



and limiting the possibility for engagement in academic and intellectual scholarly conversations (Eva, 2017; Klahr, 2013). This concern has remained for the past five years, and a shared understanding of terminology remains elusive across sports science and physical education disciplines. For example, scholars have published papers on the challenges resulting from variability in defining key terms related to motor development (e.g., physical literacy, fundamental motor skills) within the published literature (Bailey, 2022; Newell, 2020; Young et al., 2020). These scholars also emphasized that this lack of consistency in how the terms are understood or used could lead to miscommunication or misconception, suboptimal research on a topic, and complicate the researchers' ability to build on previous research (Bailey, 2022; Newell, 2020; Young et al., 2020). Within our diverse expert author team, we have arrived at a similar realization and concur with a similar sentiment.

Our observation of definitional disharmony relates to the specific area of motor development, in which patterns of varying definitions for terms is evident. The broad and fluid use of evolving terms within motor development has created indistinctness in terminology within the published literature and across the disciplines of sports science and physical education (see Table 1). For example, the term 'fundamental motor skill' has been defined as the 'building blocks' of more advanced, complex movements (Logan et al., 2018). More recently, other terms such as 'core developmental activities' have been proposed to be used as they better reflect the definition (Newell, 2020; Newell & Rovigno, 2021). The lack of a clear definition can lead to unclear agreement about what the term encompasses (Bardid et al., 2015; Rudd et al., 2015; Rudd et al., 2017). Thus, this current study investigates the implied meaning of the relatively contemporary term 'motor performance skills' in the motor development field of sports science and physical education. The promotion of motor performance skills in physical education and sport is a key task of physical education teachers and coaches, which is why a clear definition is needed for both practitioners and researchers in the field (Hastie et al., 2013).

The earliest reference to the term 'motor performance skills' that we identified in the scientific literature was from six decades ago. In fact, a 1964 article in the *Physical Educator* journal titled 'Play has a Higher Level' by Bond (1964) makes inferences that motor performance skill comprises movements such as running, jumping, hopping, skipping, sliding, climbing, balancing, rolling, throwing, kicking, striking, following a rhythmic pattern. Bond (1964) also proposed that a child at school with advanced motor performance skills requires dynamic situations to apply and test their skills. The term was referenced sporadically from the 1990s to 2021 in papers predominantly related to children and youth in sports science and/or physical education disciplines by some of the field's most distinguished leaders. It was not until the ground-breaking work by Behringer et al. (2011) examining the effects of strength training on motor performance skills in children and adolescents that a renewed interest in using the term 'motor performance skills' emerged.

Despite the use of the term in the published literature, a comprehensive definition or explanation is unstated. The varying usage of terms and their definitions in motor development can be challenging and certainly results from the lack of an explicit definition in the literature. Two of the primary challenges of the term 'motor performance skills' are the lack of a standard definition and the use of the term interchangeably with other terms to describe similar phenomena in the literature. A comprehensive definition on how 'motor performance skills' are being operationalized and measured is unavailable. Furthermore, the application of different terms that vary significantly leads to challenges in finding the literature on motor performance skills. This in turn hampers researchers' ability to expand this field of knowledge and avoid duplication of effort. Hence, developing a comprehensive definition of the term 'motor performance skills' will provide greater clarity and therefore needs to be prioritized (Barnett et al., 2016).

This study closely examines how researchers conceptualized and operationalized the term 'motor performance skills' in the sports science and/or physical education literature. The three aims of this scoping review are: (1) describe the use of the term 'motor performance skills'; (2) distinguish the observed depth of interpretation of the term in published research papers; (3) develop a comprehensive definition of 'motor performance skills' based on interpretations already used in the scientific literature.

## METHODS

### Design

According to the principles of a scoping review, we intended to keep the research question broad (i.e., describe, distinguish, develop the usage and definition of motor performance skill), defined strict study inclusion later based on the results of the current preliminary appraisal, and provided a qualitative instead of quantitative assessment vis-à-vis, methods adopted by systematic review and meta-analyses (Armstrong et al., 2011). More specifically, this scoping review followed the rigorous methodology developed by Levac et al. (2010). A protocol was developed and revised using the Preferred Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines and reports the required information accordingly (Tricco et al., 2016). The PRISMA-ScR checklist was completed to report this review and is available in the Open-Source Framework (OSF) (<https://osf.io/hpk7d/>). The scoping review protocol was registered on the OSF on the 13<sup>th</sup> of March 2022. Any divergence from the protocol is noted in the following section. Following the identification, screening and eligibility phase of the scoping reviewing, 22 full articles were eligible for data synthesis and content analysis (Figure 1).

