

Boosting Fine Motor Abilities in Children with Cerebral Palsy Through LEGO Constructive Play in Special Schools

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ABSTRACT

Children with cerebral palsy (CP) typically exhibit lower fine motor skills compared to their typically developing peers. Various interventions, including constructive LEGO play, have been explored to support fine motor skill development. This study examines the effectiveness of constructive LEGO play in enhancing fine motor skills in children with CP at SDLB Putra Jaya Malang. A Single-Subject Design (SSD) with an A-B-A format was employed. Data were collected through structured observations and assessments of fine motor skills during baseline, intervention, and post-intervention phases. Findings indicate a notable improvement in fine motor skills from the first baseline (A1) to the intervention phase (B), with sustained progress in the second baseline (A2) after the intervention was withdrawn. This suggests that constructive LEGO play positively influences fine motor skill development in children with CP. The study highlights the potential of LEGO-based activities as an engaging and effective tool for improving fine motor coordination in children with CP. The observed progress reinforces the need for structured and repetitive fine motor activities in special education settings. Constructive LEGO play proves to be a beneficial intervention for enhancing fine motor skills in children with CP. Its integration into therapy and special education programs could provide long-term benefits. Further research is recommended to explore its scalability and long-term impact.

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1. INTRODUCTION

Cerebral palsy (CP) is a type of brain injury that affects motor control systems, often caused by developmental disorders or damage to brain areas responsible for motor function. This impairment in motor function can lead to challenges in performing daily physical activities for children with cerebral palsy (Carlson et al., 2013; Odding et al., 2006; Stavness, C., 2006). Physical motor development is divided into two categories: gross motor skills and fine motor skills. Cerebral palsy, therefore, is a disorder caused

by brain damage that impacts motor coordination, including both fine and gross motor skills (Baird, M, 2010; Shapiro, B. K, 2004; Hayes, C, 2010).

Fine motor skills are crucial basic skills for children. According to (Bos, A. F, 2013; Brown, C. G, 2010; Bondi, D, 2022), fine motor skills involve the ability to control small or fine muscles, which are essential for tasks such as writing, drawing, squeezing, pinching, and more. These skills encompass precise finger movements, hand movement control, eye-hand coordination, and finger flexibility. If a child's fine motor skills do not develop optimally, they may face difficulties in performing tasks that require fine motor control, such as folding fingers, squeezing, pressing, and gripping. Therefore, it is essential to provide varied and engaging tools to attract children's attention and motivate them to practice, thereby enhancing their fine motor skills (Lorås, H., & Sigmundsson, H, 2012; Effendi, M. S, 2023; Stewart, R. A, 2007).

In addition to variety, safety is a critical aspect of any tool or medium used with children to prevent injuries. Educational toys (APE) are recommended for improving fine motor skills because they are specifically designed for this purpose. Educational toys (APE) are specifically crafted to optimize a child's development according to their age and developmental needs (Deák, G. O, 2014; Levesque, S, 2022). Constructive play, on the other hand, involves activities where children create something using specific materials. From constructive educational toys, children can build or create projects using these tools according to their developmental needs. LEGO is an educational toy from Denmark, created by Kirk Christiansen. It was designed to foster creativity and enhance fine motor skills in children. LEGO is a constructive educational toy made of plastic blocks that can be assembled into various shapes, promoting children's creativity and fine motor skills development (Chasanidou, D, 2024; Lindsay, S, 2017; Souza, I. M, 2018).

Playing with LEGO involves assembling blocks into various shapes, either freely or by following structured models. This constructive play is particularly beneficial for children with CP, as it enhances fine motor skills through activities such as touching, gripping, and connecting LEGO pieces. Engaging both hands and fingers in these tasks helps children develop better coordination and dexterity.

LEGO offers several advantages as a therapeutic and educational tool. It is made of child-friendly plastic, ensuring safety, and its bright colors, such as red, yellow, and blue, attract children's attention (Cook, A. M., 2011; Bian, Y., 2020). Additionally, the variety of shapes and themes, including animals, plants, and vehicles, keeps children engaged and motivated to participate in constructive play.

