

# Feasibility study of a Movement and Story-Telling intervention (MAST) for Reception children

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## Executive summary

### Rationale

Children’s language development critically underpins later academic success, and competence in motor skills in the early years contributes to the likelihood that children will engage with physical activities and sports as they mature. Basic motor skills are also the fundamental foundation for more specialist skills required later in the context of sport. Therefore, just as language development is a critical precursor to written language skills and subsequent access to other academic curricular areas, basic motor skills are a necessary prerequisite for developing confidence and motivation to move, and to engage with activity and sport throughout school and beyond. For these reasons it is important to review our approaches to how to support the linguistic and physical development of children just before and at school entry. MAST, a combined movement and story-telling intervention suitable for 3–5-year-olds, provides the ideal opportunity to improve these skills in a fun and easy-to-implement way.

### Project aims

The current project addressed two research questions.

1. Does MAST have beneficial short-term effects on language skills and motor development in Reception children?
2. To what extent is the intervention delivered as planned? What are the barriers to successful implementation, and what factors contribute to successful adoption?

### Method

The current study was a cluster-randomised control trial. Eight primary schools were pair-wise matched for size, percent pupil premium, and percent reaching the expected standard for KS1 reading. One school in each pair was randomly assigned to the intervention or waiting control group. One additional school was assigned as an intervention school as nine schools were recruited. Children in all schools were pre-tested (before the intervention) and post-tested (after the intervention) for language and fundamental movement skills (Research question 1), while teachers in the intervention schools took part in interviews and observations (Research question 2).

Teachers in the five intervention schools were trained for one day on how to deliver MAST at NTU and provided with a Teacher’s guide and other resources such as key vocabulary cards, books, and videos of the movements. MAST consists of 12 weeks of lessons based on two popular Julia Donaldson and Axel Scheffler books. It is a whole-class intervention that is run once or twice a week for 35 minutes. Use of the hall or large outdoor space is necessary, alongside basic equipment such as hoops, balls and beanbags.

The first six weeks cover locomotor skills and are based on 'The Gruffalo' and the following six weeks cover object skills and are based on 'Stick-man'. Each session follows the same structure of language (5 mins), movement (25 mins), and language (5 mins). Language work in the last five minutes is designed to capitalise on the post-activity window when blood flow to the brain is still elevated post-exercise.

214 Reception children were tested at pre-and post- test. There were 133 children in the intervention group (5 schools) and 81 in the control group (4 schools). Language was measured individually using the LanguageScreen (West et al., 2021) - a 10-minute, online test, delivered on a tablet consisting of 4 sub-tests: Expressive Vocabulary, Receptive Vocabulary; Listening Comprehension, and Sentence Repetition.

Fundamental movement skills (FMS) were measured using the Test of Gross Motor Development-3 (TGMD; Ulrich, 2020) which was administered in the Hall in groups of 8 children per researcher. Children were video-taped as they undertook a series of movements. Eight FMS were measured; 4 locomotor (run, jump, hop, and skip), and 4 object (underarm throw, overarm throw, catch, and kick). A brief test of self-regulation (Heads, shoulders, knees and toes) was also conducted whereby children to do the opposite of what the researcher asked (e.g. touch their head when told to touch their toes).

Five practitioners across the five intervention schools participated in the feasibility study. All attended the training day and delivered MAST to their classes for the full twelve weeks from January to May 2023. Semi-structured interviews lasting approximately an hour were conducted to explore factors that enabled and factors that hindered MAST delivery. Deductive/Theoretical thematic analysis was employed to analyse the transcripts as described by Braun and Clarke (Braun & Clarke, 2006).

Implementation fidelity was measured through observations of two MAST sessions at each school. Field notes were taken to evaluate teachers' adherence to the guidelines, activities and structure of MAST sessions as illustrated in the Teachers' guide. The research team collected data on which key components were adhered to as well as qualitative data on teachers' interactions with the children.

## Findings

- There was a significant positive effect of MAST on standardised language skills, and fundamental movement skills once the effect of previous skills, gender and pupil premium status had been controlled for.
- The effect on language was small ( $d=0.20$ ), but still of educational significance.
- The effect on fundamental movement skills was medium-large ( $d=0.65$ ), and of important educational significance.
- The effect on language skills was largely driven by improvements in expressive language (sentence repetition and expressive vocabulary).
- The effect on fundamental movement skills was largely driven by improvements in locomotor skills.
- The fundamental movement skills of boys improved more than girls', but this was unrelated to the intervention.
- There was no effect of the intervention on self-regulation.
- Interviews and observations showed that MAST was feasible for teacher delivery. Barriers to implementation were identified (behaviour management, struggle with engagement, not a school priority, and the need for practical support), as well as factors for success (being well-equipped, the utility value of MAST, and why MAST works).

- Implementation fidelity was good with four out of five settings consistently delivering all key components of MAST. All settings delivered all 12 weeks of MAST.
- Barriers to implementation were addressed through improved training and resources for the control schools.

### Key recommendations for policy and practice

- The importance of children’s language development and competence in motor skills is reflected in the EYFSP, with two of the seven areas of development being ‘communication and language’ and ‘physical development’.
- Given the reduction in TA funding, and the increases in children with learning needs who fall outside of EHCP resourcing (especially in the early years), for interventions to ‘work’ in practice, they need to be delivered as a whole-class approach by class teachers (although teachers do need support with this). Moreover, they need to have the potential to integrate into timetabled sessions.
- MAST offers an approach to using PE lessons as an opportunity to improve both physical and linguistic development more effectively than when PE and storytelling are taught in isolation from each other.
- MAST is effective when delivered by teachers to Foundation-age children in primary school settings, resulting in significant improvements to language and fundamental movement skills after just 12 weeks of lessons, 35 minutes, once a week.
- MAST is an approach that many early years practitioners see as developmentally more appropriate than more formal approaches to supporting both skills and embraces the imagination and chaos of very young children exploring narratives through playful movement.
- Schools’ Sport and PE premium money can be effectively used by school leaders to pay for MAST training and equipment. This aligns with the recent government announcement to extend Sport premium funding and increase accountability for its use.
- Given the positive effects found in the current trial, the next step for development of MAST would be an Efficacy trial. Based on power calculations using the current findings, this would need to be a cluster-randomised controlled trial involving 58 schools (29 intervention and 29 control) with 725 children in each group (1450 altogether). If positive effects hold-up under more rigorous evaluation, then the intervention will be ready for a larger-scale effectiveness trial.

## Introduction

### Language and Fundamental Movement Skills (FMS) in the early years

Language refers to skills such as vocabulary, speech, and understanding narrative and are essential for academic and general life success. It is necessary to intervene early to improve children’s language skills to prevent a cycle of ‘the rich get richer, the poor get poorer’ in education, otherwise known as Matthew effects (Stanovich, 1986).

Language skills are particularly important for literacy development (Lyster et al., 2010). For example, interventions that enhance language skills in early skills improve reading comprehension (Fricke et al., 2013), which is associated with better general academic outcomes (Oakhill et al., 2016). Benefits extend beyond academia with Interventions that enhance language skills in early years shown to improve communication and social skills (Glonek and King, 2014). Story-telling is an important part of improving language in the early years. Engaging children in story-telling, as an academic activity,

leads to benefits in language development in typical (Kory and Breazeal, 2014) and culturally diverse populations (Goodman and Dent, 2016; Peterson and Spencer, 2016).

Fundamental Movement Skills (FMS) refer to the mastery of gross motor skills that enable enjoyable participation in physical activities (e.g., running, jumping, throwing, catching and kicking; Hulteen et al., 2020). They consist of locomotor (moving forwards) and object skills (e.g. throwing a ball). Mastery of FMS are key to creating more physically active children (Jaakkola et al., 2015) which has been linked to better academic performance and self-regulation Haapala et al. (2017).

### The Policy context

The Early Years Foundation Stage Profile details statutory requirements for development by age 5 with 'physical development' and 'communication and language' as two of its prime areas of learning (DFE, 2021). However, both motor and language skills are poor in British 5-year-olds compared to other European countries (Sylva et al., 2014), particularly for children from disadvantaged backgrounds (Quigley, 2018). These difficulties have been exacerbated by Covid-related school closures in 2020/21, resulting in a widening gap between disadvantaged children and their peers in early language (Engel, 2013) and physical fitness (Kovacs et al., 2021). Lockdown restrictions increased sedentary behaviour and screen time, limiting opportunities to remain physically active (Sheldrick et al., 2022). In addition, more screen time and less reading time led to a poorer language environment (Fung et al., 2023). In the aftermath of school closures, early intervention is essential, and the school environment constitutes the only reliable place where disadvantaged pupils can be provided with such support (Eyre et al., 2022; Quigley, 2018).

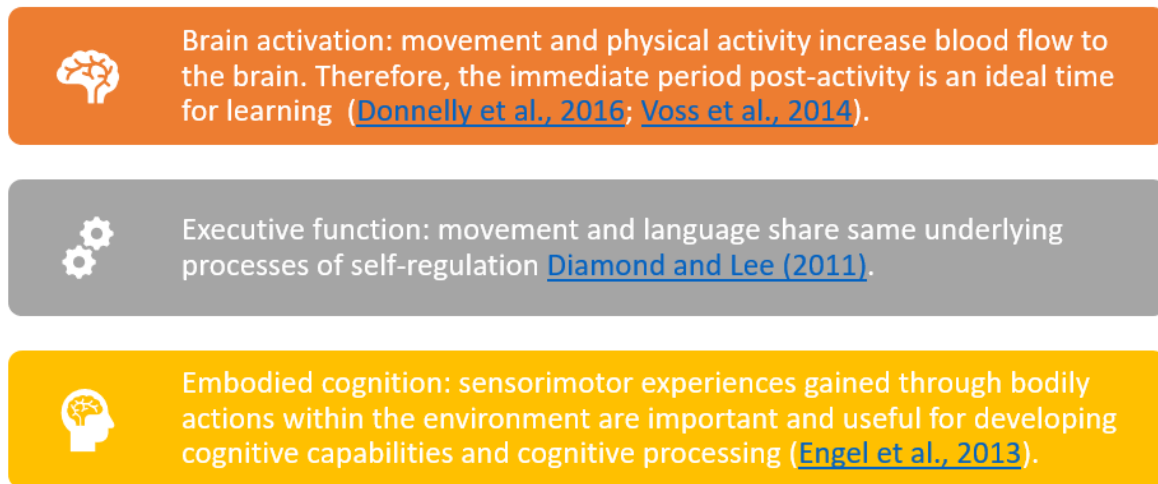
Consequently, the government launched a Covid-19 catch-up programme (£650 million for 21/22), part of which was a national roll-out of the Nuffield Early Language intervention programme (DFE, 2021). Over a third of primary schools signed up to NELI in 21/22 (DFE, 2022). With 10% of Reception children classified as obese, rising to 20% in Year 6 (HSIC, 2019), and one-in-five children leaving primary school without functional literacy (DFE, 2022), early intervention is essential. However, robust evidence on what improves motor and language skills in young children is lacking, and effect sizes from interventions are often small (Law et al., 2017). Hence the need for a programme like MAST.

### Why does it work to combine movement and language work?

Theory suggests that there could be benefits to motor and language development by combining movement and language activities in a single intervention. Movement and physical activity can improve cognitive processing, increase hippocampal volumes, enhance attention and increase blood flow to the brain (Donnelly et al., 2016; Voss et al., 2014) at least acutely post activity. This would suggest that having a period of cognitive work immediately after movement would be most beneficial for learning. Also, movement and language share the same underlying processes of self-regulation and executive function Diamond and Lee (2011). A further reason for combining the two comes from the theory of embodied cognition. Embodied cognition approaches suggest that sensorimotor experiences gained through bodily actions within the environment are important and useful for developing cognitive capabilities and cognitive processing (Engel et al., 2013).



Figure 1. Why does it work to combine movement and language work?



Despite the potential advantages to combining motor and language interventions ('two for the price of one') for young children, there are currently no such interventions available to early years educators (Early Years Toolkit, 2023).

### Pilot work

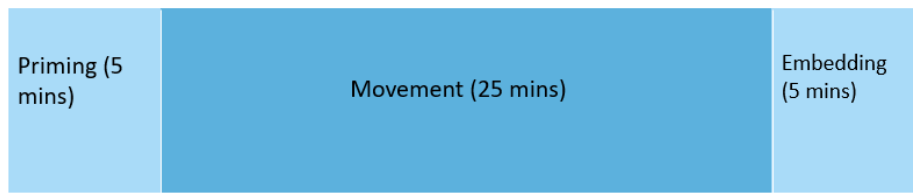
Our team conducted a pilot project to see whether Fundamental movement skills could be trained in combination with language, and whether this would be more effective than training motor competence and language separately. We developed a movement and story-telling intervention (first iteration of MAST) suitable for researchers to deliver to 3-4 year-olds. We compared the effectiveness of a movement-only, a story-telling only, and a combined version of MAST in pre-schoolers (first six weeks of the intervention only). Results showed that the combined intervention was more effective than the two separate interventions, resulting in additive benefits for both motor skills and vocabulary at immediate post-test ( $d = 0.45$  for motor competence and  $0.54$  for vocabulary; Duncan, Cunningham & Eyre, 2019). More recently, the full 12-week intervention was shown to help close the gap in FMS between South Asian and white children in Reception (language was not measured; Eyre et al., 2020).

### MAST

MAST consists of 12 weeks of lessons based on two popular books by Julia Donaldson and Axel Scheffler. It is a whole-class intervention to be run once or twice a week for 35 minutes. Use of the hall or large outdoor space is necessary, alongside basic equipment such as hoops, balls and beanbags.

The first six weeks cover locomotor skills and are based on 'The Gruffalo' and the following six weeks cover object skills and are based on 'Stick-man'. Each session follows the same structure of language, movement, language. Language work in the last five minutes is designed to capitalise on the post-activity window (described in the previous section) when blood flow to the brain is still increased post-exercise.

Figure 2. Structure of a MAST lesson



Each week focuses on a different event in the story and a link is made between this event and a fundamental movement skill, which is then taught and practised in the movement section. The final week of each story is devoted to practising all the movements from that story such that ten FMS are covered. Key vocabulary and comprehension skills are introduced and reinforced during the language work by discussing the pictures from the book.










