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# Mobility Intensive Training (Mob-IT) Protocol for Children with Cerebral Palsy: Feasibility and Fidelity Results

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**Abstract:** The Mobility Intensive Training (Mob-IT) protocol is an innovative intervention focused on motor learning to improve the mobility of children with cerebral palsy (CP). The objective was to describe the feasibility and intervention fidelity of Mob-IT. A single-subject experimental study was conducted with four children with CP, a median age of 11 (7–13) years, and a Gross Motor Function Classification System I–III. The Mob-IT included 24 h of practice of mobility goals, delivered three times a week in 2 h sessions over four weeks. Feasibility was assessed using the Qualitative Feedback Questionnaire (QFQ), evaluating adherence, acceptability, adverse effects, the clarity of procedures, and intervention time. The Canadian Occupational Performance Measure (COPM) was used to assess participant and caregiver satisfaction. Fidelity was measured by the type of feedback provided (intrinsic vs. extrinsic), task challenge level, and intervention volume. Participants reported good acceptance, few adverse effects, and satisfaction with the outcomes. The intervention adhered to the proposed principles, with a focus on extrinsic feedback and tasks showing progression over time. Time was well spent, being 78% focused on activities and using mostly extrinsic-focused feedback. The Mob-IT protocol was considered feasible and faithful to its principles. As this is a feasibility study, the results indicate the need to expand the intervention to a larger, randomized study.

**Keywords:** cerebral palsy; intensive training; task-oriented training; children and adolescents; treatment fidelity



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## 1. Introduction

Cerebral palsy (CP) is a group of disorders of movement and posture resulting from a permanent and non-progressive injury to the developing brain, causing activity limitations [1]. Rehabilitation interventions are recommended to maximize motor gains, prevent secondary musculoskeletal alterations, and promote child and family well-being [2].

Mobility, defined as the ability to move around to interact within the environment, moving from one place to another, aiming to participate in daily activities [3], is an important component of an individual's functioning. It is often ranked among the most relevant activity limitations for children with CP [4] and can result in restricted participation and decreased physical fitness, impacting quality of life [5].

High-level evidence supports interventions using task-oriented training (TOT) to improve mobility in this population [6]. TOT is based on motor learning principles, involving specific training for daily activities, with a high number of repetitions and challenging

practices at varying levels of difficulty, encouraging the child to solve problems progressively and with engagement [7,8]. The training must provide external feedback to guide the execution of the task, which can be provided either regarding the performance (e.g., "Try to walk between the lines") or the outcome (e.g., "This attempt was faster than the previous") [9], promoting a focus on the demands of the task to be performed and environmental modifications to enhance task execution [6,9–11].

The current literature supports intensive training for the improvement in motor skills [12] and recommends a total of 14 to 25 h of goal-directed practice to achieve functional goals [13]. As defined in the study by Goikoetxea-Sotelo et al. (2024) [14], the term "total dose" describes the total therapy time, integrating dose (intensity and duration of sessions) and dosage (frequency and total number of weeks).

Intensive interventions require higher levels of adherence and determination by the family and the participant when compared with less-intensive approaches [15], resulting in increased challenges in terms of feasibility and treatment fidelity.

Feasibility studies help guide the planning of large-scale studies providing preliminary evidence on the clinical efficacy of an intervention. They evaluate the adequacy of training parameters and the safety of a novel intervention protocol [16]. The feasibility of delivering intensive intervention protocols to children with CP has been demonstrated in Brazil [17] and in other countries [18], showing positive outcomes in terms of adherence, satisfaction, performance in real-life tasks, and improvement in functional capacity, particularly of the upper limb. However, studies on mobility-focused interventions that describe the feasibility of implementing the planned principles are scarce.

The fidelity of a protocol refers to the extent to which an intervention is implemented as planned in the original protocol and is recognized as a key factor for evaluating interventions that are used to guide clinical practice [19]. Assessing fidelity is crucial given the need for replicable methodologies following current recommendations.

Therefore, this study aims to describe the feasibility and implementation fidelity of a mobility-focused intervention protocol named Mobility Intensive Training (Mob-IT) [20], delivered to children with CP. Mob-IT follows TOT guidelines, in which tasks are practiced actively and playfully to maintain engagement, using a systematic approach to provide feedback with an external focus and incorporating objective measures to customize the level of challenge [7,10,13]. Thus, the results presented in this study will contribute to the expansion of evidence on the feasibility and implementation fidelity of an intensive and innovative intervention protocol. Based on recommendations from contemporary therapeutic approaches, the Mob-IT protocol addresses an existing gap in the literature, standing out for its specific focus on mobility. This is particularly relevant as intensive rehabilitation protocols currently recommended, such as Constraint-Induced Movement Therapy, Hand–Arm Bimanual Intensive Training (HABIT), and HABIT including lower extremities (HABIT-ILE), which involves intensive practice periods with task progression, either predominantly focus on the rehabilitation of the upper limbs or target the mobility and lower limb functions as secondary [13]. Additionally, this study will provide detailed information on participant adherence, acceptability, satisfaction with the protocol, and potential adverse effects, ensuring that the fundamental principles of the intervention were upheld, including the nature of feedback, task progression, level of difficulty, and applied volume. The results obtained may support the development of future large-scale clinical trials.

## 2. Materials and Methods

### *2.1. Study Design*

This is a single-subject study with multiple baselines (3 baselines and 2 post-intervention assessments). This design allows for the preservation and description of the variability of individual responses to refine data that may support future studies [21].

### *2.2. Participants and Eligibility Criteria*

Five participants were recruited, and four completed the study. The participants' median age was 11 (7–13) years, and 4 were female. The participants were included if they were diagnosed with CP, between the ages of 7 and 16 years, classified in the gross motor function classification system (GMFCS) levels as I to III, and able to understand and complete the instructions for the assessment and intervention activities. Recruitment occurred using the Child Development Analysis Laboratory from the Federal University of São Carlos (LADI-UFSCar) database, using medical records from the School Health Unit (USE-UFSCar), and through social media.

Participants were not included if they had uncontrollable seizures, had severe visual and/or cognitive problems that could interfere with the study, or underwent orthopedic or neurological surgery or botulinum toxin injection in the 6 months prior to the intervention.

Children who started another intervention concomitantly with the study, underwent surgeries, and/or were hospitalized during the application of the protocol were discontinued from the study. Participants had the opportunity to make up for any absences in the last week of the protocol application. If this was not possible, the participant remained in the study and the implemented dose was described.

### *2.3. Outcome Measures*

A wide range of instruments were used to assess the feasibility and fidelity of the Mob-IT protocol [20]. The Qualitative Feedback Questionnaire (QFQ) [22] was used to assess implementation feasibility, and the Canadian Occupational Performance Measure (COPM) [23–25] was used to rate the participants' and caregivers' satisfaction and performance. As measures of treatment fidelity, Goal Attainment Scaling (GAS) [26] was used to monitor goals and support the planning progression of the task's challenge level. The Rating of Perceived Challenge (RPC) [27] was additionally used to record the challenge placed by the task. Therapists' notes and video recordings of the sessions provided additional information on fidelity.

