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How actual motor competence and perceived motor competence influence motor-skill engagement of a novel cycling task

Jennifer Kavanagh | **Johann Issartel** | **Kieran Moran**

School of Health and Human Performance, Dublin City University, Dublin, Ireland

Correspondence
Jennifer Kavanagh, School of Health and Human Performance, Dublin City University, Ballymun Road, Glasnevin, Dublin, Ireland.
Email: jennifer.kavanagh32@mail.dcu.ie

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In early childhood, factors that contribute to motor-skill engagement (MSE) are unknown. Our aim was to explore the relationships between actual and perceived motor competence and their influences on MSE on a balance bike (bike with no pedals). A secondary aim was to investigate whether MSE had an effect on ability on a balance bike. This study comprised of 45 children (29% female) aged 4.5 ± 0.5 years. MSE was assessed using distance travelled on a balance bike over an 8-week period. Actual motor competence was assessed using the Movement Assessment Battery for Children, second edition. Perceived motor competence was assessed using the Pictorial Scale of Perceived Movement Skill Competence. Ability on a balance bike was measured using timed trials on a specifically designed track. Pearson product-moment correlations were used to assess relationships between actual and perceived motor competence and ability on a balance bike. Linear regressions were used to examine whether actual or perceived motor competence or ability on a balance bike predicted MSE. Repeated measures ANOVA was used to examine whether there was a difference in ability on a balance bike between three MSE groups over 8 weeks. No relationships were found, and none of the variables predicted MSE. There was a significant difference between the MSE groups on ability on a balance bike over time ($P = 0.019$). Investigating the contributors to MSE on a novel cycling task during early childhood provides knowledge to ensure children are given the best opportunities for practice and acquisition of skills.

KEYWORDS
cycling, early childhood, foundational movement skills, fundamental movement skills, skill acquisition

1 | INTRODUCTION

Motor competence can be defined as a Person's movement coordination quality and level of performance outcome when undertaking different motor skills.[1] Motor competence includes fine motor skills and gross motor skills.[2] The Movement Assessment Battery for Children, second edition (MABC-2) is a well-recognized test battery for assessing both fine and gross motor skills in 3- to 16-year-olds.[3] Fundamental movement skills (FMS) are measures of gross motor skills and are considered the most basic observable patterns of movement and are the building blocks for future movement and physical activity.[4,5] Motor development is the study of motor behavior, including motor competence and over time, and is often represented in phases of motor development.[6] The FMS phase of development, which occurs during early childhood, is a critical developmental period for children as many physiological and psychological changes take place.[7] Moreover, children are met with a hypothetical "proficiency barrier" at the end of the FMS phase of development. [5] At this point, greater mastery of FMS increases the likelihood of breaking through the barrier and applying these FMS to sport-specific skills, leading to a positive trajectory toward a lifetime participation in physical activity.[8]

Being on a positive trajectory means a child will be more likely to engage in physical activities throughout adolescence and into adulthood. The proficiency barrier was first proposed by Seefedlt (1979) in his motor development model.[5] Hulteen and colleagues have more recently highlighted the importance of this proficiency barrier by placing it in their motor development model (see Figure 1).[9] The proficiency barrier theory originated from the idea that children's perceptions of their motor competence or perceived motor competence are inaccurate and generally inflated in early childhood, but become increasingly more accurate as they transition into middle childhood.[10] In early childhood, inflated levels of perceived motor competence have been thought to drive the acquisition of actual motor competence.[11] This is as a result of theories from earlier research suggesting that perceived motor competence was tied to task engagement.[12-14]

Behavioral engagement is considered crucial for achieving positive performance outcomes as it draws on the idea of participation and includes involvement in extracurricular activities.[15] Previous research in behavioral engagement in motor skill contexts has defined motor-skill engagement (MSE) as the amount of practice.[16] It has been previously hypothesized that perceived motor competence would influence MSE in an activity.[17,18] However, to the authors' knowledge, there has been no research into the relationship between either actual or perceived motor competence or MSE of a novel skill in early childhood. In the current study, a novel skill represents a never before attempted skill.

