Original Article

RESEARCH ON MOTOR BEHAVIOR IN THE YEAR 2018

PESQUISA NA ÁREA DE COMPORTAMENTO MOTOR NO ANO DE 2018

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RESUMO

A área de Comportamento Motor (CoM) investiga os processos neuropsicológicos da organização da resposta motora em termos de aprendizagem, controle e desenvolvimento motor, de onde emergiram. Este estudo teve como objetivo descrever a produção intelectual da área de Comportamento Motor (CoM), e as especificidades das suas subáreas de investigação denominadas Aprendizagem Motora (AM), Controle Motor (CM) e Desenvolvimento Motor (DM) produzidos pelos programas de Pós-graduação em Educação Física no ano de 2018. A produção intelectual nas subáreas do CoM foi organizada, por estrato, tipo de tarefa e aderência com os periódicos da área 21 da CAPES. Foram encontrados 53 artigos publicados por 51 pesquisadores. A distribuição dos artigos por subáreas foi representada por 30,18% AM, 54,72% CM e 15,10% DM. A subárea CM apresentou 86% de publicação dos artigos nos estratos superiores, a subárea AM com 37%, seguida da subárea DM com 13%. A média das três subáreas resultou em 83,02% de estudos com tarefa simples construída em laboratório e somente 16,98% com tarefa complexa. O maior número de publicações com baixa aderência aliado ao maior número de pesquisas com tarefas simples parece demonstrar a dificuldade dos pesquisadores de aproximar os conhecimentos produzidos na área de CoM com a formação de um corpo de conhecimento específico da Educação Física.
Palavras-chave: Comportamento Motor. Estrato do periódico. Tipo de tarefa. Aderência.

ABSTRACT

Motor Behavior (MB) is the study of neuropsychological processes with regard to the motor response organization in terms of learning, control, and motor development. Three research sub-areas emerged from MB, that is, Motor Learning (ML), Motor Control (MC), and Motor Development (MD). The present study aimed at describing the intellectual production related to ML, MC and MD sub-areas in 2018, in addition to identifying the current profile of the MB area. The intellectual production of the MB sub-areas was organized according to stratum, type of task, and adherence to the journals of area 21 (CAPES). Fifty three articles on MB, published by 51 researchers, were found. All these studies were produced by the Graduate Programs of Physical Education in 2018. The distribution of the articles in sub-areas was represented as follows: 30.18% ML, 54.72% MC, and 15.10% MD. The MC sub-area had 86% of its articles published in the upper strata; the ML sub-area had 37%, followed by the MD sub-area with 13%. The average of the three sub-areas resulted in 83.02% of studies with simple tasks and only 16.98% with complex tasks. The greater number of publications with low adherence combined with the greater number of investigations with simple tasks seems to show the researchers' difficulty in approaching the knowledge produced in the MB area for undergraduate Physical Education students.
Keywords: Motor Behavior. Stratum. Type of task. Adherence.

Introduction

The first studies regarding Motor Behavior (MB) started around the end of the 19th century, in the 1890s[1,2]. In Brazil, this trajectory is still relatively short, having started in the early 1980s[3] after the return of five researchers who had had graduate training in the USA and Japan[4]. Professors Jefferson Thadeu Canfield, Ana Maria Pellegrini, Ruy Jornada Krebs, Go Tani and Ricardo Demetrio de Souza Petersen were the pioneers to establish research groups on MB in Brazil in public Higher Education Institutions (HEIs)[4], as soon as they returned from their training abroad. These groups grew and their disciples created new groups in other HEIs, including public and private institutions, which investigate the MB area under different approaches and levels of analysis. Considering the learning environment, the subjects generate different motivations, which is a key factor in influencing learning outcomes[1]. Therefore, the study on the variables that affect student learning is critical to their training[2].

