

## DIFFERENCES IN MOTOR COMPETENCE BETWEEN CHILDREN PERFORMING RHYTHMIC GYMNASTICS OR EXCLUSIVELY PHYSICAL EDUCATION CLASSES: A PILOT INVESTIGATION

Fábio Flôres [1,2], Catarina Rodrigues [1], Nuno Martins [1], Renata Willig [1],  
Priscila Marconcin [1,3], Joana Lourenço [4], Denise Soares [5]

[1] Insight – Piaget Research Center for Ecological Human Development, Portugal

[2] Research Center in Sports Performance, Recreation, Innovation and Technology (SPRINT), Portugal

[3] Faculty of Health Sciences, Universidad Autónoma de Chile, Chile

[4] Instituto Superior de Estudos Interculturais e Transdisciplinares de Almada, Portugal

[5] Liberal Arts Department, American University of the Middle East, Kuwait

[fabio.flores@ipiaget.pt](mailto:fabio.flores@ipiaget.pt)

### ABSTRACT

**Background:** Well-structured environments with different opportunities, such as sports spaces, seem to enable children's development of motor skills, and rhythmic gymnastics (RG) can be an important setting to this matter. **Objectives:** Verify the Motor Competence (MC) of school-aged children practicing RG, and associate with the mesosystem opportunities. **Methods:** Forty-four children ( $7.90 \pm 1.04$  years) were divided into two groups (RG and Physical Education (PE)), and their MC were evaluated using the Motor Competence Assessment (MCA) battery. **Results:** Children involved in RG had higher scores for the locomotor component of MCA, as well as for the total MC, compared to children attending PE ( $p=0.018$ ). **Conclusions:** Our findings suggest that practicing RG may lead to better MC development in children when compared to the exclusive attendance of PE classes. Thus, children need to be encouraged to perform other physical activities outside the school, such as RG, to improve their MC.

**Keywords:** Rhythmic gymnastics, Physical activity, Childhood, Sports participation

## DIFERENÇAS NA COMPETÊNCIA MOTORA ENTRE CRIANÇAS PRATICANTES DE GINÁSTICA RÍTMICA E CRIANÇAS PRATICANTES DE EDUCAÇÃO FÍSICA: UM ESTUDO PILOTO

### RESUMO

**Enquadramento:** Ambientes bem estruturados e com diferentes oportunidades, como espaços desportivos, parecem possibilitar o desenvolvimento das habilidades motoras das crianças, e a Ginástica Rítmica pode ser um cenário importante para essa questão. **Objetivos:** Analisar a Competência Motora de crianças em idade escolar praticantes de Ginástica Rítmica e associar com as oportunidades dos seus mesossistemas. **Métodos:** Quarenta e quatro crianças ( $7,90 \pm 1,04$  anos) foram divididas em dois grupos (Ginástica Rítmica e Educação Física), e os seus níveis de Competência Motora foram avaliados através da *Motor Competence Assessment* (MCA). **Resultados:** As crianças envolvidas na Ginástica Rítmica apresentaram resultados mais elevados para o componente locomotor do MCA, bem como para a Competência Motora total, em comparação com as crianças que frequentavam aulas de Educação Física escolar ( $p=0,018$ ). **Conclusão:** Os resultados encontrados sugerem que a prática de Ginástica Rítmica pode levar ao melhor desenvolvimento da Competência Motora das crianças quando comparado ao atendimento exclusivo de aulas de Educação Física. Assim, esta investigação reforça a ideia de que as crianças precisam ser estimuladas a realizar outras atividades físicas fora da escola para potenciar sua Competência Motora.

**Palavras-chave:** Ginástica Rítmica, Atividade física, Infância, Participação desportiva

### 1 INTRODUCTION

As children grow, they are influenced by an ecological framework consisting of micro-, meso-, exo-, and macrosystems (Bronfenbrenner, 1995; Flôres et al., 2019). A microsystem is defined as the immediate context in which interactions occur (e.g., home, neighbourhood, daycare centre, school, etc.), while mesosystems reflect the relationship between two or more microsystems (Bronfenbrenner, 1995). Additionally, the exosystem is comprised of the distal contexts not directly connected with the child, but that can still influence them (e.g., events that occur at the parents' workplace). Lastly, the cultural institutions or the norms/symbols that serve as molar archetypes of day-to-day interactions characterize the macrosystem (Bronfenbrenner, 1995; Krebs, 1995).