#### 2.3.1. Qualitative Feedback Questionnaire (QFQ)

The QFQ was developed by the research group [22] to assess the participants' perspective on the intervention characteristics. The questionnaire evaluates acceptability, adverse effects, clarity of procedures, time, and adherence. It comprises five questions with three options (A, B, or C). Alternative A refers to a negative perception (the activities are boring; the time is inadequate; most activities are uncomfortable; activities are difficult to understand; I prefer to do other activities). Alternative B is the neutral option (activities are neither boring nor cool; the duration is adequate; some activities cause discomfort; activities are neither difficult nor easy to understand; it makes no difference doing these activities or others). Alternative C is the positive option (cool activities; could do activities for longer periods; felt good doing most activities; activities easy to understand; would do these activities again) [22]. In this study, the questionnaire was answered directly by the participant on the last day of the intervention.

#### 2.3.2. Canadian Occupational Performance Measure (COPM)

The COPM is a validated instrument widely used to assess perceived performance and satisfaction by children or their caregivers [23–25]. Because this is a feasibility investigation, in the present study, the COPM was used exclusively to measure satisfaction within a family- and child-centered collaborative approach [28]. In this context, participants and their caregivers identified 3 to 5 main goals related to mobility. Examples of goals reported by participants included the following: reducing falls when walking fast, skipping rope, and overcoming obstacles without falling. Caregivers, on the other hand, highlighted goals such as greater independence in walking, walking while carrying objects, and walking long distances.

All goals were trained, and the information was collected separately, initially with the children and then with the parents. Participants evaluated their perception of satisfaction regarding each goal before and after the implementation of the Mob-IT protocol using a scale from 1 to 10, where 1 corresponds to low satisfaction and 10 to high satisfaction. At the end, the average change in the satisfaction score was calculated for each goal.

#### 2.3.3. Goal Attainment Scaling (GAS)

GAS was used to measure the achievement of goals chosen through the COPM by the children and task progression. The scoring scale describes specific goals in five levels, from −2 to +2, with −2 being much less than the expected result and +2 being much greater than the expected result [26]. The children's initial state was −2 on the scale. The scale was reapplied by a trained evaluator at the end of every three sessions. Using the scale, the possibility of progressing with the tasks was assessed, that is, if at the end of the three sessions, the participant reached a score of +2 in a given task, in the following week the task would be performed at a higher level of challenge. An example of GAS goals and scores based on a COPM goal is shown in Table 1.

**Table 1.** Example of a COPM goal and respective GAS goals and scores.

| COPM Goal | GAS Goals | GAS Scores |
|---|---|---|
| Improve gait speed | Walk quickly forward for 10 m in less than 9 s. | −2 (Much less than expected outcome) |
| | Walk quickly forward for 10 m in less than 8 s. | −1 (Less than expected outcome) |
| | Walk quickly forward for 10 m in less than 7 s. | 0 (Expected outcome after intervention) |
| | Walk quickly forward for 10 m in less than 6 s. | +1 (Greater than expected outcome) |
| | Walk quickly forward for 10 m in less than 5 s. | +2 (Much greater than expected outcome) |

COPM: Canadian Occupational Performance Measure; GAS: Goal Attainment Scaling.

#### 2.3.4. Rating of Perceived Challenge (RPC)

The RPC was used to record the tasks' challenge. It measures the internal burden of individuals [27] and was applied throughout the sessions at the end of each task. The participants were requested to point to the number that best represented their perception of the task challenge, which ranged from 0 (rest) to 10 (maximum challenge). The Brazilian Portuguese version adapted to the pediatric population was used (manuscript in preparation).

#### 2.3.5. Intervention Recordings

The research group prepared a form to describe the characteristics of the intervention through videos of one randomly selected session recorded every week. The videos were assessed by an independent, blinded evaluator, previously trained in the principles of the intervention. When analyzing the videos, the evaluator described the number of repetitions and the duration of each task, as well as the type of feedback used. The trained tasks were those that had been pre-established by the children and their parents. Additionally, intervention records containing detailed information on the treatment sessions provided information regarding the intervention's characteristics, such as the number of sessions and the reason for absences.

### *2.4. Intervention Protocol: Mobility Intensive Training (Mob-IT)*

The Mob-IT protocol [20] comprises an intensive, goal-directed, task-oriented mobility intervention. The tasks were planned to reflect relevant everyday situations, using a playful approach to ensure participant engagement and motivation [6]. The intervention was defined based on current recommendations for children with CP [6,10], and was delivered three times/week, two hours/day, over four weeks. The protocol is described in detail in Sudati et al. (2024) [20].

A manual of the procedures was prepared to ensure the fidelity of implementing the protocol. The manual comprised detailed information on how the tasks should be administered, the environment's preparation, materials to be used, participant positioning, feedback options for each task, and the progression possibilities according to the child's performance [29]. All activities were based on the assessment instruments used in this study that showed the participant's mobility repertoire (Gross Motor Function Measure-66, Challenge, Pediatric Evaluation of Disability Inventory-Computer Adaptive Test) and on the literature describing strategies to manipulate the tasks and elicit adaptive responses through external feedback.

The exercise program is described in Table 2 according to the Consensus in Exercise Reporting Template (CERT) checklist [30].

**Table 2.** The exercise program, summarized as per the CERT checklist.

| Item | Description |
| --- | --- |
| What: MATERIALS | Steps, bench, toys. |
| Who: PROVIDER | Expert physiotherapists. At least 2 per session. |
| How: DELIVERY | The sessions were conducted individually and in person. |
| | The exercises were supervised and delivered one-on-one. |
| | The physiotherapist responsible for each session recorded compliance. If a participant was unable to attend, the session was rescheduled. |
| | The activities were delivered in a playful manner, reflecting everyday tasks and the participants' preferences to ensure motivation and engagement. |
| | The progression of the exercises was guided by the responses to the RPC tool, ensuring that all activities were at least slightly challenging (RPC score = 4). While the context of each activity was preserved, additional task challenges were introduced. |
| | The physiotherapist provided performance feedback during the exercises to guide the task, such as "Use the stick to hit the highest colored target you can". Additionally, feedback on the outcomes was also given, such as "In this round, you scored X points". |

