Motor Skill Acquisition for Young Children with Disabilities

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We have long known the benefits of early motor activities for young children's motor skill development and other developmental domains (Iverson, 2010; National Center for Physical Development and Outdoor Play, 2010). Not only is motor skill development important in and of itself, but it has been linked to social, language, and cognitive development as well. And while motor skills develop naturally for most typically developing preschoolers, young children with disabilities often experience delays in this area. Therefore, it is essential to intervene, providing direct and intentional motor programs for children with disabilities during their early years when fundamental motor skills such as locomotion and manipulation develop. These skills form a foundation for skill development in other developmental areas.

In this chapter we will present an overview of motor development including a theory of motor development, motor challenges for children with disabilities, myths about motor development, and research that clearly demonstrates that high-quality motor programs can enhance motor abilities and overall development. In addition, using a developmental framework, we will present key features of high-quality motor interventions with examples of motor programs that exemplify these features. Lastly, we will discuss the implications for practice and policy given our current knowledge in the area motor skill development.

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Theory of Motor Development

Regardless of culture or country of origin, parents around the world see signs of early motor development when their child rolls over, sits independently, reaches and grasps objects, crawls, and walks. Over time they see motor skills becoming more refined as their child moves in increasingly more complex ways. Indeed, motor development comprises the changes in motor behavior over the lifespan and includes gross motor skills, fine motor skills, muscle tone, and the child's sensory systems.

Gross motor development refers to children's progressive ability to move about their environment using their large muscles. They include overall body coordination, balance (while moving or while stationary), agility, and strength. Early on we see infants and toddlers using their large muscles in their torso, arms, and legs to roll over, sit, crawl, stand, and walk, which enables the child to explore his/her environment by moving in increasing more efficient ways. Later, children use their gross motor abilities when undertaking everyday tasks in seated position such as eating, dressing,

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or toileting and when completing tasks in a standing position such as getting out of bed, climbing the stairs, or walking to school. *Fine motor development* refers to children's progressive ability to manipulate objects in their environments using their small muscles to grasp and release objects and modulate or change grip strength needed to manipulate objects. Fine motor skills refer to dexterity and finger speed, wrist flexibility, and steady or fluid use of fingers and hands. These skills are also important for tasks such as eating, brushing teeth, and dressing as well as school and play activities such as drawing, writing, cutting, throwing, and catching.

The development of gross motor and fine motor skills follows a somewhat predictable sequence within the child, from top to bottom and from inner body to outer body. For example, early on, infants learn to lift their head and turn their head side to side. Each time they do this, they are strengthening their muscles as they move their head with smoother, more fluid movement so as to gain a better view of the world around them. In the same way, children later develop the use of their hands and, still later, their feet, becoming increasing more proficient at manipulating objects and using their feet to walk, run, jump, and hop. These examples illustrate that young children's motor development is occurring from top to bottom. In addition, children tend to gain the use of their inner body (trunk control, arms, legs) before their outer body (hands, fingers, feet). For example, young children learn to move their arms to reach for an object, and later, they develop more proficient use of their fingers to grasp and release objects.

The progression in motor skill development is also influenced by two important factors: the child's *muscle tone* and *sensory system*. Muscle tone refers to a child's muscle development as well as their effective use of muscles. For example, strong muscle tone is initially needed for an infant to lift his head and control head rotation as well as for upright sitting, crawling, standing, and so on. In addition, the child's sensory system, especially the vestibular and proprioceptive systems, plays a major role in motor development. The vestibular system, located in the inner ear, sends input via the nervous system that controls eye movement, which enables the stabilization of eyes during head and body movement and ultimately aiding in balance and sense of spatial orientation. At the same time, the brain is receiving messages or input from the proprioceptive system, which involves the inner ear, muscles, joints, and tendons, allowing the brain to understand where the body is located and coordinate the use of muscles, joints, and tendons to continually maintain balance as a child's position and posture change. These two systems work in tandem to control motor and muscle activity to ensure the body position is balanced, regardless of the body's position. For example, when a child is learning to walk, she may be a bit wobbly, as she tries to maintain balance while moving forward. To maintain an upright position, the child may sway to the left or right, extend her arms, or bend her knees to maintain balance needed for standing and walking. In this example, the vestibular and proprioceptive systems utilize the adjusted positions of the arms, legs, and trunk to enable the child to gain balanced and coordinated movement.

Taken together, early motor progression is influenced by a child's gross motor abilities, fine motor abilities, the sequence of motor development, the child's muscle tone, and vestibular and proprioceptive systems, all of which work in tandem to support motor movement. It becomes clear that motor development is a complex and dynamic progression of motor abilities, which may not be as simple as it appears to the parent or even teachers. But as we turn our attention to the sequence of motor skill acquisition, we see how each of these interconnected aspects of motor development (gross motor skills, fine motor skills, muscle tone, sensory system) steadily progresses and shapes the child's motor skill acquisition during the childhood years (Clark, 1994, 2005; Payne & Isaacs, 2012).

Clark's "mountain of motor development" (Fig. 13.1) represents one of the most commonly accepted conceptualizations of the sequential and cumulative progression in acquiring motor skills (Clark & Metcalfe, 2002) and is consistent with

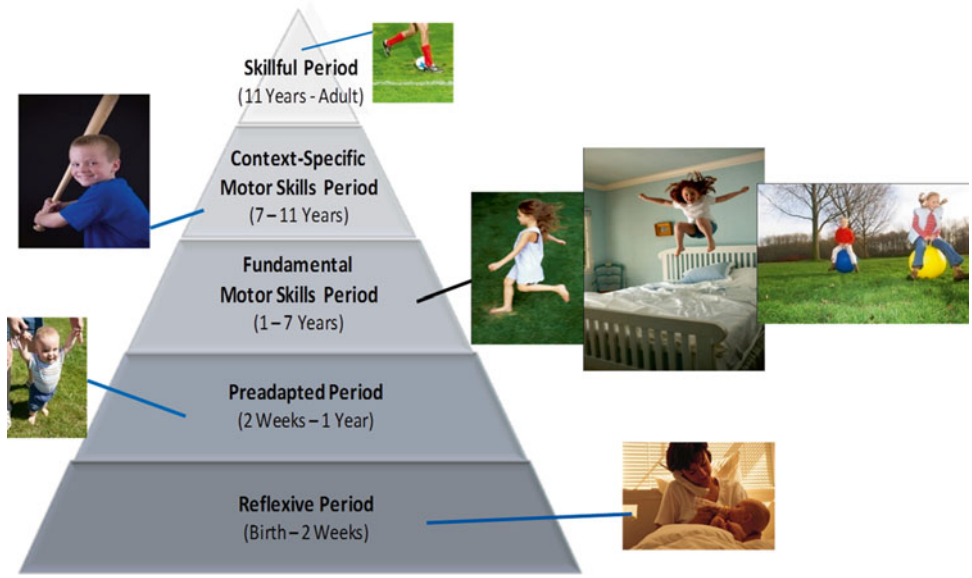

Fig. 13.1 *Clark's pyramid of motor development. Source: Adapted from Fig. 1, in Clark, J. E., & and Metcalfe, J. S. (2002). The mountain of motor development: A metaphor. In J. E. Clark & J. Humphrey (Eds.), Motor development: Research and reviews. Reston, VA: NASPE Publications*