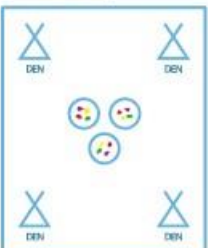

Figure 3. Contents page from MAST Teacher's guide

Contents	
<b>Gruffalo - Locomotor Skills</b>	
<b>Week 1</b> Fox-run .....	10 - 13
<b>Week 2</b> Owl-skip.....	14 - 17
<b>Week 3</b> Snake-slide.....	18 - 21
<b>Week 4</b> Frog-jump.....	22 - 24
<b>Week 5</b> Rabbit-hop .....	25 - 28
<b>Week 6</b> Whole story-all movements.....	29 - 30
<b>Stick Man - Object Skills</b>	
<b>Week 7</b> Catch .....	31 - 34
<b>Week 8</b> Throw .....	35 - 38
<b>Week 9</b> Roll .....	39 - 42
<b>Week 10</b> One-hand strike.....	43 - 46
<b>Week 11</b> Kick.....	47 - 50
<b>Week 12</b> Whole story - all movements.	51 - 52

For example, in week 7, children are read the part of the story where Stick man is thrown by a boy to a dog and they place fetch. Children talk about the pictures and how the dog is catching Stick man (priming phase). This then leads to a catch lesson in the hall (movement phase) following by a return to the story to talk about Stick man and e.g. how he felt being caught in a dog's mouth (embedding phase). A video of this lesson can be found here:

[https://www.youtube.com/watch?v=IfOG\\_u46n3U&list=PLJOC-rk6bL7gb-5Y4bTd2KZBE-m332G4k](https://www.youtube.com/watch?v=IfOG_u46n3U&list=PLJOC-rk6bL7gb-5Y4bTd2KZBE-m332G4k)

Figure 4. Extract from 'Catch' lesson plan in MAST Teacher's Guide.

<b>1 Priming</b> 	<b>2 Introduction</b> 	<b>5 Practicing the Skill 1</b> 	
<p>Read p 1-4, Questions and answers. Walk to PE hall Children to walk as straight as a stick.</p>	<p>Learning objective, The dog catches the stick. We can catch a ball. Learn to catch a ball.</p>	<p><b>Stick Catch with friend.</b> 1. Children stand back-to-back. Pass ball using two hands to partner from left to right side. 2. Children sit facing each other. They roll the ball to each other. They must use two hands to stop the ball. Hands together, watch the ball.</p>	
<b>3 Warm Up</b> 	<b>4 Teaching the Skills</b> 	<p><b>Stick Catch Roll</b>  <b>Stick Catch Throw</b> </p>	
<p>Bean Game (see video examples of object skills QR)</p>	<p>Introduce and demonstrate key components "Hands ready, watch the ball, reach for the ball, squeeze the ball" Imagine your hands are a dog's mouth and you are catching the stick in it.</p>	<p><b>Differentiation</b></p> <ul style="list-style-type: none"> <li>Can they make 5 catches without the ball touching the floor?</li> <li>Can they make 10 catches without the ball touching the floor?</li> <li>Stop the ball to either side of body</li> <li>Increase distance and speed</li> </ul> <ul style="list-style-type: none"> <li>Progress to throwing to each other, stand up if able to.</li> <li>Start close and increase distance</li> <li>Move and catch</li> <li>Provide choice in object, if they can do it well with one type of object challenging them to do it with different equipment can try to bounce it and catch</li> </ul>	
<b>5 Practicing the Skill 2</b> 		<b>6 Cooldown</b> 	
<p><b>Fetch and Drop</b> Place bean bags in hoops in the middle of the hall. Children must fetch the object and bring it back to their den. Pick up with two hands.</p> <p><b>Differentiation</b> Pass it to the next person who catches it. Pick up with two hands.</p> <p>Once object is picked up, throw ball or bean bag up and catch it. Throw, clap, catch. Who can throw the furthest?</p>	<p><b>Fetch and Drop</b></p> 	<p><b>Stick Game</b> (see video examples of object skills QR). Adapt bean game to 'stick game' e.g. tall stick, jumping stick.</p> <p><b>7 Embedding</b> </p> <p>What can you see in the picture? • What are they doing? • Why?</p> <p>How do you think stickman feels? • Why do you think they feel that way? • What does stickman say? • Can you show me what [add emotion] face looks like?</p>	
<p>33</p>			<p>34</p>

Language work during priming and embedding phases is guided by a list of questions produced in the manual. Questions follow a regular format each week (see Table 1).

Table 1. Language work in MAST

WEEK	FOCUS and KEY VOCAB	PRIMING PHASE QUESTIONS	EMBEDDING PHASE QUESTIONS	POINTERS FOR LESS ABLE CHILDREN
<p><b>General advice</b></p>	<p><b>Understanding the animal or stick:</b></p> <ul style="list-style-type: none"> <li>identifying the animal/stick</li> <li>naming the animal/stick</li> <li>describing the animal/stick</li> <li>describing how they animal/stick feels</li> <li>understanding why the animal or stick feels the way they do</li> <li>model the way the animal or stick feels (e.g. show me an unhappy face, show me a scared face?)</li> <li>sounding what noise, the animal may make</li> <li>describing how the animals/stick moves</li> <li>identifying what makes the animals/stick move well e.g. fast, far, controlled.</li> <li>showing how the animal moves or how they stick can be moved in different ways</li> </ul> <p><b>Understanding the environment:</b></p> <ul style="list-style-type: none"> <li>Identifying what is in the environment</li> <li>Describing what is in the environment</li> <li>Describing what the environment might feel like (e.g. to touch, cold, soft, wet, muddy)</li> <li>Describing what the environment might sound like (e.g. swooshing of the water)</li> </ul> <p><b>Understanding the story</b></p> <ul style="list-style-type: none"> <li>Describing what is happening in the story</li> </ul>	<p>Who is the animal/character in the book?</p> <ul style="list-style-type: none"> <li>Prompt description</li> </ul> <p>How might the character move</p> <ul style="list-style-type: none"> <li>'how'</li> <li>'why'</li> <li>'can you give me another word for that'</li> </ul> <p>Where is the character? Or where do they live?</p> <ul style="list-style-type: none"> <li>Prompt description</li> <li>Prompt sensory communication</li> </ul>	<p>Using images from the book and the page working this week</p> <p>What can you see in the picture?</p> <ul style="list-style-type: none"> <li>Prompt descriptive words</li> </ul> <p>How do you think the animal or stick feels in the picture?</p> <ul style="list-style-type: none"> <li>Why do you think they feel that way?</li> </ul>	<p><b>Talking tips:</b></p> <p>Practitioner labelling</p> <p>Modelling sentences</p> <p>Use picture resources to scaffold.</p> <p>Children narrate parts e.g. Complete the missing word in the sentence</p> <p>Children point or show you using their body</p>

## Achievement goal theory

The conceptual framework which underpins MAST is situated within Achievement Goal Theory (AGT, Rudisill, 2016). AGT describes the goals and attributions that individuals adopt in learning and the subsequent effect of these goals have on approaches and engagement in learning environments. This theory is based in the belief that children are innately motivated to learn and explore their environment. The current intervention is positive on developing mastery climates/mastery orientation within the intervention sessions themselves. Individuals who adopt a mastery orientation engage in tasks for the intrinsic value of learning itself and measure improvement using self-referenced standards (e.g., comparing current performance to previous performances). Prior classic work has demonstrated that adoption of a mastery climate approach is associated with positive educational and achievement outcomes such as more effort contributes to success (Ames, 1988), intrinsic interest and time on learning activities (Meece, et al., 1988), and positive attitudes toward learning (Ames, 1992) in classroom tasks. Latterly, AGT has been applied to movement related intervention with children and has demonstrated success as a framework from which to base motor skill interventions upon (See Palmer, et al., 2017 for a review). In the case of the current intervention, AGT would constitute the overarching conceptual framework in which the intervention is embedded and mastery orientation/climate would be adopted/facilitated using the TARGET structures (task, authority, recognition, grouping, evaluation, and time) that are commonly employed in AGT interventions for both educational attainment and motor skill mastery (Elliott and Dweck, 1988; Palmer et al., 2017).

Table 2. Strategies for implementing a Mastery Climate

	Description	Specific strategies
Task	The manual provides developmentally appropriate tasks with differentiation and skill instructions.	<ul style="list-style-type: none"> <li>• Use the key words for each skill</li> <li>• Provide different levels of challenge (differentiation)</li> <li>• Provide different activities for each skill</li> <li>• Use variety of equipment (e.g. when throwing provide different weights of ball, sizes, shapes, target areas).</li> </ul>
Authority	Teachers collaborate with children to develop the instructional climates and process	<ul style="list-style-type: none"> <li>• Identify safety rules collaboratively with children e.g. children might identify 'don't snatch' 'don't yell', teacher can guide to 'share' 'use kind words'</li> <li>• Provide children freedom to select from choices e.g. when using stations, allow children the freedom to move between them and choice in completing it e.g. distance they want to start at, choice of object.</li> <li>• Provides pictures of activities</li> <li>• Teacher facilitates by providing feedback, positive reinforcement and questioning.</li> <li>• Child experience leadership role e.g. leads the group, demonstrates, children identify factors that make people move.</li> </ul>
Recognition	Recognise effort and achievement	<ul style="list-style-type: none"> <li>• Praise behaviours using positive reinforcement</li> <li>• Provide ways for children to recognise their achievements</li> </ul>
Grouping	Create variety of grouping options	<ul style="list-style-type: none"> <li>• If using stations, keep groups as small as possible to maximise time on task</li> <li>• Children chose groups, teacher to intervene if choice affects effort and participation</li> <li>• In most instances tasks are focused as whole group activities</li> </ul>
Evaluation	The manual provides information on the standards of performance from a process perspective for different levels which can be used to monitor progress.	<p>Evaluation of performance</p> <ul style="list-style-type: none"> <li>• Teach keywords so children can self check and peer check</li> <li>• Provide feedback focused on the process using the key words</li> <li>• Ask questions about weekly content and accomplishments</li> </ul> <p>Evaluation of behaviour</p> <ul style="list-style-type: none"> <li>• Ask questions about behaviour 'how did you play today?' did you try your hardest? You might also have an effort chart on the wall that they high 5 their different effort levels.</li> <li>• Try to reinforce the idea that change is due to effort and hard work.</li> </ul>
TIME	The manual provides approximate timings for each task	<ul style="list-style-type: none"> <li>• You may need to provide flexibility in the time spent on task based off your evaluation, the pace may need to be individualised e.g. some may need longer than others on certain tasks.</li> </ul>

## Teacher-delivery of MAST

### The 'value' of PE and language in schools

Language interventions are less valued in education than literacy and maths interventions, and physical education (PE) is not traditionally accorded the same status as 'academic' school subjects. According to Snowling (2022), oral language interventions are only recently becoming prioritised by policymakers with this shift not being visible in schools yet and the emphasis still turned to early literacy instruction and a 'phonics first' model on the schools' timetable (Vousden et al., 2022). Moreover, insufficient education on delivering physical activities and assessing FMS on Teachers' Initial Training (TIT) negatively affects educators' efficacy, attitude and confidence on PE (Duncan et al., 2022; Harris et al., 2012; Ma et al., 2021). For example, the majority (88%) of teachers say they recognise PE is important, and as important as the other subjects they teach (TES, 2015); yet it is estimated that more than 40% of newly qualified teachers begin their careers with an average of just six hours initial training in PE (Youth Sport's Trust, 2018). This lack of training has led to schools using their 'Sport and PE premium' money to employ external PE 'coaches' to cover PE, resulting in teachers becoming progressively less experienced and skilled when it comes to physical activity (Smith, 2015). Sport's premium money would be better spent on training teacher's how to teach PE, for example, attending MAST training. Indeed, more than half of a sample of primary school teachers have expressed the need for more professional development opportunities in PE (Beds, 2015). It seems that the policy focus shift towards emphasising the value of PA (DFE, 2023) and language (DFE, 2021) has not yet been translated into reality in schools, with PE still considered a secondary extra curricula practice (Ma et al., 2021) and language teaching being overshadowed by phonics (Snowling et al., 2022).

### Feasibility of teacher-delivery





In order to bring practice up to date with policy, it is essential to up-skill teachers and develop their confidence and competence in teaching PE and language, as well as address contextual/school level (i.e. PE and language status and value) difficulties (Eyre et al., 2022),. Training in MAST, which is a combined programme that can be delivered at school to whole classes, has the potential to achieve this goal. Given that researchers (sport and exercise scientists) delivered the first iteration of MAST, it is important to test the feasibility of the programme for delivery by teachers in real-world context. Only by being delivered by teachers in primary schools can MAST be accessible to large parts of the population. To prepare MAST to be appropriate for teachers, the current project developed a one-day training event for teachers, a MAST Teacher's Guide, and online training resources for Reception teachers. We then assessed the feasibility of MAST by interviewing and observing teachers with a view to identifying factors for successful delivery, implementation fidelity and barriers to implementation.

### Development work


The first three months of the grant (June-August 2022) were devoted to developing the MAST programme and associated training to be suitable for Reception teachers.

Data was collected from a pre-evaluation questionnaire investigating what teachers might need to complete MAST effectively. The results were analysed using the COM-B framework (Capability, Opportunity and Motivation, leading to Behaviour change; Michie et al., 2011). These data were collected from Reception teachers and teaching assistants (n=5) from two schools.

Table 3. Analysis of the pre-evaluation questionnaire using the COM-B framework.

Model of behaviour source	Why aren't teachers developing movement & storytelling together?	What needs to change?	Education	Persuasion	Training	Environment Restructuring	Modelling	Enablement
<p>Capability</p>  	<p>Teachers lack skills and knowledge to implement methods and effective ways of teaching it.</p> <p>Teachers have limited training in movement skills prior to teaching.</p> <p>Teachers need to have better physical skills (learn correct movement patterns)</p> <p>Children have developmental delays</p>	<p>Professional development, training, and modelling for teachers.</p>	x		x		x	x
<p>Motivation</p>  	<p>Overloaded curriculum and lack of time</p> <p>Teachers' beliefs, perceptions and attitudes towards PE</p> <p>Teachers may have a preference for pedagogical methods that are not holistic.</p> <p>Teachers need to develop a habit of doing it without having to think</p> <p>Children have low perceptions of their ability</p>	<p>Teachers must plan to use MAST resources and develop habit for using &amp; implementing them through goal setting and problem solving.</p> <p>Teachers need to believe in benefits of combining movement and storytelling for all children</p> <p>Teachers must want to increase movement and language skills and need to develop a new habit.</p> <p>Children must perceive they can do the activities</p>	x	x		x	x	x
Opportunity	PE is not prioritised in the curriculum.	Development of goal setting – what if scenario – problem solving				x		x



	<p>Limited time for PE  Limited available facilities for PE</p> <p>Lack of time for quality planning for PE.</p> <p>Time and money for quality planning in PE</p> <p>Social  Lack of people around me doing it.</p> <p>Children have not had the opportunity to develop their motor skills and confidence.</p>	<p>Provision of resources and lesson plans (flexible/adaptable methods methods)</p> <p>Financial support to be relieved from teaching to attend training</p> <p>Flexibility of plans to work around space constraints (what if's), children not needing PE kit.</p> <p>Social support group</p> <p>Provision of lesson plans to support development of confidence and motor skills.</p>							
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Qualitative feedback of the challenges of delivering MAST from teachers that had delivered it following training (during previous pilot work) was also collected and summarised (n =7 Reception teachers from two schools). Teachers identified five main challenges: behaviour management, equipment set-up, PE space in use, engagement of all pupils and teacher interest. These were considered to fall within capability, opportunity and motivation needs, adding further context to those reported in Figure 5. We decided to address these challenges during training in the current project by using education (shaping knowledge) persuasion (credible source), environment restructuring (changing the environment & social support) and enablement (problem solving) which involved discussing expectations of PE vs classroom behaviour (it's okay for PE lessons to be chaotic), the flexibility of the plans to be adapted to differing environments (classroom, outdoors) and equipment, promoting role-model strategies (using well-behaved children to model behaviour), and allowing time to work together with other teachers to identify solutions. Following the training, further support was offered via prompts and cues weekly, a social support group through what's app (environmental restructuring) and through feedback and monitoring (enablement).