Stodden and colleagues (2008) developed a model to demonstrate the interactions between actual motor competence, perceived motor competence, and health-related physical fitness and physical activity over time.[11] Early childhood, middle childhood, and late childhood were separated as they proposed that the relationships among the variables would change as developmental age changed. Research into this hypothesized model in early childhood has focused on the relationships between actual motor competence and both perceived motor competence and physical activity levels.[2,19-21] In most studies in early childhood, actual motor competence was measured through ability at fundamental movement skills (FMS) and physical activity was assessed through an assessment of the amount of moderate-to-vigorous physical activity achieved.[2,19-21] Research in early childhood has shown some conflicting results when assessing the relationship between actual motor competence and perceived motor competence. Barnett, Ridgers, & Salmon, (2015) found significant positive associations between actual and perceived object control skills in children aged 4-8 years.[22] Similarly, LeGear et al, (2012) and Robinson, (2011) found significant weak and moderate positive associations between actual motor competence and perceived motor competence in pre-school children.[21,23] Contrary to these results, other research has found no relationships.[20,24]

Hulteen and colleagues proposed the addition of relevant lifelong skills, like cycling, and swimming, to the FMS phase of development within the motor development model (Figure 1) as it was thought that skills learnt at this age were being neglected in research.[9] Relevant lifelong skills along with traditional FMS are defined together as foundational movement skills.[9] Cycling in particular is one of the most commonly reported active recreational pastimes during early childhood.[25] With the varying levels of participation in relevant lifelong skills in childhood, such as cycling, it is extremely important to understand the factors that may contribute to the positive engagement in these skills during the time of the initial learning process. In order for a child to learn a complex skill like cycling, engagement and persistence in the task are required. The main aim of this paper was to investigate the relationships between actual motor competence, perceived motor competence, and ability on a balance bike (timed trial on a bicycle with no pedals) and the influence of actual motor competence, perceived motor competence, and ability on a balance bike on MSE at a novel cycling skill during early childhood. These investigations are important as they may provide a better understanding of what drives a child's

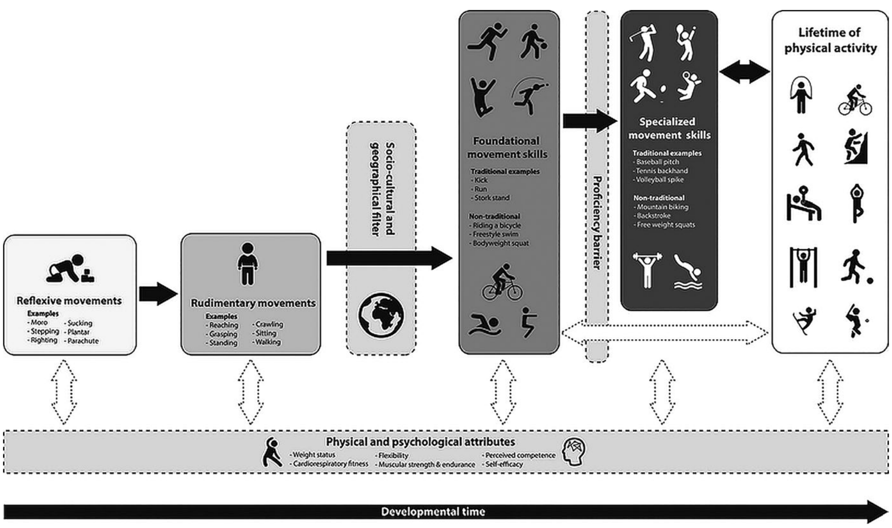

FIGURE 1 Motor development model as proposed by Hulteen et al depicting the development of foundational movement skills for physical activity across the lifespan.[9] Reprinted with permission

engagement at lifelong skills during this critical developmental window, with willingness to engage in a new skill being a potential important indicator of lifelong physical activity.