For this study, a content analysis approach was deemed an acceptable method to analyze and interpret information to identify patterns, characteristics, features and the relationship between motor performance skills and human movement (Graneheim et al., 2017). We conducted a qualitative content analysis of the following; (1) explicit inferences of

**Table 1.** Various definitions for terms used in the motor development field

Term	Definitions
Fundamental motor skills	“[are] the building blocks for learning the more complex actions of sport and physical activity in diverse [...]“ (Newell, 2020) “are basic patterns of movement such as running, jumping and catching.” (Bolger et al., 2020)
Fundamental movement skills	“[are] a group of motor behaviours which include locomotor, object manipulation and stability skills.” (Rudd et al., 2015) “[are] basic learnt movement patterns that do not occur naturally and are suggested to be foundational for more complex physical and sporting activities.” (Barnett et al., 2016)
Motor abilities	“[comprise] general body coordination through an ability to organise the body to produce smooth, well-timed movement in response to interactions with practice conditions, task requirements and constraints.” (Hands et al., 2018) “consist of endurance, strength, speed, coordination and flexibility.” (Lämmle et al., 2010)
Motor competence	“can be conceived as a person’s level of performance on one or more specific skills or different motor acts, including coordination of both fine and gross motor skills that are necessary to participate and function effectively in everyday life.” (Sigmundsson et al., 2021) “is an important component of athleticism for youths, and refers to one’s ability to perform goal-directed tasks which require controlled and coordinated movement of the human body.” (Burton et al., 2021)
Motor performance skills	“[are] crucial skills, such as running, jumping, climbing and throwing.” (Mathisen, 2016) “[are] essential components in different types of sports. It can be assumed that there is a positive transfer of resistance training effects to sport-specific performance in young athletes.” (Behringer et al., 2011)
Motor skills	“[are an] ability of the nervous system to control motion performance. Motor skills are divided into gross and fine motor skills.” (Sutapa et al., 2021) “[are] learned sequences of movements that are combined to produce a smooth, efficient action in order to master a particular task.” (Davis et al., 2011)
Neuromuscular performance	“[is an] ability of the neuromuscular system to functionally control and drive movements by an appropriate integration, coordination and use of sensory feedback, reflex activity, central motor drive, muscle recruitment pattern, muscular excitation-contraction coupling, and energy availability.” (Faude & Donath, 2019) “[comprise] dynamic or complex multi-joint movements.” (Wright et al., 2020)

what is known about motor performance skills; (2) demonstration of what motor performance skills are; (3) existing descriptions and explanations. The qualitative analysis is then used to formulate and coin a comprehensive definition of ‘motor performance skills’.

### Search Strategy and Screening

Following established scoping review methods (Munn et al., 2018), the keywords “motor performance skills” OR “motor skill performance” OR “motor performance” were used to conduct searches of the following electronic databases; PubMed/Medline, Web of Science, and Scopus. To ensure all eligible articles were identified, the first ten pages of Google Scholar search results (using the same key search terms listed above) were cross-referenced with the compiled inclusion bibliography, and additional eligible articles were collected. All databases were searched initially from inception to the 25<sup>th</sup> of February 2022. Furthermore, hand searching was conducted by selecting papers from relevant citations from included papers and checking recent publications by the lead authors. To be included in the review, the papers were required to meet the inclusion and exclusion criteria in Table 2.

All titles and abstracts returned from the search were independently assessed for suitability by two researchers (AS & KT), with discrepancies to be resolved by discussion. The authors discussed the articles to confirm the final list of in-

cluded papers. During the screening, any articles the reviewers were unsure about were discussed with a third author (PF) until consensus was reached. The inter-rater reliability was high (81.1% agreement). Papers included conceptual articles that used the term ‘motor performance skills’ and primary research articles that also used the term ‘motor performance skills’. Even though scoping review methods do not require a methodological quality assessment of included articles to be conducted (Tricco et al., 2016), papers included for this review were required to be published in peer-reviewed journals and not be regarded as grey literature. The focus of this review was to map both conceptual articles and original research papers that used the term ‘motor performance skills’ in the field of motor development related to sports science and/or physical education disciplines, thus exclusion or ranking of papers based on study quality may be inappropriate in the context of this scoping review.