Previous research has explored similar constructive play interventions for children with CP. Karitas (2018) conducted a study titled *"The Effectiveness of Constructive Play with LASY® on Fine Motor Skills in Children with Cerebral Palsy, Class 1, at SD Negeri Pojok Sinduadi Sleman."* This study assessed the impact of LASY® constructive play media on fine motor skill development. In many educational settings, LEGO is frequently used by educators as a structured learning tool to enhance fine motor skills in children with CP.

Building on this foundation, the present study further investigates the effectiveness of LEGO-based constructive play in supporting fine motor development, providing valuable insights for educators, therapists, and parents working with children with CP.

2. METHODS

This study adopts a quantitative approach, utilizing an experimental method. The experimental design applied in this research is the Single Subject Research (SSR) model. As stated by (Zhan, S., & Ottenbacher, K. J, 2001; Horner, R, 2005) "In single subject design, measurements of the dependent variable or target behavior are conducted repeatedly over a specified period." Measurements are taken under different conditions: before the intervention, during the intervention, and after the intervention, using constructive LEGO play. The aim of this research is to evaluate the effectiveness of constructive LEGO play in enhancing fine motor skills in children with cerebral palsy at SDLB Putra Jaya. The A1-B-A2 design pattern utilized in Figure 1.

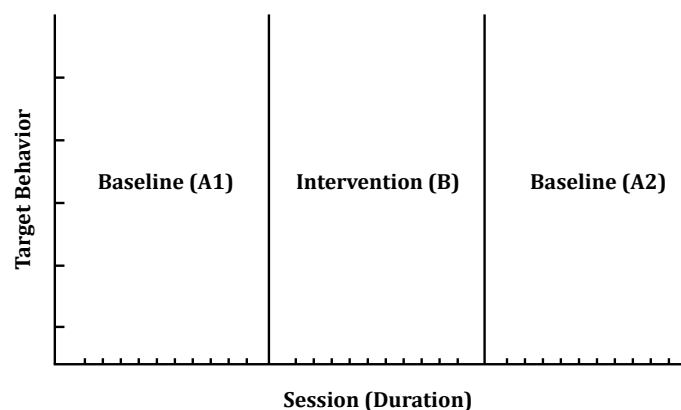


Figure 1. Single Subject Research (SSR) with A1-B-A2 Design

- a. Baseline-1 Phase: In this initial phase, measurements and data collection on fine motor skills are conducted before the intervention using constructive LEGO play. The measurements are carried out over four sessions or until the data stabilizes, with each session lasting 60 minutes.
- b. Intervention Phase: During this phase, a series of fine motor skill training sessions using constructive LEGO play are conducted, each lasting 60 minutes. The fine motor skills of children with cerebral palsy at SDLB Putra Jaya are assessed in every session. The intervention phase spans eight sessions or until the data obtained is stable. Fine motor skill tests are also administered following the treatment in this phase, and the results are used to substantiate the research findings.
- c. Baseline-2 Phase: In the final phase, measurements and data collection on the fine motor skills of children with cerebral palsy at SDLB Putra Jaya are conducted after the intervention using constructive LEGO play. These measurements are taken over four sessions or until the data stabilizes, with each session lasting 60 minutes.

Table 1. Criteria for Assessing Fine Motor Skill

No	Component	Performance Criteria	Scores
1	Playing with Plasticine	The child is able to play with plasticine, demonstrating 3 of the following skills (rolling, squeezing, and flattening)	4
		The child is able to play with plasticine, demonstrating 2 of the following skills (rolling, squeezing, and flattening)	3
		The child is able to play with plasticine, demonstrating 1 of the following skills (rolling, squeezing, and flattening)	2
		The child is unable to play with plasticine according to any of the following skills (rolling, squeezing, and flattening)	1
2	Turning Pages of a Book	The child is able to turn the pages of a book with thin paper to the instructed page	4
		The child is able to turn the pages of a book with thin paper to a page that was not instructed	3
		The child is able to turn the pages of a book with thick paper to the instructed page	2
		The child is unable to turn the pages of a book with thin paper to the instructed page	1
3	Pinching	The child is able to pinch at level 3 (≤ 3 stacked notebooks) using a clothespin	4
		The child is able to pinch at level 2 (≤ 2 stacked notebooks) using a clothespin	3