Learning to cycle is an acquired skill that requires practice to master.[26] Being able to ride a bike is fun and a popular pastime but it also opens up more opportunities for a healthy lifestyle through physical activity and transportation. Children are frequently taught to cycle using a constrained bike [ie, no pedals (balance bike/strider) or with additional wheels (bike with training wheels)] before progressing to cycling with no assistance on a traditional bike. Balance bikes are a type of constrained bike that have recently gained attention as a potentially more appropriate precursor to riding a bike, with a number of manufacturers claiming that the skills learned on a balance bike are directly transferable to riding a traditional bike.[27,28] However, no research to date appears to have examined ability on a balance bike or whether practice on a balance bike increases competency on the balance bike. The power law of practice theory would suggest that large amounts of improvement should occur during the early stages of practice on the balance bike.[29] Therefore, a secondary aim on this paper was to investigate the practice effects of a balance bike, to examine whether it is in fact a skill to be improved through practice. Furthermore, whether or not ability on a balance bike is associated with actual motor competence or perceived motor competence.

2 | MATERIALS AND METHODS

2.1 | Participants

Ninety children in total were recruited from ten pre-schools. Forty-five children (4.5 ± 0.5 years; 29% female) were given balance bikes for eight weeks to free play on and were included in the current study. Participants were included if they were between 3 and 5 years of age and had never used a balance bike before.

2.2 | Procedure

This study was approved by Dublin City University Ethical Committee (REC/2016/031), and written informed consent was provided from the parents or legal guardians for all participants. Data collection was conducted by a group of trained examiners specialized in skills acquisition in early childhood education. A warm-up was used at the beginning of the testing session which was found to provide encouragement for the children to take part in all of the data collection.

2.3 | Motor-skill engagement

Mounted counters (CATEYE Velo 5) were attached to the wheel of the balance bikes given to the children to measure each revolution of the wheel which was used to measure distance covered over the 8-week intervention period, and this was subsequently used as MSE. Parents were instructed to not allow anyone other than the participant to use the bike and to hold onto the wheel with the counter attached when moving the bike to control for additional wheel spinning during non-riding time. Parents were instructed to allow the child to decide when they wanted to play on the bike. In an attempt to assess changes in greater detail, the participants were split into high (>10.5 km), medium (2.5-10.5 km), and low (<2.5 km) MSE groups based on distance covered on the bike over the 8 weeks. Participants were split through calculation of tertiles.

2.4 | Actual motor competence

Fine motor skills, object control, and stability, as assessments of actual motor competence, were assessed using the Movement Assessment Battery for Children, second edition (MABC-2). The MABC-2 is a well-validated standardized test that assesses fundamental movement skills (FMS) of children between 3 and 16 years of age.[3] The MABC-2 assessed the participants in three fine motor skills (placing coins in a box, threading beads, and drawing trail), two object control skills (throwing a beanbag to a mat and catching a beanbag), and three stability skills (one leg balance, jumping on mats, and walking a line). The children were assessed on each skill twice, and the best score was converted into a standardized score based on their age on a scale of 1-19.

2.5 | Perceived motor competence

Perceived motor competence was assessed using the validated and reliable Pictorial Scale of Perceived Movement Skill Competence.[30] Perceived competence at each skill (run, jump, leap, hop and kick, riding a bike, riding a scooter, and skating) was scored from 1 to 4 with a minimum score achievable of 8 and a maximum score of 32. The participant was first asked to compare themselves to one of two pictures of a child performing the skill, either "well" or "not well." If they chose the child that was performing the skill "well," they were further asked if they were "pretty good" (awarded score of 3) or "really good" (awarded score of 4). If they chose the child that was performing the skill "not well," they were further asked if they were "sort of good" (awarded score of 2) or "not too good" (awarded score of 1). Each child was assessed individually at the beginning of the test period.

2.6 | Ability on a balance bike

Children's ability on a balance bike (Y-Velo) was measured, at pre- and post-intervention, using the sum of the average of two time trials over a specifically designed track that included a 4-m straight-line path and a curved path (see Figure 2). A track with both a straight and curved path was used to align the movements typically observed when playing on a balance bike. Timing gates were set up at the start and at the end of the track with the first timing gate 10 cm from the start line. Participants were instructed to go as fast as they could as ability was measured using the outcome measure of time. Seat height was adjusted per child so that while seated, both feet lay flat on the ground, and there was a slight bend in the knees.[31] Children were required to wear a helmet and given one practice trial. All children were willing and able to successfully complete the course.