The person-environment transactional relationship (Bronfenbrenner, 1999) can be linked to Gibson's theory of affordances (Gibson, 1986). According to Gibson (1979), each context has objects, places, surfaces, events, and people that provide different opportunities for children to act, depending on their capabilities. Thus, perceiving relevant environmental cues guides action and, reciprocally, facilitates the detection of new environmental properties (or affordances) (Heft, 2012). Some environments provide richer affordance landscapes than others and thus have greater potential for promoting child development, learning, and competence (Koller, 2004). Well-structured environments with different opportunities, such as sports spaces, seem to enable the development of the motor skills of boys and girls (Flôres et al., 2019). However, there is a gap in the literature regarding the study of the ecological context of school-age children in sports environments, especially during gymnastics classes.

The gymnastics practice provides a challenging environment with a multitude of discoveries for the child (Lopes, 2009). The rhythmic gymnastics (RG) practice enables numerous benefits, namely the Fundamental Motor Skills development (Culjak et al., 2014), improves higher levels of locomotor, manipulative, and stabilizing skills, and promotes a greater global development.

The Fundamental Motor Skills development is intrinsically related to the concept of Motor Competence (MC), which can be understood as the mastery of the Fundamental Motor Skills, being the basis for specialized motor skills development. MC is one of the foundations for the acquisition of specialized movements throughout the lifespan (Luz et al., 2017; Rodrigues et al., 2019). Besides, MC better levels are related to the development of children's healthy lifestyles (Luz et al., 2017; Robinson et al., 2015; Stodden et al., 2008), and sports participation (Ferreira et al., 2019; Flôres et al., 2020). The literature has suggested that a larger range of movements can support physical activity (PA) engagement across the lifespan (Scheuer et al., 2019). In fact, to Stodden et al., (2008) PA in childhood would promote the development of MC, which would lead to long-term PA participation. Therefore, studying sports environments may be crucial for the understanding of how they influence MC.

As far as we know, no other investigation has ever verified children's MC regarding the participation in RG and its comparison to children not practicing RG. Hence, the aim of this study was to verify the MC of school-aged children practicing RG and children that exclusively attend Physical Education (PE) Classes. It was hypothesized that children practicing RG would have higher MC scores than children that attend only PE classes.

## **2 METHODS**

### **2.1 Sample**

The present investigation is a cross-sectional study, composed of forty-four Caucasian children ( $7.90 \pm 1.04$  years). Twenty-two of them practiced RG ( $7.63 \pm 1.30$  years), while the other 22 exclusively attended PE classes ( $8.27 \pm 0.54$  years). Children participating in RG performed two gymnastics classes per week (1 hour each) for at least two years. Additionally, they practiced PE classes, twice a week, lasting between 45 and 60 minutes per class. The other children attended only two school PE classes per week (between 45 and 60 minutes per class). All children attended public schools.

None of the children participated in any other PA during the week. The sample was chosen by convenience in two RG clubs and three schools in a city located in the South of Brazil. None of the participants had any developmental difficulties or medical restrictions to perform the activities.

### **2.2 Instruments and Procedures**

All participants were evaluated using the Motor Competence Assessment – MCA (Luz et al., 2016; Rodrigues et al., 2019). MCA consists of six tests that assess three components: Locomotor, Stability, and Manipulative. The Locomotor component is evaluated using the Standing Long Jump and the Shuttle Run tests. The Stability component is assessed using the Shifting Platforms and the Jumping Sideways tests. Lastly, the Manipulative component is evaluated using the Ball Kicking Velocity and Ball Throwing Velocity tests. These tests are briefly described below.

### **2.2.1 Standing Long Jump (SLJ) Test**

In the SLJ test, participants were instructed to perform the jump with maximal effort starting with both feet together. The distance was measured (in centimeters) as the distance from the starting point to the location of the heel of the foot closest to the starting point after the jump – the farthest distance traveled of three attempts was used for data analysis.