Motor Behavior is the study of neuropsychological processes with regard to the motor response organization in terms of learning, control, and motor development[5]. Three sub-areas or fields of study emerged from MB, that is, Motor Learning (ML), Motor Control (MC), and Motor Development (MD)[3,6]. The ML sub-area has sought to investigate the mechanisms and processes underlying the changes in motor behavior that result from practice (the process of acquiring motor skills) and the factors that influence them. The MC sub-area evaluates the mechanisms responsible for the production of movement, and the MD sub-area investigates the changes that occur in motor behavior throughout the life cycle[7]. Although each of these fields of study has its own identities[7], the phenomena they investigate are strongly associated and interdependent, which results in experimental designs that involve more than one sub-area, however, there is always a predominance of one of them.

Research regarding these three sub-areas can be divided into two types: basic research and research synthesis. Basic research is committed to knowledge per se, that is, its purpose is better understanding the nature of the phenomena observed and discovering laws that can fully explain reality[8,9]. Considering the MB area, basic research is widely related to the type of laboratory task (e.g. typing of a numerical sequence, manual force control, and postural control)[10]. These tasks are considered simple when assessing a small number of degrees of freedom[11] involved in the task execution. These tasks are created to privilege the objectivity and reliability of the findings, which result from the great control of experimental conditions and variables[12,13].

The research synthesis arose due to the difficulty in applying the results of basic research in everyday situations[8,10,12,14], since the findings related to daily tasks are essential for applying the results[8,15]. The research synthesis privileges the ecological validity of the task[8], similar to the Teaching and Learning research[14], and it aims at verifying whether the knowledge produced in laboratory situations is replicated in situations with greater ecological validity with everyday tasks (e.g. serve in volleyball, putting in golf and walking or running on a treadmill). Everyday tasks involve a large number of degrees of freedom[11], thus, they are considered more complex than artificial laboratory tasks used in basic research[16]. Therefore, both basic and synthesis research investigate basic issues related to the area, however, basic research uses simple laboratory tasks with few degrees of freedom, whereas the research synthesis uses complex everyday tasks with a large number of degrees of freedom. Despite the fact that the research synthesis has less control of the variables compared to the basic research (greater number of intervening variables), it gains in external validity and power to generalize the results for using more complex tasks[13]. It is a type of integrative research, which, by testing the knowledge derived from basic research and privileging the task ecological validity, it has great potential to contribute to the understanding of the phenomena investigated in the MB area, in addition to providing insights for the solution of problems that arise in Physical Education and Sport[8,14]. It is important to differentiate research on MB from research in Pedagogy; the first searches to understand the underlying processes and the factors that influence changes in motor behavior, and the second seeks the best way to teach.

Research synthesis regarding the MB area does not aim at solving the specific problems of a certain sport modality or teaching situation and, thus, it is not characterized as applied research[8,17]. Applied research seeks to solve real intervention problems[9,12-14]. Such a purpose is not consistent with the delimitation of the Motor Learning area, which aims at investigating the processes underlying the acquisition of motor skills and the factors that influence this process[18]. Therefore, it can be said that there is no research applied in MB[8,19], however, the relevance of knowledge cannot be confused with its applicability in the solution of practical problems[20].

Due to the characteristics of basic research, its results are easier to be published in journals in fields other than in Physical Education, since they have a greater impact. This caused several researchers to favor basic research and migrate their publications to journals not directly

related to Physical Education. Consequently, studies began to lose their adherence to the area, especially to the Graduate Programs of area 21, which includes Physical Education, Physiotherapy, Speech Therapy, and Occupational Therapy in the Brazilian Coordination for the Improvement of Higher Education Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* - CAPES). This phenomenon was also seen in the MB area. This trajectory caused a reduction of the journals in these fields in Qualis area 21, which led to the questioning of adherence between the Graduate Programs that aim at training professors and researchers, and the resulting studies. A systemic perspective shows that the interactions existing with regard to microscopic components have macroscopic constrains[21]. Therefore, the possibilities of interaction between Graduate Programs (microscopic level) could follow the direction given by some constraints of the organ that evaluates the programs (macroscopic level, in this case, CAPES).