2.7 | Data analysis

2.7.1 | Pearson product-moment correlations

To examine whether the children have inflated levels of perceived motor competence relative to actual motor competence, Pearson product-moment correlation analyses were run between perceived motor competence and actual motor competence. Pearson product-moment correlations were also run to assess relationships between actual motor competence [and the subcomponents of actual motor competence (fine motor skills, object control, and stability)] and initial ability on a balance bike, and between perceived motor competence and initial ability on a balance bike.

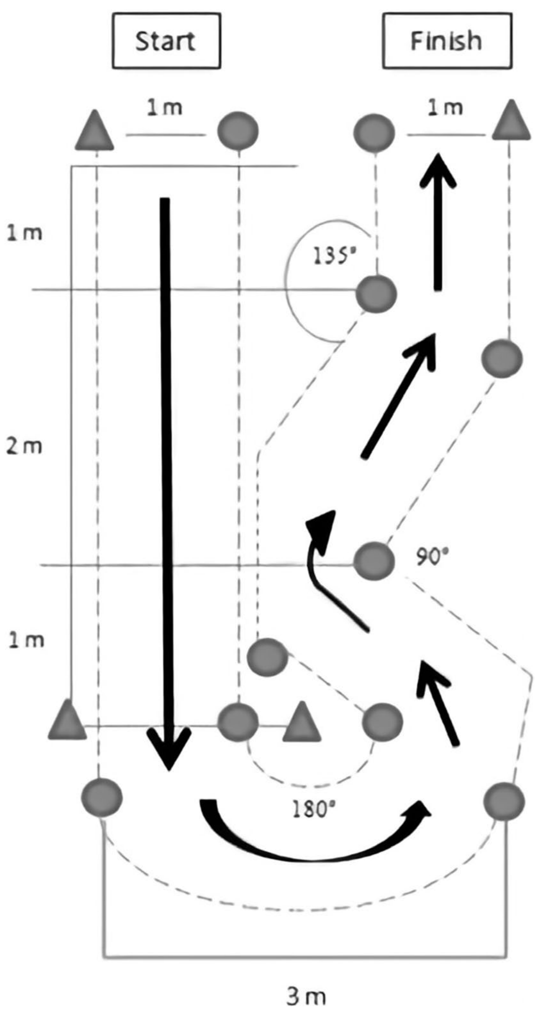

FIGURE 2 Track setup to measure ability on a balance bike. *Arrows* used to indicate direction of travel. ▲, Timing gates; ●, Big cones to indicate turn

2.7.2 | Linear regression

Six linear regression analyses were run to examine whether actual motor competence [and the subcomponents of actual motor competence (fine motor skills, object control, and stability)], perceived motor competence, or ability on a balance bike predicted MSE.

2.7.3 | 3 × 2 repeated measures ANOVA

A 3 × 2 repeated measures ANOVA and Bonferroni post-hoc test was used to examine whether there was a difference in ability on a balance bike between three MSE groups (high MSE, medium MSE, and low MSE) from before to after 8-week intervention period.

All analyses were completed using SPSS version 22 (IBM Analytics). Significance level was set at $P = 0.05$.

3 | RESULTS

3.1 | Descriptive statistics

All participants were assessed on their perceived motor competence, overall actual motor competence, fine motor skills, object control skills, stability, ability on a balance bike (pre and post), and motor-skill engagement. The mean ± SD for each of the skill categories is detailed in Table 1.

3.2 | Pearson product-moment correlations

Relationships between actual motor competence perceived motor competence and between perceived motor competence and initial ability on a balance bike and between actual motor competence and initial ability on a balance bike are presented in Table 2.

3.3 | Linear regression analyses

The results of six linear regressions, to investigate whether (a) perceived motor competence, (b) actual motor competence (combined score), (c) fine motor skills, (d) object control, (e) stability, or (f) ability on a balance bike at pre-intervention, could predict the dependent variable of MSE are presented in Table 3. None of the variables significantly predicted the MSE on a balance bike ($P > 0.05$).

