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The Ten Pillars of Neuromotricity. Theoretical-practical justification according to the BAPNE method
Los Diez Pilares de la Neuromotricidad. Justificación teórico-práctica según el método BAPNE

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Abstract. In this article we justify the ten basic pillars of Neuromotricity with the aim of showing a clear difference with respect to the theoretical and practical concepts of Motor and Psychomotor skills. In the first instance, a state of the art on this subject is presented, breaking down the number of publications and representative authors in order to subsequently break down the pillars that identify neuromotor skills. The foundations of Neuromotricity are articulated through its link to: Cognitive functions 2. Executive functions. 3. Attentional network. 4. Hormonal aspects. 5. Socioemotional aspects. 6. Theoretical models of learning. 7. Multiple skills. 8. Kinesthetic aspects. Forms of learning and 10. Musical aspects. The union of all these subjects is what gives Neuromotricity a clearly differentiating value from the rest of the other disciplines.
Keywords: Neuromotricity, BAPNE, Body percussion, cognitive functions, executive functions, dual task.

Resumen. En este artículo justificamos los diez pilares básicos que fundamentan la Neuromotricidad con el objetivo de mostrar una clara diferencia frente a los conceptos teórico-prácticos procedentes de la Motricidad y Psicomotricidad. En primera instancia, se presenta un estado de la cuestión sobre dicha temática desglosando el número de publicaciones y autores representativos para posteriormente desglosar los pilares que la identifican. Los fundamentos de la Neuromotricidad se articulan a través de su vínculo a: 1. Funciones cognitivas 2. Funciones ejecutivas. 3. Red atencional. 4. Aspectos hormonales. 5. Aspectos socioemocionales. 6. Modelos teóricos de aprendizaje. 7. Habilidades múltiples. 8. Aspectos cinestésicos. 9. Formas de aprendizaje y 10. Aspectos musicales. La unión de todas estas materias es lo que aporta a la Neuromotricidad un valor claramente diferenciador del resto de las otras disciplinas.
Palabras clave: Neuromotricidad, BAPNE, Percusión corporal, funciones cognitivas, funciones ejecutivas, dual task.

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Introduction

Neuromotricity is a discipline that requires a very clear foundation and protocol that differentiates it from Motricity and Psychomotricity (Andreu-Cabrera & Romero-Naranjo, 2021; Romero-Naranjo & Andreu Cabrera, 2023a, 2023b). In the 21st century, information and communication technologies take time away from movement and social interaction, causing a sedentary lifestyle (in addition to low cognitive stimulation). For this reason, physical activity becomes the solution to health problems, in all the dimensions of the term. The relationship between physical activity and brain functions is one of the most developed lines of research in recent decades. From the information analyzed (Rolland et al., 2008; Loprinzi et al., 2013), it appears that, in the motor domain, physical exercise is one of the best protectors against senile dementia, Alzheimer's disease and depression (de Oliveira et al., 2019; Wu & Huang, 2017).

Physical exercise possesses invaluable human benefits (Aguilar-Herrero et al., 2021; Martínez-Heredia et al., 2021; Maureira, 2021; Maureira et al., 2023; Pacheco et al., 2022; Padial-Ruz et al., 2022; Palma-Marifil et al, 2021; Pérez et al., 2022; Romero-Ramos et al., 2021; Zambrano-Pintado et al., 2022) that combined with other subjects the results can be even more brilliant (Luis-de Cos et al., 2019; Mezcua-Hidalgo et al., 2020; Villa de Gregorio et al., 2019).

In the field of Physical Activity and Sport Sciences, motricity refers to a study of the movements of human beings, their characteristics and meaning. It is also defined as the capacity of the central nervous system to produce the contraction of a muscle. Motricity as a discipline studies human movements and their kinetic and kinematic characteristics.

Following the latest studies (De Giorgio et al., 2018), exercise increases the production of neurotrophins, a protein responsible for helping us to produce more neurons, helping to have a healthy and flexible brain. That is why, every time we want to learn something new, our brain must be modified and create new structures, as Santiago Ramón y Cajal pointed out, at the beginning of the 20th century.