		The child is able to pinch at level 1 (\leq 1 stacked notebook) using a clothespin	2
		The child is able to pinch using a clothespin	1
4	Finger and Palm Painting	The child is able to paint using all fingers and the entire palm	4
		The child is able to paint using some fingers and part of the palm	3
		The child is able to paint using either fingers or the palm alone	2
		The child is unable to paint using fingers or the palm	1
5	Coloring	The child is able to color a simple picture meeting 2 of the following criteria (the picture is fully colored in and the color does not go outside the lines)	4
		The child is able to color a simple picture meeting 1 of the following criteria (the picture is fully colored in or the color does not go outside the lines)	3
		The child is able to color a simple picture, but only with scribbles	2
		The child is unable to color a simple picture	1
6	Writing	The child is able to write a simple sentence meeting 3 of the following criteria (complete, clear, and straight)	4
		The child is able to write a simple sentence meeting 2 of the following criteria (complete, clear, and straight)	3
		The child is able to write a simple sentence meeting 1 of the following criteria (complete, clear, and straight)	2
		The child is unable to write a simple sentence	1
7	Cutting	The child is able to cut precisely along a straight line	4
		The child is able to cut outside of the straight line	3
		The child is able to cut, but it is uneven	2
		The child is unable to cut	1

3. FINDINGS AND DISCUSSION

3.1 Baseline-1 (A1)

Several stages were involved in data collection, including measuring the subject's initial abilities prior to intervention. The measurements for the baseline condition 1 (A1) were conducted from November 15 to December 9, 2021. This phase involved four sessions, each lasting 60 minutes. These measurements were taken before the subject received any intervention. During the baseline condition 1 (A1), observations were made without any intervention to gather information on the subject's initial abilities. The subjects in this study were only provided with materials and tools to perform the fine motor skill tests. The baseline data (A1) obtained in this study, until the data trend stabilized, see Table 2.

Table 2. Results of Baseline Condition-1 (A1) Measurements

Session	Condition	Percentage
1	A1	53.57%
2	A1	57.14%
3	A1	57.14%
4	A1	57.14%

As shown in Table 2, the baseline condition-1 (A1) measurements for fine motor skills indicate that the initial session recorded a score of 53.57%. The second session showed a slight increase to 57.14%, which remained consistent in the third and fifth sessions. Data collection ceased when the last three session scores stabilized at 57.14%, indicating minimal variability. Stability in this context is defined as score fluctuations within or below 5.00%.

The average baseline-1 (A1) score was 50%, categorizing the children's fine motor skills as poor. This finding aligns with theoretical perspectives on children with physical motor impairments, particularly those with CP. The primary challenge for children with CP lies in their delayed psychomotor development, often due to neurological impairments affecting muscle function and coordination. As a result, low fine motor skill scores are expected and correspond with established theories on cerebral palsy-related motor dysfunction.

According to Pradipta & Andajani (2017), cerebral palsy primarily affects the cerebral system, leading to muscle dysfunction, stiffness, or paralysis. This neurological disruption hampers psychomotor development, making it difficult for affected children to perform fine motor tasks, such as gripping, manipulating objects, and coordinating hand movements. The baseline findings in this study further reinforce these theoretical underpinnings, highlighting the significant challenges faced by children with CP in developing fine motor skills.

3.2 Intervention (B)

The intervention condition (B) measurements were conducted from November 22 to December 2, 2021. This phase involved a total of 8 sessions, each lasting 60 minutes. During the intervention condition (B), the child engaged in activities involving the construction of LEGO building blocks. The data for intervention condition (B), until the data trend stabilized, see Table 3.

Table 3. Results of Intervention Condition (B) Measurements

Session	Condition	Percentage
1	B	67.86%
2	B	75%
3	B	75%
4	B	78.57%
5	B	75%
6	B	78.57%
7	B	82.14%
8	B	78.57%

Based on Table 3, the results of the intervention condition (B) measurements for fine motor skills show the following scores: In the first session, the score was 67.86%. In the second session, it increased to 75%. The score remained at 75% in the third session. In the fourth session, the score was 78.5%. The fifth session recorded a score of 75%, while the sixth session showed a score of 78.67%. In the seventh session, the score rose to 82.14%, and the eighth session recorded a score of 78.57%. Data collection ceased when the scores from the last three sessions had stabilized. Stability, in this context, is defined as a score variability within or less than 5.00.