Lerner's stage approach to development (Lerner, 1976). During the reflexive period (birth–2 weeks), motor movement is characterized by stereotypical movement elicited by specific stimuli such as the oral motor movement of the sucking reflex. The preadaptive period (2 weeks–1 year) is characterized by the attainment of new object manipulation skills needed for independent feeding (e.g., eye–hand coordination, grasp and release needed to hold a bottle, cup, or finger foods) and intentional locomotion skills such as creeping, crawling, cruising, and walking. The fundamental motor skill (FMS) period (1–7 years) includes the development of more sophisticated motor skills in both locomotion and manipulative coordination, which serve as a basis for later skills (e.g., walking and running, hopping, jumping, throwing, catching, kicking). The context-specific motor skill period (7–11 years) involves the refinement and elaboration of motor skills and often entails the complex combination of movements (e.g., run and catch at the same time), as well as qualitative cognitive shifts (e.g., learn the rules of games). The skillful period (11–adulthood) involves a young person or adult in a motor or sports environment whereby they gain very specific refinement of skills to achieve mastery (e.g., golf swing, swimming strokes, etc.).

As can be seen in Fig. 13.1, the motor skills learned during the early years correspond to the FMS development period (i.e., locomotion skills, play game manipulative skills, fine motor manipulative skills). Moreover, the acquisition of skills depends on and builds upon the motor skills in the previous period. For example, a toddler becomes proficient at walking (preadaptive period), and then those locomotion skills are honed further and combined with other skills as he learns to run with greater ease, run and stop quickly or change directions, run and jump, and run and catch or kick a ball (FMS period). In essence, the early development of motor skills form the foundation for later skill development and participation in physical activities, enabling children to control their bodies and manipulate their environment to perform complex movements used in everyday activities.

It is important to note that the development of these FMSs is not maturationally driven but requires environmental support and multiple opportunities to acquire and hone more efficient and effective skills. While motor development

occurs among most children, fluid motor development does not occur for all young children. Many young children with disabilities may experience deficits with balance/stability, gross and fine motor abilities used for locomotion, and object manipulation, all of which negatively impact their motor abilities (Goodway, Crowe, & Ward, 2003; Pan, Tsai, & Chu, 2009). In the next section, we will highlight three unique populations of young children who are recognized as having deficits in motor abilities that warrant attention during the early years: children with autism and developmental delays, children with intellectual disabilities, and children who are disadvantaged.

Children with Autism and Developmental Delays

In a meta-analysis on motor abilities of children with autism from 83 studies, Fournier, Hass, Naik, Lodha, and Cauraugh (2010) found that children with autism had challenges with motor coordination, arm movements, and gait. In addition, they have challenges with proprioception (their sense of their body's position and orientation as they move), which impacts gross motor abilities (Redlich, 2005). Several studies also confirmed that young children with autism have deficits with fine motor skills (Ozonoff, Heung, Byrd, Hansen, & Hertz-Picciotto, 2008; Pan et al., 2009; Staples & Reid, 2010). More recently, Duchan and Patel (2012) found that at least 75 % of children with autism have challenges related to muscle tone, posture, manipulative abilities, and coordination, all of which impact motor skill acquisition. Taken together, these motor challenges indicate a need for intentional motor skill interventions to ensure that the FMSs (Clark, 2005) are supported, especially during the early years.

Uzgiris (1999) theorized that an underlying factor that may contribute to these motor deficits is the absence of motor imitation, which is considered one of the earliest learning strategies for social, language, and cognitive development and a predictor of later play skills in children (Stone & Yoder, 2001). This was substantiated by McDuffie et al. (2007), who found that 2- and 3-year-old children with autism lacked the capacity to imitate behaviors, which had a negative impact on their motor as well as social and language development. Results from this collection of studies are consistent with Gowen and Hamilton's (2013) review of motor deficits found in young children with autism, confirming the presence of challenges in motor imitation, motor planning, motor coordination, balance, locomotion, and object manipulation. Likewise, in studies of young children with developmental delays (DD), Provost, Heimerl, & Lopez, (2007) and Provost, Lopez, & Heimerl (2007) found that both children with autism and DD exhibit significant motor impairment in locomotion, object manipulation, and stationary skills (such as balance) when compared to same-age peers without disabilities.

Children with Intellectual Disabilities

Similarly, children with intellectual disabilities (ID) exhibit challenges with motor abilities. Vuijk, Hartman, Scherder, and Visscher (2010) found that children with ID performed significantly low in motor abilities, with the most notable deficits in fine motor skills (manual dexterity, ball skills) and balance. Likewise, when compared with typically developing children, Westendorp, Hartman, Houwen, Smith, and Visscher (2011) found deficits in both fine motor skills and gross motor skills in children with intellectual disabilities and stressed the importance of providing attention to the development of locomotion skills and object control skills in young children with ID.

Hartman, Houwen, Scherder, and Visscher (2010) identified one possible contributing factor to motor deficits in young children with ID when they compared the motor abilities (locomotion and object manipulation) and executive functioning skills (planning, decision-making, problem solving) of children with ID to children without ID. The findings indicated that children with ID performed significantly lower on all tests of

motor abilities and executive function with a positive correlation between executive functioning and motor abilities (locomotion and object manipulation). That is, children with the low motor scores had lower executive functioning scores, and children with lower object control scores had longer execution times (took longer to perform the motor tasks). Taken together, the findings highlight the interrelatedness of motor abilities and executive functioning, suggesting the need to address both during the early years. Similar to children with autism and intellectual disabilities, there are other populations of children who do not have a disability diagnosis but who have notable deficits in motor abilities.

Children Who Are Disadvantaged

In a review of the relationship between socioeconomic status (SES) and child development, Bradley and Corwyn (2002) present a comprehensive and compelling overview of the negative impact of poverty on cognitive and academic attainment, socio-emotional development, and health. While several variables serve as moderators for child and family outcomes (i.e., family characteristics, resources), the general consensus is that children from a low SES background are at risk when they are young and the negative impact will be felt for years to come. For example, Goodway and Branta (2003) and Venetsanou and Kambas (2010) found a negative impact of low SES on motor development. McPhillips and Jordan-Black (2007) also confirmed the negative effect of low SES on motor, language, and reading abilities of over 500 preschool-age and elementary-age children. Collectively, these studies echo the findings from previous research on developmental impact associated with children from disadvantaged backgrounds (Bradley & Corwyn, 2002; Ginsborg, 2006; NICHD Early Child Care Research Network, 2005), making a strong case for motor skill intervention to address the needs of this at-risk population too.