**Table 2.** *Cont.*

| Item | Description |
| --- | --- |
| | There was no home program component. |
| | If the participant reported any adverse events during the exercise, the activity was immediately stopped and either adapted to prevent recurrence or replaced with an alternative context. In addition, the event was documented. |
| Where: LOCATION | The intervention was delivered in the Federal University of São Carlos clinical (Health School Unit) and laboratory (Laboratory for Analysis of Child Development) settings. |
| When, How much: DOSAGE | The intervention consisted of 24 h in total, delivered over four weeks with sessions held three times per week, lasting two hours per day. Each activity was performed for 20–30 min per session. While no specific number of repetitions was established, the activities were repeated until the participant experienced fatigue or found them too easy to perform. |
| Tailoring: WHAT, HOW | The exercise repertoire was chosen based on individual goals reported by the participants and their caregiver. |
| | The exercise was designed to be neither too easy nor too difficult, ensuring the participant remained motivated. As outlined in item 7, the activities were required to be slightly challenging, corresponding to a score of 4 on the RPC scale. |
| How well: PLANNED, ACTUAL | The exercise intervention was implemented as planned in the majority of cases, with minor adaptations made only occasionally, such as adjustments to obstacles, feedback, or challenges. In the case of absences, participants were not discontinued. If the number of absences allowed for make-up sessions, they were given the option to recover the missed sessions during the last week of the protocol implementation. If this was not possible, participation was maintained, and the amount implemented during the intervention period was documented. |

CERT: Consensus in Exercise Reporting Template; RPC: Rating of Perceived Challenge.

All therapists were previously trained on the principles of the protocol and were continuously monitored through weekly meetings to set goals, establish activities, check the participants' progression, and discuss challenges and potential strategies for the intervention.

### *2.5. Data Analyses*

#### 2.5.1. Feasibility

Participant adherence was assessed through the percentage of participants who were invited and agreed to participate in the protocol, as well as the percentage of doses completed by participants relative to the total planned dose [31].

To capture feasibility data (e.g., adherence, acceptability, adverse effects, clarity of procedures, and time), the frequency of positive, neutral, and negative responses from the QFQ was analyzed descriptively.

Participant satisfaction was assessed by calculating the average COPM satisfaction scores across all goals reported by each participant and their caregiver.

#### 2.5.2. Treatment Fidelity

Task fidelity was documented by recording individual goals, their corresponding GAS scores, and the progressions made during the intervention, which were analyzed using descriptive analysis.

The level of challenge of the activities was calculated by the average score of the RPC instrument for each session. It was expected that the average score would be at least 4 (slightly challenging) [27] for all proposed tasks and progressions. For further information, the weekly GAS scores were described as an additional way to illustrate the increasing challenge according to the individual child's response. In addition, the number of activities performed during the week in which the participant achieved a score of +2 in GAS (much greater than the expected outcome) was also recorded.

Further information regarding the intervention characteristics of each participant was recorded, such as the average number of repetitions and the task duration obtained from the analysis of the intervention videos. The type of feedback was analyzed descriptively. To obtain the real dose of the intervention, the average real time during which the participant performed the training activities in each session was calculated, excluding periods of guidance and rest. The calculation of the total dose of the intervention was based on the sum of the completed training sessions, considering two hours for each session without deducting the moments of guidance and rest. In both doses, participants needed to reach the minimum of 14 training hours recommended in a previous study [10].

## 3. Results

### *3.1. Feasibility*

Thirteen participants were invited, and five out of these (38%) agreed to participate in Mob-IT. Of these, one participant was discontinued during the baseline assessments and did not undergo the intervention due to personal reasons, as described in the flowchart shown in Figure 1. Four children with cerebral palsy (ages 7–13 years, female, GMFCS I–II–III) completed the study.

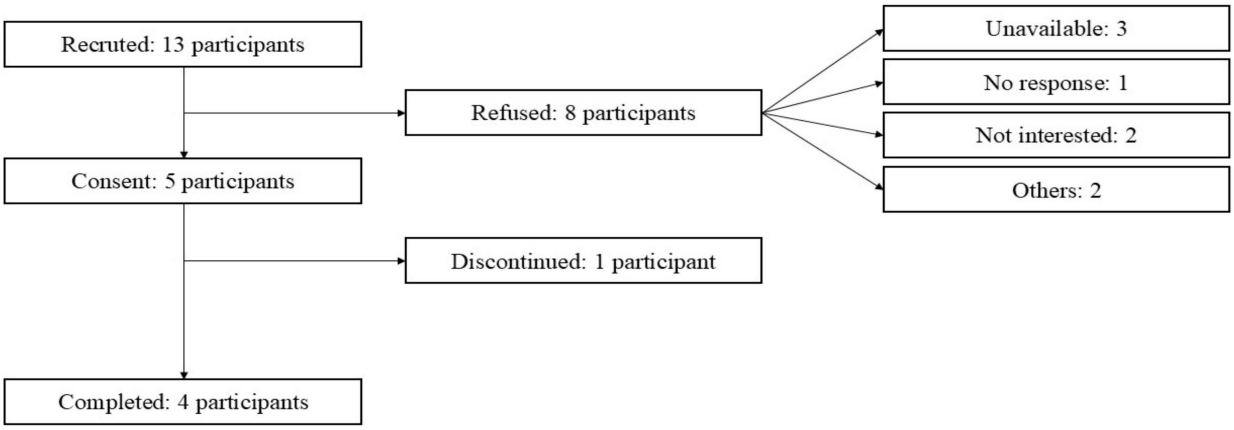


**Figure 1.** Flowchart of participant recruitment.

Out of the four participants who underwent the intervention, three showed good adherence to the Mob-IT, reporting no difficulties attending the intervention sessions. One participant missed four sessions. Regarding the assessments, all four participants completed the five initially proposed evaluations, while the participant who was discontinued from the study completed only one assessment, as described in Table 3.

**Table 3.** Total number of assessments performed, total completed sessions, and final percentage.

| Participant | Total Number of Assessments Performed | Total Number of Sessions | Attendance (Sessions) |
|---|---|---|---|
| 1 | 5/5 | 12/12 | 100% |
| 2 | 5/5 | 8/12 | 66% |
| 3 | 5/5 | 12/12 | 100% |
| 4 | 1/5 | - | - |
| 5 | 5/5 | 12/12 | 100% |

The QFQ showed the high acceptability of the protocol by the participants. Regarding adherence, all participants expressed that they would engage in these activities again during physiotherapy sessions. The duration of the sessions was considered sufficient, and

the activities were easy to understand. The participants considered the intervention well planned and effective. Regarding adverse effects, all participants experienced some discomfort, including knee, back, and leg pain, but these were reportedly related to everyday situations, not the intervention (Figure 2).

