

REVIEW PAPER

Movement and Language Development as an Early Childhood Twin Strategy: A Systematic Review

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Abstract

In this review, a critical reading of the literary and scientific production focused on the themes of the body, movement and language learning was carried out, with particular consideration given to alternative teaching methods that use movement to favour the cognitive process. After searching the databases of Pub Med, PsycInfo, Sport Discus, Psyc Articles and Eric electronic, the choice was narrowed down to 8 international scientific studies with publication dates ranging between the years 1999 and 2017 concerning pre-school subjects between 2 and 5 years of age, excluding those regarding other target users and/or particular characteristics such as pathologies, obesity, and nutrition. All of these studies analysed the benefits of motor activity on language, communication, learning and academic performance. Of the 7 filtered studies, 4 examine the specific relationship between motor activity and language, while the other 3 between language and general academic performance. Through the analysis of the filtered reports and some of the bibliographical references used, we conclude that motor activity positively influences language, attention and concentration of the pupils in this age range, with effects on academic performance. Furthermore, it also improves motor skills as a result of decreased sedentary behaviour.

Key words: *movement, language, learning, pre-school*

Introduction

It is now a well-established fact that motor activity is of fundamental importance because it plays a primary role in the fields of socialization, emotionality and interpersonal relationships as well as in the pure physicality and well-being, contributing to the psychic development and promoting freedom from inhibitions towards oneself and others. The search for possible common elements or relationships between body, movement and language is a fundamental condition for researching a possible transversal teaching-educational methodology that improves academic performance. Motor activity is a fundamental factor during the child's growth in the formation of his/her personality (Raiola, 2013) because body and movement give a significant response to the communicative need with the use of languages that are not only verbal (D'Isanto, 2016, D'Isanto

& Di Tore, 2016, Casolo, 2011). In the same manner that playing coincides with learning, dramatization helps the child to develop his/her potential and to satisfy his/her needs for socialization, creativity, autonomy (Rostagno & Pellegrini, 1978), involving various types of language to be used in a personal way, prompting a connection between linguistic expressivity and motor expressiveness and supporting the conquest of the ego through the process of identification. The dramatic-theatrical-ritual expressiveness is used at all ages even in the East (Raimondo, Kay, Ellender, & Akerman, 2012); for centuries, this has proven to be effective, even in cultures that are different from ours, in improving parameters such as inhibitory control, self-perception and cohesion (Valentini & Beretta, 2016).

Verbal language reaches a certain competence in early childhood and develops alongside the experiences of



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game-movement and the motor evolution underlying the establishment of basic motor patterns (Raiola, Tafuri, & Altavilla, 2015), which follow a genetically pre-established neuromotor activation (Meraviglia, 2012), heavily conditioning the subsequent complex learning processes and becoming the most important behaviour mediator and regulator through internal language structuring: from perception to symbolization and from the latter to verbalization. Movement and motor activity support and complete the process of symbolizing thought—a trait which had been considered for a long period of time as exclusive to the verbal communication system.

Academic success, performance in homework and tests depend both on a) factors closely related to school grades, such as: attention, concentration, memory, recognition and understanding of information, and b) from unconscious factors that play a statistically important role in learning, such as spatial-temporal perception, self-esteem, sedentariness and media consumption (Trudeau & Shephard, 2008); these are all factors that can be affected by physical activity. The inhibitory control is the centre of the highest cognitive functions and is based on mental processes that are closely related to attention, behaviour, emotions and mainly involves the neural networks in the prefrontal and parietal cortices. It has been proven that the inhibitory control ability is a fundamental predictor of both academic performance and cognitive development in early childhood (Diamond, 2013). Chaddock et al. (2012) carried out constant monitoring subsequent to the Eriksen Flanker test, one of the most used tests on the evaluation of this ability, showing that fitter children have superior performance results in accuracy and reaction times, better attention span control during the test and greater concentration direct-

ed towards the requested stimulus, therefore better cognitive control. This is also reflected in the modern theoretical foundations of Appraisal and cognitive theories, in which a close correlation between emotional experience and mental elaboration can be found, where the second is dependent on the former. This is confirmed by the work done by Scherer (1993) and Brosch, Scherer, Grandjean and Sander (2013).

The purpose of this review of the literature is to clarify what effects brings physical activity to different cognitive processes (language, verbal and non-verbal communication, learning) and academic performance.