A contributing factor to these findings can be found in the related research on physical activity of both children who are from disadvantaged backgrounds and those with disabilities. Simply put, young children with disabilities and those who are considered at-risk engage less in active motor play when compared with typically developing peers. For more discussion on this topic, see Barton's chapter on *Play* and the Brown et al. chapter entitled *Physical Activity and Young Children with Developmental Delays*. Given that active motor play is the primary context for honing motor skills and the context for learning in general, motor deficits are exacerbated by more sedentary behavior, increasing a child's risk for poor motor skill development, poor overall health, decreased self-esteem, and decreased social acceptance associated with inactivity (Fragala-Pinkham, Haley, Rabin, & Kharasch, 2005; Murphy, Carbone, & The Council on Children with Disabilities, 2008). This array of negative outcomes makes a compelling case for providing intentional motor skill programs, especially for children with disabilities and those from disadvantaged backgrounds.

Myths About Motor Development

There are several misconceptions or myths about motor development that are worth discussing before turning our attention to the connection between motor development and other developmental domains. One myth is that motor development is merely a series of milestones experienced in the same way by all children. What becomes clear from the previous section is that while motor development occurs in a general pattern for many children, there are wide variances in motor abilities. Motor skill development is shaped by both the strengths and challenges within the child (such as poor motor imitation, poor executive functioning skills associated with autism and ID, respectively). Moreover, motor development is shaped by the presence or absence of supportive opportunities to advance motor abilities needed by both children with disabilities and those from disadvantaged backgrounds.

Another myth is that motor milestones are universal and develop at approximately the same time among all children, as Clark's pyramid has

us believe. Rogoff (2003) shed some light on this myth with her extensive description of how the many aspects of one's culture can impact human development as she examined the traditional cultural aspects of gender roles, independence, and autonomy. Let us look at examples from diverse regions of the world that illustrate how cultural differences may result in variances in motor development.

In a Mayan village, boys as young as 8 or 9 hone their gross motor abilities as they cut and carry the family's wood, while young girls walk great distances, carrying their younger siblings and fetching water needed for cooking. These gender-related expectations provide early opportunities to utilize motor skills, and yet in many Western cultures, these expectations and early motor opportunities do not exist. In a Bolivian village, a 5-year-old walks 2 miles, balancing atop his head food or wares to sell at market, while a child of similar age from other countries may not be allowed to move independently until much later. These examples could accelerate the development of specific motor skills because of cultural expectations and views about independence, gender roles, and the need for young children to work to support the family. In stark contrast, far away in a Kenyan village, the cultural views of children with disabilities may serve to limit a child's motor skill development as a young child with intellectual disabilities may be restricted to an empty room in the home. In this culture, the expectations for children with disabilities are very limiting as the pervasive view is that they cannot learn or improve upon their limited motor, social, or language abilities. Not surprisingly, as the child ages, she has no language, social, or motor abilities, despite her capacity to develop all three (Favazza, Siperstien, & Ghio, 2014). These few examples illustrate that motor skill development is influenced by cultural expectations related to gender and child development and the opportunities they are given (or not given) which impact motor development. So while there is a general pattern to the developmental timing of specific motor abilities, children have culture-related influences that can accelerate or limit motor development.

A third myth is that if "critical periods" of development are missed, opportunity for development is lost forever. This myth was examined in the seminal and often quoted study of the Hopi Indians (Dennis & Dennis, 1940). They found that some infants are raised using the native tradition of tightly carrying the swaddled child on the mother's back in a cradleboard for the first 6 months of life, limiting the use of their hands and arms. They also found other infants were allowed to lay and sit on their beds, moving their arms and legs freely. The assumption was that the infants in their cradleboards would miss the critical period of motor development, when infants begin extensive motor movement of arms and legs, delaying and/or limiting their ability to walk. As it turns out, both groups of children walked roughly at the same time, dispelling the myth that missed or delayed experiences during "critical periods" limit motor development.

A fourth motor development myth is that increased motor development automatically leads to increased physical activity or vice versa that when children are engaged in play and physical activity, they will naturally become proficient in motor skill development (Goodway & Branta, 2003; Payne & Isaacs, 2012). In truth, all children are born with strengths and challenges. Some children may have talents in motor abilities, while others may have talents in their social and communication abilities. Therefore, as with all other areas of development, children need multiple opportunities to hone all of their abilities, including the area of motor development (Gallahue & Ozmun, 1998). And while motor skills are developed in the *context* of physical activity, increase in motor development does not naturally lead to increase in physical activity nor does increased physical activity automatically lead to strong motor skills. Opportunities for learning motor skills need to be intentionally supported, and opportunities for physical activity need to be intentionally provided (Brown, Pfeiffer, McIver, Dowda, Addy, & Pate, 2009).

Simply put, motor development occurs within a flexible temporal sequence and is influenced by a child's abilities or disabilities and the cultural

norms, which sometimes determine a child's early motor experiences. As we discuss in the next section, motor development can also be influential, enhancing or inhibiting development in other areas.

Connection Between Motor Development and Other Developmental Domains

During the early childhood years, there is rapid and simultaneously development and growth in young children in many areas such as communication, social, and cognitive development. Because of this rapid growth and development, it is important to understand the role that motor development plays for these developmental domains. Let us look at how FMSs (also referred to as the "building blocks" of motor development) are scaffolded from one period to the next, serving as a foundation for other areas of development (Gabbard, 2000; Payne & Isaacs, 2012) and setting the stage for school readiness.

Communication and Socialization

Motor skill development has been linked to communication and language development (Iverson, 2010; Oja & Jorimae, 2002; Piek, Dawson, Smith, & Gasson, 2008); understanding of spatial, temporal, and sequential concepts (Rapoport, van Reekum, & Mayberg, 2000); verbal fluency (Iverson, 2010; Wassenberg et al., 2005); and adaptive behavior skills (MacDonald, Lord, & Ulrich, 2013). When infants and toddlers turn their head or body toward someone speaking, crawl toward their parent, or raise their arms to be picked up, they are using motor movement to support early communication. Motor development can also impact social and emotional development as children develop social skills (Burdette & Whitaker, 2005; Provost, Heimerl, et al., 2007; Provost, Lopez, et al., 2007) or a sense of belonging and experience enhanced self-esteem and improved personal confidence (Calfas & Taylor, 1994; Dykens, Rosner, & Butterbaugh, 1998). For example, when children play on the slide or swing, they often engage in social interactions with others and, in doing so, become a part of the motor play activity using phrases such as "Look at me!, Push me!, and My turn!" These and other social exchanges serve to support social and emotional development in the context of motor play.