### **2.2.2 Ball Kicking Velocity (BKV) and Ball Throwing Velocity (BTV) Tests**

The BKV test required children to kick a soccer ball (circumference, 64.0 cm; mass, 360.0g) against a wall with maximum effort. The BTV test required subjects to use an overarm action to throw a size tennis ball (diameter, 6.5cm; mass, 57.0g) against a wall with maximum effort. The speed of each attempt (BKV and BTV tests) was measured in meters per second using a radar gun (Pro II STALKER radar gun). The fastest speed of three kicks and the fastest speed of three throws were used for data analyses.

### **2.2.3 Jumping Sideways (JS) Test**

In the JS, participants should jump sideways with two feet together over a wooden beam (60 cm length×4 cm high ×2 cm width) as fast as possible for 15 seconds. Each correct jump scored one point and the best result over two trials was considered.

### **2.2.4 Shifting Platforms (SP) Test**

In the SP test, children were asked to move sideways for 20 seconds using two wooden platforms (25cm x 25cm x 2cm). Each successful transfer from one platform to the other was scored with two points (one point for each step – passing the platform and moving the body to the platform). Participants were given two trials and only the best score was considered.

### **2.2.5 Motor Competence Assessment Calculation**

The standardized values of the MCA were calculated for each test and component (locomotion, stability, and manipulation). T-scores were calculated for all tests; thus, the stability, locomotor, and manipulative components scores were computed as the sum of the two tasks t-scores. Shuttle run scores were inverted due to the nature of the task (higher values represent lower performance). The total MC was calculated as the mean of the t-scores for all tests.

Two PE teachers were trained to collect data, regarding the specifications of the MCA protocol, and at least one of the authors of this study personally supervised every data collection. All the investigators followed the same protocol, which was conducted in November 2019.

None of the participants had any developmental difficulties or medical restrictions to perform the activities. Participants could warm up and try the tests before the beginning of data collection. Motivational feedback and a demonstration of the tests were also provided to all children. Participants' oral assent was obtained before beginning the experiment, as the parent's consent. The research was approved by the Universidade Federal de Santa Maria (Brazil) Ethics Committee (Protocol: 76336117.0.0000.5346), and the study protocol followed all guidelines laid down by the Declaration of Helsinki.

### 2.3 Statistical analysis

Descriptive analysis with mean and standard deviation was used to characterize data. The Shapiro-Wilk test was used to test normality, which was confirmed as well, all statistical assumptions (all,  $p > 0.05$ ). Independent sample t-tests were used to compare variables regarding PE Classes and RG, and we used Cohen’s d as the index of effect size (considering d’s of 0.20 small, 0.50 medium, and 0.80 large) (Cohen, 1992). The Statistical Package for Social Sciences (SPSS), version 28.0, was used, adopting an alpha level of significance of 5%.

### 3 RESULTS

Our data showed that RG children present, in general, better results compared to children performing only in PE classes. Table 1 shows the sample descriptive values of all six MCA tests. Results are presented for all the children, and separated by type of practice (i.e., PE or RG).

**Table 1** – Descriptive values of the sample

MCA tests	PE classes (n=22)	RG (n=22)	Total (n=44)
	Mean±SD	Mean±SD	Mean±SD
Jumping Sideways	17.27±4.83	22.45±6.51	19.86±6.24
Shifting Platforms	16.05±2.94	14.18±3.53	15.11±3.34
Standing Long Jump	113.05±20.58	129.59±15.77	121.32±19.96
Shuttle Run	15.04±1.38	15.35±1.54	15.19±1.45
Ball Throwing Velocity	8.88±1.96	9.24±2.64	9.06±2.31
Ball Kicking Velocity	8.93±2.33	10.43±7.80	9.68±5.74

**Note:** PE classes (physical education classes); RG (rhythmic gymnastics)

The comparisons between the MCA standardized values regarding PE and RG demonstrated differences between the two groups (Table 2). Scores for the locomotion component were higher in children attending RG ( $p=0.007$ ). Additionally, children performing RG presented higher scores for total Motor Competence compared to children exclusively attending PE classes ( $p=0.018$ ).