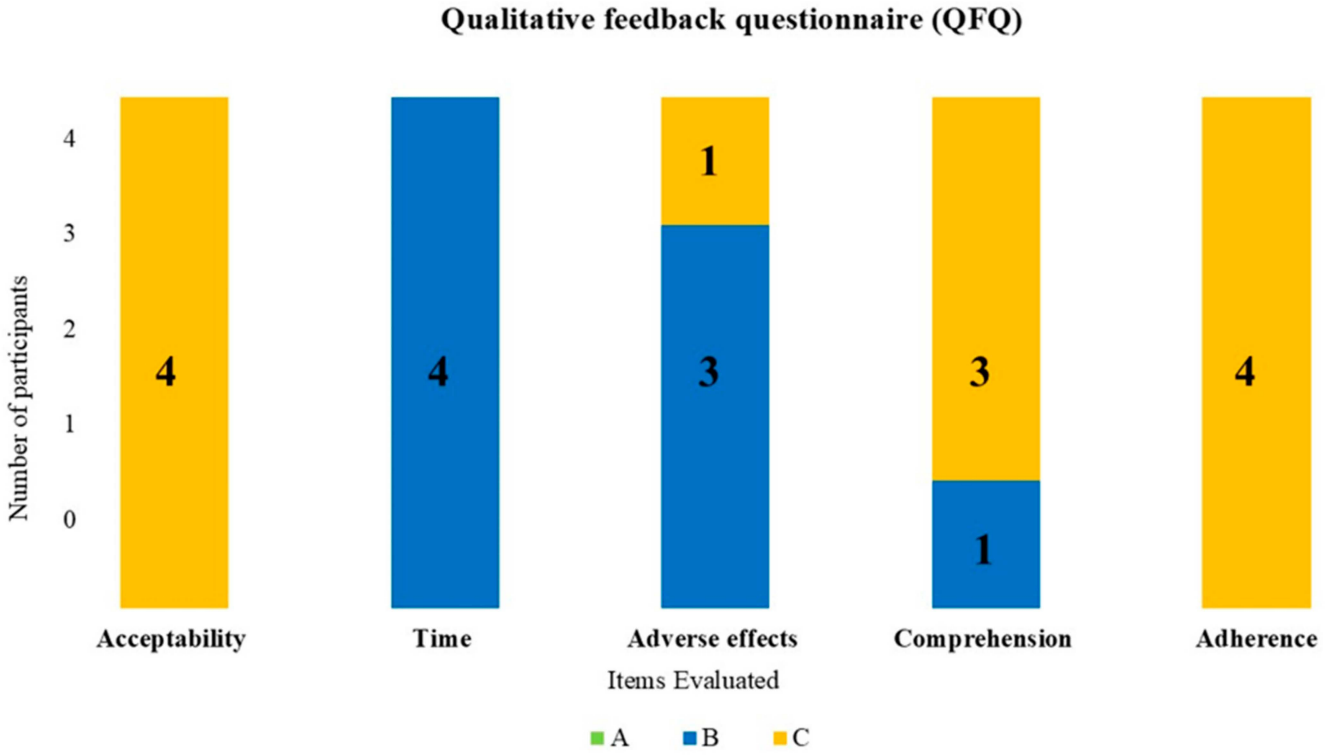


**Figure 2.** Feasibility according to the QFQ on the intensive training protocol focused on mobility (Mob-IT). Option A (negative choices); Option B (neutral choices); Option C (positive choices).

The COPM satisfaction scores are presented in Table 4. All participants and their caregivers showed an increase in their post-intervention scores compared to the baseline.

**Table 4.** Average satisfaction with goal performance of children/adolescents and caregivers after the intervention.

| Participant | COPM Satisfaction Scores (Average (SD)) | | | |
|---|---|---|---|---|
| | Children/Adolescents | | Caregivers | |
| | Baseline | Post-Training | Baseline | Post-Training |
| 1 | 3.2 (2.4) | 9.2 (0.8) | 3 (2.6) | 5.6 (4.9) |
| 2 | 5.5 (6.3) | 8.5 (0.7) | 4.3 (4.0) | 9 (1.7) |
| 3 | 2.6 (2.0) | 8 (2.6) | 0.25 (0.5) | 9 (1.1) |
| 5 | 2.75 (1.0) | 8.8 (0.75) | 6 (1) | 10 (0) |

### *3.2. Fidelity*

#### 3.2.1. Goal Achievement and Progression

Two participants achieved a +2 GAS score in all activities in the first and second weeks of intervention. In the third week, only one participant achieved a +2 score in all activities, and in the fourth week, no participants reached +2 in all activities, as described in Table 5.

**Table 5.** Percentages of tasks scoring +2 on the GAS scale.

| GAS Goals Achieved | | | | |
|---|---|---|---|---|
| **Participant** | **First Week** | **Second Week** | **Third Week** | **Fourth Week** |
| 1 | 100% | 83.3% | 0% | 0% |
| 2 | 100% | 100% | 0% | Absence |
| 3 | 50% | 100% | 100% | 0% |
| 5 | 100% | 33.3% | 50% | 66.6% |

GAS: Goal Attainment Scaling.

#### 3.2.2. Task Challenge

The RPC scored close to 4 (moderately difficult) for most participants. Only one participant occasionally presented an average score below 4, as shown in Figure 3.

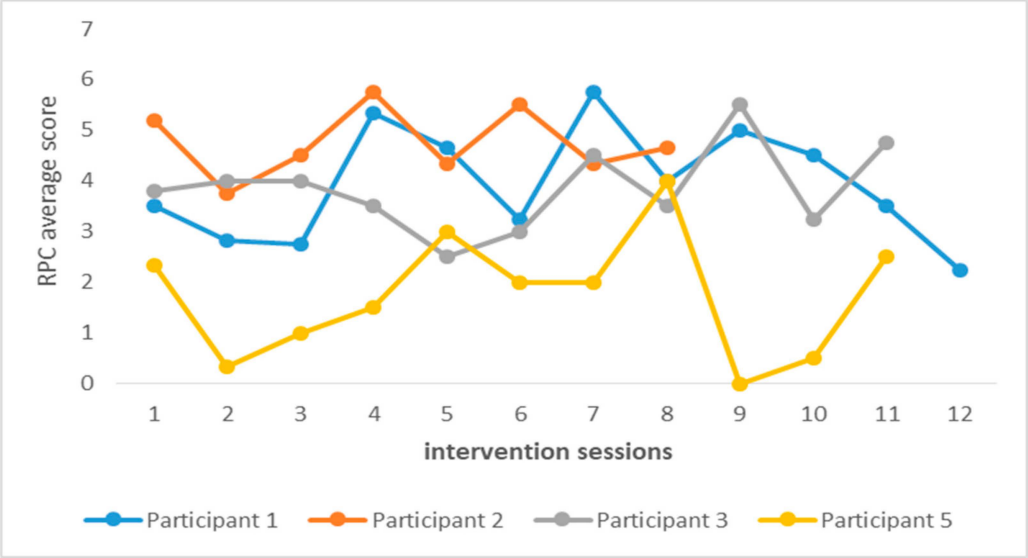


**Figure 3.** Average RPC score per session. RPC: Rating of Perceived Challenge.

#### 3.2.3. Feedback and Dose

Table 6 shows the weekly video analysis of the intervention and data from the records to aid in identifying the dose. Overall, the sessions ensured the use of feedback with an external focus as recommended by the protocol, with only a few activities using internal-focus feedback. In addition, the averages of the real and total dose of the intervention for each participant after all recorded sessions are also reported in Table 6. Considering the total dose, all participants reached the recommended minimum of 14 training hours.