### Data Extraction and Synthesis of Findings

Content that inferred or provided meaning to the term ‘motor performance skills’ was collected by searching peer-reviewed articles. The data extraction included content relating to ‘motor performance skills’ and coded as; extrapolating, demonstrating (showing by example), describing, or explaining. The data coding was conducted independently by two reviewers (AS, KT) and then reviewed

Figure 1. PRISMA flowchart for identification, screening, eligibility, and inclusion of articles

Table 2. Articles inclusion and exclusion criteria

Inclusion	Exclusion
(1) Articles that extrapolate or define, or demonstrate by example motor performance skills;	(1) Articles that do not use the term ‘motor performance skills’;
(2) Studies must: a. Use the term motor performance skills in-text; b. Be reported within the sports science and physical education discipline context.	(2) Case reports, conference abstracts, editorial and opinion pieces, book chapters, book reviews, and book synopsis;
(3) All peer-reviewed academic publications that are conceptual, theoretical, reviews, or original research articles will be included.	(3) Articles where full text is not available; (4) Full text not available in English; (4) Articles that are not peer-reviewed.

to check for consistency. The data were analysed through open coding (careful reading, highlighting key phrases and segments of text relating to descriptions or definitions of motor performance skills). Data charting was completed within spreadsheets and tables to organise extracted information (Cornish et al., 2020). The spreadsheet tables included information pertaining to the term and definitions of motor performance skills. Inductive reasoning and analysis were used to synthesise the critical information from the data in response to the scoping review’s aims (Braun & Clarke, 2006; Colorafi & Evans, 2016). After data extraction was completed, a qualitative content analysis was conducted to formulate a standardised definition of ‘motor performance skills’.

The content analysis was conducted to analyse the extracted information and interpret its meaning using a systematic coding approach to identify patterns and relationships in the data (Graneheim et al., 2017; Vaismoradi et al., 2013). This approach was deemed appropriate as it allows a reliable analysis through systematic examination and evaluation of meanings and context (Manimozhi & Srinivasan, 2018). In using this approach, the authors included the coding and abstraction phase of data analysis as suggested by Elo and Kyngäs (2008). The ‘observed use and level of interpretation’ (OULI) of the term ‘motor performance skills’ within the paper were coded in bands according to their complexity level and comprehensiveness. The coded categories or rating bands were: ‘extrapolation’, ‘demonstration’, ‘description’, ‘explanation’. The paper’s content was coded as “extrapolation” when authors inferred meaning about motor performance skills within the text. The OULI was coded as “demonstration” if examples of the term were provided. The OULI was rated as a “description” if it provided characteristics and features of motor performance skills. Lastly, the OULI in the paper was rated as an “explanation” if it provided a stated meaning, identified essential qualities, and demonstrated a relationship to human movement potential.

## RESULTS

The coding of the observed depth of interpretation of the term “motor performance skills” in the included papers are presented in Table 3. Eighteen papers (~81.8%) provided examples of motor performance skills, while only three papers (~13.6%)

provided an explanation reflecting the level of complexity to enhance understanding. Table 4 summarizes the range of motor performance skills examples appearing in the included papers published until 2021. The identified examples were assessed and grouped according to Mraković et al. (1993) into four categories of movement skills. Table 5 outlines the characteristics, features of motor performance skills and the effect on movement potential observed in the included papers. These attributes and meanings assigned by researchers and academics were then extracted and used to formulate the comprehensive definition detailed in the discussion.

## DISCUSSION

This scoping review offered a novel insight into the depth of interpretation of the term ‘motor performance skills’ provided by researchers and academics. A surprising finding is that many analyzed papers did not provide a relational and extended abstract definition. The comparison of 22 papers demonstrated wide variability in the meaning of the term ‘motor performance skills’ being used, and no single comprehensive definition or detailed explanation of the construct was observed in the literature. The use of the term motor performance skills over the last 30 years to represent the motor domain accentuates the importance of researchers possessing a shared global understanding and a relational and extended abstract definition.