State of the art

With regard to neuromotricity, there are very few scientific references and studies since it is a term of recent appearance and academic development. It is important to note that for many authors Neuromotricity is to perform any type of motor exercise and then talk about the brain; an aspect completely opposite to the essence of the term. By way of justification, there are three recent articles that present a historical evolution; as well as a proposal of practical resources that serve as a precedent for this publication, citing that the first time this term appears is in 1974 by the researcher André Lapierre (Andreu-Cabrera & Romero-Naranjo, 2021; Romero-Naranjo & Andreu Cabrera, 2023a, 2023b). Still, the bibliometrics of Arnau-Mollá (Arnau-Mollá & Romero-Naranjo, 2021, 2022) and the excellent state of the art of Di Ruso (Di Ruso & Romero-Naranjo, 2023) are extremely enlightening.

A bibliographic update was carried out in 2023 on this term, providing the following table (Table 1).

Regarding the number of the most prolific authors on this term, we provide the following table (Table 2).

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Table 1.
Table of documents in academic search engines.

Neuromotricity	
WOS	15 documents
Scopus	13 documents
Jstor	12 documents
Proquest	10 documents
Dialnet	19 documents
Pubmed	0 documents

Table 2.
Table of authors with the highest academic production on neuromotricity.

Most prolific authors in Neuromotricity	
Francisco Javier Romero-Naranjo	28
Antonio Francisco Arnau-Mollá	15
Roberto Sayago-Martínez	7
Eliseo Andreu-Cabrera	4
Luisamer González de Benatuil	4

All these authors belong to the University of Alicante and research within the specific research group on Neuromotricity of the Faculty of Education.

Differences between motor skills, psychomotor skills and neuromotricity.

From a theoretical and practical point of view, there are clear differences between each of these concepts, so we will now proceed to define them.

Motricity: is the ability to control the movements of the body in a voluntary and coordinated manner involving the motor system. Activities such as walking, jumping, running, rolling, crawling, going up or down stairs, etc., clearly represent motor skills.

Psychomotricity: according to the Spanish Federation of Psychomotricity Associations, "psychomotricity is the set of cognitive, emotional, symbolic and sensory-motor interactions in the capacity to be and to express oneself in a psychosocial context". Activities such as following a path, tying shoelaces, inserting one object into another according to its geometric shape, making a circuit with specific goals, etc.

There are several definitions of neuromotricity, but Romero-Naranjo (2004) is the first author to link it to executive functions through his educational proposals in the BAPNE method (Romero-Naranjo, 2018; Andreu-Cabrera & Romero-Naranjo, 2021; Romero-Naranjo & Andreu-Cabrera, 2023a, 2023b, 2023c). Next, we proceed to show the few existing definitions.

Lapierre (1974) is the first author to use the word Neuromotricity but only as a chapter title. It is important to note that he does not provide a specific definition. All he argues is that "between psychism and the mechanics of a muscle, there is a whole neurological structure of transmission and regulation" which Lapierre himself calls the psychoneuromotor system.

From the point of view of neurorehabilitation, Hernando and Useros (2007) define neuromotricity as the nervous response that goes from the cortical and subcortical nerve centers and activates the motor neurons to produce a motor response.

Regarding Martín Lobo (2015) defines it as analysis of the neurological aspects involved in the development of a movement, its programming, control and the acquisition of the models of execution of the movement.

According to Romero-Naranjo & Andreu-Cabrera (2023a, 2023b) Neuromotricity is the educational and neurorehabilitative procedure that affects cognitive stimulation through executive functions in which the dual task and mainly language (spoken, sung, recited, etc.) thus providing a superior function to stimulation. The example of language as a task independent of the upper and lower extremity is the main element that differentiates it from motor and psychomotor skills.

Concretely, the terminological and conceptual difference of the three terms is shown in the following table (Table 3).

Table 3.
Key concepts of motor, psychomotor and neuromotricity.

Key Concepts
Motricity. It is the ability to control body movements in a voluntary and coordinated manner involving the motor system. Activities such as walking, jumping, running, rolling, crawling, going up or down stairs, etc., clearly represent motor skills.
Psychomotor. It is the set of "cognitive, emotional, symbolic and sensorimotor interactions in the capacity of being and expressing oneself in a psychosocial context".
Neuromotricity. It is the educational and neurorehabilitative procedure that affects cognitive stimulation through executive functions in which the dual task and mainly language (spoken, sung, recited, etc.) coexist, thus providing a superior function to stimulation.