The proposal of assessing the intellectual production of the programs in area 21 by using the concept of adherence (ADE) was put into practice. Adherence is a stratification measure of journals that evaluates whether the identity of the journals employed in the dissemination of the knowledge produced is linked to the programs of the area. Thus, four adherence indicators were established (ADE1 to ADE4). ADE1 was at one extreme, which characterized a lower adherence to area 21, besides no linking with the themes, objects, actions or knowledge of the area. ADE4 was at the other extreme, which characterized a high and unequivocal adherence to area 21, whose scope was closely and directly related to objects, themes, knowledge, and actions that coincided with area 21. In general, the titles of these journals show the name of the area, sub-areas or objects of study of area 21. Each journal and study title published by a Graduate Program was evaluated by the Committee of area 21 at the time, and then classified in one of the ADEs according to the evaluation of the majority of the Committee members[22]. The adoption of ADEs seems to have led to a greater alignment of publications with both, the Graduate Programs and area 21, which was easily observed by the decrease in the number of journals with low adherence to area 21. This can be seen in the lists of the WebQualis (CAPES). However, since area 21 is new, and the MB area with its sub-areas is even newer, the studies developed might still be looking for their trajectory, that is, between basic research that gives few subsidies to the area of Physical Education and synthesis research, which has a greater potential to be used by professionals in the field.

The identification of the state of the art regarding the academic production of the MB sub-areas according to stratum, type of task and adherence shall enable the researchers to better understand the relationship between intellectual production and the area of origin. The present study aimed at describing the characteristics of the intellectual production regarding the ML, MC and MD sub-areas originated from the Graduate Programs in Physical Education in 2018, according to stratum, type of task and adherence to the area of origin.

Methods

A search for data was carried out on the Brazilian Platform known as *Sucupira* for Graduate Programs in Physical Education in order to identify which laboratories are included in the MB area and their responsible researchers.

Procedures

The three MB sub-areas are the focus of research in CAPES area 21 that involve Physical Education, Physiotherapy, Speech Therapy and Occupational Therapy. However, it is in Physical Education that the highest concentration of researchers is found. Two researchers carried out an investigation in 2018 on the 66 research groups registered in the National Council for Scientific and Technological Development (CNPq) linked to the Graduate Programs of area 21. Since 98% agreement rate among the evaluators was found, the analysis continued. Twenty

five research groups were identified with the focus on at least one of the three MB sub-areas, and a total of 51 researchers.

After identifying the 51 researchers, an analysis of the curriculum of each of them was performed on the CNPq Lattes Platform. This analysis consisted of verifying the academic production carried out by each researcher in 2018. Then, a spreadsheet was developed, which included the year the article was published (e.g. 2018), the title of the paper, the name of the journal, the classification of the journal in relation to the Qualis of the area in force at the time (from stratum A1 to B5), in addition to the sub-area of knowledge the research belonged to (motor control, motor learning and motor development), and the type of research (basic or synthesis) with emphasis on the type of task (simple or complex). The articles were separated, stratified into three categories in relation to the journal they were published in, according to the area document: 1) strata A1 and A2 because they had higher Journal Citation Reports (JCR) and an impact factor; 2) stratum B1 for being indexed in the most relevant databases and being part of better quality strata; 3) strata B2 to B5 that indicated a less qualified production and less adherence.

Only the original articles published in journals in 2018 that included themes related to the MB area were considered as inclusion criteria. Literature review articles, systematic reviews, meta-analyses, and studies that did not fit the MB area were regarded as exclusion criteria. Data collection was completed on February 28th, 2019.