In the intervention condition, we obtained results that we can refer to in table 3, where the average results in this intervention phase were an increase, where there was a change in the abilities or skills of children with cerebral palsy regarding their psychomotor abilities. according to expert notes in their theory on research regarding therapy or exercises carried out to help children with cerebral palsy improve their motor skills or abilities. This is in line with Wang (2021), where the physical and motor skills of children with cerebral palsy can be improved by carrying out interventions in the form of

exercises or treatment that focus on muscle stiffness problems according to the problem points experienced.

3.3 Baseline-2 (A2)

Baseline condition-2 (A2) measurements were conducted from December 6 to December 9, 2021. This phase comprised four sessions, each lasting 60 minutes. These measurements were taken after the child had received treatment or intervention. In baseline condition-2 (A2), observations were made without any additional intervention to obtain information on the subject's final abilities. The subjects were provided only with materials and tools to perform fine motor skill tests. The data for baseline condition-2 (A2), until the trend stabilized, see Table 4.

Table 4. Results of Baseline Condition-2 (A2) Measurements

Session	Condition	Percentage
1	A2	67.86%
2	A2	71.43%
3	A2	75%
4	A2	71.43%

Based on Table 4, the results of the fine motor skill measurements for baseline condition-2 (A2) are as follows: In the first session, the score was 67.86%. The second session recorded a score of 71.43%, while the third session achieved a score of 75%. The fifth session also yielded a score of 71.43%. Data collection was halted once the scores from the last three sessions had stabilized. In this context, stability is defined as a score variability within or less than 5.00.

Next, at the baseline condition stage 2, which is the result of the subject's condition after being given intervention, where there may be a decrease in value but it is not significant, this is due to the release of the intervention treatment on the subject. However, this decrease does not have a significant impact so that the intervention process has persisted in the abilities or motor skills of children with cerebral palsy. Even though this condition has not been consistently maintained, there are still changes that occur after the intervention is given. This is in accordance with research conducted by Herskind et al, (2013) where in their literature study it was found that providing intervention to children with cerebral palsy regarding their physical activity required consistent and structured training or treatment, however it was also found that it was a form of intervention nor will they completely remain in their abilities or can be said to have temporary motor skills, which in other words can decrease or return to the initial condition of children with cerebral palsy.







3.4 Condition Analysis

The analysis of conditions was conducted by examining several key components to assess changes in fine motor skill development over time. These components included the duration of each condition, trend direction, data stability, trajectory, range of data variation, and level changes. By analyzing these aspects, the study aimed to determine the effectiveness of constructive LEGO play as an intervention for children with cerebral palsy (CP).

Trend direction was evaluated to identify whether the data showed an increasing, decreasing, or stable pattern throughout the intervention phases. Data stability was assessed based on score variability, ensuring that fluctuations remained within an acceptable range. Trajectory analysis examined the progression of fine motor skill improvements, while the range of data variation helped determine the extent of individual differences among participants. Level changes were analyzed to measure immediate and sustained effects following the intervention phase.

These analytical components provide a comprehensive overview of the intervention's impact and ensure that the observed changes were systematic and measurable rather than occurring by chance. For a detailed breakdown of these analyses, refer to Table 5, which presents the specific values and patterns observed during the study. The findings contribute to a better understanding of how constructive LEGO play can support fine motor skill development in children with CP, reinforcing the need for structured, engaging, and repetitive interventions in therapeutic and educational settings.

Table 5. Results of Visual Data Analysis

No	Condition	A-1	B	A-2
1	Duration of Condition	4	8	4
2	Estimated Trend Direction			
3	Trend Stability	100%	87,5%	100%
4	Data Trajectory	(+) 	(+) 	(+) 
5	Level Stability and Range	<i>stable</i> <u>53,14% – 57,14%</u>	<i>stable</i> <u>67,86% – 82,14%</u>	<i>stable</i> <u>67,86% – 75%</u>
6	Level Changes	<u>57,14% – 53,57%</u> (+3,57)	<u>82,14% – 67,86%</u> (+14,28)	<u>67,86% – 75%</u> (+7,14)