Cognition and Learning

When a child uses his locomotion and object manipulation skills to explore his/her environment, people, and materials, it provides stimulation that in turn leads to increased knowledge about their world. Research supports the connection between motor development and cognitive development with links to higher intellectual functioning (Ayers, 1972), pre-academic skills, and later cognitive performance (Piek et al., 2008). For example, using play equipment (cones, balls, Hula-Hoop, bean bags), children learn colors, shapes, and sizes. While lining up for a turn on the swing, they learn ordinal number words representing position (first, second, third) or use sequencing as they learn the steps to catching a ball (stand in ready position, hold hands out, eyes on ball, grasp thrown ball with hands and fingers, pull ball into chest). Through active engagement in motor play, they are learning pre-academic skills such as basic concepts (i.e., shapes, which are the precursor to learning letters and numbers) or sequencing tasks that will be used repeatedly in facilitating working memory and many other cognitive tasks. As children move, they explore their surroundings, are stimulated by the people and the objects, use both to actively engage in motor play, and, in the process, have the opportunity to develop a wide array of skills (see Fig. 13.2). Clearly motor play provides opportunities to hone not only motor skills, which in turn supports other developmental domains, all of which are vital to children's readiness to succeed in school (Bredekamp, 2005; Phillips & Shonkoff, 2000).

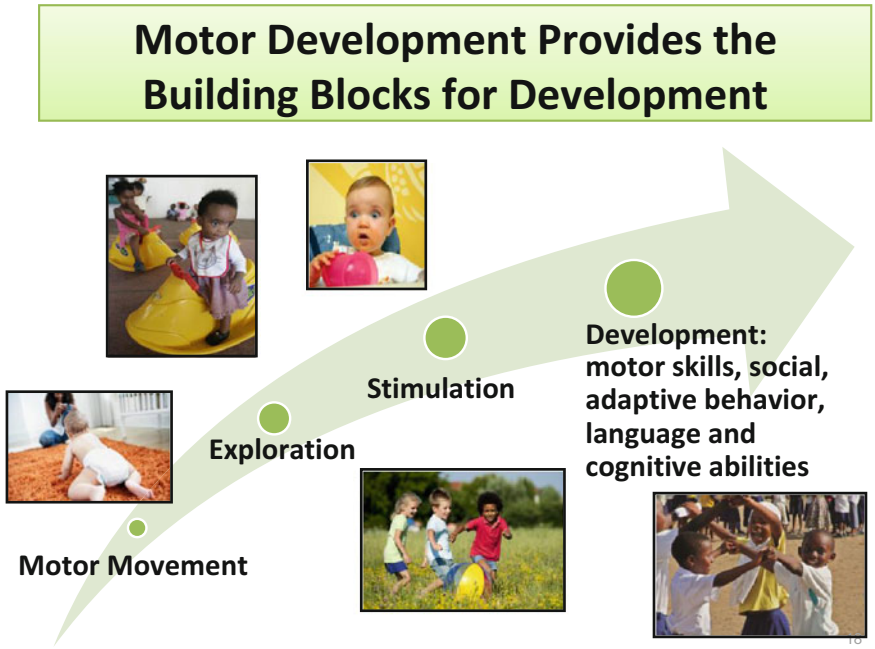

Fig. 13.2 Motor development serves as building blocks for development. Paddy created this

School Readiness

One might say that these developmental skills fall under the larger, broader umbrella of school readiness. While there are many definitions of school readiness, there is consensus that school readiness is represented by a combination of *interrelated skills* that cover a range of developmental domains that include the following: (1) physical well-being and motor development, (2) socio-emotional development, (3) language development, (4) cognitive skills (such as pre-math and pre-reading) and general knowledge, and (5) approaches to learning (Ackerman & Barnett, 2005; Howard, 2011; Kagan, Moore, & Bredekamp, 1995). For example, active participation in motor activities provides important opportunities for preschoolers to develop pre-reading, prewriting, and pre-math skills considered precursors to kindergarten readiness (Iverson, 2010; Oja & Jorimae, 2002). More recently, Becker, McClelland, Loprinzi, and Trost (2014) found that active motor play is associated with self-regulation and academic achievement in preschool children.

In sum, there is a growing evidence that links motor development to other interrelated areas of development such as social skills, language skills, and cognitive functioning, all of which influence school readiness and success in the classroom. Motor skill development facilitates participation in all aspects of the child's life. However, because of the motor challenges faced by children with disabilities and those who are from disadvantaged backgrounds, there is clearly a need for direct and intentional instruction of motor skills to support the motor development of young children, especially given the importance of motor skills for overall development. Simply put, many other areas of development depend on motor development as it impacts not only locomotion and object manipulation, but it is interrelated to language, social, and cognitive development.

Motor Skill Intervention

We have a good understanding about how motor skills develop, the myths about motor development, the unique motor challenges faced by young children, and the interconnectedness of motor development to other developmental domains and school readiness. But what do we know about the

effectiveness of motor skill intervention, the features that should be considered when selecting motor skill interventions, or the learning factors that need consideration when planning and implementing a motor skill intervention? This section will be focused on these important issues, which ensure that motor skill interventions reflect evidence-based practices and standards shaped by current professional guidelines.

Effectiveness of Motor Skill Interventions

There is a wealth of research demonstrating that the FMSs of young children with and without disabilities are amenable to change. This finding was confirmed in a meta-analysis of the effectiveness of preschool motor interventions that examined whether motor improvement for locomotion and object manipulation were similar across motor interventions and if there was a correlation between duration of motor interventions and improved FMS (Logan, Robinson, Wilson, & Lucas, 2011). The results of the meta-analysis confirmed that children who participate in motor skill interventions made significant improvements from pre-post on overall motor skills as well as gains on locomotion and object manipulation. Interestingly, the duration of the intervention was not significantly related to improvements on FMS. While this unexpected finding seems counterintuitive, the authors speculated that perhaps children reach a plateau in the development of the FMS after a period of focused instruction.

The conclusion drawn from this meta-analysis is that *intentional* motor skill interventions are effective at improving the FMSs of young children with developmental disabilities. It is also clear that these same gains in FMS do not happen for children who participate in only unstructured free play or recess. Rather, they need to be practiced with models and guidance by teachers and parents. These results have implications for the nearly 60 % of preschool-age children in the USA who are in preschool or early education centers (U.S. Department of Education, Institute of Education Sciences, 2009), many of which do not provide intentional motor skill intervention (Gagen & Getchell, 2006). The motor movement opportunities in early education settings need to include *intentional motor skill interventions* where children can learn all of the FMS through repeated practice *and* have multiple and varied opportunities to apply the motor skills learned in the context of ongoing motor play.

Evidence-Based Features of Motor Skill Interventions

Prior to implementing intentional motor skill interventions, it is important for teachers and practitioners to think about what to look for in selecting an evidenced-based motor skill program. In a meta-analysis of preschool motor interventions, Riethmuller, Jones, and Okely (2009) demonstrated the challenge of identifying evidenced-based motor skill interventions as they sought programs that possessed several key research indices such as (a) randomized design, (b) strong methodological qualities (e.g., comparable groups at baseline, documented fidelity to treatment), (c) valid measures with the individual child as unit of analysis, and (d) demonstrated effectiveness at posttest and follow-up. In addition, they sought to identify programs that possessed key intervention indices such as interventions that had (a) strong theoretical basis as evident by addressing all of the FMSs, (b) adequate duration and intensity of program, and (c) teacher/staff training and family involvement to support sustainability of outcomes. Only 17 studies of motor skill interventions met the criteria, and of these studies, less than 20 % of them possessed robust research as evidenced by high methodological quality. Subsequently, the authors made recommendations for preschool motor interventions, stressing that attention should be given to these key indices when selecting preschool motor skill interventions.