Statistical analysis

Descriptive analysis was used to infer the results based on the relative and absolute frequencies. The relative frequency was used to describe the total intellectual production of the MB sub-areas in 2018. Both relative and absolute frequencies were assessed according to stratum, type of task and adherence so as to understand the distribution of intellectual production in each sub-area. The chi-squared test was used to evaluate the association between the intellectual strata production (A1-A2, B1, with B2-B5) of the sub-areas and both, the task complexity and the adherence to area 21 journals.

Results

Fifty three articles on MB, published by 51 researchers, were found. All these studies were produced by the Graduate Programs in Physical Education in 2018. The distribution of the articles in sub-areas was represented as follows: 16 on ML (30.18%), 29 on MC (54.72%), and 08 on MD (15.10%) (Figure 1), which shows the predominance of articles in the MC sub-area, followed by ML, and finally by MD.
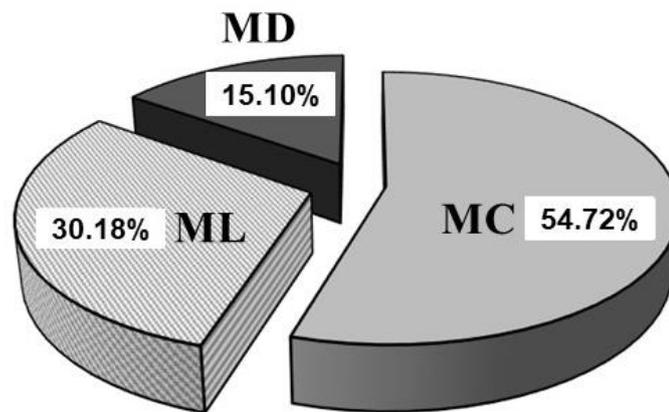
Figure 1. Relative distribution of the intellectual production in the sub-areas in 2018
Source: The authors

Considering each sub-area, the articles were separated according to the strata of the journals published, then assessed and separated into three categories. The type of task (simple or complex) used in each category was evaluated. Box 1 shows that regarding each category of strata (A1 and A2; B1; B2 to B5) there was a predominance of simple laboratory tasks, with the exception of the MD sub-area, in which there was only one article in the upper extracts that had been performed with a complex task. In addition, in the upper strata (A1-A2) and intermediate one (B1) more than 80% of the articles used simple tasks.

Box 1. Distribution of the relative and absolute frequencies according to the strata of the journals published and the type of task in MB sub-areas in 2018.

Sub-areas	Strata											
	A1-A2				B1				B2-B5			
	simple		complex		simple		complex		simple		complex	
	fr%	f	fr%	f	fr%	f	fr%	f	fr%	f	fr%	f
ML	50.00	03	50.00	03	77.78	07	22.22	02	100	01	-	-
MC	96.00	24	4.00	01	100	03	-	-	100	01	-	-
MD	-	-	100	01	80.00	04	20.00	01	50.00	01	50.00	01
Total	84.37	27	15.63	05	82.35	14	17.65	03	75.00	03	25.00	01

Note: relative frequency (fr%), absolute frequency (f)
Source: The authors

More specifically, out of the 53 studies developed on MB, the difference considering the type of task is clearly identified. The average of the three sub-areas and all strata resulted in 83.02% of studies with simple tasks and only 16.98% with complex tasks.

Afterwards, an analysis of all the studies in the same strata categories of the journal published was performed according to the adherence to the journals of area 21 (Box 2). The ML sub-area had a predominance of publications in ADE4, which had total adherence to the area, always exceeding 83% in all strata. Considering the MC sub-area, in the upper strata, 60% of the publications were in ADE1, however, regarding the intermediate stratum, the proportion reversed, with approximately 66% of the publications in ADE4. Considering the MD sub-area, the tendency was more evident, with 100% publication in ADE1 in the upper strata, and 100% in ADE4 in the intermediate strata.