The duration of each condition was as follows: baseline-1 (A1) consisted of 4 sessions, the intervention condition (B) comprised 8 sessions, and baseline-2 (A2) involved 4 sessions. The analysis was based on the trend estimates of fine motor skills for students with cerebral palsy observed during the baseline, intervention, and post-intervention phases. In baseline-1 (A1), the estimated trend indicated a positive increase, suggesting an enhancement in fine motor skills, albeit with a relatively flat trajectory. During the intervention phase (B), the trend continued to show a positive increase. After the intervention (A2), the estimated trend also demonstrated a positive increase, indicating an improvement in fine motor skills, though the rate of increase was somewhat gradual. These results suggest a favorable impact of the intervention. The stability trend results during baseline-1 (A1), which spanned sessions 1 through 5, showed a stability trend of 100%, indicating stability. During the intervention phase (B), which covered sessions 5 through 12, the stability trend was 87.5%, also reflecting stability. In baseline-2 (A2), which encompassed sessions 13 through 16, stability reached 100%, confirming stability. The trace line data in baseline-1 indicated an increasing trend (+). In the intervention phase (B), the trend line also showed an upward trajectory, suggesting that fine motor skills improved during the intervention. In baseline-2, the trend line indicated a positive increase (+), albeit weak, reflecting a positive effect following the intervention. The stability and range in baseline-1 (A1) improved with a stability range of 53.14%-57.14%. Similarly, during the intervention phase (B), stability increased with a range of 67.86%-82.14%. Baseline-2 (A2) also saw an improvement in stability, with a range of 67.86%-75%. Changes in levels for baseline-1 (A1), the intervention phase (B), and baseline-2 (A2) all exhibited positive trends (+), indicating that fine motor skills improved under these conditions.

3.5 Inter-Condition Analysis

The analysis involves examining several key components: firstly, the number of variables that have been altered, which provides insight into the extent of changes within the dataset. Secondly, the direction of trends is assessed to determine whether the patterns are shifting upwards or downwards. Thirdly, changes in trend stability are evaluated to understand how consistent or fluctuating the trends are over time. Additionally, changes in level are analyzed to observe any shifts in the baseline or average values. Lastly, the percentage of overlap is calculated to measure the degree to which the changes in the dataset align or intersect with each other, offering a comprehensive view of the overall impact of the modifications, see Table 6.

Table 6. Iter-Condition Analysis

Comparison of Conditions	B/A-1	B/A-2
Number of Variables	1	1
Changes in Trend Direction and Their Effects		
Changes in Trend Stability	stable to stable	stable to stable
Changes in Level	14.29%	3.57%
Percentage of Overlap	0%	-

The analysis presented in Table 6 reveals the data across different conditions, focusing on the number of variables that underwent changes. The study highlights a singular variable shift from baseline condition 1 (A1) to the intervention condition (B). The trend direction from baseline-1 (A1) to the intervention (B) and from the intervention (B) to baseline-2 (A2) shows a consistent upward trajectory, indicating an enhancement in fine motor skills among students. Specifically, the intervention condition (B) exhibits a trend toward 87.5%, while the baseline condition approaches 100%, suggesting stability in the comparison between intervention (B) and baseline-1 (A1). Similarly, the comparison between baseline-2 (A2) and the intervention (B) also remains stable, with baseline-2 (A2) trending towards 100%. Notably, the fine motor skills of children with cerebral palsy improved by X% from baseline-1 (A1) to the intervention (B) phase, and by 14.29% from the intervention (B) to baseline-2 (A2). The percentage of overlap between baseline-1 (A1) and the intervention (B) is 0%, indicating no data overlap and reinforcing that the intervention has a significant impact on fine motor skills behavior.

Discussion

LEGO play plays a crucial role in enhancing hand-eye coordination in children, as it involves manipulating small blocks through gripping, arranging, and assembling. These activities actively engage fine motor skills, which are fundamental for daily tasks such as writing, drawing, using tools, and playing musical instruments. Additionally, LEGO fosters focus, critical thinking, and patience, making it an effective tool for cognitive and motor skill development.

Beyond its impact on fine motor skills, LEGO also supports broader aspects of child development. It nurtures creativity and imagination by encouraging children to design and construct unique structures. It also strengthens problem-solving skills, requiring logical thinking and planning to successfully assemble pieces. LEGO introduces children to basic mathematical and scientific concepts, such as spatial reasoning, symmetry, and structural balance. Moreover, it helps build self-confidence, as completing a LEGO design provides a sense of accomplishment and motivation.