**Table 6.** Characteristics of intervention sessions.

| Participant | * Number of Activities/Sessions (Average ± SD) | ** Repetitions of Specific Activities (Average ± SD) | Total Session Time (Average ± SD) | *** Feedback Type (Internal Focus/Total) | Intervention Dose in Hours (Real/Total) |
|---|---|---|---|---|---|
| 1 | 5 ±2 | 13 ± 7.5 | 1 h 34 ± 00:04 | 4/13 | 18/24 h |
| 2 | 4 ± 1 | 31 ± 26.9 | 1 h 21 ± 00:01 | 2/31 | 12.2/16 h |
| 3 | 4 ± 0 | 19 ± 19.0 | 1 h 32 ± 00:08 | 1/19 | 18.6/24 h |
| 5 | 2 ± 0 | 10 ± 5.23 | 1 h 37 ± 00:05 | 2/10 | 20/24 h |

* Average number of tasks performed per session. ** Average number of repetitions per task. *** Amount of feedback provided with internal focus per repetition of each task.

## 4. Discussion

### *4.1. Feasibility*

This study described the feasibility and fidelity of Mob-IT [20] implementation, a goal-directed, task-oriented, intensive mobility intervention. As will be discussed next, the protocol was feasible to implement and faithfully adhered to the pre-established principles.

Five participants consented to participate in this study, and four completed it. One participant was discontinued after attending only one baseline assessment due to personal reasons. Considering that the Mob-IT protocol is an intensive training program that requires significant availability from both caregivers and participants [15], adherence to the protocol proved to be somewhat challenging, with only 38% of the invited children agreeing to participate. Most caregivers contacted reported a lack of time due to work, the child's school schedule, and the absence of a support network, even when scheduling was proposed during school holidays and with flexible hours, which could optimize the availability of both the participants and caregivers. This finding highlights that to ensure the effective application of intensive protocols, adaptations may be necessary to align the protocol with families' unique needs and the local context. Strategies to achieve the required dose may include supplementing the intervention with home programs, telehealth, and family education. These strategies are supported by current guidelines [13] and should be considered in a larger-scale trial.

Of the four who began the intervention, only one was unable to attend all sessions due to personal reasons. An additional session was proposed to achieve the recommended minimum of 14 training hours [10]. Based on this result, we considered that the participants who agreed to participate in the Mob-IT demonstrated good adherence. This finding is similar to studies such as that of Brandão et al. (2018) [32], which involved intensive training for Brazilian children and also reported good adherence among participants.

Corroborating the findings, the QFQ indicated that the intervention was feasible in terms of adherence, as all participants reported that they would engage in these activities again during physiotherapy sessions. Regarding acceptability, the questionnaire indicated that the intervention was well accepted, with all participants reporting that the activities were enjoyable. Similarly, none of the four participants gave negative feedback on the duration of the intervention or the clarity of the activities. In terms of duration, all participants found the session length sufficient, and the majority reported that the activities were easy to understand. These findings suggest that the intervention was well planned and executed, being considered both effective and appropriate by the participants.

Regarding adverse effects, all participants experienced some discomfort during the period of the study. Two participants reported knee pain; in one case, the caregiver reported that the pain had been recurring since before study participation and was also reported after other interventions, i.e., it was not related to the participation in the Mob-IT. In the second case, the participant arrived at the session experiencing knee pain, attributed to a slight "twist" that occurred the previous night, according to the caregiver. Another participant experienced back and leg pain, which was attributed to postural changes and compensations during walking, as reported by the caregiver. None of the reported adverse events were specifically related to the Mob-IT protocol, rather being related to everyday situations. Nevertheless, the therapists chose to adapt the activities to avoid pain and maintain the participants' engagement in the other activities.

The Mob-IT protocol was designed to engage the child and enhance motivation during the activities, aiming to promote neuroplasticity [33,34]. However, intensive training targeting mobility with increasing progression and challenges requires physical and mental effort [8]. Examples of these activities, such as moving around in large and irregular spaces, climbing ramps and stairs, and walking at high speeds, may explain the occurrence

of musculoskeletal discomforts. Despite this, the sessions did not directly cause these discomforts, as participants' caregivers reported prior histories of such issues. Nevertheless, whenever any kind of discomfort was reported, the activity was stopped immediately, leaving it up to the participant and their caregiver to decide whether the activity could continue or not. Although there were isolated adverse effects, the Mob-IT protocol was deemed feasible across all proposed criteria, with its mobility activities being appropriate in terms of acceptability, duration, comprehension, and adherence.

Regarding the satisfaction scores from the COPM, when comparing the post-training average with the baseline average and considering the instrument's clinically significant change (MMCI) threshold of two points [25], both the participants and their caregivers were satisfied with the attainments. Although the COPM instrument was valid for the target population [25,35–37], it is important to highlight that goal setting in collaboration with the children was not always straightforward. In some cases, even when the researchers provided examples and requested that the participants only set goals related to mobility outcomes, participants sometimes reported goals unrelated to mobility, requiring the team to select only those goals directly linked to mobility. All goals were trained, both the ones set by the children and those set by the parents. Setting goals in collaboration with the caregivers was less challenging, although some caregivers identified goals related to body structure, which triggered the use of the same selection strategy. The scoring of each goal was also challenging in the cases of the participants. In these cases, we did not use any specific strategies other than explaining as many times as necessary.

The challenges faced in this goal-setting process align with those reported in the literature. In Darrah et al. (2012) [38], many families expressed satisfaction with their involvement in the goal-setting process; however, some felt that physiotherapists should have taken more responsibility. In this study, caregivers appreciated participating in this process, with some expressing satisfaction in knowing their children were receiving treatment aligned with their goals, highlighting the importance of their involvement in this process.

### *4.2. Fidelity*

#### 4.2.1. Achievement of Goals and Progression/Task Challenge

The weekly monitoring through GAS showed that all participants made progress toward their goals throughout the intervention, indicating that the intervention was faithful to its objective of ensuring task progression according to each participant's performance. Although studies focusing on mobility did not detail task progression, Friel et al. (2016) [39] demonstrated that a structured bimanual training program, including task progression, and the practice of a part-task or whole task led to greater functional gains in children with unilateral CP compared to unstructured training (intensive bimanual use only) without progression. This highlights the importance of ensuring task progression in mobility interventions as well.