Box 2. Distribution of the relative and absolute frequencies according to the adherence to the MB sub-areas

Sub-areas	Strata											
	A1-A2				B1				B2-B5			
	AD4		ADE1		ADE4		ADE1		ADE4		ADE1	
	fr%	f	fr%	f	fr%	f	fr%	f	fr%	f	fr%	f
ML	83.33	05	16.67	01	88.89	08	11.11	01	100	01	-	-
MC	40.00	10	60.00	15	66.67	02	33.33	01	-	-	100	01
MD	-	-	100	01	100	05	-	-	50.00	01	50.00	01
Total	46.87	15	53.13	17	88.24	15	11.76	02	50.00	02	50.00	02

Note.: relative frequency (fr%), absolute frequency (f)
Source: The authors

Finally, an analysis was carried out in order to evaluate the association between the intellectual production of A1-A2 strata of the sub-areas and both, the complexity of the task and the adherence to area 21 journals (Box 3).

Box 3. Association between the intellectual production and both, the task complexity and adherence to MB sub-areas in strata A1-A2.

Sub-areas	Strata A1-A2							
	Complexity of the task				Adherence			
	simple		complex		AD4		AD1	
	f	%	f	%	f	%	f	%
ML	03	(9,7)	03	(9,7)	05	(16,1)	01	(3,2)
MC	24	(77,4)*	01	(3,2)	10	(32,3)	15	(48,3)**
MD	0	(0)	01	(3,8)	0	(0)	01	(3,8)

Note: * $X^2 = 9.11$, $p = 0.004$ (significant association) ** $X^2 = 3.64$, $p = 0.056$ (marginal association)
Source: the authors

A significant association was found only regarding the intellectual production of the upper strata (A1-A2) of MC sub-area. The first test showed an association with the complexity of the task, more specifically with the use of simple tasks. The second test indicated a marginal association ($p = 0.056$) with the adherence of the area, more specifically regarding the journals with less adherence to area 21. No significant associations were found with the intellectual production of strata B1 and B2-B5 ($p > 0.05$).

Discussion

The present study aimed at describing the profile of the intellectual production in MB sub-areas originated from the Graduate Programs in Physical Education in 2018 with regard to the stratum, type of task, and adherence to the area of origin. Therefore, studies of the three sub-areas were organized into three categories, classified according to the strata of the journals published, type of task, and adherence of the journal to the area of Physical Education. In general, the MC sub-area was the one with the highest total number of publications, and also the most publications in journals with low adherence to the area of Physical Education.

The comparison among ML, MC, and MD sub-areas showed that the articles on MC represented more than half of all papers published in the MB area. Each sub-area has its issues and purposes, and the three of them can be considered to be of equal significance. However, the higher incidence of research on MC may have different motivations, ranging from the taste for the object of study to the agility of collection. More specifically, investigations on MC might have shorter collection time[23,24] when compared to studies on ML[25,26]. The speed for performing

the data collection makes the speed of publications easier. It is not a criticism to the quality of the studies on MC, however, this significance is undeniable in the sense that the researchers can compete for funds regarding their research and for a productivity research scholarship in CNPq. Studies on MD can comprise both, cross-sectional descriptive studies, which are faster[27,28], and studies that seek to identify the factors that lead to changes in motor development[29,30]. Moreover, the articles that sought to evaluate the production on MB worldwide joined the ML/MC sub-areas and compared them with MD[5], which makes this comparison difficult. In addition, when assessed, the strata of the journals in which the articles were published and the type of task used, it was seen that the MC sub-area was the one that most published in the upper strata, with approximately 86% of the articles. The ML sub-area published 37% and the MD approximately 13%. This potential for publication in higher strata seems to be linked to the type of task. There was an association between the articles on MC published in strata A1 and A2 with the use of simple laboratory tasks, which provides greater control of the variables and reliability of the results[8,12,15,17]. When visualizing all strata and the three sub-areas, it was seen that the studies published in the MB area in 2018 predominantly used simple tasks, approximately 83%, with 17% remaining that used complex tasks.