Methods

The research was performed using databases from Pub Med, Psyc Info, Sport Discus, Psyc Articles, Eric, with the main filter being the year of publication 1999-2017. The keywords used in the search for the articles were: age 2-5 years; primary school; motor activity; language; learning; academic performance. Exclusion filters on the yielded results were: obesity; pathology; nutrition.

Results

The selection highlighted 7 articles concerning studies in the journals of African Journal for Physical, Developmental Psychology, Health Education, IDEA Fitness Journal, Journal of Physical Activity & Health, Journal of Physical Education & Sport, O & P Business News, Palaestra, Percentual and Motor Skill, and the Scandinavian Journal of Medicine & Science in Sports. Specifically, 4 studies examined the relationship between motor activity and language and 3 studies between language and general academic performance (Table 1).

Table 1. Relationship between physical activity and language (4 studies)-Relationship between language and academic performance (3 studies)

Year	Authors	Sample	Age	Activity	Results/Goals
2011	Goldstein, J. & McCoach, B.D.	1670	5 years	Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K)	To evaluate cognition, knowledge and academic goals reached
2014	Nelson, E.L., Campbell, J.M., & Michel, G.F.	38	6-14 months; 18-24 months	Hand preference evaluation, through 2 measurements designed to identify the age-related manual skills. The measurements for infants evaluated the hand use to acquire objects in a monomanual manner and consisted of 22 objects presented individually to the child's midline and 10 pairs of objects presented in pairs.	Consistent right-handedness during childhood associated with advanced language skills at 24 months of age, measured by Bayley Scales of Infant and Toddler Development (Bayley-III; Bayley, 2006)
2015	Oudgenoeg-Paz, O., Leseman, P.M., (Chiel) Volman, J.M.	59	9-36 months 20-36 months	Exploration of 2 sets of objects: the children were filmed for 8 minutes while exploring each set	-Age of acquisition of motor stages - Spatial exploration - Spatial memory - Spatial processing - Spatial language
2015	Diaz-Williams, P., Silliman, F.L., French, R., Nichols D., & Moorer-Cook, L.	30	3.6-5.3 years	Gross Motor Activities, structured table activities, structured table activities with letter tracing	Define gross motor activity effect of homework on children with a primary communicative difficulty of phonological disorder -Improve the phonological skills of young children

2015	Brighi, A., Mazzanti, C, Guarini, A., & Sansavini, A.	84	62.5 months (media)	Sociometric Interview for the evaluation of Reciprocal Nominations (RN) -Peabody Picture Vocabulary Test - Revised (PPVT-R; Dunn & Dunn, 1981) -The Social Competence and Behaviour Evaluation (SCBE-30) -Questionari Italiani del Temperamento (QUIT)	Study of the acceptance process amongst peers and peer group aggregation.
2015	Toumpaniari, K., Loyens, S., Mavilidi, M.F., & Paas, F.	67	4 years	Teaching 20 foreign words	-Interaction between physical activity and learning - Physical activity and its incremental effects on learning outcomes -The embodied activities become more pronounced when physical activities are embodied
2016	Marouli, A., Papavasileiou, G., Dania, A., & Venetsanou F.	29	3.5-5 years	Psychomotor program	Effect of an 8-week psychomotor program on motor skills and self- awareness of preschool children

This study was approved in advance by the University of Urbino (Italy). Each participant has voluntarily provided written informed consent before participating.

Discussion

Every little gesture or movement made, whether or not it may reflect a conscious goal of the subject who performs it, must be considered a motor activity. Nelson, Campbell and Michel (2014) tried to assess whether the choice consistency in the use of one of the two hands at 6-14 months of age is linked to better language skills at a later age (18-24 months) using the 3rd Edition Bayley Scale. The results show that subjects with strong right-handedness in the first period had better linguistic skills in the second, but that even those who did not have a strong lateralization in the first months had subsequent standard skills. The entire adult world population has a high percentage of right-handed lateralisation, probably also due to specific cultural, social and ethnic influences; in relation to the infancy period, Esseily, Jacquet and Fagard (2011) and Franco and Butterworth (2016) have verified a preference on the right hand for pointing but many other studies have had mixed results based on the choice of the hand or the finger according to the modality of use (Vauclair & Imbault, 2009; Kotwica, Ferre, & Michel, 2008; Michel, Sheu, & Brumley, 2002). Others find important relationships only during the fundamental stages of linguistic improvements (Jacquet, Esseily, Rider, & Fagard, 2012; Vauclair & Imbault, 2009; Bates, O'Connell, Vaid, Sledge, & Oakes, 1986), even if they do not explain their motivations. Wilbourn, Gottfried and Kee (2011) found a specificity of the female gender between the constant use of the right hand during childhood and verbal cognitive ability estimated at 10 and 17 years of age, correlating the phonological improvement also to the amount of exposure to listening to readings at 15 months of age in the mother-daughter relationship. Similarly, Fenson et al. (1994) had a gender advantage over linguistic development but with much lower percentage differences compared to males (1%-2%) and for an exclusive timeperiod between 8 and 30 months of age on a sample of 1803 subjects. Vauclair and Cochet (2012) found in children aged 10-40 months, the use of right-hand finger for pointing also in left-handed and ambidextrous subjects, confirming the hy-