The fact that no participants reached the maximum score on the GAS in the last week of intervention indicates that the tasks remained challenging through the end of the intervention. Ostensjo et al. (2008) [40] showed a 70% goal attainment rate after 3 months of intervention, which increased to 82% after 5 months of training, suggesting that practice time, in addition to goal content, influences outcomes. This emphasizes the need to set appropriate goals and ensure the correct dose of intervention to support progress.

Our results support the use of GAS for setting and progressing toward goals according to the participant's performance. GAS can be complemented by simpler tools such as the RPC during tasks to ensure the implementation of challenging training. It is well established that a minimum level of challenge is necessary to maintain the child's engagement, favoring

motor learning [41]. In this study, task challenge was monitored using the RPC, which indicated that the tasks were generally kept challenging, as most participants rated the activity as at least "slightly challenging" [27]. Although a previous study has used shaping strategies to gradually increase the challenge of a task as the child improves without exceeding the child's ability [42], this is the first study to systematically report the level of challenge throughout the intervention.

#### 4.2.2. Training Dose

To comprehensively assess the Mob-IT protocol's fidelity, this study described both the total dose and the real dose of the intervention. Most studies only present the total dose of the intervention or the average practice time. For instance, Gordon et al. (2011) [43] reported that all participants completed a total dose of 90 h of intensive upper limb training (TCI and HABIT) but also provided the average real practice time, which ranged from 79% to 81% of the total, with the remaining time spent on task transitions, breaks, and other activities. Other studies on intensive interventions, such as those of Brandão et al. (2018) [32] and Bleyenheuft et al. (2017) [44], did not provide details on the real dose.

In this study, analyzing both measures of dose showed that all participants reached the minimum practice time recommended for goal-directed training, which ranges from 14 to 25 h based on Jackman et al.'s recommendations [10]. However, when considering the real dose, which excluded rest periods and instructions, one participant faced difficulties and did not meet the minimum practice time of 14 h. It is important to note that the recommended range of 14 to 25 h is based on studies focusing on upper limb function [10], as mobility studies are too heterogeneous to determine the threshold dose [45].

#### 4.2.3. Feedback

Video analysis demonstrated that most activities utilized external focus feedback, utilizing visual cues, instructions on task performance, and outcomes, such as the number of points scored, the speed, and the distance covered. Incorporating external focus and extrinsic feedback is essential to ensure motor learning principles and improve neuroplasticity [7,46]. Indeed, Pourazar et al. (2017) [47] demonstrated that children with CP who received external focus instructions during a throwing task performed better and showed greater retention compared to those who received internal focus instructions.

The continuous training of therapists was one of the strategies implemented to ensure the fidelity of the type of feedback used. Challenges in keeping external focus were evident in participants with more severe motor impairments, highlighting the need for future studies to systematically explore ways to incorporate motor learning techniques into interventions targeted at this subgroup.

On an individual level, it was observed that a participant using a walking aid device, classified at GMFCS level III, faced more challenges following external focus feedback related to movement accuracy. To address this, strategies such as a greater use of visual cues and performance feedback were employed. It is suggested that individuals with mobility limitations may benefit from additional resources, such as biofeedback, to assist with positioning and movement guidance. In this case, it became evident that greater attention was needed to ensure external focus feedback, as the challenges led to a tendency to use internal focus feedback.

Overall, the literature on task-oriented training for individuals with significant motor limitations is scarce, and these individuals often receive interventions that are not supported by evidence [48]. Therefore, future studies should investigate effective strategies for this population. To ensure the fidelity of the intervention, critical elements, such as professional training, ongoing updates, and the pre-planning of sessions to provide an adequate

repertoire of feedback are necessary. These elements were implemented in this study and strategies were developed to ensure the faithful continuation of protocol application.

Overall, the implementation of the protocol was faithful to the pre-established principles, particularly in terms of task difficulty, intervention dose, and the nature of the feedback provided.

## 5. Conclusions

This study demonstrated that the Mob-IT protocol is feasible and can be applied with high fidelity. The results support the use of the strategies described for the effective application and accurate documentation of intervention protocols. Additionally, the data provide valuable parameters for improving interventions focused on the lower limbs of children with cerebral palsy (CP). We highlight that as this is a feasibility study, the positive results support scaling up the intervention into a larger, randomized study in order to provide further evidence on the effectiveness of the protocol.

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**Informed Consent Statement:** Written informed assent and consent were obtained from the participants and their caregivers, respectively.

**Data Availability Statement:** The raw data supporting the conclusions of this article will be made available by the authors on request.

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## References

1. Rosenbaum, P.; Paneth, N.; Leviton, A.; Goldstein, M.; Bax, M.; Damiano, D.; Dan, B.; Jacobsson, B. A report: The definition and classification of cerebral palsy April 2006. *Dev. Med. Child Neurol. Suppl.* **2007**, *109*, 8–14. [PubMed]
2. Graham, H.K.; Rosenbaum, P.; Paneth, N.; Dan, B.; Lin, J.P.; Damiano, D.L.; Becher, J.G.; Gaebler-Spira, D.; Colver, A.; Reddihough, D.S.; et al. Cerebral palsy. *Nat. Rev. Dis. Primers* **2016**, *2*, 15082. [CrossRef] [PubMed]
3. Forhan, M.; Gill, S.V. Obesity, functional mobility and quality of life. *Best. Pract. Res. Clin. Endocrinol. Metab.* **2013**, *27*, 129–137. [CrossRef] [PubMed]
4. Burgess, A.; Reedman, S.; Chatfield, M.D.; Ware, R.S.; Sakzewski, L.; Boyd, R.N. Development of gross motor capacity and mobility performance in children with cerebral palsy: A longitudinal study. *Dev. Med. Child. Neurol.* **2022**, *64*, 578–585. [CrossRef]
5. Webber, S.C.; Porter, M.M.; Menec, V.H. Mobility in older adults: A comprehensive framework. *Gerontologist* **2010**, *50*, 443–450. [CrossRef]
6. Novak, I.; Morgan, C.; Fahey, M.; Finch-Edmondson, M.; Galea, C.; Hines, A.; Langdon, K.; Namara, M.M.; Paton, M.C.; Popat, H.; et al. State of the Evidence Traffic Lights 2019: Systematic Review of Interventions for Preventing and Treating Children with Cerebral Palsy. *Curr. Neurol. Neurosci. Rep.* **2020**, *20*, 3. [CrossRef]
7. Hubbard, I.J.; Parsons, M.W.; Neilson, C.; Carey, L.M. Task-specific training: Evidence for and translation to clinical practice. *Occup. Ther. Int.* **2009**, *16*, 175–189. [CrossRef] [PubMed]