**Table 2** – Comparisons between the Standardized values of MCA Physical Education and Rhythmic Gymnastics

Standardized values of MCA components	PE classes (n=22)	RG (n=22)	t	p	d
	Mean ± SD	Mean ± SD			
Locomotion	46.04±10.44	53.96±7.93	-2.831	0.007*	0.854
Stability	47.90±8.68	52.10±10.96	-1.41	0.166	0.425
Manipulation	48.54±6.02	51.46±12.81	-0.967	0.339	0.884
Total Motor Competence	47.49±5.75	52.51±7.61	-2.465	0.018*	0.743

**Note:** PE classes (physical education classes); RG (rhythmic gymnastics)

\*Statistically significant differences between RG and PE;  $p < 0.05$ .

#### 4 DISCUSSION

This investigation aimed to compare MC scores between children practicing RG and children exclusively attending PE classes. Our findings showed that children involved in RG had higher scores for the locomotor component of MCA, as well as for the total MC, compared to the ones exclusively attending PE classes.

RG presents movements specificity, in which its practitioners perform numerous technical movements and gestures (Botti, 2008). Santos et al. (2015) reported that children who practice sports (ballet and futsal) showed higher levels of global motor skills and balance when compared with children who exclusively attend PE classes. The literature also pointed out that children attending only PE showed lower performance when compared to children engaged in sports, including RG (Nazario & Vieira, 2014). Furthermore, Ribeiro-Silva et al. (2018) observed the performance of the Fundamental Motor Skills in children between 8 and 10 years who practiced or did not practice sports and found that children who were engaged in sports after school exhibited higher levels of Fundamental Motor Skills compared to non-practitioners.

MC is an important child development component, and it is related to the performance of various sports. Flôres et al. (2020), using the same instrument, observed that levels of MC in futsal practitioners outperformed children who only attended PE classes. Additionally, their findings showed that futsal provides better stabilization, locomotion, manipulation, and total MC scores compared to PE classes. Similar results were found in the present study, regarding the MC of children practicing RG. The present investigation also showed a large effect size in the locomotion component and a medium effect size in Total MC, revealing that our results can be generalized and used to be compared with different samples. Despite that, one of the main reasons for these differences can be the total amount of time spent during RG classes, which may have influenced our results. Thus, more effort should be made to enhance the sample size and the generalization of these findings.

Some researchers also tried to compare children's MC regarding their country (Bardid et al., 2015; Flôres, Rodrigues, Luz, et al., 2021), sex (Flôres, Rodrigues, Luz, et al., 2021), and the quality of their environments (affordances) (Flôres, Rodrigues, & Cordovil, 2021). Flôres, Rodrigues, Luz, et al. (2021), analyzed one hundred and forty-eight Brazilian children (80 boys and 68 girls) regarding their levels of MC. The author's results showed that MC increases with age and that boys outperformed girls. Flôres, Rodrigues, & Cordovil (2021) found positive associations between the affordances provided by children's environments and MCA, although weak to moderate. In this study, children whose environments were richer in affordances showed higher levels of the total MC (Flôres, Rodrigues, & Cordovil, 2021). Despite that, due to the lack of specific instruments to analyze the environmental contexts, it was not possible to evaluate the quality of opportunities offered in the RG classes.

In general, research indicates that it is from the experiences gained from living in the environment that the child can learn and discover new motor skills (Côté, 1999; Gabbard, 2011). Therefore, studying the association between the environments experienced by children with their MC may be important, and it seems plausible to expect that environments that are richer in affordances (as is the case with RG) could allow for higher levels of MC. Since many children fail to meet the guideline recommendations for PA (at least 60 minutes a day of moderate-to-vigorous PA) (WHO, 2020), RG could be understood as an important setting to promote PA and can be seen as an important factor in combating the negative spiral of disengagement (Stodden et al., 2008).

Despite the important results found in the present investigation, some limitations must be acknowledged. Firstly, we could not assess the quality of the RG and PE classes, as well as the materials provided to children in both groups. Even though the important effect sizes, a bigger sample, with cultural variety, could provide stronger findings to our research. Furthermore, despite the parents saying that the children did not do any other sport, the number, and type of other regular PA done by children on their daily routine were not assessed (i.e., cultural activities, running, biking, cycling, etc.). However, this study highlighted a critical finding in which children involved in activities outside PE may have MC benefits through better development of Fundamental Motor Skills.