Factors to Consider When Planning Motor Skill Interventions

In addition to ensuring that motor skill interventions possess features that demonstrate evidenced-based practice, teachers and practitioners also need to think about the process by which learning

occurs so as to understand how to foster motor skills development. For this section, we turn to Newell (1986) who proposed that young children acquire motor skills through the interactions between the organism (child), the environment, and the task. Using this dynamic systems theory, we examine how learning occurs with three interacting factors: aspects of the child, the environment, and the motor task itself.

Aspects of the organism are in reference to the child. For example, if the child has a disability such as communication challenges, sensory deficits (vision or hearing), or cognitive challenges, it will influence the way in which instruction is provided. If the child has an easygoing or rigid temperament, it may impact the structure and strategies used. *Aspects of the environment* also impact instructional approaches. These could include the equipment (type and amount, appropriateness of size, and multisensory features), the space (large, small, noisy, cluttered, indoor, outdoors), or the people (number of adults and peers). *Aspects of the motor task* also impact instructional approaches. This includes considerations such as the motor movement needed for specific tasks (e.g., balance for hopping, visual tracking, and eye/hand coordination for catching) or motor activities that utilize specific motor skills. In essence, children acquire new skills through the interaction between the child, the environment, and the motor task.

Let us look at an example that illustrates how all three of these factors interact and influence a motor skill activity such as "human tunnel" (see Fig. 13.3). The successful completion of a "human tunnel" requires that a child go down on his hands and knees and hold that position, while other children crawl under the tunnel (made of several children side by side in kneeling position).

In addition to these motor movements, the ability to successfully complete this skill involves the interaction of child characteristics (cognitive understanding of the knee and the kneeling position, the ability to tolerate children in close proximity) and environmental factors (identification of a carpeted surface comfortable for kneeling, the noise level, the use of child motivators for desired behavior).

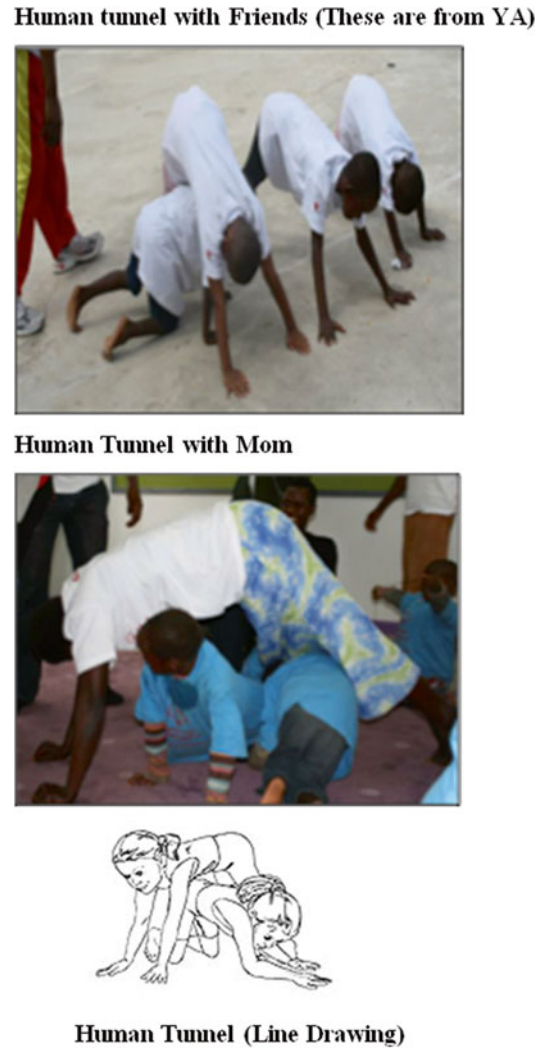

Fig. 13.3 Human tunnel with friends (these are from YA). Human tunnel with mom. Human tunnel (*line drawing*)

Therefore, factors related to the motor task (upper body strength, sustained kneeling position), the child (understanding of body parts and position, ability to tolerate the close proximity of others), and the environment (instructional approach, noise, carpeted surface) all influence the child's ability to successfully complete the motor activity and need consideration to optimize the motor outcomes of children as they participate in motor skill interventions, physical activities, and daily life. Now we turn our attention to the developmental framework and standards of National Association for Sport and

Physical Education (NASPE) and NAEYC, which are used to inform practice.

Professional Guidelines That Inform Motor Skill Interventions

While Riethmuller et al. (2009) and Logan et al. (2011) stress the need to utilize the professional guidelines to inform motor skill interventions, only a few states have a comprehensive preschool curriculum dedicated to health, motor, and physical activities (Barnett, Robin, Hustedt, & Schulman, 2003). Moreover, most preschools do not have motor skill programs that follow the requirements from the NASPE on appropriate practices in movement programs, and they are often led by teachers who lack both training and experience (Gagen & Getchell, 2006). Clearly, motor skill interventions should reflect the principles from the National Association for the Education of Young Children (DEC/NAEYC, 2009) and the recommendations of NASPE (2010, 2013) which have been carefully vetted by experts in early childhood, early childhood special education, and motor development specialist and which provide extensive information regarding planning and implementing high-quality motor skill interventions. Both organizations emphasize play as a context for learning, the need for interventions that are responsive to the developmental needs of *all* children, the need to provide interventions that includes the child's family and peers, the use of culturally responsive strategies, activities and equipment, and the provision of motor programs that address all developmental domains.

Lastly, because motor interventions provide a context for addressing child development in an integrated fashion as children acquire motor, social, communication, and cognitive skills (NASPE, 2010), the interventions need to be rooted in a developmental framework. A developmental framework *informs practice*, shedding light on the key features of motor skill interventions so as to optimize the impact on the child. In addition, a developmental perspective *focuses the attention and expectations of parents and teachers* on intentionally addressing the development of the whole child. As a result, interventions cannot be viewed simply as play as the developmental perspective *draws attention to the breadth of development* that is occurring in the context of motor skill intervention and *affects expectations for program outcomes*. The National Association for the Education of Young Children (DEC/NAEYC, 2009) identifies 12 basic principles that reflect the developmental perspective (see Table 13.1), recognizing the collateral benefits of motor programs on other areas of development. This is a critical point given the converging realities: the decrease in time allotted to motor play and physical activity (Elkind, 2007; Tucker, 2008); the need for evidence-based programs to support all areas of development (No Child Left Behind Act, 2001); the research on benefits of motor interventions on improvements in language and social skills (MacDonald et al., 2013); working memory, verbal fluency, and understanding of spatial, temporal, and sequential concepts (Jensen, 2005; Wassenberg et al., 2005); pre-reading, pre-math, and prewriting skills (Iverson, 2010; Oja & Jorimae, 2002); and self-regulation and academic achievement (Becker et al., 2014; Fedewa & Ahn, 2011). The need for motor skill interventions from a development perspective becomes apparent when we consider the potential impact on all children, especially those who are from disadvantaged backgrounds or with disabilities.