3.4 | 3 × 2 repeated measures ANOVA

Differences in ability on a balance bike between three groups of MSE (high, medium, and low) across two time periods (pre-intervention and post-intervention) can be seen in Figure 3. There was a significant interaction effect between MSE groups and time, Wilk's Lambda = 0.788, $F(2,33) = 4.45$, $P = 0.019$. The post-hoc analysis revealed a significant difference between the high and the low MSE groups ($P < 0.025$) with the high MSE group producing the highest improvements in ability on a balance bike over the 8 weeks, followed by the medium group and lastly the low group. There was a substantial main effect for time, Wilk's Lambda = 0.590, $F(1,33) = 22.9$, $P < 0.001$, with both the medium and high MSE groups showing an improvement in ability on a balance bike over time (see Figure 3). There was no significant main effect for MSE groups, $F(2,45) = 0.416$, $P = 0.663$.

4 | DISCUSSION

The main aim of this paper was to examine the relationships between actual motor competence, perceived motor competence, and initial ability on the balance bike and to examine whether any of these variables predict the MSE of a novel cycling task (on a balance bike). It has been suggested that during early childhood, children have inflated levels of perceived motor competence.[10] The current results support children having inflated levels of perceived motor competence as their average perceived motor competence score was 28.1 ± 3.9 (Table 2), which was much closer (top 25% range) to the maximum score of 32 than the minimum score of 8,[30] indicating that children perceive themselves to be very good at most of the skills assessed. Moreover, the results also support children having inflated levels of perceived motor competence relative to their actual motor competence as there were no correlations between their perceptions of ability and actual motor ability, including when actual motor competence was split by subcomponents (fine motor skills, object control, and stability) (Table 3). Furthermore, these results agree with the theory that perceived motor competence has little to no relationship to actual motor competence in early childhood.[11] The high levels of perceived motor competence found in the current study are consistent with ranges previously reported in pre-school children.[21] Additionally, neither perceived motor competence nor actual motor competence was related to initial ability on a balance bike. Lopes et al[20] and Spessato et al[24] found similar results with no significant relationship between perceived motor competence and actual motor competence in pre-school children. In contrast, Barnett et al[22] found positive relationships between these factors in children aged 4-8 years, with Robinson[23] finding weak relationships in children aged 4 years, and LeGear et al[21] finding moderate relationships in pre-school children. The lack of associations found in our study is probably due to children in early childhood not having the cognitive ability to make accurate self-judgements of ability[32] or to be able to differentiate between actual motor competence and effort.[10,33]

The tendency toward inflated levels of perceived motor competence found in the current and previous studies has

TABLE 1 Descriptive statistics [mean and standard deviations (M ± SD)] for each variable

	(M ± SD)	Scoring range
Overall actual motor competence (a.u)	7.9 ± 3.2	1-19
Fine motor skills (a.u)	8.1 ± 2.9	1-19
Object control (a.u)	9.8 ± 3.4	1-19
Stability (a.u)	8.1 ± 3.6	1-19
Perceived motor competence (a.u)	28.1 ± 3.9	8-32
Ability on a balance bike (pre) (s)	14.6 ± 5.4	N/A
Ability on a balance bike (post) (s)	10.1 ± 3.9	N/A
Motor-skill engagement (km)	10.3 ± 12.4	N/A

a.u, arbitrary units; km, kilometers; s, seconds.

TABLE 2 Correlations (r) between actual motor competence, perceived motor competence, and ability on a balance bike

	Perceived motor competence (a.u)		Ability on a balance bike pre-intervention (s)	
	r	P	r	P
Overall actual motor competence (a.u)	0.024	0.955	0.123	0.618
Fine motor skills (a.u)	0.023	0.705	0.008	0.810
Object control (a.u)	0.014	0.989	0.008	0.771
Stability (a.u)	0.089	0.762	0.118	0.339
Ability on a balance bike pre-intervention (s)	0.119	0.196		

a.u, arbitrary units; s, seconds.
*Correlation is significant at the 0.05 level ($P < 0.05$).