With all that we have observed above, we make a hierarchy that goes from automated movements to more complex skills and possibly requiring more stimulation (Figure 1).

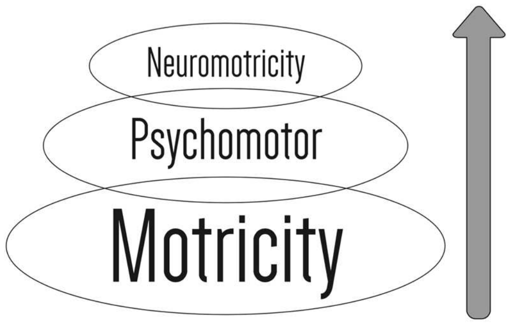

Figure 1. Hierarchical figure of motor, psychomotor and neuromotricity.

Pillars of Neuromotricity

Neuromotricity is conditioned by a series of factors that clearly differentiate it from motor and psychomotor skills. For this reason, the executive functions and especially the dual task with the use of language is fundamental. This is the reason why we propose the basic pillars that make it up.

Cognitive functions

Through movement, cognitive functions are the basis for working neuromotricity, since this has a protocol that differs from motor and psychomotor functions (Romero-Naranjo & Sayago-Martínez et al., 2023; Romero-Naranjo & Pujalte-Cantó & Arnau-Mollá, 2023). Cognitive functions are those that are responsible for receiving, selecting, storing and processing information from the environment around us.

With movement we can work in parallel with memory, language, praxias, gnosias, spatial orientation, visuospatial

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ability, attentional network, social cognition and executive functions. It is important to emphasize that spoken, recited or sung language is of utmost importance because we can use it while performing any motor activity. Clear examples are, for example, walking while bouncing a ball and performing arithmetic operations, answering capitals of countries, saying opposites (black/white), singing a melody, etc. (Kozio et al., 2012; Sheridan & Hausdorff, 2007; Yogev-Seligmann et al., 2008).

Within cognitive functions, praxias have a very important role in neuromotricity due to their relationship with the kinesthetic part because they are a neurological process by which cognition directs motor actions. There are several types of praxias that are classified as: facial, ideomotor, ideational and visoconstructive. When we perform motor coordination activities and use objects such as balls, pikes, hoops or clubs, praxias are always present due to the appropriate use that must be given to them as well as the use of well-coordinated sequences to provide their correct execution. Praxis are very important in body expression because they involve gestures, facial grimaces, cheeks or motor movements that are detailed below.

Ideomotor praxis

It is the ability that includes the performance of simple movements such as communicative hand gestures when gesturing and saying to someone: come, goodbye, silence, military salute, a comb, a finger wave, etc.

Ideational Praxis

It is the ability related to the use of utensils or objects with a sequence of well-coordinated actions. For example, passing a tennis ball from one hand to the other, brushing our teeth, combing our hair, tying our shoelaces, threading a needle, cutting with a knife, etc. In neuromotricity we use ideational resources linked to the double task where we start from simple movements as we observe below (Figure 2).

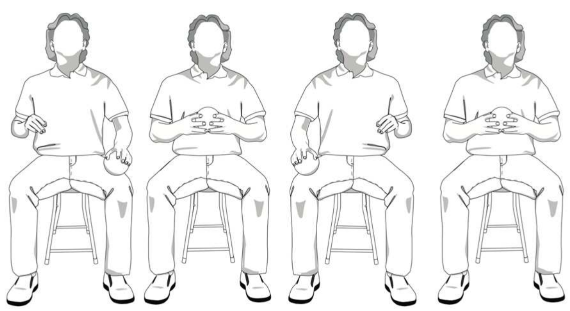

Figure 2. Ideational praxis with a tennis ball.

In neuromotricity, praxias can be combined with language, two fundamental cognitive functions in the BAPNE method. The exposed plate should be read where each time a stick is seen, "bread" is pronounced and when two sticks are seen, "house" is pronounced (Figure 3).