Collectively, these principles illustrate that the young child learns through active motor play with peers and family members through engagement in culturally relevant activities that match their strengths and challenges while utilizing all of their senses. As can be seen in Table 13.1, these principles are highlighted with specific examples of how each principle might be reflected in a motor skill program that informs practice (structure of programs, types of activities), focuses parent and teacher attention, shapes their expectation of developing the whole child, draws attention to the breadth of development that can occur in motor skill programs, and affects expectations for program outcomes.

Table 13.1 Principles of child development: implications for motor interventions

Play is an important vehicle for developing self-regulation and promoting communication skills, cognition, and socio-emotional competence. *Because motor play supports multiple areas of development, motor programs should provide intentional opportunities to support communication, social, and cognitive development*
Children develop best when they have secure relationships. *Secure relationships begin with the family and expand to include peers. It is critical that motor programs include family members and peers in positive motor play experiences as these experiences have the potential to positively influence overall development*
Early experiences have profound effects on development and learning. *Because the early years are a critical time period, which lays the foundation for future learning, it is important that both parents and teachers understand the broader impact that motor play can have on a child's overall development and be a participant in the motor intervention*
Learning and development follow sequences. *Therefore, to ensure success, skills addressed* in *motor programs should build upon one another with careful attention to the scope and sequence of skills and children's abilities at each developmental stage*
Development proceeds toward greater complexity, self-regulation, and symbolic or representational capacities. *A continuum of early motor experiences should reflect this gradual progression toward more complex and abstract aspects of motor play (*e.g.*, rules of a game and different roles of team members should be introduced later in the developmental continuum of early motor play activities)*
Development and learning proceed at varying rates. *Therefore, expectations and guidelines for age of transition from one motor program need to be flexible with regard to the age of transition in/out of motor programs with decisions based on abilities and interests of the child, not strictly based on chronological age*
Development and learning occur in and are influenced by multiple social and cultural contexts. *Motor play is a social experience with family members, siblings, and/or same-age peers that should include culturally relevant, interactive motor activities, songs, dance, and games*

Now we turn our attention to motor skill interventions that utilize the NASPE and NAEYC guidelines to inform practice, address the recommendations of Riethmuller et al. (2009), and employ Newell's (1986) dynamic systems theory to address the individual needs of children.

Motor Skill Interventions

There is an abundance of information and online resources on preschool motor movement programs (www.pecentral/preschool/preschoolindex.html; www.peacefulplaygrounds.com; SPARK, 2009). However, while many existing programs meet many of the NASPE and NAEYC guidelines for preschool motor programs, not all programs employ Newell's (1986) dynamic system theory or address the recommended indices for evidenced-based programs (Riethmuller et al., 2009). We will highlight four programs that meet all or most of these indices.

The SKIP Program

The Successful Kinesthetic Instruction for Preschoolers (SKIP) program (Goodway & Branta, 2003) is a 9-week instructional motor skill program designed to improve FMSs of young children through developmentally appropriate activities delivered in twice weekly sessions. Each 35-min session consists of three 10-min periods of skill instruction with time allotted for introductions and transition. The skills targeted in SKIP include locomotion (running, galloping, skipping, and jumping) and object manipulation (ball handling, striking/kicking, catching/throwing) and involve children rotating through stations, while the teacher uses a direct instruction to teach motor skills. SKIP uses developmentally appropriate practices and is adapted to individual children, the tasks, and the environment (Newell, 1986). In addition, program efficacy was demonstrated in a randomized experimental study with 57 at-risk children (4–5 years of age). The pre- to post-intervention scores on the Test of Gross Motor Development (TGMD) (Ulrich, 1985) indicated that children in SKIP had significant improvement on locomotion and object control skills as compared to children in the control group who did not make significant motor skill gains (Goodway & Branta, 2003). Similar findings were found when SKIP

was implemented with at-risk Hispanic preschoolers (Goodway et al., 2003).

JumpStart

The JumpStart intervention (Jones et al., 2011) is a 3-day a week, 20-week motor program to support five motor skills (e.g., run, jump, hop, catch, kick). The potential efficacy of JumpStart was examined in a pilot study using a randomized controlled trial with 97 preschoolers. After receiving training, teachers implemented each 20-min lesson using direct instruction of one of the motor skills, a series of fun activities to practice using the skill taught, and unstructured free play with the same equipment used in lesson. Results on the TGMD indicated that children in JumpStart showed significantly greater improvements in overall motor skill abilities and increased activity level when compared to children in control group. In addition, attention was given to components of each motor skill task, the equipment, and the environment (Newell, 1986).

The Young Athletes Curriculum

The Young Athletes (YA) Curriculum (Favazza, Zeisel, Parker, & Leboeuf, 2012) is a 3-day a week, 8-week program designed to promote the motor skill development of young children with disabilities through motor play activities that correspond to the FMS. After receiving training, teachers provide 24 comprehensive lessons (30 min each) with 187 motor activities to support the following FMS: foundational skills (visual tracking, motor imitation), walking/running, balance/jumping, trapping/catching, throwing, striking, and kicking. Teachers were encouraged to adapt the intervention with regard to the needs of the child, task, and environment (Newell, 1986) and include families, by sending suggestions for YA activities for families each week. A randomized experimental design was used to study the impact of YA on the motor skills of 234 preschool children with disabilities. Results indicated that YA participants exhibited significant gains in locomotion and object manipulation on the PDMS (Folio & Fewell, 2000) as compared to children in the control group (Favazza et al., 2013). Additional benefits reported by teachers were improvements in social/play skills and kindergarten readiness skills. These findings were replicated in Kenya and Romania with significant motor skill gains found in children with developmental disabilities (Favazza et al., 2014; Favazza, Siperstein, Ghio, Wairimu, & Masila, 2016).

Mighty Moves

The Mighty Moves intervention is an 18-week motor program that occurs for 20 min, 4 days a week (or 80 min per week) (Bellows & Anderson, 2013; Bellows, Davies, Anderson & Kennedy, 2013) and is implemented by classroom teachers utilizing 72 lessons comprised of 143 music and motor play activities. The intervention focused on all of the FMS and includes a home component and a Food Friends component to encourage children to try new healthy foods. The effectiveness of Mighty Moves was examined using a randomized experimental treatment design to study its impact on the motor skills of over 200 Head Start preschoolers. Using the PDMS (Folio & Fewell, 2000) to measure motor skills, researchers found that children in the intervention made significant gains in motor skill abilities (stability/balance, locomotion, object manipulation) as compared to children in the control group.