The literature did provide four distinct aspects pertaining to the definition of ‘motor performance skills’. These aspects were; (1) they are crucial skills for athletic performance and engagement in sports (Behringer et al., 2011; Faigenbaum, 2000; Faigenbaum et al., 2016; Harries et al., 2012; Zwolski et al., 2017); (2) required for everyday movement tasks (Greene & Wight, 1990; Kwon & Ahn, 2016; Mathisen, 2016); (3) require learning and development (Altinkok, 2017; Faigenbaum et al., 2016; Greene & Wight, 1990; Hastie et al., 2018; Mathisen, 2016); (4) are interrelated with muscular fitness, which encompasses key critical motor abilities such as explosive strength (Behringer et al., 2011; Boyat et al., 2017; Sortwell et al., 2021). These key multifaceted elements may form the foundation for the development of a comprehensive definition of ‘motor performance skills’, which can be explored further by examining the quality of the current descriptions. In addition, using a term which is specific and has a shared understanding in sports science and physical education disciplines supports professionals in understanding and planning for the development and transition of skills. Moreover, this will support the long-term development of physical health literacy in children and adolescents, supporting life-long engagement in physical activity (Lloyd et al., 2016).

Scholars and readers can easily construe the research context regardless of readers’ knowledge base. This issue is crucial for the term motor performance skills, considering

**Table 3.** Coding of the observed depth of interpretation of the term motor performance skills

Reference	Depth of interpretation			
	Extrapolation	Demonstration	Description	Explanation
Altinkok (2017)		✓		
Behringer et al. (2011)		✓	✓	✓
Boyat et al. (2017)	✓			
Faigenbaum (2000)		✓		
Faigenbaum (1993)		✓		
Faigenbaum et al. (2007)		✓		
Faigenbaum et al. (2016)	✓	✓	✓	
Faigenbaum et al. (2009)	✓	✓		
Fischetti et al. (2019)		✓		
Gondin et al. (2011)		✓		
Greene et al. (1990)		✓		
Harries et al. (2012)	✓	✓	✓	
Lee et al. (2020)		✓		
Martino et al. (2021)		✓		
Mathisen (2016)	✓	✓	✓	
Peitz et al. (2018)	✓			
Piazza et al. (2014)		✓		
Sortwell et al. (2021)		✓	✓	✓
Sortwell et al. (2022)		✓	✓	✓
Tveter et al. (2010)	✓			
Zech et al. (2010)	✓			
Zwolski et al. (2017)		✓		

**Table 4.** Showing by example motor performance skills in the literature

Categories	Examples from the literature
Space covering	<ul style="list-style-type: none"> <li>- agility (Altinkok, 2017; Faigenbaum, 2000);</li> <li>- lateral movements (Greene &amp; Wight, 1990);</li> <li>- running (Altinkok, 2017; Faigenbaum, 2000; Faigenbaum et al., 2009; Faigenbaum et al., 2016; Fischetti et al., 2019; Gondin et al., 2011; Greene &amp; Wight, 1990; Harries et al., 2012; Mathisen, 2016; Sortwell et al., 2022; Sortwell et al., 2021; Zwolski et al., 2017);</li> <li>- shuttle runs (Behringer et al., 2011; Faigenbaum et al., 2007).</li> </ul>
Surmounting obstacles	<ul style="list-style-type: none"> <li>- climbing (Mathisen, 2016);</li> <li>- jumping (Behringer et al., 2011; Faigenbaum et al., 2016; Gondin et al., 2011; Harries et al., 2012; Mathisen, 2016; Sortwell et al., 2022; Sortwell et al., 2021; Zwolski et al., 2017);</li> <li>- long jump (Behringer et al., 2011; Faigenbaum, 2000; Faigenbaum et al., 2009; Fischetti et al., 2019; Harries et al., 2012);</li> <li>- climbing (Mathisen, 2016);</li> <li>- vertical jump (Behringer et al., 2011; Faigenbaum et al., 2009; Fischetti et al., 2019; Harries et al., 2012; Piazza et al., 2014; Requena et al., 2005).</li> </ul>
Object manipulation	<ul style="list-style-type: none"> <li>- catching (Sortwell et al., 2022);</li> <li>- dribbling (Sortwell et al., 2022);</li> <li>- in-hand manipulation (Lee et al., 2020; Martino &amp; Lape, 2021);</li> <li>- motor dexterity (Martino &amp; Lape, 2021);</li> <li>- object control with the feet (Altinkok, 2017);</li> <li>- throwing (Altinkok, 2017; Behringer et al., 2011; Faigenbaum et al., 2016; Mathisen, 2016; Sortwell et al., 2022; Sortwell et al., 2021; Zwolski et al., 2017).</li> </ul>
Overcoming resistance	<ul style="list-style-type: none"> <li>- medicine ball toss (Behringer et al., 2011; Faigenbaum et al., 2009; Fischetti et al., 2019);</li> <li>- stability (Kwon &amp; Ahn, 2016; Lee et al., 2020);</li> <li>- whole body coordination (Kwon &amp; Ahn, 2016).</li> </ul>