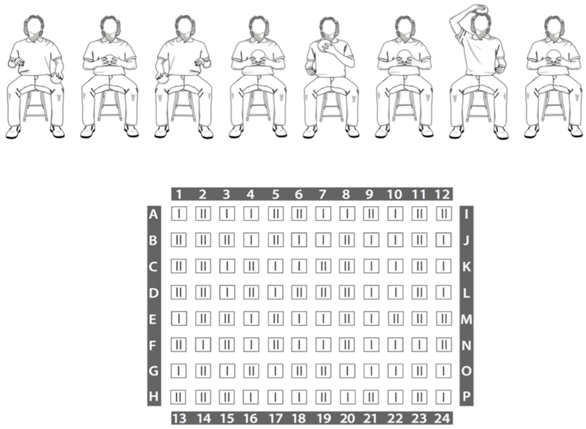

Figure 3. Performance of a BAPNE activity in which coded language is implemented with ideational praxis.

Visoconstructive Praxis

It is linked to the ability to plan and execute movements in space such as doing a puzzle, assembling an ikea piece of furniture, making a drawing, or building something from its components such as a small boat, etc.

Orofacial Praxis

It is everything that has to do with movements or gestures with different parts of the face. Activities such as frowning, squeezing the cheeks, making faces, giving a kiss, clicking the tongue, etc. All these aspects are also fundamental in body expression.

Executive Functions

Executive functions are the Swiss army knife of our prefrontal cortex. From the didactic point of view, we have in our brain a toolbox that must be used according to the activity to be performed. Many authors have contributed to expose their models, such as Diamond (2013), Furley et al., (2023), Tirapu (2008), Fuster (2000), Koechlin & Sommerfield (2007), Damasio (1996), Miyake (2000), etc. In our case, we follow Tirapu's proposal since it is in line with the type of activities of the methodology.

Through movement we can work on executive functions (processing speed, working memory, inhibition, verbal fluency, dual task, cognitive flexibility, planning, branching and decision making). The concrete link of unifying executive functions to movement using language and body percussion as completely independent tasks was created by Romero-Naranjo (2004). Executive functions are the heart of neuromotricity in which dual-tasking is the differentiating element. Dual-tasking has a unique importance, considering it as the ability to perform two completely different tasks such as eating and reviewing an exam in parallel, etc.

Neuropsychology researchers have structured three classic paradigms regarding the so-called dual task (Baddeley, 1986; Falbo et al. 2016; Fritz et al., 2015; Koch et al., 2018; Mendel et al., 2015; O'Shea et al., 2022; Ruthruff et al., 2001; Sasaki et al., 2015) called Motor/Motor;

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Cognitive/Cognitive; and Cognitive/Motor. Subsequently, several authors provided a fourth model named Rhythmic/Motor (Park et al., 2014; Kim et al, 2017a, 2017b, 2020, 2022) and finally Romero-Naranjo (2023a) provides a possible fifth paradigm named Rhythmic/Motor/Cognitive.

In summary, the five paradigms of the dual task are presented as follows (Table 4).

Table 4.
Classification of the five paradigms of the Dual Task.