Finally, two teachers from one school and three members of our expert advisory group (two teachers and a sport and exercise scientist) provided feedback on an initial version of the 'Teacher's guide' for MAST. All teachers agreed that a booklet was better than individual lessons plans as it was portable and simple and easy to use.

Feedback was very positive and all liked the format and layout of the Guide. All agreed that a booklet was better than individual lessons plans as it was portable and simple and easy to use. Other feedback included making the colour of font easier to read, including links to videos of a 5-year-old doing the movements (which we actioned), and reading the whole story to the class before each set of lessons. We also added key vocabulary each week.

## Aims and objectives

The current project addressed two research questions.

3. Does MAST have beneficial short-term effects on motor development and language skills in Reception children?
4. To what extent is the intervention delivered as planned? What are the barriers to successful implementation, and what factors contribute to successful adoption?

These were published on the project website in June 2022.

<https://www.nuffieldfoundation.org/project/a-movement-and-story-telling-intervention-for-reception-children>

## Method

### Changes to protocol

Some minor changes were made to the project protocol, mainly due to unforeseen difficulties with school recruitment.

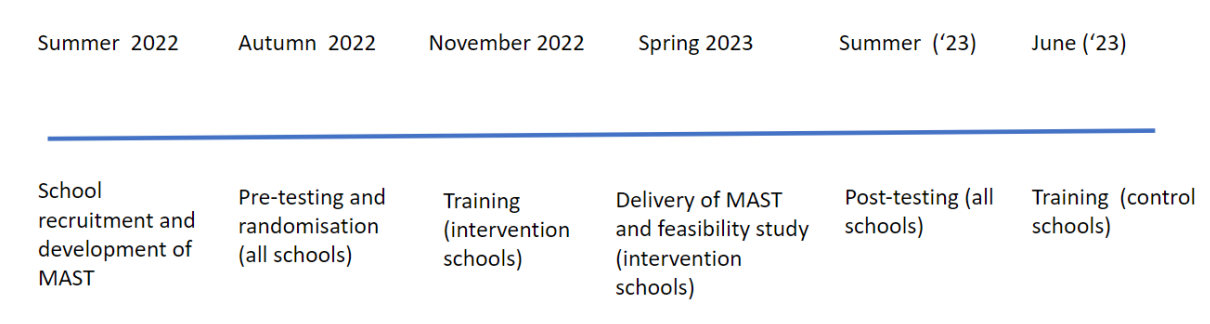
- a) To allow us more time to recruit, the intervention began in January 2023, rather than November 2022.
- b) Schools with average and below average numbers of Pupil Premium children, plus schools in Manchester were recruited.

- c) An additional intervention school was recruited to maximise the number of teachers participating in the feasibility study.
- d) An additional measure was included at pre- and post- test to assess self-regulation (because of advice from the advisory board).
- e) No ethnicity data was collected to reduce burden on the schools.
- f) No survey was given to teachers due to the necessary data being collected at interview.

## Study design

The current study was a cluster-randomised control trial. Eight schools were pair-wise matched on background characteristics and one school in each pair was randomly assigned to the intervention group or a waiting control group. One additional school was assigned as an intervention school. Children in all schools were pre- and post-tested for FMS and language skills (Research question 1), while teachers in the intervention schools took part in the feasibility study (Research question 2).

Figure 5 Study Time-line



## Recruitment

Recruitment of schools was a challenge for this project. We initially reached out to school trusts in our local network of contacts that were characterised by high percentages of children eligible for free school meals or pupil premium. Although there was a good deal of support for the project from senior colleagues within the trusts, individual schools were often unable to commit to it. In some cases there was interest, but the schools were ineligible because they had already committed to participate in the NELI research project (approx. 40% of primary schools were signed up to NELI in 21/22). Other schools informally reported feeling overwhelmed by requests to participate in research projects given their pupil profile, given the push to recruit schools to participate in EEF trials in the region. So, although there was some interest there was a strong sense that the schools were already feeling stretched by other demands being placed on them both externally and internally. We did have some expressions of interest from schools who already had good working relationships with members of the research team from previous projects (and were therefore familiar with working in a research relationship with us) or who were otherwise made aware of the work of Nottingham Trent University. Of the final recruits, 5/9 schools had an above average percentage of children on Pupil premium (>25%), 1 =25% and 2 <25%. 7/9 schools had below average numbers of children reaching the expected standard for KS1 reading (<75%), 1= 75% and 1>75%.

## Schools and randomisation

The table below summarises information on the nine schools recruited to the trial and the final sample of 214 children.

Table 4. School Information

School number. School allocation  (Pairs highlighted in same colour)	Size (number of forms in Reception)	EAL %	Pupil premium %	KS1 reading % (2022)	KS1 Writing % (2022)	Number of children in year	Consents	Final sample for pre- and post- test
1. Intervention	1 ½	11	47	48	48	30	16	16
2. Control	1 ½	27	46	67.3	55.1	45	8	6
3. Intervention	2	42.5	46.3	65	57	58	33	32
4. Control	2	26	52	74	62	60	28	27
5. Intervention	1	18.5	25.1	80 (2019)	69 (2019)	30	28	27
6. Control	¼	2	10	75 (2019)	75 (2019)	20	16	15
7. Intervention	2	6	15	72	60	60	30	30
8. Control	2	81	24	70	58	58	34	33
9. Extra intervention	1	33	33.6	67	67	30	30	28

Notes. % EAL national average 2022 = 20%; % Pupil Premium national average 2022 = 25% ; % KS1 Reading expected level or above national average 2019 = 75%, % KS1 Writing expected level or above national average 2019 = 69%.

Randomisation: Eight schools were pair-wise matched as closely as possible on the following background characteristics, in order of priority: Size, Pupil Premium, KS1 reading, KS1 writing, EAL. One school from each pair was randomly assigned to the intervention group and another to the waiting control group. Due to request, schools were informed of their allocation just prior to, or during pre-testing. A ninth school was recruited late, after randomisation, and was therefore designated as an extra intervention school to maximise the number of teachers in the feasibility study.

Consents: Consent forms were sent out to all parents of children in Reception (paper and online versions). There was a lower consent rate in control schools (46% vs 65%), driven by an extremely low consent rate at one control school (8 out of 45). This is because this school was already participating in a research project and the school and parents did not want the children over-tested. This effect, plus the extra intervention school, meant there were more participants in the Intervention compared to the control group. Statistically, the difference was still within acceptable levels for the group comparisons we planned.

### Participants

238 children consented to participate in the study. 15 of these children (10 intervention, 9 control) were not tested due to SEND or persistent absenteeism.

223 children were tested at pre-test. Nine children left their school in between pre- and post-test leaving a final sample of 214 tested at pre-and post- test. There were 133 children in the intervention group and 81 in the control group.

Sample size was not sufficient to detect significant effects for the planned analyses at the recommended power level of 80%. However, the sample was sufficient to show evidence of promise, with the plan to lead to a larger trial if promise was found.

*Table 5. Participant demographics*

Variable	Intervention (n = 133)	Control (n = 81)
Gender (boys)	56.4%	46.9%
Pupil Premium	22.6%	23.5%
EAL	24.1%	42.0%
Height (cm)	107.5	109.5
Weight (kg)	19.1	18.6

Note. Data were collected at participant-level for these variables.

## Training

We ran a 1 day training event at NTU in November for the intervention schools. 6 practitioners from 5 schools attended the training. Five were class teachers, four of who would be delivering MAST to their own classes, and one was a ‘floating’ class teacher who delivered PE to Reception. There was one teaching assistant who would be delivering MAST on her own to a Reception class. Training included the characteristics best for improving FMS as outlined in Lander et al., (2017) ( $\geq 1$  day; comprehensive subject and pedagogy content; framed by a theory or model; with follow-up or ongoing support; and measure teacher satisfaction)

During the training, teachers were given the opportunity to review the Teacher’s Guide, plan a lesson, see an example lesson taught by one of the researchers, practice teaching a lesson (with the other teachers and researchers), and go through ‘what-if?’ scenarios with the research team (i.e., use of PE equipment, SEN integration, class behavioural management).

*Figure 6. Programme for MAST training day (intervention schools, Nov 2022).*

9.30 - 10.00	Welcome	
10.00 - 10.20	Introduction to the MAST project	Anna Cunningham
10.20 - 10.40	The feasibility study	Clare Wood
10.40 - 12.00	The structure of MAST and planning a lesson.	Mike Duncan and Emma Eyre
12.00 - 1.00	Buffet lunch	
1.00 - 3.00	Watch Mike teach a lesson and practice delivering planned lesson (in sport studio)	Mike Duncan and Emma Eyre
3.00 - 3.30	What-if scenarios	Team

Attendees at the training were given the following resources: the Teacher’s Guide to MAST, Key Vocabulary cards, The Gruffalo and Stick man books, blow-ups of the extra pages for the Gruffalo (rabbit hop and frog jump), a toy Gruffalo and a toy Stick man. The Guide included links to videos of an adult ([link](#)) and a child performing the movement skills on YouTube ([link](#)). Videos of other activities from the programme (e.g., the Bean game) were also provided ([link](#)).

Teachers requested What's app as their preferred form for a support forum and as such one was set-up so that they could be provided with 'just in time' support by the researchers during delivery of the intervention.

### Evidence of Promise: measures

#### LanguageScreen

The LanguageScreen (West et al., 2021) was individually-administered in a quiet area of the school. This was a 10-minute, online test, delivered on a tablet. It was developed by the NELI team and consisted of 4 sub-tests: Expressive Vocabulary (naming a series of pictures), Receptive Vocabulary (matching spoken words to a series of four pictures); Listening Comprehension (listening to 3 spoken stories and answering questions tapping both literal and inferential comprehension), and Sentence Repetition (repeating each of a series of sentences verbatim). Scoring was automated and results uploaded to a secure website ([LanguageScreen.com](https://www.language-screen.com)). Standard scores were automatically generated for each sub-test as well as for the whole test. Reports of these scores were shared with teachers and parents. Standard scores provide a score that is reflective of the child's performance in comparison to other children their age nationally. Standard scores have a mean of 100, with 85-115 being within the average range. Published reliability for the LanguageScreen is high (Cronbach's  $\alpha = 0.84$ ) as is concurrent validity with a correlation of  $r = 0.95$  with a 30 minute language assessment used by speech therapists (West et al., 2022).

Figure 7 Picture of expressive vocabulary test from the LanguageScreen



#### Fundamental Motor Skills (FMS): TGMD -3

The Test of Gross Motor Development-3 (TGMD; Ulrich, 2020) was administered in the Hall in groups of about 8 children per researcher. First, height (cm) and weight (kg) are measured. Then, movement patterns of children are video-taped as they undertake a series of movements reflective of fundamental motor skills. Eight FMS were measured in the current study; Locomotor: run, jump, hop skip, and Object: underarm throw, overarm throw, catch, kick. Run, jump and hop were coded out of 8 (4 dimensions across two trials) while skip and catch were coded out of 6 (3 dimensions across two trials). Therefore locomotor skills and object skills each had a maximum score of 30, resulting in a maximum total of 60. Researchers with experience in assessing children's movement skills analysed the videos and were trained during a minimum of a one-hour session where they watched and rated video clips of children performing the skills. Following this, trainees coded 10% of already coded footage from the lead researchers. Congruent with prior research (Barnett, Minto, Lander, & Hardy, 2014), training was considered complete when each observer's scores for the two trials differed by

no more than one unit from the instructor score for each skill (>80% agreement). Percentage agreement across all skills reached 89% agreement.

*Figure 8. Picture of child doing the TGMD*



Self-regulation: Heads, shoulders, knees and toes

Children are asked to play a game in which they must do the opposite of what the experimenter says. The experimenter instructs children to touch their head (or their toes), but instead of following the command, the children are supposed to do the opposite and touch their toes (or their head). If children pass the head/toes part of the task, they complete an advanced trial where the knees and shoulders commands are added. The HTKS task was conceptualized by Ponitz, et al., (2008) as a measure of inhibitory control (a child must inhibit the dominant response of imitating the examiner), working memory (a child must remember the rules of the task) and attention focusing (must focus attention to the directions being presented by the examiner). 2 points are given for each correct trial, 1 point if the child self-corrects, and 0 if incorrect. There were 30 trials. The test had a maximum score of 60 and was stopped after the first 10 trials if all were incorrect.

### Feasibility of teacher-delivery: method

#### Participants

Five practitioners participated in the feasibility study. All attended the training day and delivered MAST to their classes during the course of the project. Two had less than 5 years teaching experience, while three had over 8 years experience. Four were qualified teachers, while one was a teaching assistant. Each was from one of the MAST intervention schools described above. A qualitative analysis of teachers' interviews and field observations of MAST implementation was employed. The study adhered to the consolidated criteria for reporting qualitative research (COREQ) checklist (Tong et al., 2007) to ensure transparency in reporting of the study components.

#### Interviews

Semi-structured interviews lasting approximately an hour were conducted to explore factors that enabled and factors that hindered MAST delivery (see Appendix B for interview schedule). The interviews were semi structured to enable the research team to guide the interview according to the research questions, but with the conversation around these topics being led by participants in terms of the issues that were most pertinent to them. The topics that the interviews covered included: teachers' experiences, confidence and attitudes towards MAST delivery and the training received; perceptions of barriers and facilitators to delivery; perceptions of impact and suggestions for

improvement of the intervention; pupils' experiences of taking part in the intervention and improvement on motor/language skills as perceived by the teachers. The interviews were held online around the middle of MAST implementation (approximately 6 weeks into the intervention). Background information was also collected on teachers' PE teaching experience, their level of PE training, and their familiarity with movement and storytelling activities.