8. Levin, M.F.; Demers, M. Motor learning in neurological rehabilitation. *Disabil. Rehabil.* **2021**, *43*, 3445–3453. [CrossRef]
9. Sunaryadi, Y. The Role of Augmented Feedback on Motor Skill Learning. In Proceedings of the 6th International Conference on Educational, Management, Administration and Leadership, Bandung, Indonesia, 28 August 2016; Volume 14, pp. 271–275. [CrossRef]
10. Jackman, M.; Lannin, N.; Galea, C.; Sakzewski, L.; Miller, L.; Novak, I. What is the threshold dose of upper limb training for children with cerebral palsy to improve function? A systematic review. *Aust. Occup. Ther. J.* **2020**, *67*, 269–280. [CrossRef]
11. Te Velde, A.; Morgan, C.; Finch-Edmondson, M.; McNamara, L.; McNamara, M.; Paton, M.C.B.; Stanton, E.; Webb, A.; Badawi, N.; Novak, I. Neurodevelopmental Therapy for Cerebral Palsy: A Meta-analysis. *Pediatrics* **2022**, *149*, e2021055061. [CrossRef]
12. Bleyenheuft, Y.; Dricot, L.; Gilis, N.; Kuo, H.C.; Grandin, C.; Bleyenheuft, C.; Gordon, A.M.; Friel, K.M. Capturing neuroplastic changes after bimanual intensive rehabilitation in children with unilateral spastic cerebral palsy: A combined DTI, TMS and fMRI pilot study. *Res. Dev. Disabil.* **2015**, *43–44*, 136–149. [CrossRef] [PubMed]
13. Jackman, M.; Sakzewski, L.; Morgan, C.; Boyd, R.N.; Brennan, S.E.; Langdon, K.; Toovey, R.A.M.; Greaves, S.; Thorley, M.; Novak, I. Interventions to improve physical function for children and young people with cerebral palsy: International clinical practice guideline. *Dev. Med. Child. Neurol.* **2022**, *64*, 536–549. [CrossRef] [PubMed]
14. Goikoetxea-Sotelo, G.; van Hedel, H.J.A. Reporting Completeness of Intensity-, Dose-, and Dosage-Related Items in Active Pediatric Upper Limb Neurorehabilitation Trials: A Systematic Review. *Arch. Phys. Med. Rehabil.* **2024**, *105*, 1784–1792. [CrossRef]
15. Hsu, C.W.; Kang, Y.N.; Tseng, S.H. Effects of Therapeutic Exercise Intensity on Cerebral Palsy Outcomes: A Systematic Review With Meta-Regression of Randomized Clinical Trials. *Front. Neurol.* **2019**, *10*, 657. [CrossRef]
16. Thabane, L.; Ma, J.; Chu, R.; Cheng, J.; Ismaila, A.; Rios, L.P.; Robson, R.; Thabane, M.; Giangregorio, L.; Goldsmith, C.H. A tutorial on pilot studies: The what, why and how. *BMC Med. Res. Methodol.* **2010**, *10*, 1. [CrossRef]
17. Feitosa, A.M.; Mancini, M.C.; Silvério, A.P.M.; Gordon, A.M.; Brandão, M.B. "Help Me to Improve my Own Priorities!": A Feasibility Study of an Individualized Intensive Goal Training for Adolescents with Cerebral Palsy. *Phys. Occup. Ther. Pediatr.* **2021**, *41*, 601–619. [CrossRef]
18. Geerdink, Y.; Aarts, P.; van der Burg, J.; Steenbergen, B.; Geurts, A. Intensive upper limb intervention with self-management training is feasible and promising for older children and adolescents with unilateral cerebral palsy. *Res. Dev. Disabil.* **2015**, *43–44*, 97–105. [CrossRef]
19. Slaughter, S.E.; Hill, J.N.; Snelgrove-Clarke, E. What is the extent and quality of documentation and reporting of fidelity to implementation strategies: A scoping review. *Implement. Sci.* **2015**, *10*, 129. [CrossRef]
20. Sudati, P.I.; Gonçalves, L.P.O.; Pereira, N.D.; Melger, M.J.C.; Rocha, N.A.C.F.; Campos, A.C. Mobility intensive training (Mob-IT) for children with cerebral palsy: Single subject study protocol. *Rev. Mov.* **2024**, *in press*.
21. Romeiser-Logan, L.; Slaughter, R.; Hickman, R. Single-subject research designs in pediatric rehabilitation: A valuable step towards knowledge translation. *Dev. Med. Child. Neurol.* **2017**, *59*, 574–580. [CrossRef]
22. Santana, C.A.S.; Tudella, E.; Rocha, N.A.C.F.; de Campos, A.C. Lower Limb Sensorimotor Training (LoSenseT) for Children and Adolescents with Cerebral Palsy: A Brief Report of a Feasibility Randomized Protocol. *Dev. Neurorehabil* **2021**, *24*, 276–286. [CrossRef] [PubMed]
23. Law, M.; Baptiste, S.; McColl, M.; Opzoomer, A.; Polatajko, H.; Pollock, N. The Canadian occupational performance measure: An outcome measure for occupational therapy. *Can. J. Occup. Ther.* **1990**, *57*, 82–87. [CrossRef]
24. Law, M.; Cardoso, A.A.; Magalhães, L.V.; Magalhães, L.C. *Medida Canadense de Desempenho Ocupacional (COPM)*; Editora UFMG: Belo Horizonte, Brazil, 2009; pp. 1–63.
25. Cusick, A.; Lannin, N.A.; Lowe, K. Adapting the Canadian Occupational Performance Measure for use in a pediatric clinical trial. *Disabil. Rehabil.* **2007**, *29*, 761–766. [CrossRef]
26. McDougall, J.; Wright, V. The ICF-CY and Goal Attainment Scaling: Benefits of their combined use for pediatric practice. *Disabil. Rehabil.* **2009**, *31*, 1362–1372. [CrossRef]
27. Hendricks, S.; Till, K.; Oliver, J.L.; Johnston, R.D.; Attwood, M.J.; Brown, J.C.; Drake, D.; MacLeod, S.; Mellalieu, S.D.; Jones, B. Rating of perceived challenge as a measure of internal load for technical skill performance. *Br. J. Sports Med.* **2019**, *53*, 611–613. [CrossRef]
28. An, M.; Palisano, R.J. Family-professional collaboration in pediatric rehabilitation: A practice model. *Disabil. Rehabil.* **2014**, *36*, 434–440. [CrossRef]
29. Persch, A.C.; Page, S.J. Protocol development, treatment fidelity, adherence to treatment, and quality control. *Am. J. Occup. Ther.* **2013**, *67*, 146–153. [CrossRef]
30. Slade, S.C.; Dionne, C.E.; Underwood, M.; Buchbinder, R.; Beck, B.; Bennell, K.; Brosseau, L.; Costa, L.; Cramp, F.; Cup, E.; et al. Consensus on Exercise Reporting Template (CERT): Modified Delphi Study. *Phys. Ther.* **2016**, *96*, 1514–1524. [CrossRef]
31. Dennett, R.; Madsen, L.T.; Connolly, L.; Hosking, J.; Dalgas, U.; Freeman, J. Adherence and drop-out in randomized controlled trials of exercise interventions in people with multiple sclerosis: A systematic review and meta-analyses. *Mult. Scler. Relat. Disord.* **2020**, *43*, 102169. [CrossRef]