	Dual Task Paradigms
1	Motor/Motor. These are two tasks that possess a motor component (Amboni et al., 2012; Beurskens & Bock, 2013; Hung et al., 2013; Lee et al., 2017; Shim et al., 2016). They are classified into two major blocks: A. Balancing tasks: we observe this in the hospitality world when we see a waiter carrying a tray, several plates in his hands or a simple glass of water. B. Oculo-manual tasks: an example is walking forward while fastening the buttons of a shirt.
2	Cognitive/Cognitive. These are two activities with a cognitive component (Baddeley & Hitch, 1974; Corlu et al., 2015, Wang & Gathercole 2013). A practical example is writing the alphabet on a piece of paper while answering cognitive tasks such as the capital of Germany, the opposite of white, tell me the result of 2x9, translate the word "chair" into English, etc.
3	Cognitive/Motor. It consists of performing one task with a cognitive component and another with a motor component (Bridenbaugh & Kressig, 2015; Crockett et al., 2017; Falbo et al., 2016; Fok et al., 2011; Hawkins et al., 2018; Lin & Lin, 2016). There are many variables of activities because the literature on it is abundant. The voice has a fundamental role since the person must speak continuously according to the verbal fluency tasks that are indicated. There are many variants and here we show a few of them: a) Walking and arithmetic tasks (addition, multiplication, division…). b) Walking and working memory (remembering words from a story…). c) Walking and verbal fluency (counting backwards the days of the week). d) Walking and semantic fluency (saying words beginning with "N"). e) Walking and categorical fluency (say only fruits or musical instruments…).
4	Rhythmic/Motor. It consists of performing a rhythmic and a motor task (Park et al., 2014; Kim et al, 2017). A practical example is walking forward while playing a percussion instrument following a rhythmic pattern. The same can be executed by performing a rhythmic structure with clapping.
5	Rhythmic/Motor/Cognitive (Romero-Naranjo et al, 2023a). It consists of performing a task with a motor component linked to movement, another with a cognitive component and another with a rhythmic component. The BAPNE method provides many practical variants where the novelty lies in the fact that the subject must not only speak but also sing, recite, hum, etc. For this, the methodology not only uses the body, but it is supported by hoops of different sizes, feathers, strings, chopsticks, cones, maces and other objects. The neuromotor table (Figure 4) helps the initial activities. The activities are classified into three major groups: A. Dual-task activities walking freely in space. B. Bipedal dual-task activities with geometric figures (figure 8). C. Seated dual-task activities. Each of these activities has the task of moving the lower limbs completely independently of the upper limbs while performing verbal, rhythmic or melodic fluency tasks.

The activity protocol of the BAPNE program is based on activities in which the subject must perform motor movement activities while executing rhythmic structures with the upper limb and from the verbal point of view performs cognitive activities that the teacher can indicate (addition, subtraction, country capitals, saying opposites, translating words, repeating certain changing syllabic structures, singing a melody, etc.). The BAPNE method has a "Chart" that summarizes all the variants that can be performed (Figure 4). For example, the following sequence indicates that for each step, two claps are given, and the teacher can also ask you for the capital of Germany.

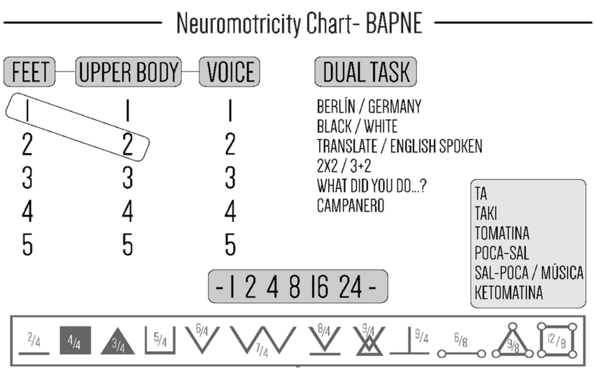

Figure 4. Table of initial Neuromotricity activities of the BAPNE method.

All the detailed aspects of this type of activities are detailed in the publications of the BAPNE method, including the evaluation of the attentional network and anxiety (Romero et al., 2022).

The executive functions and their link to neuromotor activities are as follows (Andreu-Cabrera & Romero-Naranjo, 2021; Bååth et al., 2016; Romero-Naranjo et al., 2023).

Processing speed

It indicates the amount of information that can be processed per unit of time or even the speed at which a series of cognitive operations can be performed, but also the time that elapses from the appearance of the stimulus to the execution of a response (Ríos et al., 2004). Processing speed can be visual (letters and numbers), auditory (language and singing) and movement. We work with the BAPNE Cognitive Plates and also with the Clap Change, by means of rhythmic and melodic oral question/answer structures, verbalizing mathematical operations and moving in different "horizontal meters" (geometric figures) in space.

Working memory

Several authors also call it working memory, which is the ability to record, encode, maintain and manipulate information during a very specific interval of time in order to maintain the sense of unity of cognitive activity. In various types of activities using varied repetitions and combining new rhythmic structures both verbally and with body percussion.