### Analysis

Data from the interviews were anonymised and transcribed verbatim. Deductive/Theoretical thematic analysis was employed as described by Braun and Clarke (Braun & Clarke, 2006). The identification of key themes thus involved a step-by-step analytical process involving data familiarisation through transcribing, reading, and re-reading the data, code generation whereby short descriptive labels were assigned to the data set, categorisation where similar descriptive labels formed categories, searching and reviewing the themes, and defining and naming themes. In this analysis, we sought to answer research questions concerning factors behind successful MAST delivery and barriers that hindered adoption. Therefore, a deductive/theoretical approach was considered the most appropriate analysis, and two overarching themes "*Barriers*" and "*Facilitators*", were pre-set.

### Observations

The research team conducted observations of two MAST sessions at each school to gather contextual information about what the intervention looked like on the ground. The primary aim of these observation was to evaluate teachers' adherence to the guidelines, activities and structure of the MAST sessions as illustrated in the Teachers' guide. Field notes were taken during the observation on the process of delivery, the layout of the room and teachers' degree of compliance to key components of the intervention. In addition, notes were taken on frequency of delivery, duration and structure of the sessions (see Appendix C for the observation checklist). Two observations were conducted at each school, aiming to capture alterations in delivery and in teachers' confidence over time. Ten observations lasting approximately 45 minutes were completed.

### Analysis

Implementation fidelity was assessed through the observations. The initial field notes were written in the form of brief descriptions. At a second stage, field notes were elaborated further, organised per school and the content compared against the corresponding week's lesson plan in the MAST guide. A summary table of the degree to which each school site adhered to MAST guidelines was prepared, followed by a ranking of schools based on that degree of compliance.

## Results

### Evidence of promise

#### Research question:

Does MAST have beneficial short-term effects on motor development and language skills in Reception children?

**Analysis plan**<sup>1</sup>: To be analysed using two hierarchical linear regressions. Regression 1 outcome = post-test language skills, Regression 2 outcome= motor skills. Step 1 predictors for each model = pre-test language or motor skills, gender, and pupil premium status. Step 2 predictor = group (intervention or control). This will provide the unique contribution of group to gains in motor and language skills.

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<sup>1</sup> The analysis plan was set in advance. The regressions originally included ethnicity as a co-variate. However, as we did not collect ethnicity data from the schools, this was not included in the final analysis. The feasibility analysis originally included analysis of a teacher questionnaire. However, as we collected the questionnaire data via interview, this was not necessary.



## Results of analysis

Table 6. Descriptive statistics for Evidence of Promise

Variable	Max. possible score	N	Intervention Mean (SD)	Control Mean (SD)	T (two-sided)	P
Pre-test HSKT	60	212	26.30 (15.71)	26.01 (17.39)	-.12	.90
Post-test HSKT	60	206	34.07 (16.59)	33.09 (15.35)	-.42	.67
Language (standard scores)						
Pre-test listening comprehension	-	214	94.44 (12.54)	94.40 (14.30)	-.03	.98
Post-test listening comprehension	-	205	98.51 (12.74)	97.42 (11.68)	-.61	.54
Pre-test receptive vocabulary	-	214	94.56 (12.81)	95.64 (14.50)	.19	.85
Post-test receptive vocabulary	-	205	97.55 (13.12)	96.47 (12.81)	-.58	.57
Pre-test sentence repetition	-	214	95.57 (15.78)	96.70 (13.81)	.53	.59
Post-test sentence repetition	-	205	101.65 (13.04)	98.27 (12.90)	-1.81	.07
Pre-test expressive vocabulary	-	214	95.10 (14.69)	94.84 (12.90)	-.13	.90
Post-test expressive vocabulary	-	205	98.38 (15.14)	95.60 (12.54)	-1.36	.17
Pre-test language	-	214	94.20 (13.14)	94.28 (13.28)	.05	.96
Post-test language	-	205	98.98 (13.34)	96.50 (12.44)	-.42	.19
Fundamental movement skills						
Pre-test Locomotor	30	182	12.86 (4.69)	14.32 (5.05)	1.98	.05*
Post-test Locomotor	30	196	18.17 (5.36)	15.30 (4.30)	-3.93	<.001**
Pre-test Object skills	30	164	11.76 (4.26)	12.27 (5.28)	.67	.50
Post-test Object skills	30	182	13.64 (5.38)	11.61 (4.64)	-2.64	.01*
Pre-test FMS	60	145	25.00 (6.21)	26.50 (8.56)	1.16	.25
Post-test FMS	60	181	31.84 (8.75)	26.91 (7.81)	-3.90	<.001**

Note: N = number of participants with complete data. Significantly lower Ns for FMS are as a result of a) child refusal (particularly at pre-test), b) child absence on day of testing, c) technical problems with the cameras, and d) problems with video upload/coding. HSKT = heads, shoulders, knees and toes. Total FMS = 8 skills; catch, throw (underarm and overarm), kick, jump, run, skip, and hop. \* $p < .05$ , \*\* $p < .001$

There were no significant differences between groups for HSKT, language, or object skills at pre-test, which demonstrates that they were well-matched. There was a significant difference at pre-test for locomotor skills in favour of the control group. However, this pattern flipped after the intervention as there were significant differences at post-test in favour of the intervention group for locomotor, object and total FMS. There were no significant differences in any of the language skills at post-test but there were mean differences in favour of the intervention group (of about 3 standard points) for the two expressive language skills (sentence repetition and expressive vocabulary). This does not mean that the intervention did not significantly affect language skills as these tests do not take into account pre-test skills (see regressions below for analyses that do).

Table 7. Correlations between variables for total sample at pre-test

Variable	HSKT	Language	Locomotor	Object	Total FMS
HSKT	-	.54**	.09	.05	.09
Language		-	.06	.01	.05
Locomotor			-	.28**	.80**
Object				-	.80**
Total FMS					-

Note. \* $p < .05$ , \*\* $p < .001$

There were significant correlations between HSKT and language, and object and locomotor skills, as well as between total FMS and locomotor and object (which is to be expected as total FMS is a composite of these variables). There was no relationship between FMS and language skills. The correlation between HSKT and language may be explained by the role of executive function in language tasks (Gooch et al., 2015). However, the non-significant correlation between HSKT and FMS is contrary to research showing a positive association between FMS and self-regulation (Van der Fels et al., 2015).

### Language

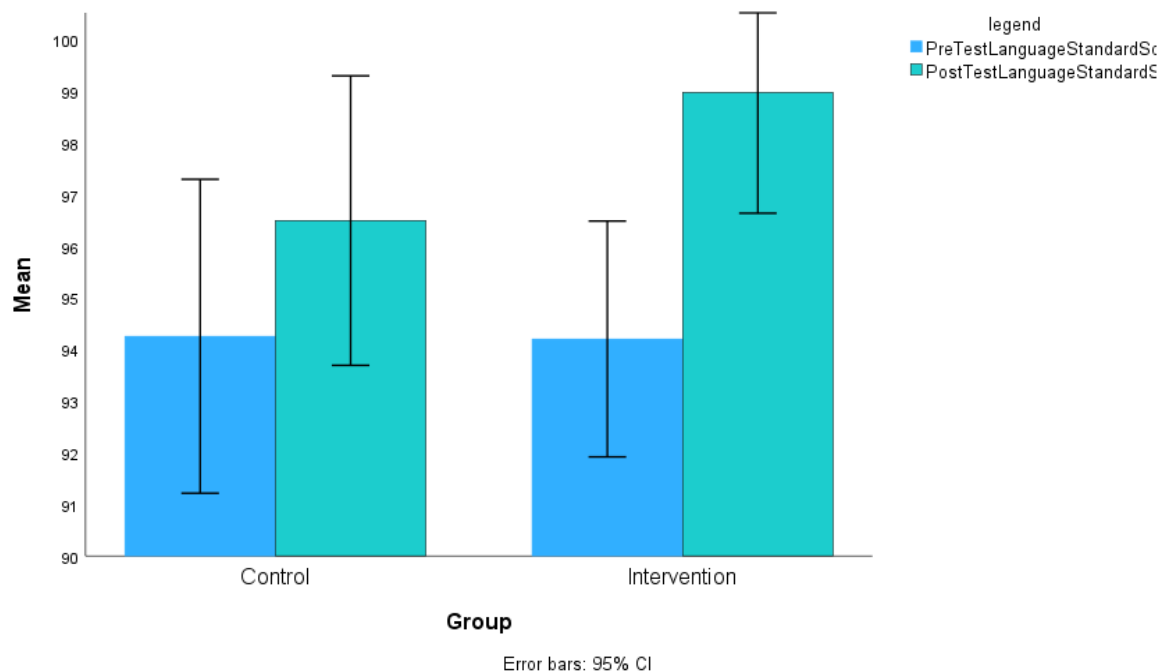
Table 8 presents the results of a multiple hierarchical regression predicting post-test language (standard scores). Pre-test language, gender and pupil premium status were entered in step 1, while group (intervention vs. control) was entered in step 2. The overall model was significant,  $F = 100.09$ ,  $p < .001$ . Group significantly predicted post-test language once the effects of pre-test language, gender and pupil premium status were partialled out;  $\text{Change}R^2 = .01$ ,  $p < .05$ . This means that **there was a significant positive effect of the intervention on language scores (effect size  $d = 0.2$ )**. This is a small effect size, but is still of educational significance (RELWest, 2021). Mean differences displayed in Table 6 show that this effect is largely driven by sentence repetition and expressive vocabulary. Gender and pupil premium status did not have a significant effect on language.

Table 8. Regression predicting post-test language standard scores.

Predictor	b	SE	$\beta$	t	Change $R^2$
Intercept	24.90	4.11		6.05**	0.66**
1. Pre-test language	0.79	0.05	0.79	18.83**	
1. Gender	-.75	1.09	-0.03	-0.68	
1. Pupil premium	-2.08	1.32	-0.07	-1.58	
2. Group (0 = control, 1 = intervention)	2.57	1.10	0.10	2.33*	0.01*

Note.  $N = 204$ . \* $p < .05$ , \*\* $p < .001$

Figure 9. Graph to show increase in language scores from pre- to post- test across groups.



#### Fundamental movement skills

Table 9 presents the results of a multiple hierarchical regression predicting post-test total FMS scores. Pre-test FMS, gender and pupil premium status were entered in step 1, while group (intervention vs. control) was entered in step 2. The overall model was significant,  $F = 11.63$ ,  $p < .001$ . Group significantly predicted post-test FMS once the effects of pre-test FMS, gender and pupil premium status were partialled out;  $\text{Change}R^2 = .10$ ,  $p < .001$ . This means that **there was a significant positive effect of the intervention on FMS scores (effect size  $d = 0.65$ )**. This is a medium-large effect size and is of important educational significance. Mean differences displayed in Table 6 show that this effect is largely driven by locomotor skills. Pupil premium status did not have a significant effect on FMS while gender had a significant effect (boys had better FMS than girls).

Table 9 Regression predicting post-test FMS scores.

Predictor	b	SE	$\beta$	t	$\text{Change}R^2$
Intercept	16.37	2.74		5.98**	.18**
1. Pre-test FMS	0.45	0.10	0.37	4.53**	
1. Gender	3.43	1.44	0.20	2.39*	
1. Pupil premium	-0.16	1.74	-0.77	-.93	

2. Group (0 = control, 1 = intervention)	5.64	1.39	0.32	4.04**	.10**
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Note. N = 129. \*p<=.05, \*\*p<.001

Figure 10. Graph to show increase in FMS scores from pre- to post- test across groups.

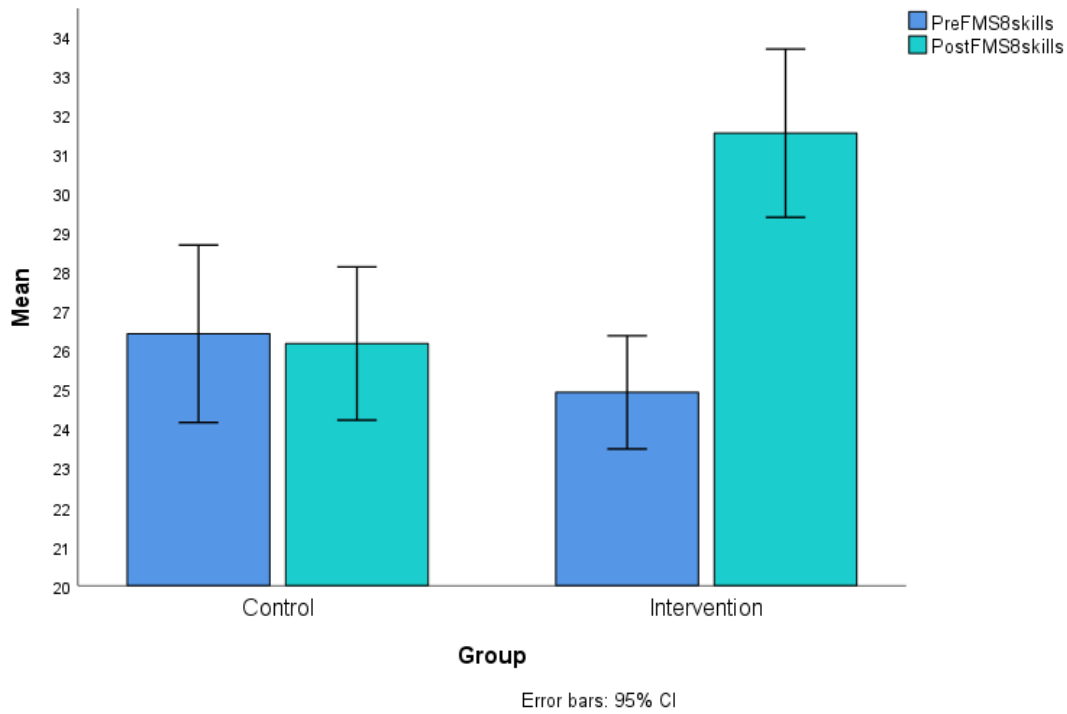


Figure 11. Explaining effect sizes and statistical significance

Dimension	Effect Size	Statistical Significance
<b>Definition</b>	A measure of the strength or magnitude of the effect of a program on an outcome compared to a situation without the program.	The probability of observing a difference at least as large as the one between the two groups (for example, program versus no program) even if the true difference were zero.
<b>Benchmark</b>	Standard deviation	p-value

Note. From RELWest (2021).