TABLE 3 Linear regression results (r^2) to the dependent variable MSE

Predictors of MSE (km)	r^2	P
Overall actual motor competence (a.u)	0.003	0.729
Fine motor skills (a.u)	0.009	0.545
Object control (a.u)	0.000	0.930
Stability (a.u)	0.000	0.889
Perceived motor competence (a.u)	0.010	0.537
Ability on a balance bike (pre) (s)	0.002	0.782

a.u, arbitrary units; km, kilometers; MSE, motor-skill engagement; pre, before 8-week intervention; s, seconds.
*Correlation is significant at the 0.05 level ($P < 0.05$).

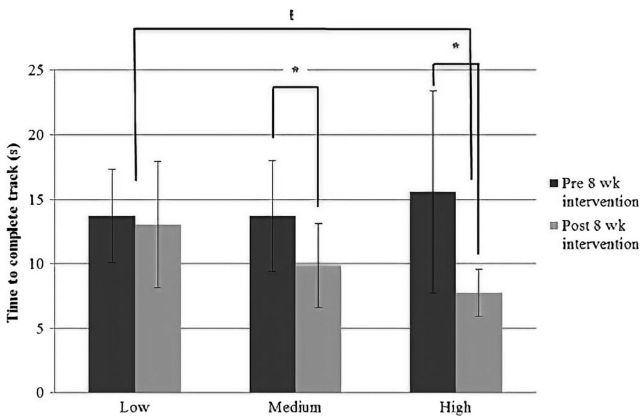

FIGURE 3 Ability on a balance bike from before to after 8-week intervention per high, medium, and low MSE groups. (Lower values indicate faster times over the course and therefore better ability). *Significant difference pre- to post-intervention at $P < 0.05$. +Significant difference pre- to post-intervention between groups at $P < 0.05$

been hypothesized to drive acquisition of actual motor competence[11] and MSE.[12-14] However, the current study found varying levels of MSE of a novel skill that was not predicted by perceived motor competence. Investigation into other measured contributors showed similar results, with neither actual motor competence (fine motor skills, object control, stability, and overall motor competence) nor initial ability on a balance bike showing predictive power toward MSE of a novel cycling task. This would indicate that it is not the perception of motor competence, actual levels of motor competence, or initial ability at the chosen skill that are driving MSE. While no comparison to other studies could be made when investigating perceived motor competence as a predictor of MSE, it is not surprising perhaps that if no relationship exists between perceived motor competence and actual motor competence then no relationship would also exist between perceived motor competence and MSE. Engagement of the skills used to measure actual motor competence (ie, fine motor skills, object control, and stability) is required in order to improve ability at these skills, as they must be learned through practice as they are not developed naturally.[34] Future research should investigate which other factors, for example parental influences,[35] environment,[36] culture and individual differences (body composition, motivation, and personality/emotional make-up),[4,34] may explain why a child chooses to engage or not in a novel skill or physical activity.

A secondary aim of this paper was to examine whether the volume of practice on the balance bike affects the amount of improvement in the ability of that skill. It was found that those who rode the balance bikes over greater distances (high MSE group) improved significantly more than those who did not (low MSE group) with the high MSE group improving by 101%, the medium MSE group by 13%, and the low MSE group by 3% (Figure 3). The large improvement made by the high MSE group fits within the power law of practice theory as generally during the early stages of practice of a novel skill there is a large amount of improvement relatively quickly.[29] This is due to the learner making large errors in the beginning that are often easy to correct after some practice. Previous studies have also shown that when you practice a certain skill you will subsequently improve at that skill.[37,38] The improvement observed is likely due to significant improvements on the balance bike emerging from greater interactions between the individual characteristics, the task constraints, and the properties of the environment.[39] Consequently to these interactions, new coordination patterns emerge allowing for greater performance on the balance bike.

5 | LIMITATIONS

The non-prescriptive nature of the intervention, while imperative to assess actual MSE, is not without limiting factors. The parents of the participants were asked to not allow anyone other than the participant to use the balance bike; however, there is no evidence that each participant was not the sole rider contributing the distance covered on the bike, and subsequently, the MSE group allocated. The counters used also only allowed for distance covered to be measured and not amount of practice which may have had an effect as some children may have moved slower but had longer practice times. Furthermore, environment, parental influences, physical activity levels, previous experience with similar toys, family demographics, parent's views on importance of learning new skills, and opportunities to practice were not recorded during the study.