Verbal fluency

It is related to the processes that carry out the appropriate strategies for the search of information and its appropriate

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response in the shortest possible time. It works through the ability to improvise verbally within certain structures provided by the teacher. It is related to dual task since it is performed while moving in certain geometric figures.

Dual task

Dual-tasking is the ability to perform two completely different tasks simultaneously and paying equal attention to both of them constantly. It is about working in parallel a visual task and a visuospatial task. In BAPNE all the activities present dual task since the purpose is to make the lower limbs independent from the upper limbs with different movements and voice (spoken or sung).

Inhibition

It is the ability to inhibit or control impulsive responses, interferences or distracters while performing a task. It can be worked at motor, attentional and behavioral levels. Multiple activities related to psychomotor melodies, canon, concentric circles and reverse reaction.

Cognitive flexibility

It is the ability that allows us to make changes in what was previously planned and thus adapt to the circumstances of our environment. The teacher constantly provides indications that modify the psychomotor movement.

Planning

It is the ability to generate objectives, develop action plans to achieve them, and choose the most appropriate one based on anticipation of consequences. When indications of what to do next are received, the participant develops action plans to achieve them.

Decision making

It is the process of making a choice between several possible choices according to the needs, assessing the results and consequences of each one of them. Mainly works with Clap Change, Handsball Change and when the student, within certain parameters, leads the group temporarily assuming the role of teacher.

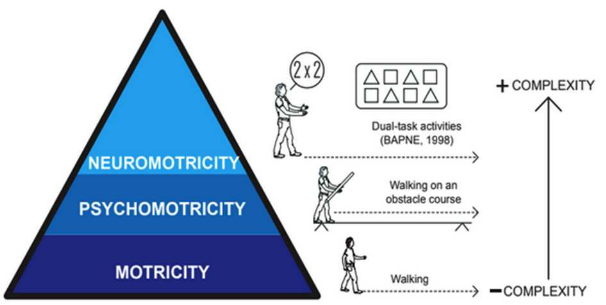

Figure 5. Neuromotor pyramid according to the BAPNE method. (Romero-Naranjo & Andreu-Cabrera, 2023).

Branching

It is the ability to organize and perform three tasks optimally simultaneously, interleaving them and knowing where each of them is at any given moment.

Therefore, as a conclusion of this section we can observe that the level of complexity is always conditioned by the use of the double task in Neuromotricity, as shown in the following pyramid (Figure 5).

Attentional network

Attention allows us to selectively focus our interest on a certain stimulus, discarding, activating, filtering or inhibiting non-relevant information. Neuromotor activity requires a high level of attention because controlling that the movement is independent of language requires a high level of concentration. There are thirteen attentional models according to Fernandez (2014), exposed by different authors; models of attention with a very precise justification according to each researcher such as Broadbent, Norman and Shallice, Mesulam, Mirsky, Postner and Petersen, as summarized by Onandia-Hinchado (2019). The model proposed by Sohlberg and Mateer (1987, 1989) is the one that best fits the Neuromotricity activities of the BAPNE method. These authors classify attention in a hierarchical manner and graduating to greater complexity as arousal, focal, sustained, selective, alternating and divided. Following the postulates of Onandia-Hinchado (2019), Sohlberg and Mateer's clinical model of attention is explained as follows:

Arousal. It is the ability to be awake and to maintain alertness and therefore involves the ability to follow stimuli or commands.

Focal attention. It is the ability to focus attention on a given stimulus where the time of fixation dedicated to the stimulus is not valued.

Sustained attention. The ability to maintain a response consistently over a prolonged period of time.

Selective attention. The ability to select information from different variables with the aim of inhibiting attention to some stimuli while attending to others.

Alternating attention. The ability to switch the focus of attention between tasks that involve different cognitive requirements, controlling which information is processed at each moment.

Divided attention. According to Onandia-Hinchado "is the ability to attend to two things at the same time. It is the capacity to select more than one piece of information at the same time or more than one process or action scheme simultaneously. It is the process that allows the distribution of attentional resources to different tasks or requirements of the same task. It may require rapid switching between tasks or the automatic execution of some of them" (Onandia-Hinchado et al., 2019).