## Feasibility of teacher-delivery

Research question:

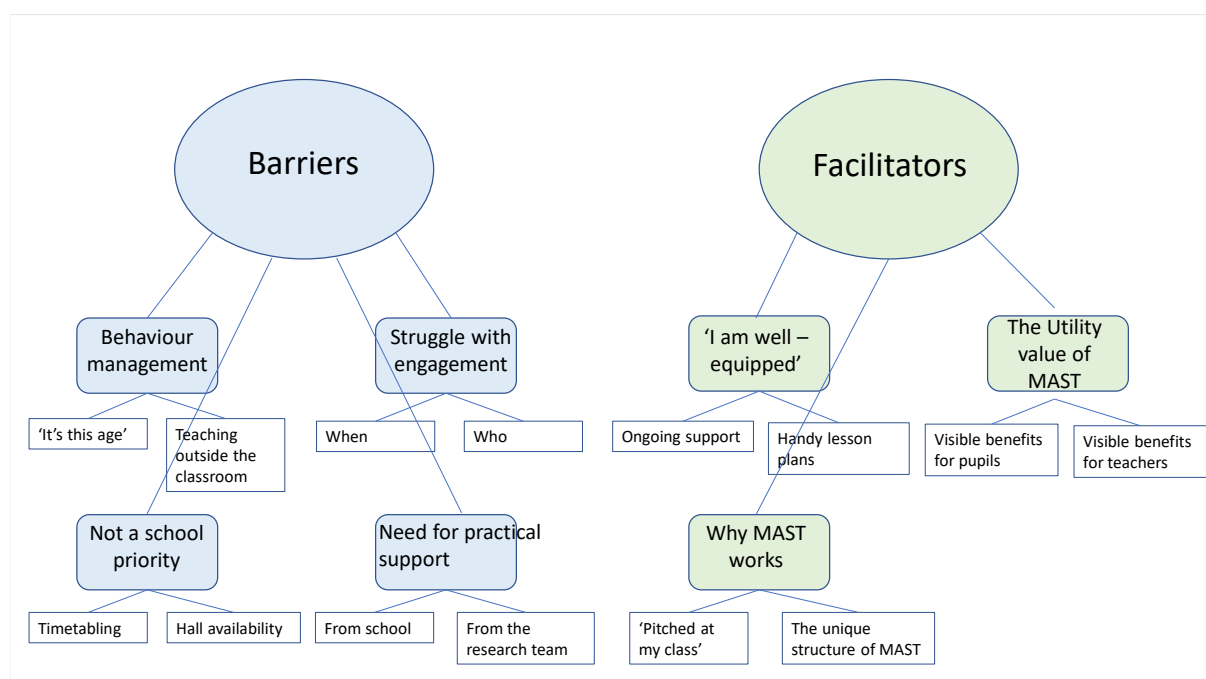
To what extent is the intervention delivered as planned? What are the barriers to successful implementation, and what factors contribute to successful adoption?

Analysis plan1: To be analysed through thematic analysis using data from observations of training and teacher-delivery, and interviews with teachers.

## Results of analysis

Seven themes and fourteen subthemes were identified under the two overarching themes of 'Barriers' and 'Facilitators'.

Figure 12. MAST feasibility: Themes & Subthemes



### Barriers

#### Behaviour management

##### Teaching outside the classroom

Teachers described difficulty maintaining control of their classes during the MAST sessions, highlighting behaviour management as the biggest challenge they experienced. All teachers but one delivered the movement part of the intervention in the school's hall, which constitutes a school area that children in reception haven't visited for a lesson before, rather they've gone there for fun after-school events. According to most teachers, the hall is linked to such activities for them and not structured lessons, which was the reason behind their hyperactivity and their difficulty to follow instructions when there.

*'I think it having the whole class does create some challenges and particularly with reception and I think often when you go into the hall, they get very excited and it's more the challenges was like getting them to listen to what they're supposed to be doing rather than just like running around or anything' (Teacher Site 2, lines 57-59)*

A similar experience was shared by the teacher who delivered MAST in the playground. It seems that behaviour management challenges teaching regardless of the space chosen. Considering that the participating teachers were lacking in PE training, such a challenge might reflect low efficacy in teaching outside of the ordinary classroom.

#### It's this age

The age factor was also stated by most as a contributor to this barrier. All the teachers attributed the difficulty to listen and follow instructions to pupils' young age and the corresponding limitations in social skills development. As one of the participants said,

*'They're just not very good. They're not good at taking turns and they're not that good at listening yet. And so I think that that's the big challenge for this intervention' (Teacher Site 2, lines 65-67).*

Pupils were described as non-school-ready by most teachers who referred to the impact of the pandemic and skipping nursery as the reasons behind this, which consequently influenced ease of MAST delivery.

Age-related disruptions were also described by some teachers as challenging to the flow of the lesson. The level of school readiness was mirrored not only in pupils' listening skills as previously explained, but also in children's needs and behaviours that correspond to a younger age, distracting teachers' focus from teaching MAST.

*'And the only thing is that sometimes we have in our lesson, we have to lose adults because we've got to go out and somebody's had a nappy accident or there's injuries and things like that. So that's the only thing every lesson that seems to be something that does stop it running completely fluidly. There's lots of children needing the toilet, things like that I think that probably be the case in every early years, so soon. Yeah' (Teacher Site 1, lines 322-323).*

It is clear from this evidence, together with later comments about not having enough TA support (see 'Need for practical support'), that one of the main problems with behaviour management is staff: child ratio (bearing in mind that these children are just out of pre-school where the ratio is 1:8). In some cases, one teacher is on their own with 30 children. One way to mitigate this is to include more behaviour management strategies in the training, and where possible, shadowing/mentoring of teachers by a researcher on site.

The difficulties around behaviour management of the whole class highlights the needs that the teachers have in terms of coaching and modelling with their children. For example, a researcher coming in to teach a MAST lesson with the teacher. This would enable their capability to be developed through practice and rehearsal of behaviour strategies modelled by the researcher – which will then influence opportunity (e.g. they will be able to implement the behaviour strategies regardless of the space, and affects their motivation to teach). The current training helped their understanding of the intervention and how to deliver it alongside the resources/videos, but studies suggest the need for coaching alongside to translate to practice (Kraft et al., 2018). For example, as modelling, working with teachers to explore strategies and how they can use these with their own strategies (Sailors and Shanklin, 2010) to enable sustained support. This would then boost their self-efficacy, leading to increased motivation and enjoyment (e.g. Bandura 1977; McAuley, 1985).

#### Struggle with engagement

##### Who

Following a whole-class approach in MAST delivery seemed to challenge teachers, with some expressing their disappointment in failing to engage all pupils in the session and particularly the ones 'that needed it the most' (Teacher Site 5, lines 883). The difficulty to differentiate the session to

accommodate the learning pace and needs of the less able and less confident pupils constituted one of the barriers to teaching MAST fluidly. Teachers also referred to the need of supporting the SEN pupils not included in the session as an additional barrier.

*'Just like time getting in the hall, getting them all to listen and getting the ones to speak who you know, need to be speaking cause some of the ones who are confident always putting their hand up. But the ones that need to practice that vocabulary and that language, they're the ones that need to be doing it and they don't join in and yeah' (Teacher Site 2, 406-410)*

This theme highlights the challenge of having the whole class together for MAST sessions. Often, particularly in Foundation, the children split into smaller groups for intervention work, so that work can be set at a more tailored level, and each child can be given time to speak. One way to mitigate this is to provide more information on differentiation in the Teacher's Guide and training, and to encourage teachers to focus on a different group of 4 children each week for language work.

### When

Difficulty in engaging pupils was not only related to the less able learners though. The five teachers highlighted the limited engagement of all pupils after the movement part of a session as an important barrier to MAST implementation. Tiredness and hyperactivity after high-intensity activity along with enjoyment of the physical activities were amongst the prominent explanations behind pupils' reduced concentration in the post physical activity part of the MAST session.

*'I think possibly the after the lesson, when they're all quite hyped up, I think getting them to cool down and listen to another tiny input at the end. I think that I've been struggling with that and they're just feeling like I want to go home now yeah, I think that's a little bit challenging in that bit' (Teacher Site 1, lines 283-286).*

One possibility here is to take the children back to the classroom for the embedding phase (although this increases the chance of missing the post-activity window for increased blood flow to the brain). An alternative is to play music in the hall to calm the children down and to make sure not to leave out the cool-down.

### Not a school priority

#### Timetabling and Hall availability

Most of the teachers shared their struggle with the organisation of MAST sessions, with some referring to time restrictions due to their heavy timetable and others stating hall availability as a great challenge in their school. On a more latent level, these points reflect the low value assigned to PE in these schools. There were a few times when teaching other subjects (e.g. phonics) meant that MAST was not delivered that day or only part of the lesson was delivered, confirming the fact that there were other priorities in the schools' timetable. As a participant said, *'I've been trying to do it sort of first thing like 9:00 o'clock because then we have cause we have phonics at 9:30'* (Teacher Site 2). During the discussion with the teachers, it seemed that MAST hadn't received the support needed on a school management level, leaving teachers struggling to find a place and a time for a session.

*'I think it's the timetabling of the whole slots is the trickiest thing because that involves a lot of staff and maybe they aren't aware of sort of the importance of the project so and it's like, for example, one of our hall sessions, science coordinator said Ohh It's science week, so we're having a visitor, so the hall will be out of use for your PE session. Hadn't asked first, just said that is, so that's that's tricky then, because then you've got to find another slot because you've got you're in the programme' (Teacher Site 5, lines 542-547)*

*'I think just just as I say, I think we've had to sometimes shorten it a bit. And so I think sometimes we have not been able to do all the elements that we would like to and missing out bits like the walk to the forest and the cooldown and things like that' (Teacher Site 1, lines 514-516).*

This theme ties in with the theme below ('Need for practical support from the school.'). Basically, PE is not a priority for most schools (see 'Implications for policy and practice' section of this report).

#### *Need for practical support*

##### *From school*

Other difficulties around the logistics of delivering the sessions shed a light on issues primary school teachers are facing daily that go beyond the value placed on PE-related endeavours. Specifically, the overall level of support received from the school management to enable comfortable stress-free lesson delivery. The need for an 'extra pair of hands' emerged as the first common topic of discussion from most of the teachers, who expressed a general difficulty in teaching alone. The teachers seemed to acknowledge that school staff shortages constitute a great obstacle that consequently affected MAST delivery, arguing that a teaching assistant alongside them would have contributed to a more fluid, stress-free session.

*'So teaching assistants quite often there would be a teaching assistant in a reception class as good practice, but now budgets can't afford to have a teaching assistant just helping out in class and it's tricky then running interventions because a lot of teaching assistants are just working one to one with high level needs children, and because that's all the budget will cover, and so running interventions like this year is very difficult' (Teacher Site 5, lines 70-75).*

Sport equipment shortages constitute another area of need for schools that negatively affected MAST implementation. Some of the teachers discussed the limited resources provided by the school (e.g., balls, cones, bean bags, etc.), compromising their ability to follow the proposed activities for the whole class. As one of the teachers mentioned,

*'I think the resources, it's something that I should get from my, from my school and I'm going. I would just say as well, if you want me to do this again from September, I need these resources' (Teacher Site 3, lines 672-674).*

The school's lack of appropriate sport equipment often leads teachers to adjust MAST lesson plans to what they have instead of following the planned activities.

*'Just sometimes, it's like the PE resources that have to find in the right number in school and things. And but we can adapt it when needed' (Teacher Site 2, lines 331-332).*

PE not being a priority for school leaders is a wider issue that is well-reported within the PE and sport sector. This appears to be what has indirectly led to difficulties with MAST delivery (lack of hall availability, lack of TA support and insufficient equipment). Fortunately, recent changes to (more accountability through an online reporting system), and an extension of the PE and Sport premium mean that PE will hopefully start to become more important to school leadership teams, as well as more responsible use of the money. For example, on equipment and training. Impact work from the current project which demonstrates the effectiveness of MAST, will also be really helpful in this regard.



### From the research team

The need for practical support in MAST delivery was extended beyond the schools' capacity. Most of the teachers called for a more applied guidance on the sessions by the research team. Prescribed information on how to enhance the language part of the intervention was the most prominent comment in the interviews, with most of them expressing the need for a list of specific questions they could address to their pupils after the storytelling. As a teacher said

*'Eerm so maybe if you did it like two or three years running you get to know what's in it, and so then you sort of more confident with it. But this year, no, wasn't at all and particularly the.. I mentioned it in the WhatsApp the questions after the PE session, what we should be asking and whether I was asking the right sort of things' (Teacher Site 5 lines, 419-421).*

On the same line, some teachers requested a mock lesson to be delivered in their schools by the research team, highlighting again teachers' need for 'hands-on' information rather than written descriptions of the steps to follow.

It seems that teachers struggled with taking initiative and acting freely when delivering the sessions, despite being told on the training day that they were free to 'make it their own'. The call for prescribed guidance shows that either that message wasn't transferred to them clearly enough or that the teachers found it difficult to adjust to such a process. A feeling of insecurity about deviating from the MAST manual and a 'fear of doing it wrong' frequently emerged as an obstacle to the delivery of the sessions. As a teacher stated,

*'I think eerm I was very worried about going off script because I didn't want it to affect the outcome of the project, but I needed to make it my own a little bit' (Teacher site 5 lines 415-417).*

That reluctance shared might have consequently contributed to a lack of ownership of the intervention on behalf of the teachers, a factor necessary for effectively adopting an intervention (Snowling et al., 2022).

A lack of confidence and self-efficacy on the part of the teachers may be at the root of this desire for more support. Most of the teachers on the project (and indeed across the UK) had not received any formal PE training (until MAST). Therefore, they may have required more support than with e.g. a phonics intervention, where this is part of their ITT.

### Facilitators

*'I am well-equipped'*

#### Ongoing support

Despite the barriers faced, teachers provided positive feedback on MAST during the interviews. All the teachers felt satisfied with the level of support received by the research team and the materials and resources provided to deliver the programme. Although a different programme than the ones they were used to in the past (mainly literacy-related), most of them described gaining confidence in their competence to adopt MAST following the training. The structure of the training, in particular, received a lot of praise, with the teachers claiming that the applied stage of the day prepared them well to implement the programme effectively. According to one teacher,

*'So at the at the beginning, I was a little bit scared and nervous, but after the first, you know the session with you in the university act, I thought it's like, yeah, I can do it. Why not, you know? So it's like now I think yes, after the training, I thought it's just the first, the first, like the description what will you expect from me and I thought oh oh it is going to be difficult it will bounce back but in the end I really enjoyed' (lines, 159-164).*

Moreover, there was overall satisfaction with the variety and quantity of resources provided, with teachers highlighting the alignment of the materials with their teaching needs and practices.