All of these motor skill interventions illustrate how motor skill interventions could be evaluated to ensure the use of evidenced-based practice by using the recommendations of Riethmuller et al. (2009), Newell (1986), and NASPE (2002, 2010) and NAEYC (2003) to inform decisions when selecting motor skill interventions (see Table 13.2).

Table 13.2 Indices for evaluating motor skill interventions

		SKIP	Mighty moves	YA	JumpStart
Represents evidence-based practice (Riethmuller et al., 2009)	Randomized experimental design	*	*	*	*
	Strong methodological quality	*	*	*	*
	Valid measure with child as unit of analysis	*	*	*	*
	Demonstrated effectiveness (for improving motor skills)				
	At post	*	*	*	*
	At follow-up			*	
	Comprehensive intervention components				
	Strong theoretical basis (as evidenced by addressing *most* or *all* FMS: balance/stability, walk, run, jump, hop, gallop, skip, throw, catch, strike, kick, ball manipulation)	*	*	*	
	Appropriate duration and intensity	*	*	*	*
	Family component		*	*	
	Training component	*	*	*	*
Utilizes Newell's (1986) dynamic systems theory	Attention to *at least two* of the following aspects: child, environment, and motor task	*	*	*	*
Informed by NAEYC (1998) and NASPE (2002, 2010)	Provides appropriate structure and strategies (i.e., variety of ways to engage child with motor tasks, people, equipment, space)	*	*	*	*
	Uses unstructured and structured motor experiences	*	*	*	*
	Provides guidance for adults (i.e., active involvement, observation, modeling)	*	*	*	*
	Encourages/addresses multiple developmental domains (integrates all areas of development in regularly scheduled movement experiences)				
	Is culturally responsive	*		*	
	Involves families		*	*	

*Indicates that the recommendation is addressed within the program and/or the research on the program

Moving Forward: Implications for Practice and Policy

As we look to the future of motor skill interventions, we turn our attention to implications for practice and policy, with the understanding that each of these influences the other.

Implications for Practice

There are several implications for practice that can be derived from what we know about motor skill acquisition such as the need to set the bar high when selecting motor skill interventions, rethinking motor play as a place where learning across domains intersects, intentionally addressing the needs of all children, and finding ways to increase family engagement in motor skill development. Each of these will be discussed next followed by implications for policy.

Set the bar high when selecting motor skill interventions. It is important that we examine existing motor interventions using all of the knowledge, research, and expertise available to ensure the intentional inclusion of the essential ingredients for a high-quality program. The paucity of preschool motor interventions that met high standards highlights the need to address this challenge (Gagen & Getchell, 2006; Riethmuller et al., 2009). Using the broad indices presented in Table 13.2 would be a step in that direction, ensuring that motor skill intervention addresses key ingredients. Indices such as these can be used by researchers to guide the improvement of existing motor skill interventions and used by practitioners to tailor the program

to specific programmatic needs. To do this well implies close attention to the broader context in which children and families live, so as to recognize the added value of a motor skill intervention for each unique community of learners. Only when we have done all of this will the potential of a motor skill intervention be fully realized.

Rethink motor play as a place where learning across domains intersects. For young children, learning ignites in active and interrelated ways in the context of motor play. Learning does not happen in quiet, disconnected silo fashion, separately learning skills in the three traditional domains of learning—physical, cognitive, and socio-emotional development (Stork & Sanders, 2013). Moreover, motor skill development has a corner stone role to play as it supports areas such as school readiness, which includes socio-emotional development, language development, cognitive development, and approaches to learning (Ackerman & Barnett, 2005; Howard, 2011). Because of the interrelatedness of motor skill development to other developmental domains, we can no longer afford to view motor interventions in isolation or view motor interventions in competition with academic content or view motor interventions as optional. All of these views would undervalue the importance of motor skill interventions for child development.

As suggested by Goodway, Robinson, and Amui (2007), motor skill activities present an ideal opportunity for reinforcing many pre-academic skills as children could learn counting while jumping on ten poly-dots counting by ones, twos, fives, and tens or could learn new vocabulary related to body parts, affective feelings (tired, thirsty, sweaty), and spatial, temporal, and sequential concepts (over/under, next/then, first/second) while running an obstacle course (Wassenberg et al., 2005; Westendorp et al., 2011). In the context of active motor programs, children may also hone executive function skills such as following directions and sustained attention (Best, 2010). This point is especially important for children with disabilities and those who are disadvantaged, who experience delays and deficits across multiple developmental domains.

Intentionally address differences. It is no longer optional to include children with diverse abilities in early childhood classes. Their presence is well documented and growing, reflecting the broad push for more inclusive society. And given that many inclusive school-based programs have music and motor movement classes and adaptive physical education, attention needs to be given to specific strategies that accommodate the multiple needs of children with disabilities when planning all activities. To do less would be a disservice to the children with diverse abilities. Our professional organizations have chimed in on this point in the joint position statement on early childhood inclusion, stressing the use of strategies such as universal design for learning (UDL) to ensure full access and meaningful inclusive programming (DEC/NAEYC, 2009).

UDL enables *all* children to access *all* learning opportunities, activities, and environments (Cunconan-Lahr, 2006) and provides a strategy for addressing Newell's (1986) dynamic systems theory. Specifically, UDL emphasizes the need for *multiple means of representation* (i.e., instruction and learning activities include various formats and differences in task complexity and/or expectations in response to different ability levels), *multiple means of engagement* (i.e., employing a variety of ways to motivate and obtain children's attention in response to different learning styles, interests, preferences), and *multiple means of expression* (i.e., variety of response modes used to demonstrate knowledge or skill in response to different ability levels) (CAST, 2010) to accommodate all learners. For example, using motor task of walking across a balance beam, a teacher could provide multiple means of representing a balance beam by using a taped line on the floor, a 1-in. soft foam beam and a 4-in. raised beam. This would allow children a variety of ways to access the beam task by having multiple representations of the beam. In addition, allowing a variety of graduated steps for walking on the beam illustrates multiple means of expression as some children walk with one foot on the beam, others with 2 ft on the beam, and others with 2 ft on the beam with heel/toe steps, or some could

walk backward on the beam. Another way to apply multiple means of representation could be to use balls of different sizes and density to increase the "clutch ability," which increases the likelihood of success in catching a ball for children with varying grasping strength. Such variations allow each child to fully participate, ensuring that the motor skill intervention meets the diverse needs of children in inclusive early childhood settings.

In addition, motor skill interventions have a unique potential in providing support across domains for young children who are living in poverty. Currently, international policy guidelines such as the New Millennium Goals (2013) and the Convention on the Rights of Persons with Disabilities (CRPD) (UNICEF, 2006) stress the rights of children with disabilities in all corners of the world to high-quality early childhood programs. These and other global efforts from organizations such as Special Olympics International (2015) and the Right to Play (2000) echo the voices of millions, to harness the power of motor play, especially in impoverished corners of the world to stem the negative impact on development, stigma, and isolation (Britto, Yoshikawa, & Boller, 2011). Especially in low-income urban and rural settings around the globe, motor skill interventions present a promising opportunity for halting the diminished development of children.