Regarding attention and neuromotricity studies there are more than 15 intervention studies with control and experimental group both in Spain and Italy such as the studies conducted in primary school (Arnau-Mollá & Romero-Naranjo, 2020; Cozzutti et al., 2017; Torró-Biosca et al., 2019), and Secondary (Álvarez-Morales & Romero-Naranjo, 2018; Romero-Naranjo, et al., 2022; Piqueres-Juan et al., 2019), also in Conservatories (Ros-Silla et al., 2019) and in healthy elderly people (González-Sánchez et al., 2019) among others.

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Hormonal aspects

Hormones play a very important role in the chemical processes of our organism since they transmit messages between cells and organs (García-Arnés et al., 2022). The intergroup relationship always generates a hormonal bond both positively and negatively due to the interpersonal relationships that are generated (Romero-Naranjo & Romero-Naranjo, 2022). Our brain translates our emotional and affective bond into a series of hormones that provide emotional stability to the subject depending on the type of circumstance he/she is experiencing at that moment.

It is true that certain hormones have the duality of being also neurotransmitters because they are produced by the adrenal glands and poured into the bloodstream, which provides a hormonal effect; it is important to note that they are released in parallel in the nerve endings, also acting as neurotransmitters. Important neurotransmitters linked to motor activity and neuromotor activity are glutamate, which enhances communication between neuronal groups; dopamine, which is linked to reward and pleasure; acetylcholine, which is involved in learning and memory processes; serotonin which is linked to our mood and sleep processes; endorphins which have the ability to inhibit neurons involved in pain and regulate the release of stress; noradredalin which is involved in keeping us awake, active and focused.

Socioemotional aspects

Emotions have a unique value when it comes to relating and working collaboratively. There are several models on working with emotions such as Plutchik (1980), Salovey & Mayer (1990), Bisquerra (2011), Aguado (2014a, 2014b), Ibarrola (2001), Cowen & Keltner (2017), etc. In the case of neuromotor we follow the model of Roberto Aguado (2014), in which he classifies pleasant emotions into CASA (curiosity, admiration, security and joy) and unpleasant emotions TRAM (sadness, anger, disgust and fear). Regarding the socioemotional bases from the neuromotor point of view, there is a previous publication that provides the ten pillars of socioemotional learning, which are divided into:

1. Systematic learning. 2. Learning based on cognitive and executive functions. 3. 3. Environment. Forms of learning. Non-hierarchical learning. 4. My relationship with the other. 5. Link with the error and link with the methodology. 6. Infrastructure. Classroom conditions and materials. Creativity. Teacher's competence and voice. 9. The value of play. 10. Evaluation.

Theoretical models of learning

The way in which we teach and disseminate knowledge can vary depending on the optic in which we focus the information.

Gregorc's model

Our learning style depends on our way of perceiving and ordering information (Terry, 2002). Depending on the culture and personality of the student, learning can be linear (first course, second course, third course, etc.) or random (typical of non-Western cultures).

Kolb's model

This celebrated author elaborated his well-known "Learning Style Inventory" (Manolis et al., 2013). He proposes four possible ways of learning:

a) Concrete experience: those people who prefer to learn through the experience of active participation and their relationship with other people.
b) Reflective observation: These are people who discover the meaning of learning through listening, observation and attending to diverse opinions.
c) Abstract conceptualization: People who prioritize learning through abstract theories and concepts.
d) Active experience: People who prefer to learn by testing theories and experimenting with them.

Myers Briggs Model

The Myers Briggs model is based on Carl Jung's work on psychological types (Salter et al., 2006). In pedagogy it is taken into account when looking at the psychological profiles of our students because we will understand the need to diversify with respect to what and how we ask them to learn. This model classifies four categories that describe key areas, which when combined form the basis of a person's personality. These are:

a) The center of their attention: Extroversion (E) or Introversion (I).
b) The way of perceiving information: Sensation (S) or Intuition (N).
c) The way of making decisions: Thinking (T) or Feeling (F).
d) The way of dealing with the external world: Judgment (J) or Perception (P).