32. Brandão, M.B.; Mancini, M.C.; Ferre, C.L.; Figueiredo, P.R.P.; Oliveira, R.H.S.; Gonçalves, S.C.; Dias, M.C.S.; Gordon, A.M. Does Dosage Matter? A Pilot Study of Hand-Arm Bimanual Intensive Training (HABIT) Dose and Dosing Schedule in Children with Unilateral Cerebral Palsy. *Phys. Occup. Ther. Pediatr.* **2018**, *38*, 227–242. [CrossRef]
33. Sudati, I.P.; Damiano, D.; Rovai, G.; de Campos, A.C. Neural Correlates of Mobility in Children with Cerebral Palsy: A Systematic Review. *Int. J. Environ. Res. Public. Health* **2024**, *21*, 1039. [CrossRef] [PubMed]
34. Sogbossi, E.S.; Sotindjo Adon, S.; Adjagodo, L.; Dossou, S.; Dakè, H.; Ebner-Karestinos, D.; Araneda, R.; Saussez, G.; Paradis, J.; Kpadonou, T.G.; et al. Efficacy of hand-arm bimanual intensive therapy including lower extremities (HABIT-ILE) in young children with bilateral cerebral palsy (GMFCS III-IV) in a low and middle-income country: Protocol of a randomised controlled trial. *BMJ Open* **2021**, *11*, e050958. [CrossRef] [PubMed]
35. Figueiredo, P.R.P.; Mancini, M.C.; Feitosa, A.M.; Teixeira, C.M.M.F.; Guerzoni, V.P.D.; Elvrum, A.G.; Ferre, C.L.; Gordon, A.M.; BrandÃo, M.B. Hand-arm bimanual intensive therapy and daily functioning of children with bilateral cerebral palsy: A randomized controlled trial. *Dev. Med. Child. Neurol.* **2020**, *62*, 1274–1282. [CrossRef] [PubMed]
36. Kara, O.K.; Yardimci, B.N.; Sahin, S.; Orhan, C.; Livanelioglu, A.; Soylu, A.R. Combined Effects of Mirror Therapy and Exercises on the Upper Extremities in Children with Unilateral Cerebral Palsy: A Randomized Controlled Trial. *Dev. Neurorehabil* **2020**, *23*, 253–264. [CrossRef]
37. Reedman, S.E.; Boyd, R.N.; Ziviani, J.; Elliott, C.; Ware, R.S.; Sakzewski, L. Participation predictors for leisure-time physical activity intervention in children with cerebral palsy. *Dev. Med. Child. Neurol.* **2021**, *63*, 566–575. [CrossRef]
38. Darrah, J.; Wiart, L.; Magill-Evans, J.; Ray, L.; Andersen, J. Are family-centred principles, functional goal setting and transition planning evident in therapy services for children with cerebral palsy? *Child. Care Health Dev.* **2012**, *38*, 41–47. [CrossRef]
39. Friel, K.M.; Kuo, H.C.; Fuller, J.; Ferre, C.L.; Brandão, M.; Carmel, J.B.; Bleyenheuft, Y.; Gowatsky, J.L.; Stanford, A.D.; Rowny, S.B.; et al. Skilled Bimanual Training Drives Motor Cortex Plasticity in Children With Unilateral Cerebral Palsy. *Neurorehabil Neural Repair.* **2016**, *30*, 834–844. [CrossRef]
40. Ostensjø, S.; Oien, I.; Fallang, B. Goal-oriented rehabilitation of preschoolers with cerebral palsy—A multi-case study of combined use of the Canadian Occupational Performance Measure (COPM) and the Goal Attainment Scaling (GAS). *Dev. Neurorehabil* **2008**, *11*, 252–259. [CrossRef]
41. Bulea, T.C.; Jonghyun, K.i.m.; Damiano, D.L.; Stanley, C.J.; Park, H.-S. User-driven control increases cortical activity during treadmill walking: An EEG study. *Annu. Int. Conf. IEEE Eng. Med. Biol. Soc.* **2014**, *2014*, 2111–2114. [CrossRef]
42. Gordon, A.M.; Charles, J.; Wolf, S.L. Methods of constraint-induced movement therapy for children with hemiplegic cerebral palsy: Development of a child-friendly intervention for improving upper-extremity function. *Arch. Phys. Med. Rehabil.* **2005**, *86*, 837–844. [CrossRef]
43. Gordon, A.M.; Hung, Y.C.; Brandao, M.; Ferre, C.L.; Kuo, H.C.; Friel, K.; Petra, E.; Chinnan, A.; Charles, J.R. Bimanual training and constraint-induced movement therapy in children with hemiplegic cerebral palsy: A randomized trial. *Neurorehabil Neural Repair.* **2011**, *25*, 692–702. [CrossRef] [PubMed]
44. Bleyenheuft, Y.; Ebner-Karestinos, D.; Surana, B.; Paradis, J.; Sidiropoulos, A.; Renders, A.; Friel, K.M.; Brandao, M.; Rameckers, E.; Gordon, A.M. Intensive upper- and lower-extremity training for children with bilateral cerebral palsy: A quasi-randomized trial. *Dev. Med. Child. Neurol.* **2017**, *59*, 625–633. [CrossRef] [PubMed]
45. Sudati, I.P.; Sakzewski, L.; Fioroni Ribeiro da Silva, C.; Jackman, M.; Haddon, M.; Pool, D.; Patel, M.; Boyd, R.N.; de Campos, A.C. Efficacy and threshold dose of intensive training targeting mobility for children with cerebral palsy: A systematic review and meta-analysis. *Dev. Med. Child. Neurol.* **2024**, *66*, 1542–1557. [CrossRef] [PubMed]
46. Carter, M.J.; Ste-Marie, D.M. Not all choices are created equal: Task-relevant choices enhance motor learning compared to task-irrelevant choices. *Psychon. Bull. Rev.* **2017**, *24*, 1879–1888. [CrossRef]
47. Pourazar, M.; Mirakhori, F.; Bagherzadeh, F.; Hemayattalab, R. Efeccts of external and internal focus of attention in motor learning of children with cerebral palsy. *Int. J. Med. Health Biomed. Bioeng. Pharm. Eng.* **2017**, *11*, 361–366.
48. Bailes, A.F.; Greve, K.; Long, J.; Kurowski, B.G.; Vargus-Adams, J.; Aronow, B.; Mitelpunkt, A. Describing the Delivery of Evidence-Based Physical Therapy Intervention to Individuals with Cerebral Palsy. *Pediatr. Phys. Ther.* **2021**, *33*, 65–72. [CrossRef]