## 5 CONCLUSIONS

To our sample, our findings suggest that practicing RG may lead to better MC development in children when compared to the exclusive attendance of PE classes. Therefore, this investigation highlights the importance of children being encouraged to perform other PA outside PE classes, such as RG, to improve MC development, provide higher levels of locomotor, manipulative, and stabilizing skills, and increase their global development. Thus, understanding the importance of child microsystems is important to search for new strategies to tackle low levels of MC and PA in school-aged children, preventing them from entering a negative spiral of MC.

## CONFLICTS OF INTEREST

There is no conflict of interest in this investigation.

## REFERÊNCIAS

- Bardid, F., Rudd, J., Lenoir, M., Polman, R., & Barnett, L. (2015). Cross-cultural comparison of motor competence in children from Australia and Belgium. *Frontiers in Psychology*, *6*, 1–8, article 964. <https://doi.org/10.3389/fpsyg.2015.00964>
- Botti, M. (2008). *Ginástica rítmica: estudo do processo de ensino-aprendizagem-treinamento com suporte na teoria ecológica*. [dissertação de mestrado, Universidade Federal de Santa Catarina]. Repositório institucional Universidade Federal de Sta Catarina. <http://repositorio.ufsc.br/xmlui/handle/123456789/91907>
- Bronfenbrenner, U. (1995). The bioecological model from a life course perspective: Reflections of a participant observer. In P. Moen, G. H. Elder, Jr., & K. Lüscher (Eds.), *Examining lives in context: Perspectives on the ecology of human development* (pp. 599–618). American Psychological Association. <https://doi.org/10.1037/10176-017>
- Bronfenbrenner, U. (1999). Environments in developmental perspective: Theoretical and operational models. In S. L. Friedman & T. D. Wachs (Eds.), *Measuring environment across the life span: Emerging methods and concepts* (pp. 3–28). American Psychological Association. <https://doi.org/10.1037/10317-001>
- Cohen, J. (1992). A Power Primer. *Psychological Bulletin*, *112*(1), 155–159. <http://www2.psych.ubc.ca/~schaller/528Readings/Cohen1992.pdf>
- Côté, J. (1999). The influence of the family in the development of talent in sport. *The Sport Psychologist*, *13*(4), 395–417. <https://doi.org/10.1123/tsp.13.4.395>
- Culjak, Z., Miletic, D., Kalinski, S. D., Kezic, A., & Zuvella, F. (2014). Fundamental movement skills development under the influence of a gymnastics program and everyday physical activity in seven-year-old children. *Iranian Journal of Pediatrics*, *24*(2), 124–130. PMID: [25535529](https://pubmed.ncbi.nlm.nih.gov/25535529/)
- Ferreira, L., Vieira, J., Silva, P., Chaves, R., Fernandes, R., Cheuczuk, F., Rocha, F., & Caçola, P. (2019). The role of sport participation and body mass index in predicting motor competence of school-age children. *Journal of Physical Education*, *30* (1), 1–10, artigo 3024. <https://doi.org/10.4025/jphyseduc.v30i1.3024>
- Flôres, F., Milani, M., Copetti, F., Luz, C., & Cordovil, R. (2020). O impacto da prática do futsal na competência motora de crianças. *Motrivivência*, *32*(63), 01–13. <https://doi.org/10.5007/2175-8042.2020e73696>
- Flôres, F., Rodrigues, L. P., Copetti, F., Lopes, F., & Cordovil, R. (2019). Affordances for Motor Skill Development in Home, School, and Sport Environments: A Narrative Review. *Perceptual and Motor Skills*, *126*(3), 366–388. <https://doi.org/10.1177/0031512519829271>
- Flôres, F., Rodrigues, L. P., & Cordovil, R. (2021). Relationship between the Affordances for Motor Behavior of (MCA) in