The aforementioned results show the tendency of the area in the sense of favoring studies with simple tasks. It is noteworthy that MB research was developed within the scope of Graduate Programs in Physical Education, which take place in Universities, and which only exist due to the undergraduate courses offered there. The maintenance of an area in the University depends on the existence of a body of specific knowledge[31-33], which is a prerequisite for a professional preparation course[34], as characterized by a Higher Education course in Physical Education[34]. However, there is a big gap between the simple skills used in most research assessed and the everyday skills. There are two possible explanations. The first is that building a body of specific knowledge for the training of professionals in Physical Education is not a primary concern in the area. Since the professors who train professionals in Brazilian universities are the same ones who conduct the research, having good publications has become more important than professional training. The second is that the search for information about the process of changes in motor skills led to an approximation with the areas of Neuroscience and Biomechanics[35,36]. In order to have a more micro level of analysis, such areas have been used to explain the underlying process existing in motor behavior. Currently, there is an overlap, and knowledge regarding these related areas has become the focus of research, with motor behavior working as a way to test it.

Both explanations seem to have led to publications in journals in these related areas, which have less adherence to the Physical Education field, especially in MC and MD sub-areas. The analysis of the upper strata showed that considering the ML sub-area the publication in journals with high adherence to the area (approximately 83%) is predominant, whereas regarding the MC and MD sub-areas the publication predominates in journals in other areas with less adherence to Physical Education (60% and 100%, respectively). More specifically, the MC sub-area showed a marginal association with the journals with less adherence to area 21 in the upper strata. It is probably because of this that the studies predominantly use simple tasks in publications in the upper strata. Whether this characteristic is a consequence of the previous explanations, or whether the search for journals with a greater impact than those in Physical Education led to publication outside the area is unclear. However, it shall have consequences for the training of future professionals in any case, since among other factors, the specificity of the body of knowledge is extremely important[37]. On the one hand, if researchers have been able to publish in high-impact journals, on the other hand, journals with low adherence and with tasks that have little generalization power predominate. This condition hampers the advancement of a specific body of knowledge to be used in Undergraduate and Licentiate Degree Courses, and consequently the social recognition of the field[8,12,14,19,20].

A study carried out on the production of knowledge in Physical Education from Brazilian journals showed the MB area represented with the number of 14 publications in 2015[38]. In the present study, 13 publications were found in Brazilian journals and 40 in international journals. The Graduate Programs in Physical Education, with a concept higher than five, seem to signal for a smaller number of publications in national magazines. Such data show that researchers have prioritized the submission of their manuscripts to international journals[38], probably to support or improve the evaluation of the Graduate Programs and because of the financial support to foster scientific research. The greater number of international publications in journals with low adherence to area 21, combined with the greater number of research with simple tasks, seems to show the difficulty of researchers in bringing together the knowledge produced in the MB area for undergraduate students in Physical Education because the knowledge from basic research is often not replicated in research synthesis[8,16]. This situation shows the significance of knowledge complementarity, which is a result of the types of investigation. Since the research synthesis privileges the ecological validity of the task[8,14], it approaches everyday situations and its results are more easily used in the training of a specific body of knowledge in Physical Education that provides the area with academic-scientific legitimacy[37] and supports professional preparation courses.

In spite of the researchers' freedom to select their object of study, perhaps it is the moment for them to reflect on a paradigm shift with regard to the MB area. This change would make such researchers to use complex skills in their studies, and motor behavior would be the focus of the investigations instead of issues concerning related areas, but without failing to use different levels of analysis, which shall guarantee the understanding of complex phenomena[14]. This position indicates the need to review the direction taken in research in the area[34].

Conclusions

The data assessed in 2018 showed the predominance of simple tasks and publications outside the field of Physical Education, mainly regarding the studies on MC. There is still a great distance between the knowledge produced and its applicability for the training of professionals. However, further studies should evaluate an entire quadrennium (CAPES evaluation period) so that a better understanding on the state of the art regarding MB research in the field of Physical Education is achieved.

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