*'Really helpful. It's good to have the visual images. It's good to have the vocabulary cards and the story books and pictures are really helpful as well' (Teacher site 2, lines 355-357)*

*'I found the little bit of background that you gave me about I thought it's kind of ties in quite well with how I sort of approach PE anyway and so I think it kind of fitted in with that sort of style of how we're kind of would teach it' (Teacher site 4, lines 50-53)*

In spite of the MAST resources, the teachers emphasised the ongoing support provided, as of paramount importance for successful delivery. According to all, their call for more practical guidance was responded to, with the research team offering prescribed information and additional materials when needed to address that barrier immediately. As a teacher shared

*'It was brilliant that you showed examples because sometimes when you read it, you can't actually understand what exactly what does it mean. But if you have both, you know a version of showing a practical one and then write it you know and then it's brilliant. So definitely the links that was sent you know and how showing examples of that game or example of that. It was definitely it was brilliant' (Teacher site 3 lines 1090-1093).*

Through open communication with the researchers throughout the MAST delivery, teachers received tailored support which enabled teaching and improved their confidence.

*'The questions that there were sent over that that question booklet and the prompts that was helpful. And so I think that sort of helped improve the confidence for the end part of the sessions' (Teacher site 2, lines 275-277)*

#### Handy lesson plans

The content and structure of the weekly lesson plans in the Teacher's guide received particular attention during the interviews. Most of the teachers considered the lesson plans clearly articulated, well-structured, and easy to follow. Teachers acknowledged that they required minimum preparation and time investment on their behalf, with some highlighting the advantage of having 'ready-made' and effort-saving lessons to follow. Such feedback was particularly positive considering the weight of their workload and the time restrictions earlier discussed.

*'Yeah, I think I've overall quite positive. It's, I think if you're trying to do speech and language intervention by yourself, without the help of MAST, for example, then it can be quite could be a little bit harder to think of ideas for sort of our EAL children, things that excite them, and whereas this it's quite nice that we've been given that structure, so we don't have to think the ideas of ourselves, which is quite nice. Quite refreshing' (Teacher site 1, lines 76-80).*

*'I think I like it because it's already everything is planned I easily I don't need actually think in advance. Oh my God. What I'm going to do what? It's everything it's prepared now already did one session and it's actually I'm very happy to carry on this even after this project would finish because then I know that we'll teach them every skill and everything is prepared.... So I think it's just very easy for me just to jump and be independent and do it that session' (Teacher site 3, lines 213-222).*

## *The Utility value of MAST*

### *Visible benefits for pupils*

Teachers acknowledged and value that MAST had on their pupils. In fact, most of them referred to MAST's relevance to their developmental and learning needs as a source of motivation for them to continue implementing the programme, with a few arguing its importance, particularly for this target group. As a teacher stated;

*'I know a lot of our children don't have gardens and probably don't have the opportunity to be using those gross motor skills as much as you'd probably get in a village school and so I think it is very important and also a lot of our children really struggle with fine motor skills as well. And obviously they're very closely linked, aren't they? Gross motor leads into your fine motor really. So I think it's really really important for our children. To be accessing high-quality gross motor lessons' (Teacher site 1 lines, 151-157).*

The belief that MAST could contribute meaningfully to their attempts to support children from disadvantaged backgrounds constituted a significant motivation, with some referring to the need to counterbalance the effects that the Covid pandemic had on their pupils' language and physical development.

*'I'm interested because during COVID I know that speech and languages the children suffered quite a bit because of various things during lockdown and COVID, so if it meant that it might improve the speech and language communication language goes with the children that were coming up through reception and nursery eerm that's what I was interested in. And I'm always interested in new ways of doing things and tries to pop out, and if it doesn't work fine, but you've had to go and you've tried it out. And so so yeah, that's why we're interested.'* (Teacher site 5, lines 38-44)

While some of them were encouraged to deliver MAST in an optimal way following their training day when felt convinced of its significance, others admitted being reluctant at first but gaining confidence later when witnessed its effects in their classroom. Pupils' endorsement of MAST from the first days acted as a source of motivation for the teachers who observed their pupils' response, excitement, and engagement. According to one practitioner;

*'So it's when sometimes I think it's like Ohh didn't go very well but the children still they love it and still they wanted to actually you know so I think when I hear like you heard one of the kids it was like telling you I LOVE GRUFFALLO PE!!.'* (Teacher site 3 lines, 487-493).

Additionally, the observed improvement in language and movement skills confirmed teachers' value of the programme which in turn encouraged most of them to invest their attention and efforts in delivery.

*'The thing I enjoy most about it is doing the movement bit and teaching them the skills cause I can see progression there'* (Teacher site 5, lines 296-297)

The importance of teaching fundamental movement skills in the early years is backed-up by research. Children can't develop these basic skills into more specialist skills e.g. they don't have the building blocks for more sophisticated movement, if they are not explicitly taught early on (Gallahue model). Also, motor competence is a prime driver of physical literacy, motivation, confidence and enjoyment leads to lifelong physical activity.

Teachers also saw visible improvements to children's language skills.

*'So as I told you before, we have a few children that I have a girl that she came with no English whatsoever and now she's able to say whole sentences from the book where in normal language she's just was saying, you know, when she is like she was only using the simple words maximum like two words together. And now she actually she said whole sentence, you know from the book.'* (Teacher site 3, lines 426-430).

#### Visible benefits for teachers

Many of the teachers discussed the positive impact MAST delivery has had on their personal and professional development as a source of motivation that facilitated teaching and endorsement of the programme. A few teachers referred to their enjoyment and the pleasant experience of delivering MAST, and among others the teacher at school site 4 described the utility value of teaching these sessions;

*'So it kind of if anything I do feel I feel fairly confident now, but maybe I should have maybe have been a bit more ignorant before and been thought well, I know how to run so I can teach them how to and I know how to throw or something so I can teach you how to throw. But actually reminding people as a correct way and an incorrect way to do things and I think yeah, most people could probably do with just that refresher'*(lines, 201-205).

Lastly, all the teachers highlighted their improved confidence and competence in teaching MAST time and practice as one of the benefits of this programme.

#### Why MAST works

##### 'Pitched at my class'

The design of the programme's content was considered one of the most powerful elements of MAST, with all the teachers finding it highly relevant and suitable for their pupils' learning and individual needs. First, they had the flexibility to adapt the sessions for their mixed-ability groups, enabling them to create an inclusive lesson that all could participate in. One teacher stated,

*'So like on last week we did throwing and catching, so some children that they couldn't do it, so I gave them a high ability child so they could actually follow their instruction as well. So it's when you put the high and low ability child there, the slow ability child is learning as well'* (Teacher site 3 lines, 868-872).

Moreover, all of them found MAST content *'aiming at the right children and the right age group'* (Teacher site 2, lines, 534-535)

#### The unique structure of MAST

The unique structure of MAST lessons (story, movement, story) with a familiar book seemed to be appreciated the most, with the teachers finding it beneficial for their pupils' learning and continuous engagement.

*'If every sort of session was kind of approached in a completely different way and wasn't so clearly structured, then it wouldn't work as well. But I think because it does, I think it helps the children feel more relaxed because they know they've done something similar before and also helps them know they know straight they know what's gonna happen next week'* (Teacher site 4, lines 670-674).

The combination of movement and storytelling was successful, with most of the teachers arguing that children's familiarity with the books 'Gruffalo' and 'Stickman' contributed to their increased engagement on vocabulary learning, while by acting out the book characters, participation and confidence in physical activity improved. As a teacher explained;

*'I think because they like, they like that it's a story they're familiar with. I think everyone, even if they're not, read the story, everyone's aware of the story of the Gruffalo and it feels quite safe as well you know, it's so it's kind of if everyone's acting out in reception, If everyone is acting a role and you know, all of your classmates are doing it and in reception, even if you're maybe kind of quite shy, reserved it's like, well, everybody's doing it' (Teacher site 4, lines 528-530).*

### Improvements to training as a result of the feasibility work

The control school training day in June 2023 gave us the ideal opportunity to use everything that we'd learnt from the feasibility study to update the training materials. In particular, we revised the Teacher's guide to make the language components at the beginning and the end of sessions more detailed (practical support from the research team), clarified how each week's lesson can be run over two sessions, adjusted timings to make them more realistic, and added information on mastery approach and inclusivity (to improve behaviour management and engagement). We also recorded a video of a teacher from an intervention school delivering a MAST lesson so that teachers could see it running in context (practical support from the research team). This video can be viewed on our YouTube channel ([put link here](#)). It is possible that in future, a further half day of MAST training will be provided half-way through the intervention to trouble-shoot problems.

Support from school management and prioritisation of PE will be addressed by our impact work post-project as we highlight the benefits of combining movement and language work and the effectiveness of MAST and to a wider audience.

### Was the intervention delivered as planned?

Implementation fidelity was assessed through observations of MAST lessons. Five practitioners across five primary schools were observed twice. Below is a table summarising adherence to key components of MAST at each site, followed by a summary of field notes from the observations.

Table 10. Adherence to key components of MAST

Site	Session overall					Priming and Embedding Phase			Movement Phase			
	Dosage 2/week	Length (>= 35')	Structure (story–movement –story)	Act in character	Learning Objective	<u>Resources</u>	<u>Questioning/ Probing</u>	<u>Key vocabulary</u>	<u>Warmup</u>	<u>Practice activities</u>	<u>Teaching the skill (using teaching cues)</u>	<u>Cooldown</u>
Site 1		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Site 2			✓		✓	✓	✓	✓		✓	✓	
Site* 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Site 4		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Site 5		✓		✓	✓	✓	✓	✓	✓	✓	✓	

Overall, the programme was faithfully followed in four out of five school sites. In *Site 2* a substantial deviation from the Teachers’ Guide was observed while only *Site 3* was delivering MAST for two days per week, as recommended. *Site 3* had the highest degree of compliance to the Teacher’s guide, followed by *Site 4* which demonstrated minor deviations.

### *Site 1*

At site 1, the observations took place at week 7 (catching) and week 9 (rolling) of MAST. At time 1 the movement part of MAST was delivered in the school's playground and at time 2 in the school's hall. The class teacher was responsible for the storytelling elements of the lesson (priming and embedding phase), while the movement components were delivered by two external PE coaches who haven't attended the MAST training. During the movement component, four adults were present in both sessions observed (the class teacher, PE coaches, and a teaching assistant). The priming phase was conducted in the playground and hall at the two time points respectively, while the embedding phase took place inside the classroom. Overall, the sessions were highly organised, with each member of staff being in control and having clear roles and responsibilities. The pupils seemed engaged and supported throughout the sessions, while effective behaviour management techniques were in place as advised in the training day.

In this school, MAST was delivered once a week, and the duration of both sessions observed was slightly shorter than instructed (<35'). There were minor deviations from the Teachers' guide although the structure of the sessions was followed accurately (storytelling-PE- storytelling). The learning objectives were introduced at both sessions, and some of the teaching cues were given during the activities, with skill demonstration offered throughout the session to the less confident pupils. The main activities for practicing the skill of the week were delivered with fidelity, but no differentiation was implemented at time 1. That changed at time 2, with the PE leads differentiating the distance and equipment used to practice object rolling in one of the two main activities. While the warm-up was implemented accurately at both time points, the cool-down was omitted. Lastly, the storytelling component was delivered as instructed, with the corresponding book extracts being read and the teacher stimulating discussion and vocabulary growth through questioning and probing at both time points successfully.

### *Site 2*

At site 2, the observations took place at week 8 (throwing) and week 11 (kicking). At both time points the movement part of the session was delivered in the school hall by the class teacher and no additional staff members. In the first observed session, the priming phase was delivered in the hall while the embedding phase wasn't implemented. The second time, the priming phase was conducted in the classroom while the embedding phase took place in the school hall. The priming and embedding phases observed were delivered in accordance with the guidelines, with the teacher reading the book extracts, emphasising the key vocabulary, and encouraging conversation around the book's pictures and story. Although the teacher stayed consistent with the sessions' overall structure, there were multiple deviations from the lesson plan advised to follow.

MAST was delivered one day per week and the first observed session lasted 25' and the second 30'. This meant that the embedding phase along with the cooling down activities were sometimes omitted, according to the class teacher. In both school visits, the pupils weren't acting in character during the activities and while walking to/from the school's hall. Moreover, no differentiation was introduced. Behaviour management difficulties were observed, interrupting the flow of the sessions. However, the teacher's confidence and efficacy in delivery noticeably improved on the second visit, with the teacher being more physically involved in demonstrating the movement skills and reminding pupils of the teaching cues.

### *Site 3*

At site 3, the observations took place at week 6 (all locomotor movements) and at week 11 (kicking). At both time points, the movement part of the session was delivered in the playground, and the priming and embedding phase was inside the classroom. MAST was delivered by the classroom's

teaching assistant who attended the training day, plus a SEN support assistant was present for pupils with additional needs. Overall, there was close adherence to the sessions' structure and MAST was implemented twice per week for  $\geq 35'$  as instructed.

In both school visits, the teaching assistant recapped last week's learning objectives, introduced the new one and read the corresponding book extracts, cultivating long discussions around the book characters and the storyline. Pupils acted in character during the movement part as well as when walking to/from the playground. Each week's activities were followed accurately, and differentiation was introduced to challenge the more physically confident pupils. In the second session observed, the last activity for practicing kicking along with the cooling down phase were omitted as the session was interrupted by other classes using the playground. That instance however constituted an exception and the teacher planned to deliver the session again the next day. The teaching assistant seemed confident and in control of delivery at both time points and pupils remained engaged throughout the lessons.

#### *Site 4*

The observations took place in week 8 of MAST (throwing) at this school site, as the session was implemented twice (for the two classes participating). At this school, MAST was delivered by a PE coach who was also a qualified teacher and had attended the training. The teacher delivered the 8<sup>th</sup> week of MAST for two weeks, dedicating one session to overarm throwing and one to underarm throwing instead of combining them in one lesson as recommended. Therefore, in the observed sessions, overarm throw was the skill being taught. The movement part and the embedding phase were delivered in the school's hall, while the priming phase was done in the classroom. Two teaching assistants and one SEN support staff member accompanied the class in the school's hall. The assisting staff were responsible for maintaining pupils' engagement and providing feedback throughout the session. MAST was implemented once per week, but the sessions' length ( $>35'$ ) and structure were followed as instructed. Overall, there was high adherence to the key components of MAST, with small alterations observed.

During the priming and embedding phase, the book extract was read to the pupils who participated in conversation around the story, the book's pictures, and the new words learned. Apart from the big book, no additional resources were used at this stage. The previous week's skill was recapped and the new learning objective was introduced as advised. The pupils walked to and from the hall in character according to that week's lesson plan and during the movement part of the session, they acted out different roles from the book which was projected on a big screen in the school's hall to remind them of the story. All the components of the movement part of the session were closely adhered to and the teacher introduced differentiation to all the activities (different equipment, distance, and throwing target variations). Lastly, the cooldown stage was omitted at the 2<sup>nd</sup> session observed due to time restrictions. Behaviour management techniques were effectively placed, and a high degree of pupil engagement was observed.

