist explained in addition to the time consuming task that accompanies learning a letter, the letter K was among one of the hardest letters to write because of the different directional strokes involved.

In addition to the discrepancies with the time that should be devoted to every letter, there were also discrepancies with the scoring criteria for slant and formation with the intervention. Initially, the researcher was taught to grade slant and formation very rigidly with specific criteria on the exactness of the slant and the neatness for formation. The first author realized halfway through the intervention that with the pre-existing criteria for scoring the letters the students may never attain the goal for any letter despite the fact that the letters are legible. As a result, the researcher set up a meeting with her supervisor to discuss the criteria for scoring. The supervisor told the

researcher that the criteria was unrealistic and to score the letters again given a new improvised criteria for slant and formation given Participant 1 and Participant 2's age and the population of the students. After multiple sessions with minimal progress made and conversing with the third and fourth authors, the researcher paired the muscle memory activities with an additional intervention to help Participant 2.

### **Suggestions and Recommendations**

The muscle memory activities alone was used at the start of the study, but was later paired with fading worksheets. The muscle memory activities alone proved to be motivating for the students especially for Participant 1. The assortment of materials for the students made learning the letters more interactive. However, the data itself showed that muscle memory activities alone did not prove to be effective due to the lack of a consistent increasing trend. It was hypothesized that the students did not acquire enough practice with the letters prior to the permanent product to master the correct directional strokes from memory. Also, it was hypothesized that although the muscle memory techniques emphasized on the verbal prompts for the correct directional strokes the students were not able to generalize the muscle memory activity to the final permanent product when asked to write out the letters.

For Participant 1, the progress with the additional fading worksheets was not as effective as we had initially thought. Due to Participant 1's small attention, both the implementation of the muscle memory activities with fading worksheets took too much time to complete. Also, he at times was more interested in drawing rather than writing the letters especially on the fading worksheets and on the final products. Or he would intentionally not follow the researcher to get a reaction out of her because he is adult attention maintained. The whole intervention segment for every session required too much time and increased his distractibility and decreased his tolerance for staying on-task.

With regards to Participant 2, several fading worksheets were implemented. The reason behind all the changes was for multiple reasons. First the researcher made fading worksheet one to see if Participant 2 was capable of making the strokes necessary to make the first letter of her name or if she was developmentally unable to do the strokes quite yet. However as the worksheet showed, she was able to do the strokes. The researcher then made fading worksheet two and implemented it with Participant 2. However, the cooperating teacher reviewed it and realized the fading worksheet was not written in sequential steps for a fading out process. As a result, the researcher made a revised fading worksheet with the write sequential steps that resulted in fading worksheet three. After two days of implementation with fading worksheet three, the cooperating teacher realized that Participant 1 did not understand the concept that the letters that he was learning was part of his name. As a result, the cooperating teacher made a new fading worksheet that incorporated the full length of their names for both Participant 1 and 2.

The various changes in procedures and strategies clearly show the efficacy of employing daily measurement and data based decision-making to improve student academic performance (McLaughlin, B. Williams, R. Williams, Peck, Derby, Bjordahl, & Weber, 1999; Shapiro, 2011). Teaching such a skills to preservice teachers have been advocated by the national and state teacher certification organizations and departments (See B. Williams, McLaughlin, R. Williams, Howard, & Marchand Martella, 1993; McLaughlin et al., 1999). In the present analysis we were able to employ single case research methodology with daily measurement in an attempt to assist preschool students to learn to write their names. It appears that other procedures such as tracing and systematic instruction (Caletti et al., in press; Park et al., 2008) or employing *Handwriting without Tears* materials and procedures (Carlson et al., 2010; LeBrun et al., 2012; McBride et al., 2009; Morris et al., 2012; Thompson, McLaughlin, Derby, & Conley, 2012). This will have to be examined in future research.

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