**Table 5.** Examples of manifest content used to depict motor performance skills in the literature

Categories	Examples from the literature
Characteristics	<ul style="list-style-type: none"> <li>- crucial skills that children need to master (Faigenbaum et al., 2009; Mathisen, 2016; Sortwell et al., 2022);</li> <li>- can be performed explosively (Gondin et al., 2011; Harries et al., 2012);</li> <li>- influenced by neuromuscular function (Behringer et al., 2011; Faigenbaum, 2000; Faigenbaum et al., 2009; Faigenbaum et al., 2016; Faigenbaum et al., 2007; Gondin et al., 2011; Harries et al., 2012; Requena et al., 2005);</li> <li>- development of proficiency is influenced by specific capacities, such as power, speed, and strength (Peitz et al., 2018; Sortwell et al., 2022);</li> <li>- essential components of sport movements (Faigenbaum et al., 2016; Sortwell et al., 2022);</li> <li>- muscle strength and balance are essential components in many motor performance skills (Tveter &amp; Holm, 2010).</li> </ul>
Features	<ul style="list-style-type: none"> <li>- used interchangeably with fundamental movement skills (Hastie et al., 2018; Sortwell et al., 2022);</li> <li>- improvement occurs with exposure to an appropriate stimulus (Boyat et al., 2017; Faigenbaum et al., 2009; Faigenbaum et al., 2016; Faigenbaum et al., 2007; Harries et al., 2012; Zwolski et al., 2017);</li> <li>- used interchangeably with motor skills (Alsaedi, 2020; Sortwell et al., 2022);</li> <li>- includes gross and fine motor skills (Kwon &amp; Ahn, 2016; Martino &amp; Lape, 2021);</li> <li>- need to be learned, practiced and reinforced (Mathisen, 2016; Sortwell et al., 2022).</li> </ul>
Effect on movement potential	<ul style="list-style-type: none"> <li>- improvements transfer to sporting performance (Behringer et al., 2011; Faigenbaum, 2000; Faigenbaum et al., 2016; Faigenbaum et al., 2007; Harries et al., 2012; Sortwell et al., 2022);</li> <li>- positive educational experience (Martino &amp; Lape, 2021);</li> <li>- prepare children for participation in sport (Faigenbaum, 2000; Sortwell et al., 2022);</li> <li>- essential components in sports (Behringer et al., 2011; Faigenbaum et al., 2009; Faigenbaum et al., 2016; Zech et al., 2010);</li> <li>- reduce injuries (Faigenbaum et al., 2009; Fischetti et al., 2019);</li> <li>- higher participation levels in health-enhancing physical activity and fitness activities later in life (Sortwell et al., 2021);</li> <li>- supports physical literacy (Sortwell et al., 2021);</li> <li>- foundation for complex sport-specific skills (Sortwell et al., 2021);</li> <li>- determinant of enjoyment and future participation in physical activity (Sortwell et al., 2022).</li> </ul>

the interdisciplinary research collaborations that examined a strong background in physical education but are interested in how motor performance skills proficiency contributes to

participation levels in physical activity and associated health outcomes. Providing a high-quality, relational and extended abstract definition of ‘motor performance skills’ can significantly improve consistency and understanding within and across fields of study.