6 | PERSPECTIVES

The current study has taken a unique approach to investigating the MSE of skills in early childhood. Until recently, lifelong skills like cycling, which are first learnt during the early childhood years, have been neglected in early childhood research. It was hypothesized that perceived motor competence would drive skill acquisition as children would have inflated levels of perceived competence that would increase likelihood to engage and persist at a novel task. The current results have shown that while children do have inflated levels of perceived competence, this does not appear to be a prominent driving factor in MSE of a novel cycling task. Similar to perceived motor competence, neither actual motor competence nor initial ability on a balance bike predicted a child's engagement levels on a balance bike. Investigating these relationships opens up opportunities for future research to investigate possible contributors to MSE during the early childhood years. Understanding the predictors of MSE of lifelong skills like cycling would mean that more effective strategies could be designed to ensure that children are given the best opportunities for practice and acquisition of skill during a critical developmental window, when perceptions of competence are not found to be a limiting factor.

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ORCID

Jennifer Kavanagh https://orcid.org/0000-0002-2867-7115
Johann Issartel https://orcid.org/0000-0003-1016-1409
Kieran Moran https://orcid.org/0000-0003-2015-8967

REFERENCES

1. Robinson LE, Stodden DF, Barnett LM, et al. Motor competence and its effect on positive developmental trajectories of health. *Sport Med*. 2015;45(9):1273-1284.
2. Lubans DR, Morgan PJ, Cliff DP, Barnett LM, Okely AD. Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports Med*. 2010;40(12):1019-1035.
3. Brown T, Lalor A. The movement assessment battery for children—second edition (MABC-2): a review and critique. *Phys Occup Ther Pediatr*. 2009;29(1):86-103.
4. Clark JE, Metcalfe JS. The Mountain of Motor Development. In: Clark JE, Humphrey J, eds. *Motor Development: Research and Reviews*. Reston, VA: NASPE Publications; 1989:163-190.
5. Seefeldt V. Developmental motor patterns. Implications for elementary school physical education. In: Nadeau CH, Halliwell WR, Newell KM, Roberts GC, eds. *Psychology of Motor Behavior and Sport - 1979*. Nadeau CH, Champaign: Human Kinetics; 1980, 314–323.
6. Clark JE, Whitall J. What is motor development? The Lessons of History. *Quest*. 1898;41(3):183–202.
7. Ortega FB, Ruiz JR, Castillo MJ, Sjöström M. Physical fitness in childhood and adolescence: a powerful marker of health. *Int J Obes*. 2008;32(1):1–11.
8. De Meester AN, Stodden D, Goodway J, et al. Identifying a motor proficiency barrier for meeting physical activity guidelines in children. *J Sci Med Sport*. 2018;21(1):58–62.
9. Hulteen RM, Morgan PJ, Barnett LM, Stodden DF, Lubans DR. Development of foundational movement skills: a conceptual model for physical activity across the lifespan. *Sport Med*. 2018;48(7):1533–1540.
10. Harter S. *The Construction of the Self: Developmental and Sociocultural Foundations*, 2nd edn. New York: Guilford Press; 1999.
11. Stodden DF, Goodway JD, Langendorfer SJ, et al. A developmental perspective on the role of motor skill competence in physical activity: an emergent relationship. *Quest*. 2008;60(2):290–306.
12. Harter S, Pike R. The pictorial scale of perceived competence and social acceptance for young children. *Child Dev*. 1984;55(6):1969–1982.
13. Nicholls JG. The development of the concepts of effort and ability, perception of academic attainment, and the understanding that difficult tasks require more ability. *Child Dev*. 1978;49(3):800–814.
14. Nicholls JG, Miller AT. The differentiation of the concepts of difficulty and ability. *Child Dev*. 1983;54(4):951–959.
15. Fredricks JA, Blumenfeld PC, Paris AH. School engagement: potential of the concept, state of the evidence. *Rev Educ Res*. 2004;74(1):59–109.
16. Lacy AC, Martin DL. Analysis of starter/nonstarter motor-skill engagement and coaching behaviors in collegiate women's volleyball. *J Teach Phys Educ*. 1994;13(2):95–107.
17. Eccles JS, Harold R. Gender differences in sport involvement: applying the Eccles' Expectancy-Value Model. *J Appl Sport Pyschol*. 1991;3:7–35.
18. Eccles JS, Wigfield A. Motivational beliefs, values and goals. *Annu Rev Psychol*. 2002;53:109–132.
19. Crane JR. Fundamental motor skills and perceived competence : kindergarten to grade 2. *Sports*. 2017;5(59):12–14.
20. Lopes V, Barnett L, Rodrigues L. Is there an association among actual motor competence, perceived motor competence, physical activity, and sedentary behavior in preschool children? *J Mot Learn Dev*. 2016;4(2):129–141.
21. LeGear M, Greyling L, Sloan E, et al. A window of opportunity? Motor skills and perceptions of competence of children in Kindergarten. *Int J Behav Nutr Phys Act*. 2012;9:29.
22. Barnett LM, Ridgers ND, Salmon J. Associations between young children's perceived and actual ball skill competence and physical activity. *J Sci Med Sport*. 2015;18:167–171.
23. Robinson LE. The relationship between perceived physical competence and fundamental motor skills in preschool children. *Child Care Health Dev*. 2011;37(4):589–596.
24. Spessato BC, Gabbard C, Robinson L, Valentini NC. Body mass index, perceived and actual physical competence: the relationship among young children. *Child Care Health Dev*. 2013;39(6):845–850.
25. Dunst CJ, Hamby D, Snyder D. Preschool children's emerging participation in leisure and recreation activities. *World Leis J*. 2009;51(4):219–228.
26. Åström KJ, Klein RE, Lennartsson A. Bicycle dynamics and control. *IEEE Control Syst Mag*. 2005;25(4):26–47.
27. LIKEaBIKE [Internet]. [Accessed September 5, 2018]. 2018. Available from: www.likeabike.co.uk/.
28. Strider [Internet]. *Strider Sports International*. 2018. [Accessed September 5, 2018]. Available from: www.striderbikes.com/.
29. Magill RA. *Motor learning concepts and applications*. 7th ed. Boston, MA: McGraw–Hill International, editor; 2004.
30. Barnett LM, Vazou S, Abbott G, et al. Construct validity of the pictorial scale of perceived movement skill competence. *Psychol Sport Exerc*. 2016;22:294–302.
31. Cox I. *How to Ride a Balance Bike* [Internet]. wikiHow. 2019 [Accessed February 1, 2019]. Available from: https://www.wikihow.com/Ride-a-Balance-Bike.
32. Weiss MR, Amorose AJ. Children's self-perceptions in the physical domain: between- and within-age variability in level, accuracy, and sources of perceived competence. *J Sport Exerc Psychol*. 2005;27(2):226–244.