pothesis of Iverson and Goldin-Meadow, (2005) and Volterra, Caselli, Capirci and Pizzuto (2005) on the independence and specialization in language and gestural communication of the Broca Area with respect to the one dedicated to manual motor control, suggesting that gestures support language learning. Iverson (2010) indicates that the change of gestures predicts advances in the linguistic development of children, also in relation to the gesture-word modalities used in adulthood; also, that prior to the intentional use of hand and mouth for communication, sensorimotor links exist that provide the basis for their future cognitive interdependence, confirming the presence of multimodal coordination. This cerebral flexibility, already present in the neonatal period thanks to the establishment of relations between white and grey matter, is confirmed by Deniz Can, Richards and Kuhl (2013). In recent years, the focus on Cognition Embodied Theory and on its possible implications in the stimulation of language learning has increased exponentially (Mahon, 2015), even if part of the scholars do not share the results as they believe that now the structuring of the language is an emerging autonomous trait of the human species. Toumpaniari, Loyens, Mavilidi and Paas (2015) investigated whether combining gross-motor activities and gestures could improve foreign language acquisition in preschool children, verifying positive effects especially with *embodied*-type activities and also confirming those obtained from previous studies (e.g. Fedewa & Ahn, 2011; Tomporowski, Davis, Miller, & Naglieri, 2008; Strong et al., 2005; Sibley & Etnier, 2003) that used generic motor activities prior to the execution of a task, even in adolescence and adulthood. Lindgren and Johnson-Glenberg (2013) have recorded positive effects of using *embodiment* techniques in the fields of psychology, mathematics and linguistics, with advantages in both finding and retaining acquired concepts. Croom (2014) believes that *embodiment* enhances the 5 individual characteristics of the PERMA framework, leading to psychological well-being; Pouw, de Nooijer, van Gog, ZwaanandPaas (2014) argue that learning is, for all practical purposes, a cognitive process and is inextricably linked to the various experiences of the subject. This is also supported by Gogate and Hollich (2010), Iverson (2010), and Hockema and Smith (2009); therefore, it is justifiable to use not only *embodiment*-type techniques, but also theatrical *enact-*