#### *Site 5*

At this site, the observations took place at week 6 (all locomotor movements) and week 9 (rolling) of MAST. The class teacher delivered the sessions, and an SEN support staff member was present to assist one child with additional needs. At both time points, the movement part of the session took place at the school's hall, and the embedding phase was in the classroom. In the first observed session, the priming phase was delivered in the hall while in our second visit, it was delivered in the classroom. MAST was implemented one day per week and a typical lesson lasted longer than recommended (50' - 55'). Overall, although the embedding phase was always delivered as recommended following the movement part of the session, delivery of the priming phase varied, resulting in reduced adherence to MAST's structure.



On our first visit, the priming phase was not completed as in the lesson plan. Instead, book extracts were read to the pupils between the movement activities. Similarly, in the second session observed the corresponding book extract was read partly at the beginning of the session and partly following the warm-up phase. The teacher encouraged conversation around the story during both the priming and embedding phase, the book characters, and their living habits as recommended, and the children seemed highly engaged. The movement part of the sessions received particular attention at this school, with the teacher emphasising the quality of movement and providing feedback, demonstration, and positive reinforcement throughout. Moreover, the key vocabulary was reminded to pupils who acted in character while performing the activities. Lastly, the main activities were accurately followed with minor adaptations, but no differentiation was introduced.

In summary, MAST was delivered faithfully in four out of five school sites. Lessons at these four sites adhered to the following criteria; length ( $\geq 35$  mins), acting in character, sharing the learning objective, using the story resources, appropriate questioning, emphasising key vocabulary, doing the warm-up, doing the practice activities, and teaching the movement skill. Only two school sites administered the cool-down and one school site did not follow the correct structure (story-movement-story). Finally, only one school delivered MAST twice a week, while four schools delivered it once a week. All schools delivered the full 12-week programme. In conclusion, implementation fidelity was good, with the cool-down and dosage being the main areas for improvement.

## Discussion

The main findings of the current project are:

- There was a significant positive effect of MAST (delivered for 12-weeks) on standardised language skills (effect size,  $d = 0.2$ ), and fundamental movement skills (effect size,  $d = 0.65$ ).
- The effect on language skills was largely driven by improvements in expressive language (sentence repetition and expressive vocabulary).
- The effect on fundamental movement skills was largely driven by improvements in locomotor skills.
- The fundamental movement skills of boys improved more than girls', but this was unrelated to the intervention.
- There was no difference in self-regulation between the intervention and control groups.
- Interviews and observations showed that MAST was feasible for teacher delivery. Barriers to implementation were identified (behaviour management, struggle with engagement, not a school priority, and the need for practical support), as well as factors for success (being well-equipped, the utility value of MAST, and why MAST works).
- Implementation fidelity was good with four out of five settings consistently delivering all key components of MAST.
- Barriers to implementation were addressed through improved training and resources for the control schools.
- Given the positive effects found in the current trial, the next step for development of MAST would be an Efficacy trial. Based on power calculations using the current findings, this would need to be a cluster-randomised controlled trial involving 58 schools (29 intervention and 29 control) with 725 children in each group (1450 altogether). If positive effects hold-up under more rigorous evaluation, then the intervention will be ready for a larger-scale effectiveness trial.

The effect on language was smaller than that found in our pilot study ( $d=.5$  for vocabulary; Duncan et al., 2019) where a researcher delivered the intervention. This may have been due to fact that one of our largest control schools had a significant emphasis on language during 22/23, with lots of language-focused work going on within their early years (not NELI). This would have boosted their language skills beyond 'business as usual,' thus increasing the mean for the control group. It is also the case the for the pilot study, only expressive vocabulary was measured, which is the language skill that was most improved by MAST in the current trial. With regard to FMS, the effect size was  $d= 0.45$  in the pilot which is lower than that found in the current trial. This may be because the pilot just did the first six week (the 'Gruffalo') which covered locomotor skills only. The current trial also delivered 6 weeks of object skills, which will have boosted the effect on FMS.

### Limitations

The findings are strong but do have some limitations. First, sample sizes were mismatched across groups with more children in the intervention than the control group. However, the statistical tests that we used were tolerant to this, and the groups well-matched for background characteristics which gives us confidence that this did not effect the findings. Sample size overall was very good. Initially, the project was underpowered (more than 20% chance of Type 2 error). However, the significant effects found mean that Type 2 error did not occur (not finding a significant effect when there is one). Type 1 error (finding a significant effect when there isn't one) is fixed at 5%, so the chance of this having occurred is very small.

Additionally, the two groups were not well-matched for EAL (42% control, 24% intervention). However, the fact that the standardised language scores for both groups were highly similar at pre-test means that the EAL children did not have poorer language skills to start with (possibly due to having been born in the UK and having two languages at home). This reassures us that different EAL levels did not influence the results. Finally, we had 30-40% missing data for FMS. This was due to logistical difficulties with testing whole classes of children simultaneously in the hall, which necessitated 4 members of research staff, plus 4 days of staff time to code the videos afterwards. We had not budgeted for RA support for this, therefore had to rely on volunteers. In future, RA support for the TGMD will be written into the budget of any further grant.

### Implications for policy and practice

The policy context for this project has progressed during the funded programme of activity. For example, the research review series for PE was published by the DFE in March 2022 (DFE 2022). Additionally, in March 2023 the government announced a two-year extension to the PE and Sports Premium funding and stated that schools will be required to deliver at least 2 hours of PE per week, with the School Sport and Activity Action Plan and new online reporting tool being subsequently published to support schools in these recommendations in July 2023 (DFE, 2023). This means that schools will be mindful of their need to fulfil these obligations but in a wider context of other curriculum pressures which will make initiatives like MAST more attractive to schools where teachers may lack confidence in delivering PE, and where the schools may feel that areas like early language and literacy work are just as much of a priority. For example, in the summer of 2023, the Youth Sport Trust published a survey of PE teachers, which found that the reduction in PE in schools was likely due to a combination of factors which included issues like timetabling, prioritisation, competition with core subjects and the pressure to 'catch-up' on Covid-related learning losses.

The national curriculum for PE in England mandates teachers to include lessons that develop fundamental movement skills, and that by the end of KS1 children should have 'mastered' their FMS (DFE, 2022). However, data consistently suggests children in the UK are not mastering the FMS at

the age they supposedly should (Duncan et al., 2022). The issue was highlighted by Ofsted in their recent review of PE provision in English schools; 'Significant gaps in motor competence are not identified and addressed quickly in many primary schools, particularly fundamental movement skills' (Ofsted, 2023). This is important in respect to MAST as the motor activities that MAST seeks to develop are explicitly linked to the FMS that teachers are expected to work on within statutory PE in KS1, and also the motor development activities that are a focus in EYFS. As a consequence, MAST directly addresses a key need and is directly aligned with the requirement of the curriculum, but in a way that is holistic and develops more than the objectives of PE.

A key focus of the guidance document for schools with respect to the PE and Sports Premium is to use the investment to increase staff confidence, knowledge and skills with respect to PE, and to invest in professional development in this area (DFE, 2023). MAST training fulfils these criteria and with increased accountability for spend, it's important to offer schools alternatives to bringing in external PE coaches. Given the success of MAST this is an area that we plan to support over the next year at least. That is, we have been in contact with the Early Years Lead in Nottingham City Council and given them an overview of MAST during a stakeholder engagement event held at NTU during April 2023. We then invited her to sit in on the training we provided for the control schools in the summer term. Following this, she fed back to local schools during a regular schools briefing, which resulted in 20 schools indicating that they would like to attend MAST training in 2023/24. An additional meeting is scheduled for September 2023 to see if there is scope to increase the number of schools who can be invited to such training in the city. Another knowledge exchange session for 50 teachers and academics was held in July in Leicestershire (this session had a specific focus on language and communication challenges in schools). Schools who attended this session have also expressed an interest in receiving MAST training. As a result of these high levels of interest in the approach, we plan to roll-out MAST training in primary schools in Nottingham in January 2024 as a first phase of impact, and to track the adoption and implementation of the programme in those settings who sent staff to receive training as a further extension to the feasibility analysis. We have applied for internal funds from NTU enable this work. We will hold other areas in the UK as potential regions for recruitment in future funded research, which will examine the efficacy of the programme when delivered to a larger cohort of schools than that used in the present feasibility study. But what is clear is that there is both an interest in MAST as an approach in Foundation and Key Stage 1, and external pressures on schools in relation to both PE hours and Covid catch-up which means that we are ideally placed to support pedagogical developments in this area.

The 'whole class' approach to implementing MAST has proved to be a particularly important element underpinning wider interest in its adoption. In a stakeholder engagement event held at NTU in April 2023, a key challenge faced by schools in the region has been the limited staffing resource (and a reduction in TAs in particular) and the need to find approaches to supporting all children, especially those who present with difficulties or delays in their learning but who do not qualify for additional resources or other support in the classroom. This means that interventions need to be suitable for delivery by existing staff within the existing timetabled sessions and need to be suitable for children with diverse needs. The fact that MAST is intended to be a whole-class session that can be adapted to respond to the specific needs of individual children means that it addresses these needs.

With respect to language development in the early years, during the summer of 2023 the All-Party Parliamentary Group on Literacy was re-convened and launched a request for evidence with respect to language development in the early years specifically (National Literacy Trust, 2023). We worked with colleagues from the Nottingham Citycare Partnership to draw up a joint response to this call for

evidence, which referenced MAST and our preliminary language findings as an approach to embedding language work in a developmentally appropriate way. We would like to see a wider conversation about the nature of language and early literacy work in Foundation Stage such that schools are encouraged to adopt more integrated approaches to teaching and learning, rather than teaching language and physical development skills in separate lessons and in isolation from each other.

### Next steps

The current project completed stages 4 (feasibility study) and 5 (pilot for outcomes) of the '10 steps for evaluation success' from the Early Intervention Foundation (EIF, 2019). The next step would be 6 'Test for efficacy'. This is defined as 'A rigorous evaluation designed to determine if an intervention works under ideal circumstances. Efficacy studies do this through research designs that systematically reduce potential sources of study bias, so that causality can confidently be attributed to the intervention model.' This trial would include a longitudinal follow-up to see if benefits were maintained over time. For example, by re-visiting the children a year later to re-test their language and FMS skills.

### Power

58 schools will be recruited to take part, with 29 schools allocated to the intervention group and 29 to the control group. Assuming that 25 children in each school participate (56% consent rate for a 1.5 form entry school), there will be 1450 children in the sample, with 725 in each arm. This will be a two-level cluster randomized design with children (level 1) clustered within schools (level 2). The power calculation is based on the language findings from the current project and assumes an intra-class correlation of 0.10, and covariates (pre-test language, pupil premium and gender) that account for 66% of variance in the post-test score (Raudenbush et al., 2011). 80% power is achieved at  $p = .05$  (2-tailed) to detect an effect size of  $d = 0.20$ . Repeating this calculation with the FMS findings from the current project resulted in a lower sample size ( $n=175$ ), hence we based the target sample size on the more conservative calculation.

### Recruitment

We are confident that we should be able to achieve this level of recruitment given the outcomes of the feasibility study and the impact work that we are undertaking in Nottingham during 2023-2024 which is raising the profile of the intervention with teachers and schools, and can be used to create marketing resources to promote school-level recruitment via social media. That is, we now have professional training resources that have been coproduced by teachers, videos of teachers implementing the sessions with reception children, and videos to support staff development in relation to teaching the motor skills concerned and we can showcase these online. We plan to couple this bottom up (school-level) promotion with top down (MAT level) conversations. Recruitment conversations with MAT CEOs and early years leads in key areas of the country will be grounded by references to specific data on outcomes in schools 'like theirs', experience of issues that the schools may face in trying to implement the project in practice, and publications that provide further evidence for them that MAST is a tried and tested approach. We would propose to recruit the 58 schools nationally rather than regionally to maximize recruitment. This will be feasible as our model for scaling up the delivery and trial logistics will centre on recruiting 'within school' project liaisons who will be paid by the project to take responsibility for overseeing the trial delivery and testing at their school site (rather than using RAs). This will mean that schools will benefit from engagement with the project not just in terms of intervention training but also in staff development for colleagues who will have responsibility for overseeing assessment of language and motor skills

(note that the motor skills assessment will be different from that adopted in this trial to enable it to be adopted and used by schools both for this project and longer term). We will work this year with schools to negotiate and cost this model of school collaboration so that we can be confident that we have costed it appropriately and in a way that will incentivise schools to engage with research.

## Key messages

- Children’s language development critically underpins later academic success, and competence in motor skills in the early years contributes to the likelihood that children will engage with physical activities and sports as they mature. This is reflected in the EYFSP, with two of the seven areas of development being ‘communication and language’ and ‘physical development’.
- For these reasons it is important to review our approaches to how to support the linguistic and physical development of children just before and at school entry.
- Given the reduction in TA funding, and the increases in children with learning needs who fall outside of EHCP resourcing (especially in the early years), for interventions to ‘work’ in practice, they need to be delivered as a whole-class approach by class teachers (although teachers do need support with this). Moreover, they need to have the potential to integrate into timetabled sessions.
- MAST offers an approach to using PE lessons as an opportunity to improve both physical and linguistic development more effectively than when PE and storytelling are taught in isolation from each other.
- MAST is effective when delivered by teachers to Foundation-age children in primary school settings, resulting in significant improvements to language and fundamental movement skills after just 12 weeks of lessons, 35 minutes, once a week.
- MAST is an approach that many early years practitioners see as developmentally more appropriate than more formal approaches to supporting both skills and embraces the imagination and chaos of very young children exploring narratives through playful movement.
- Schools’ Sport and PE premium money can be effectively used by school leaders to pay for MAST training and equipment. This aligns with the recent government announcement to extend Sport premium funding and increase accountability for its use.
- We want to share the approach of MAST with early years professionals and trainees, and school SLTs so that they feel confident to review curricular provision using an evidence-based approach that is still one that teachers can successfully adapt to suit their own teaching style and pupils’ needs.
- Given the positive effects found in the current trial, the next step for development of MAST would be an Efficacy trial. Based on power calculations using the current findings, this would need to be a cluster-randomised controlled trial involving 58 schools (29 intervention and 29 control) with 725 children in each group (1450 altogether). If positive effects hold-up under more rigorous evaluation, then the intervention will be ready for a larger-scale effectiveness trial.