Embrace family-centered programs to increase family engagement. While most motor programs occur in school-based settings, there are long-held beliefs that strong family involvement is essential for optimizing child development of all children and especially those with disabilities (Booth & Dunn, 1996; Bronfenbrenner, 1979). When we place families at the center of programming in order to optimize child development, it is referred to as *family-centered programming*. Family-centered programming refers to practices that support the family's capacity to promote child development by utilizing strategies that are culturally relevant, individualized, flexible, and responsive to family needs, provide families with opportunities to make choices and decisions, and require parent–professional collaboration and partnerships to optimize child and family outcomes (e.g., Dunst & Bruder, 2002; Shelton & Stepanak, 1994).

Motor skill interventions represent an ideal programmatic match for family-centered programs as it provides a natural opportunity to replicate school-based motor skill interventions at home, as used in Mighty Moves (Bellow et al., 2013) and YA (Favazza et al., 2012). Simply put, motor skill intervention is the main stage of learning for children, and parents have a leading role to play. When planning for motor skill interventions, families should be part of the discussion, identifying motor goals for their child and identifying ways in which they can play their role in their child's development.

Moreover, while school settings should provide opportunities for planned motor programs to support child development (Logan et al., 2011), we should not rely solely on school-based programs to promote motor skill development, especially given the lack of substantive time at school for physical activity (Elkind, 2007; Tucker, 2008). When we think about home-based strategies to support motor development, we turn to the research on routine-based interventions (McWilliams, 2010) to engage families in naturally occurring home activities. These strategies take advantage of the daily interactions that occur between young children and their parents or teachers by intentionally embedding learning goals into daily routines to address all aspects of development (Campbell & Sawyer, 2007; Stremel & Campbell, 2007). Using this approach, parents identify the routines (i.e., mealtimes, bathing, or going to bed) and other regularly occurring activities (i.e., playing with siblings, going to the park, going to grandparents' home) to embed activities that support their child's development. Parents also identify common household items and materials that can be used for the motor skill intervention (i.e., kitchen towels for scarves, paired socks for small balls, tile lines on floor for balance beam, and so on). By using child and family routines and common household materials, multiple opportunities to use school-based motor intervention occur in motivating motor play with family members.

In summary, to ensure that motor skill programs meet the highest level of quality, attention needs to be given in setting a high bar when

selecting motor skill interventions, rethinking motor play as a place where learning across developmental domains occurs, intentionally addressing the needs of all children, and finding ways to increase family engagement in motor skill development. Doing so will ensure that motor skill acquisition is intentionally and thoughtfully addressed for all children without leaving it for chance development for children who have challenges or by mistakenly thinking it will automatically happen during recess.

Implications for Policy

If we are to set the bar high when selecting motor skill interventions, we need to turn our attention to implications for policy at the national and global level. Policy makers could address two specific areas: the types of motor experiences that are needed in the early years and attention to the time for and quality of motor skill interventions.

First, there are three common types of motor experiences found in early childhood settings: *unstructured motor play* (such as daily recess monitored by teachers and volunteers), *structured motor intervention* (such as physical therapy, occupational therapy, adaptive physical education for children with disabilities 1–2 times a week), and *motor and music movement* (brief motor experiences for the whole class led by early childhood teachers). What is notable is that neither of the class-wide motor experiences (recess, motor and music movement) addresses the need for *intentional* strategies to support the development of the FMS in all children. Early educators may assume the natural attainment of motor skills even though that assumption does not reflect the reality for many children. It is time to address this challenge by informing policy makers about the disconnect between the typical kinds of motor experiences found in early childhood programs and what we know it should be given about the importance of motor skills on physical activity, general health, self-esteem, and other areas of development. Relatedly, we need to engage policy makers in advocating for *class-wide* motor skill interventions that teach FMSs.

Second, it is time to utilize policy to address the time for and quality of motor skill programs in early childhood classes in this moment when national and international attention is focused on universal preschool and early education for at-risk children. According to the US Department of Education, Office of Special Education Programs' 2011 Report to Congress on the Implementation of IDEA (http://nces.ed.gov/programs/digest/d11/tables/dt11_048.asp), over the past two decades, there has been a steady increase in the number of children with disabilities who are educated in the USA. Suffice to say, the growing numbers of young children with disabilities in inclusive settings, many of who could benefit from motor skill programs. At the same time, there is increasing attention on academics and pre-academics during the early childhood years due to the No Child Left Behind Act (2001). An while most would agree that children's academic success is critical, perhaps one of the unintended outcomes of the increased focus on young children's academic success has been decreased time and programming dedicated to motor skill development, physical activities, and play, the very contexts that support overall development.

Both NAEYC (1998) and NASPE (2002, 2010) recommend substantial daily time for motor play and physical activity. However, nearly half of the preschoolers are not sufficiently engaged in motor (Tucker, 2008), and between 20 and 40 % of US schools have eliminated recess altogether (Center on Education Policy, 2008; Elkind, 2007). Diminished time for motor play, the context for honing motor skills, presents an alarming picture given that physical activity is important for general health and the need for intentional motor programs to support motor skill acquisition (Trevlas, Matsouka, & Zachopoulou, 2003; Williams et al., 2008). Clearly, motor skill programs are needed, not for a few children but for all children. Beyond offering occupational therapy and physical therapy for children with significant disabilities, motor skill acquisition needs are not given the same attention or value in the class schedule as reading, math, and sciences, which belies the foundational role that motor skill acquisition and motor movement play in all of these. Inherent in this suggestion is addressing

the squeeze on time with the implication for length of school day, which could bring resolution to the half-day versus full-day debate. Having full-day universal preschool and full-day kindergarten would ensure that there is enough time to address all pre-academic/academic areas as well as provide both unstructured and structured motor opportunities. In doing so, it could serve as a foundation for other areas of development and be in sync with the call for attention to academics and pre-academics.

Closing Remarks

The time for active learning at school and home through intentional motor interventions for all children is now. There is enough evidence of the positive and critical role that FMSs play in overall child development. It is time to intentionally address motor skill acquisition, going beyond the traditional understanding of play, and move motor interventions into the current landscape. Most early childhood classes have increasing numbers of children who have developmental delays and/or disabilities, and there is significant research on these children's motor skill deficits—such as challenges with balance, locomotion, and object manipulation. For these children, play is not a luxury but a necessity, especially given the links between active motor interventions and cognitive development, self-regulation, language and social development, self-esteem, and sense of belonging. Thus, it is time to do more than recognize the importance of play but to legitimize and expand upon the conventional view of play. Such an expanded view would include intentionally teaching motor skills with efficacy-based motor play programs during regularly scheduled school time, providing opportunities for daily physical activity to utilize those skills, and developing strategies to engage families in both. Such motor skill programs have a prominent role in our current push to nationalize preschool and the global push to open early education to all children, emphasizing the understanding that the majority of learning during the early childhood years occurs through active motor play.

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