ment gestures, as positively tested by Toumpaniari et al. (2015) and already suggested by Hostetter (2011) when analyzing the works of Cohen and Otterbein (1992) and Engelkamp and Cohen (1991). For Assaiante, Barlaam, Cignetti and Vaugoyeau (2014) the information received from the environment modifies and generates new interaction possibilities, defining and shaping the various reference frameworks for the subject, including motor and body frameworks; for Pulvermüller and Fadiga (2010) the latter is important both for the execution and understanding of the actions and the language used to describe them. Oudgenoeg-Paz, Leseman and Volman (2015) have analysed this possibility and hypothesize that exploration acts as a mediator between the achievement of the motor stages and the development of spatial cognition and language, eliminating the possibility that such developments are simply to be attributed to the general maturation process, given that the developmental relationships between motor skills, exploration, cognition and spatial language are highly specific. Perry, Samuelson, Malloy and Schiffer (2014) have demonstrated that specific categories are better acquired in specific contexts, and therefore stimulating environments full of opportunities can be used in a targeted way by competent subjects to offer focused and specific learning possibilities. Cross-sectional studies have demonstrated correlations between motor and language skills in both children with normal development (Alcock & Krawczyk, 2010) and those with developmental disabilities (Müürsepp, Ereline, Gapeyeva, & Pääsuke 2009; Hill, 2001). Karasik, Tamis-LeMonda and Adolph (2011) and Campos, Anderson and Telzrow (2009) also agree on linking walking, exploration and cognitive-linguistic development to the development of spatial language. Diaz-Williams, French, French and Nichols (2015) confirm that managing spatial practices in motion for phonological learning favours a solid memorization of terms thanks to the iconic spatial aid because it obliges a greater use of kinaesthetic stimuli, as well as being more engaging for children, even in subjects with a vocal production deficit. Furthermore, Diaz-Williams et al. (2015) found that the motor activities can enhance the learning of specific voice and language concepts, improving the focus on the task and on the production of sound to be emitted also through visual representations of basic concepts. By adding play-motor and drama activities in school exercise programs, it is possible, even at a more advanced age, to improve self-perception (Spanaki, Skordilis, & Venetsanou, 2010; Landazabal, 1999), body awareness (Sherborne, 1990), self-confidence and self-esteem in children (Zimmer, 2006), create programs aimed at developing specific motor skills (Lobo & Winsler, 2006) in relation to fitness aspects (Schmidt, Valkanover, Roebbers, & Conzelmann, 2013; Mayorga-Vega, Viciano, Cocca, & De Rueda Villén, 2012), and therefore to counter obesity, with further results in social skills. The linguistic abilities expressed and the socio-emotional relationship with peers or in the cliques is already important at 4-6 years of age (Brighi, Mazzanti, Guarini, & Sansavini, 2015; Tallandini & Morsan, 2006), as children with poor linguistic skills are more at risk of being ostracized or isolated from their school friends (Menting, van Lier, & Koot, 2011). The emotional content of the aggregating environment influences both the adjustment phase and congregation (Snyders-Sowers & Kariuki, 1997), and once the group is formed, their members mutually influence each other (Dishion & Dodge, 2005), with further repercussions on academic performance. Moreover, through vari-

ous Spearman correlations, Brighi et al. (2015) found that the linguistic competence scores of children are distinctly and positively connected to social competence and orientation, positive emotionality, attention and linguistic skills, along with their social reference group. The authors suggest that these relationship types may be bi-directional: language skills and competencies improve relationships and vice versa, in a virtuous cycle favoured by a stimulating environment. Physical activity, language and academic performance are certainly connected. It is feasible to consider the realization of learning paths based on dramatization using language, communication and personal expressive channel as mediators in the improvement of academic performance, influencing mnemonic and focusing abilities, personality, self-esteem and inhibitory control management. It is very important to promote interventions right from kindergarten in order to bring substantial benefits not only to the development of motor skills, but also for future cognitive performance, given that good performance of the former has a positive response in the latter: through motor activity, better results are obtained in the intervention groups than in the control groups with respect to all the parameters examined. Movement improves language, behaviour, self-efficacy and cognitive abilities. There are 3 theoretical approaches within developmental psychology: behaviourist, genetic, and psychoanalytic; the common factor of these theories is that language takes on a symbolic instrumental value, becoming the main thought medium and always affiliating itself to corporeal paralanguage. This stems from sensorimotor activity, which will, in turn, be linked to psychomotor development. When strategic synergies are employed on spoken language, perceptive-motor skills, behavioural dynamics of relationships, improvements can also be achieved with difficult subjects. Corporeal and sensorial dynamic take on an important role and must be followed in parallel psychosocial and relational development, given that they are regulated by psycho-cognitive levels. The processes of the self, of the Ego, are in continuous formation (Zimmer, 2006) and take place in a body that finds its coherence in rhythm, in movement or in its dynamics within a spatial context, allowing it to connote and denote itself in a relationship that is also the prescription of the limits and relationships it imposes, similarly to what already takes place in new-borns at a cerebral level (Deniz Can et al., 2013). Based on the data analysis, the benefits brought about by the development of motor skills and abilities have clearly emerged in the children of the age group taken into consideration, since the body is not only an extraordinary means to learn about reality, but also a formidable tool to discover, through active experience, one's potential and self. Through the body we learn to relate to our surrounding environment, learning and using interrelated motor gestures with cognitive, affective and linguistic skills to promote our global development—right from early childhood. We can now formulate some guidelines on how to use motor activity, in order to optimize and maximize language learning and consequently improve academic performance, although we suggest in-depth future studies to find specific application methodologies that can be applied to most school settings. Studies have emphasized the scope of the body experience by highlighting its relationship with cognitive processes, taking also into account the new contributions in neuroscience that demonstrate the close relationship between subject, movement, language and learning.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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