This aligns with findings from Sari et al. (2023), who reported that LEGO-based activities significantly improved children's fine motor skills, leading to measurable developmental progress. Similarly, Bian et al. (2020) emphasized that structured LEGO activities stimulate motor skills in children with CP. Their study demonstrated that assembling LEGO pieces enhances hand-eye

coordination, concentration, and muscle flexibility, all of which are critical for improving fine motor function.

For children with CP, regular LEGO play can facilitate muscle relaxation and improve fine motor movement. Assembling LEGO requires precise coordination between the hands and eyes, gradually strengthening fine motor control. When integrated into therapeutic and educational settings, LEGO serves as an engaging and effective intervention to support the motor development of children with special needs.

Based on the data analysis presented in the tables and line graphs utilizing the ABA design, it can be concluded that the use of constructive LEGO play is effective in enhancing fine motor skills in children with cerebral palsy in Grade VI. This conclusion is further supported by the finding that the overlap percentage between conditions is 0%, indicating no data overlap and affirming the effectiveness of LEGO construction play in improving fine motor skills. The focus of this study is on enhancing fine motor skills, including twisting, squeezing, flattening playdough, opening books to the correct page upon instruction, pinching with clothespins, finger and palm painting, coloring simple images, writing simple sentences, and cutting straight lines. These skills are targeted due to the subject's difficulties with hand and finger movements (Bulgarelli, D, et al, 2018; Pfeifer, L. I, et al, 2014; Papavasiliou, A. S, 2009; Chan, G., & Miller, F, 2014).

Field observations indicate a lack of structured activities designed to develop fine motor skills in children with cerebral palsy (CP). This limitation is primarily due to the broad curriculum demands, which leave little room for individualized motor skill development. Additionally, in many cases, there is only one child with CP in a classroom, making it challenging for teachers to allocate additional materials and instructional time for fine motor training (Irvan et al., 2023; Jauhari et al., 2022; Richards et al., 2013). As a result, the limited time dedicated to fine motor activities negatively affects the development of essential skills required for academic and daily tasks (Roostaei et al., 2017; Niazi et al., 2022).

Integrating constructive LEGO play into learning environments offers a practical and engaging solution for improving fine motor skills in children with CP. The grasping, pressing, lifting, assembling, and pulling motions involved in LEGO play actively engage small hand muscles, promoting dexterity, coordination, and strength. After incorporating LEGO-based activities, noticeable improvements in fine motor function have been observed in children with CP (Hains & Mazzearella, 2019; Wolf, 2014). These findings confirm that constructive LEGO play positively influences hand function, reinforcing the importance of structured, play-based interventions for motor development in children with CP (LeGoff, 2004; Gauntlett, 2014).

Thus, integrating LEGO activities into educational and therapeutic settings can provide an accessible, effective, and engaging approach to support fine motor skill development, particularly for children with special needs. Future research should explore long-term benefits and assess how LEGO-based interventions can be systematically integrated into special education curricula to enhance holistic child development.

4. CONCLUSION

The findings of this study demonstrate that constructive LEGO play effectively enhances fine motor skills in children with cerebral palsy (CP). Prior to the intervention, the child's hand strength and dexterity were limited, making it difficult to perform tasks such as squeezing, grasping, and applying pressure. The child also experienced stiffness in the fingers and hands, which affected activities like finger painting, writing, and cutting along straight lines. However, after engaging in LEGO-based activities, there was a noticeable improvement in fine motor skills. The child developed the ability to paint using all fingers and the palm, color within the lines, and cut along straight lines with greater accuracy. The results show that fine motor skill development improved significantly from baseline-1 to

baseline-2, with a 0% overlap percentage, indicating a clear and measurable effect of LEGO play on motor function.

Despite these promising findings, this study has several limitations. The research was conducted on a single participant, limiting its generalizability to a broader population of children with CP. Additionally, the short intervention period may not fully capture the long-term impact of LEGO-based activities on motor skill development. Future research should expand the sample size to include a diverse group of children with CP and examine the long-term effects of LEGO interventions. Studies should also explore how LEGO-based therapy can be integrated into structured rehabilitation programs to provide sustained benefits for children with motor impairments.

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