33. Jacobs JE, Lanza S, Osgood DW, Eccles JS, Wigfield A. Changes in children's self competence and values: gender and domain differences across grades one through twelve. *Child Dev*. 2002;73(2):509–527.
34. Gallahue DL, Ozmun JC. *Understanding Motor Development*. 6th ed. New York, NY: Mc Graw Hill; 2006:46–60.
35. Freeberg NE, Payne DT. Parental influence on cognitive development in early childhood: a review. *Child Dev*. 1967;38(1):65–87.
36. Barros KMFTd, Fragoso A, Oliveira ALBd, Cabral Filho JE, Castro R. Do environmental influences alter motor abilities acquisition? A comparison among children from day-care centers and private schools. *Arq Neuropsiquiatr*. 2003;61(2):170–175.
37. Altunsöz IH. Motor skill interventions for young children. *Niğde Univ J Phys Educ Sport Sci*. 2015;9(1):133–149.
38. Morgan PJ, Barnett LM, Cliff DP, et al. Fundamental movement skill interventions in youth: a systematic review and meta-analysis. *Pediatrics*. 2013;132(5):1361–1383.
39. Davids K, Button C, Bennett S. *Dynamics of Skill Acquisition*. 1st ed. Champaign, IL: Human Kinetics; 2008;4-26.

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