## References

- Ames C. (1992). Classrooms: goals, structures, and student motivation. *J Educ Psychol.* 84(3):261–71
- Ames C, Archer J. (1988). Achievement goals in the classroom: students' learning strategies and motivation processes. *J Educ Psychol.* 80(3):260–7
- Barnett LM, Minto C, Lander N, et al. (2014) Interrater reliability assessment using the Test of Gross Motor Development-2. *Journal of Science and Medicine in Sport* 17(6): 667–670.
- Beds.ac.uk. 2015. *Supporting Primary Teachers To Promote Physical Literacy During PE Lessons – Beds.Ac.Uk | University Of Bedfordshire.* [online]  
<<https://www.beds.ac.uk/news/2015/june/supporting-primary-teachers-to-promote-physical-literacy-during-pe-lessons>>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- DFE (2023). PE and Sports Premium for primary schools. <https://www.gov.uk/guidance/pe-and-sport-premium-for-primary-schools>
- DFE (2022). Research review series: PE - GOV.UK (www.gov.uk)
- DFE (2022). NELI (Nuffield Early Language Intervention Programme) <https://www.gov.uk/government/publications/neli-nuffield-early-language-intervention-programme>
- DFE (2021). The Reading Framework. <https://www.gov.uk/government/publications/the-reading-framework-teaching-the-foundations-of-literacy>
- DFE (2021). Early years foundation stage profile handbook. <https://www.gov.uk/government/publications/early-years-foundation-stage-profile-handbook>
- Diamond A, Lee K (2011) Interventions shown to aid executive function development in children 4 to 12 years old. *Science* 333(6045): 959–964.
- Donnelly JE, Hillman CH, Castelli D (2016) Physical activity, fitness, cognitive function, and academic achievement in children. *Medicine and Science in Sport and Exercise* 48(6): 1197–1222.
- Duncan, M. J., Fowweather, L., Bardid, F., Barnett, A. L., Rudd, J., O'Brien, W., ... & Clark, C. C. (2022). Motor competence among children in the United Kingdom and Ireland: an expert statement on behalf of the international motor development research consortium. *Journal of Motor Learning and Development*, 10(1), 7-26.
- Duncan, M., Fitton Davies, K., Africa, E., & Sevel, E. (2022). Early Years professionals' perceptions and practices of motor skill development, physical activity, and healthy eating. *Education 3-13, (In-press)*.
- Duncan, M., Cunningham, A. J., & Eyre, E. (2019). A combined movement and story-telling intervention enhances motor competence and language ability in pre-schoolers to a greater extent than movement or story-telling alone *European Physical Education Review*.
- Early Intervention Foundation (2019). <https://www.eif.org.uk/resource/10-steps-for-evaluation-success>
- Early Years toolkit (2021). Early years toolkit. Accessed 23.06.21  
<https://educationendowmentfoundation.org.uk/evidence-summaries/early-years-toolkit/>

- Elliott ES, Dweck CS. (1988). Goals: an approach to motivation and achievement. *J Personal Soc Psychol.* 54(1):5–12.
- Engel A.K., Maye A., Kurthen M. and Konig P. (2013) Where's the action? The pragmatic turn in cognitive science. *Trends in Cognitive Science* 17(5): 202–209.
- Eyre, E. L. J., Clark, C. C. T., Tallis, J., Hodson, D., Lowton-Smith, S., Nelson, C., Noon, M., & Duncan, M. J. (2020). The Effects of Combined Movement and Storytelling Intervention on Motor Skills in South Asian and White Children Aged 5–6 Years Living in the United Kingdom. *International Journal of Environmental Research and Public Health*, 17(10), 3391.
- Eyre, E., Adeyemi, L., Duncan, M., Cook, K., Noon, M., & Tallis, J. (2022). Barriers and Facilitators to Physical Activity and FMS in Children Living in Deprived Areas in the UK: Qualitative Study. *International Journal of Environmental Research and Public Health*, 19(3), 1–17.
- Fricke, S., Bowyer-Crane, C., Haley, A. J., Hulme, C., & Snowling, M. J. (2013). Efficacy of language intervention in the early years. *Journal of Child Psychology and Psychiatry*, 54(3), 280–290.
- Fung, P., Pierre, T. S., Raja, M., & Johnson, E. K. (2023). Infants' and toddlers' language development during the pandemic: Socioeconomic status mattered. *Journal of Experimental Child Psychology*, 236, 105744.
- Glonek K, King PE (2014) Listening to narratives: An experimental examination of story-telling in the classroom. *International Journal of Listening* 28(1): 32–46.
- Gooch, D., Thompson, P., Nash, H. M., Snowling, M. J., & Hulme, C. (2016). The development of executive function and language skills in the early school years. *Journal of Child Psychology and Psychiatry*, 57(2), 180–187.
- Goodman G, Dent V (2016) One story at a time: Studying the effectiveness of the Story-Telling/Story-Acting (STSA) play intervention on Ugandan pre-schoolers' emergent literacy, oral language, and theory of mind in two rural Ugandan community libraries. In: The 8th qualitative and quantitative research methods in libraries conference. London, UK, 24–27 May 2016.
- Harris, J., Cale, L., & Musson, H. (2012). The predicament of primary physical education: A consequence of 'insufficient' ITT and 'ineffective' CPD? *Physical Education and Sport Pedagogy*, 17(4), 367–381.
- Hulme, C., 2021. Early language screening and intervention can be delivered successfully at scale: evidence from a cluster randomized controlled trial. *Journal of Child Psychology and Psychiatry*.
- Kory J, Breazeal C (2014) Story-telling with robots: Learning companions for pre-school children's language development. In: The 23rd IEEE international symposium on robot and human interactive communication. Edinburgh, UK, 25–29 August 2014, pp.643–648. New York: IEEE Publishing.
- Kovacs, V.A., Starc, G., Brandes, M., Kaj, M., Blagus, R., Leskošek, B., Suesse, T., Dinya, E., Guinhouya, B.C., Zito, V. and Rocha, P.M., (2021). Physical activity, screen time and the COVID-19 school closures in Europe—An observational study in 10 countries. *European Journal of Sport Science*, pp.1–10.
- Kraft, M. A., Blazar, D., & Hogan, D. (2018). The effect of teacher coaching on instruction and achievement: A meta-analysis of the causal evidence. *Review of Educational Research*, 88(4), 547–588.
- Haapala EA, Väistö J, Lintu N, et al. (2017) Physical activity and sedentary time in relation to academic achievement in children. *Journal of Science and Medicine in Sport* 20(6): 583–589.

Jaakkola T, Hillman C, Kalaja S, et al. (2015) The associations among fundamental movement skills, self-reported physical activity and academic performance during junior high school in Finland. *Journal of Sports Science* 33(16): 1719–1729.

Lander, N., Eather, N., Morgan, P. J., Salmon, J., & Barnett, L. M. (2017). Characteristics of teacher training in school-based physical education interventions to improve fundamental movement skills and/or physical activity: A systematic review. *Sports medicine*, 47, 135-161.

Law J. et al., (2017). *Early Language Development: Needs, provision, and intervention for preschool children from socioeconomically disadvantaged backgrounds*. A Report for the Education Endowment Foundation.

Lyster, S. A. H., Snowling, M. J., Hulme, C., & Lervåg, A. O. (2020). Preschool phonological, morphological and semantic skills explain it all: Following reading development through a 9-year period. *Journal of Research in Reading*.

Ma J., Michael J. Hogan, Emma L. J. Eyre, Natalie Lander, Michael J. Duncan, & Lisa M. Barnett. (2021). Enhancing the implementation and sustainability of fundamental movement skill interventions in the UK and Ireland: Lessons from collective intelligence engagement with stakeholders. *Int J Behav Nutr Phys Act*, 18(144).

McAuley, E. (1985). Modeling and self-efficacy: A test of Bandura's model. *Journal of Sport and Exercise Psychology*, 7(3), 283-295.

Meece JL, Blumenfeld PC, Hoyle RH (1998). Students' goal orientations and cognitive engagement in classroom activities. *J Educ Psychol*. 80(4):514–23.

Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science*, 6(1), 1-12.

National Literacy Trust (2023). <https://literacytrust.org.uk/policy-and-campaigns/all-party-parliamentary-group-literacy/>

Oakhill, J., & Cain, K. (2016). Supporting reading comprehension development from research to practice. *Perspectives on Language and Literacy*, 42(2), 32-39.

Ofsted (2023). [Levelling the playing field: the physical education subject report - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/114111/levelling-the-playing-field-the-physical-education-subject-report-2023.pdf)

Palmer K, Chinn, K, Robinson L. (2017). Using Achievement Goal Theory in Motor Skill Instruction: A Systematic Review. *Sports Med*. 47: 2569–2583.

Peterson D, Spencer T (2016) Using narrative intervention to accelerate canonical story grammar and complex language growth in culturally diverse pre-schoolers. *Topics in Language Disorders* 36: 6–19.

Ponitz, C. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly*, 23, 141–158.

Quigley, A. (2018). *Closing the Vocabulary Gap*. London: Routledge.

Raudenbush, S.W. et al (2011) *Optimal Design Software for Multi-level and Longitudinal Research (Version 3.01)*.



Regional Education Laboratory at WestEd (2021). Effect Size Basics: Understanding the Strength of a Program's Impact. [https://ies.ed.gov/ncee/edlabs/regions/west/relwestFiles/pdf/4-2-3-14\\_Effect\\_Size\\_Infographic\\_Final\\_508c.pdf](https://ies.ed.gov/ncee/edlabs/regions/west/relwestFiles/pdf/4-2-3-14_Effect_Size_Infographic_Final_508c.pdf)

Rudisill ME. (2016). Mastery motivational climates: motivating children to move and learn in physical education contexts. *Kinesiol Rev.* 5(3):157–69.

Sailors, M., & Shanklin, N. L. (2010). Introduction: Growing evidence to support coaching in lit[1]eracy and mathematics. *The Elementary School Journal*, 111(1), 1–6.

Sheldrick, M. P. R., Swindell, N. J., Richards, A. B., Fairclough, S. J., & Stratton, G. (2022). Homes became the “everything space” during COVID-19: Impact of changes to the home environment on children’s physical activity and sitting. *International Journal of Behavioral Nutrition and Physical Activity*, 19(1), 134.

Smith, A. (2015). Primary school physical education and sports coaches: Evidence from a study of School Sport Partnerships in north-west England. *Sport, Education and Society*, 20(7), 872–888.

Snowling, M. J., West, G., Fricke, S., Bowyer-Crane, C., Dilnot, J., Cripps, D., Nash, M., & Hulme, C. (2022). Delivering language intervention at scale: Promises and pitfalls. *Journal of Research in Reading*, 45(3), 342–366.

Sylva K., et al., (2014). *The effective provision of pre-school education (EPPE) project. Findings from pre-school to the end of key Stage 1*. London: Department for Education and Skills.

TES, 2015. *More Than A Quarter Of Primary Teachers Feel Unqualified To Teach PE*. [online] Tes. <https://www.tes.com/news/more-quarter-primary-teachers-feel-unqualified-teach-pe>

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, 19(6), 349–357.

Ulrich, D. (2020). *Test of Gross Motor Development, 3rd ed (TGMD-3 Examiner's Manual)*. Austin, Texas: Pro Ed.

van der Fels, I. M., te Wierike, S. C., Hartman, E., Elferink-Gemser, M. T., Smith, J., & Visscher, C. (2015). The relationship between motor skills and cognitive skills in 4–16 year old typically developing children: A systematic review. *Journal of science and medicine in sport*, 18(6), 697-703.

Voss MW, Carr LJ, Clark R (2014) Revenge of the still: Does lifestyle impact neuronal and cognitive health through distinct mechanisms associated with sedentary behaviour and physical activity?

Vousden, J. I., Cunningham, A. J., Johnson, H., Waldron, S., Ammi, S., Pillinger, C., Savage, R., & Wood, C. (2022). Decoding and comprehension skills mediate the link between a small-group reading programme and English national literacy assessments. *British Journal of Educational Psychology*, 92(1), e12441.

West, G., Lervåg, A., Snowling, M. J., Buchanan-Worster, E., Duta, M., & Hulme, C. (2022). Early language intervention improves behavioral adjustment in school: Evidence from a cluster randomized trial. *Journal of School Psychology*, 92, 334-345.

West, G., Snowling, M. J., LervAag, A., Buchanan-Worster, E., Duta, M., Hall, A., ... & Hulme, C. (2021). Early language screening and intervention can be delivered successfully at scale: evidence

from a cluster randomized controlled trial. *Journal of Child Psychology and Psychiatry*, 62(12), 1425-1434.

Youth sport's trust (2023): [Stop the squeeze: Schools cutting back on PE for GCSE students when they need it most - Youth Sport Trust](#)

Youth Sport's Trust, 2018. *Teachers Need More Support To Nurture A Love Of PE And School Sport* | Youth Sport Trust. [online] Youthsporttrust.org. Available at: <https://www.youthsporttrust.org/news/teachers-need-more-support-nurture-love-pe-and-school-sport>

## Appendices

### Appendix B

#### Interview schedule

1. Tell me a little bit about your school and your role within the school.
2. Were you the one to decide to take part in the project? If so, why? If not, how did you feel about taking part?
3. Have you done a movement and storytelling activity with your class before?
4. Have you run an intervention with your class before? Tell me a little bit about that. How has your experience with MAST compared with that?
5. How is the program going?
6. Are the children engaged with the sessions?
7. How confident do you feel about delivering the program?
8. Do you feel you have the support and resources you need from the research team/ management at your school? Are you satisfied with the support/ resources provided
9. Were there any elements to the approach that simply did not work/ or you struggle with?
10. What have been the best aspects of MAST? Which parts worked really well?
11. How did you manage differentiation in language/motor skills during the sessions?
12. Will you continue with the approach you currently have for the rest of the programme?
13. Would you recommend this program to other schools?

14. Will you do it again next year in some form?
15. What will you retain from the MAST approach?
16. What advice would you give to other teachers who were thinking of adopting MAST at their school?

## **Appendix C**

### **Observation Checklist**

- Duration (should be approx. 35 mins)
- Dosage (ideally twice per week)
- Structure (storytelling/priming element - PA - storytelling/embedding element)
- Differentiation
- Walking to/from classroom in character
- Acting in character during PA
- Warm up as per the teacher's guide
- Cool down as per the teacher's guide
- Practicing the skill (all activities)
- Priming/embedding phase: questioning, probing, key vocabulary.
- Teaching cues reminded throughout the session.
- Learning objectives recapped
- Learning objectives introduced
- Type of feedback (technical instruction, mistake-contingent encouragement, positive reinforcement)
- Desirable: Use a variety of equipment (e.g. when throwing provide different weights of balls, sizes, shapes, and target areas).
- Desirable: Provides children the freedom to select from choices e.g. when using stations, allow children the freedom to move between them and choice in completing it e.g. distance they want to start at, choice of object.
- Desirable: Provides pictures of activities

- Desirable: The child experiences leadership role e.g. leads the group, demonstrates.