- Brazilian Children. *Children*, 8(8), 1–10, article 705. <https://doi.org/10.3390/children8080705>
- Flôres, F., Rodrigues, L. P., Luz, C., & Cordovil, R. (2021). Cross-cultural comparisons of motor competence in southern Brazilian and Portuguese schoolchildren. *Motriz*, 27, artigo e10210018420. <http://dx.doi.org/10.1590/S1980-657420210018420>
- Gabbard, C. (2011). *Lifelong motor development*. Pearson Higher Ed. (6ª edição).
- Gibson, J. J. (1979). *The theory of affordances: The Ecological Approach to Visual Perception*. Boston: Houghton Mifflin.
- Gibson, J. J. (1986). *The ecological approach to visual perception*. Lawrence Erlbaum Associates.
- Heft, H. (2012). Foundations of an Ecological Approach to Psychology. in S. D. Clayton (ed.), *The Oxford Handbook of Environmental and Conservation Psychology*, Oxford Library of Psychology (online edn, Oxford Academic), <https://doi.org/10.1093/oxfordhb/9780199733026.013.0002>.
- Koller, S. (2004). *Ecologia do desenvolvimento humano: Pesquisa e intervenção no Brasil*. Casa do Psicólogo.
- Krebs, R. J. (1995). *Urie Bronfenbrenner e a ecologia do desenvolvimento humano*. Casa Editorial.
- Lopes, P. R. (2009). *Motivação e ginástica artística formativa no contexto extracurricular*. [Dissertação de Mestrado, Escola de Educação Física e Esporte, Universidade de São Paulo]. Biblioteca Digital de Teses e Dissertações da USP. doi:10.11606/D.39.2009.tde-31082009-134201.
- Luz, C., Rodrigues, L. P., Almeida, G., & Cordovil, R. (2016). Development and validation of a model of motor competence in children and adolescents. *Journal of Science and Medicine in Sport*, 19(7), 568–572. <https://doi.org/http://dx.doi.org/10.1016/j.jsams.2015.07.005>
- Luz, C., Rodrigues, L. P., De Meester, A., & Cordovil, R. (2017). The relationship between motor competence and health-related fitness in children and adolescents. *PLoS ONE*, 12(6) article e0179993. <https://doi.org/10.1371/journal.pone.0179993>
- Nazario, P., & Vieira, J. (2014). Sport context and the motor development of children. *Revista Brasileira de Cineantropometria e Desempenho Humano*, 16(1), 86–95. <https://doi.org/10.5007/1980-0037.2014v16n1p86>
- Ribeiro-Silva, P. C., Marinho, N. F. S., Brito, W. S., Costa, N., & Benda, R. N. (2018). Desempenho motor em habilidades básicas de crianças participantes e não participantes de prática esportiva orientada (Motor performance in basic skills of children participants and nonparticipants of oriented sport practice). *Journal of Physical Education*, 29(1), article e2903.
- Robinson, L., Stodden, D., Barnett, L., Lopes, V., Logan, S., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine*, 45(9), 1273–1284. doi: 10.1007/s40279-015-0351-6
- Rodrigues, L. P., Luz, C., Cordovil, R., Bezerra, P., Silva, B., Camões, M., & Lima, R. (2019). Normative values of the motor competence assessment (MCA) from 3 to 23 years of age. *Journal of Science and Medicine in Sport*, 22(9), 1038–1043. <https://doi.org/10.1016/j.jsams.2019.05.009>
- Santos, C. R., Silva, C. C., Damasceno, M. L., Medina-Papst, J., & Marques, I. (2015). Efeito da atividade esportiva sistematizada sobre o desenvolvimento motor de crianças de sete a 10 anos. *Revista Brasileira de Educação Física e Esporte*, 29(3), 497–506.
- Scheuer, C., Bund, A., & Herrmann, C. (2019). Diagnosis and monitoring of basic motor competencies among third-graders in Luxembourg. An assessment tool for teachers. *Taylor & Francis*, 23(3), 258–271. <https://doi.org/10.1080/1091367X.2019.1613998>
- Stodden, D., Goodway, J., Langendorfer, S., Roberton, M., Rudisill, M., Garcia, C., & Garcia, L. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest*, 60(2), 290–306.
- World Health Organization (2020). *WHO Guidelines on physical activity and sedentary behaviour*. World Health Organization. <https://www.who.int/publications/i/item/9789240015128>