Based on how the term was used in the research literature, we can infer that the meaning of ‘motor performance skills’ has been interpreted in somewhat similar ways. We suggest that high-quality, relational and abstract definitions would be beneficial to solidify a globally shared understanding, which guides the interchangeable use across and within fields of knowledge. Therefore, given the current variability and no evident existence of a comprehensive definition for motor performance skills, after a thorough systematic scoping review, we have achieved our aim of comprehensively defining ‘motor performance skills’ as:

*Motor performance skills form the basis for developing specialized movement and sports skills through childhood, adolescence, and across the lifespan. Motor performance skills involve space-covering movements such as rolling, crawling, walking, running, changing direction and dodging. Motor performance skills also involve movements required for surmounting obstacles (vertical, diagonal, horizontal), including jumping, landing, climbing, skipping, hopping, and leaping. Motor performance skills encompass object manipulation such as throwing, catching, shooting, targeting, tossing, dribbling and other movements that enable the handling of objects. Motor performance skills distinctly require different degrees and kinds of pushing, pulling, holding, and carrying to overcome and or manipulate static and dynamic forces when participating in movement activities. Development of motor performance skill proficiency increases the ability of the individual to adapt to situations with increasing demands with respect to form, speed, accuracy and complexity of the skilled performance.*

### Strength and Limitations

One of the strengths of this paper is undoubtedly the adequacy of the proposed comprehensive definition, which is grounded in a combination of previously published research descriptions, coupled with the knowledge of researchers and academics who are experts in this area. In our view, the study has three limitations. First, the inclusion criterion of the presence of the term ‘motor performance in skills’ or ‘motor skill performance’ in the title and/or abstract may have resulted in relevant studies being overlooked during the literature search. However, the ‘motor skill performance’ term was included to increase the scope of papers that may have used motor performance skills within the full text. As we used only publications in English, we have to acknowledge that authors from non-English backgrounds had to translate their native language concepts into English. This is often more than merely a translation and may involve transculturation (Choi et al., 2012). In that case, our content analysis may contain incomplete characteristics, features, examples and effects of motor performance skills on human movement.

Furthermore, we could not determine how many papers in sports science and physical education literature in non-En-

glish speaking countries use the term ‘motor performance skills’ and how they may add meanings that are not captured in English. Throughout the review, it was not possible to determine the researchers’ rationale for providing an inadequate or no operational definition of the term. Researchers may assume that readers understand motor performance skills in-depth and that a comprehensive definition is unnecessary. This lack of clarity is an important issue as the study of motor performance skills continues in a broader context of physical education and sports sciences, such as physical literacy (Lloyd et al., 2016). To the best of our knowledge, this is the first study that tried a deeper interpretation of the term ‘motor performance skills’ provided by researchers.

### CONCLUSION

This study examined how researchers in the fields of sports science and physical education conceptualize and operationalize the term ‘motor performance skills’ in the literature. The scoping review and content analysis notes the lack of a comprehensive explanation or definition of the term ‘motor performance skills’, potentially leading to definitional inconsistency in the academic literature. Despite this deficit in the literature, the observed interpretation of aspects related to motor performance skills appear to be aligned and in agreement. We strongly believe these aspects are essential in contributing to the comprehensive development of the definition of ‘motor performance skills’. Consequently, based on the content analysis in this paper, a comprehensive definition is proposed by the authors of this study. The new definition will help provide greater clarity and demonstrate how the term can be consistently applied in future sports science and physical education literature.

### Supplementary Materials

The scoping review protocol can be downloaded <https://osf.io/hpk7d/>

### Author Contributions

Conceptualization, A.S.; methodology, A.S. and K.T.; validation, A.S., K.T. and P.F.; formal analysis, A.S., K.T.; preparation of original draft, A.S., M.B.; writing original draft, A.S.; review and editing, R.R., M.B., H.N., P.F., V.C., U.G., F.K., E.T., B.F., H.S., L.B., R.F., J.A.; all authors reviewed, edited and gave their approval for the proposed comprehensive definition of ‘motor performance skills’. All authors have read and agreed to the published version of the manuscript.

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