Dunn & Dunn Model

Rita and Keneth Dunn's model is the most comprehensive in providing insight into the learner's preferred way of learning, possessing a full spectrum of age, ability, and gender (Klitmøller, 2015). Dunn & Dunn's studies based the mode of learning on five categories: environmental (is structured in sound, light, temperature and design), emotional (consists of motivation, constancy, responsibility, structure), sociological (focuses on self, with another person, with peers, with adults, various), physiological (is visual, auditory, kinesthetic and tactile) and psychological (articulated in global, analytical, left or right hemisphere dominance, impulsive or reflective).

Multiple skills

Through neuromotricity we can work multiple skills where the kinesthetic part and praxis have a relevant role. Cognitive functions serve as a link to justify many skills. For this reason, there is a link between cognitive functions and multiple skills. Language with linguistic ability; praxis with kinesthetic ability; social cognition with interpersonal and intrapersonal skills, and the same happens with visuospatial

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ability, etc. For this reason, we believe that students may feel more comfortable working within some parameters than others.

Kinesthetic aspects

Neuromotor skills revolve around movement and for this reason biomechanics, body schema and expression serve as a bridge for the development of activities. In this regard, there is already initial literature on biomechanics (Alonso-Marco & Romero-Naranjo, 2022), laterality (Romero-Naranjo, 2013a, 2013b, 2013c; 2014, 2016, 2017, 2018, 2019, 2020a, 2020b, 2020c, 2020d, 2020e), fine psychomotor skills (Carretero-Martínez, 2016), body schema (Romero-Naranjo et al., 2022), etc. The activities require specific motor skills that are sequenced and aim to provide "motor literacy" in a correct way.

A basic neuromotor activity is the Clap Change, which aims to dissociate the lower train from the upper train through "micro-activities" that vary. The student counts from one to four whose numbers coincide with the movement of the feet. The teacher will tell him/her on which number to clap his/her hands, since they are continuously changing (Figure 6). Subsequently, many variants can be performed, such as the mathematical one, where the students are told to clap on 2+1 or 3 - 1, etc. Another variant is to sing a melody while it is being played and to pay attention to the numerical indications given by the teacher. There are more than 20 variants of this activity based on the double task.

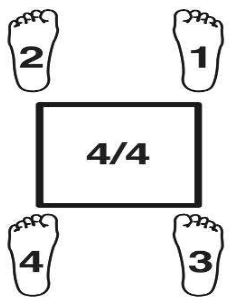
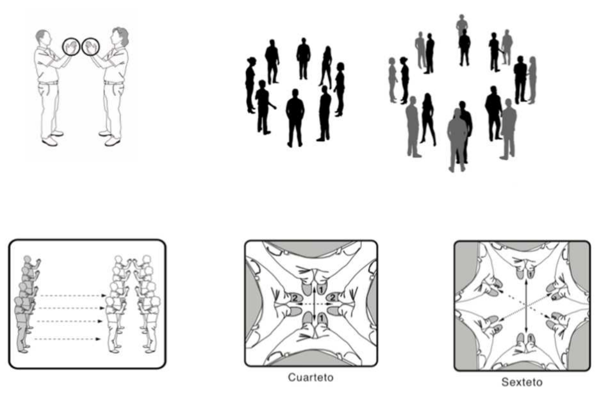


Figure 6. Geometric figure model to work on Clap Change.
Figure 7. Sample of some visuospatial learning models.



Visuospatial forms of learning

From the point of view of the execution of movement in space, neuromotor skills, having a specific protocol, the activities can be carried out in different ways. The visuospatial ability can be worked in different ways such as working in pairs, circles, concentric circles, facing rows, quartets or sextets, among other possibilities (Figure 7).

Musical aspects

In neuromotor skills, many of the exercises require a temporal structure of movement called rhythm (Romero-Naranjo, 2020e). One of the first activities is the proposal of movement by geometric figures, which allows students to know when each rhythmic structure or beat begins and ends (Figure 8). Through multiple neuromotor activities we can work on pulse, rhythm, meter, musical figures, metrical division and subdivision, beats and counter beats, timbre, aglogic, improvisation and even some basic rudiments of composition, as well as other structures such as canon, echo, etc.(Romero-Naranjo et al 2022a, 2022b, 2022c).

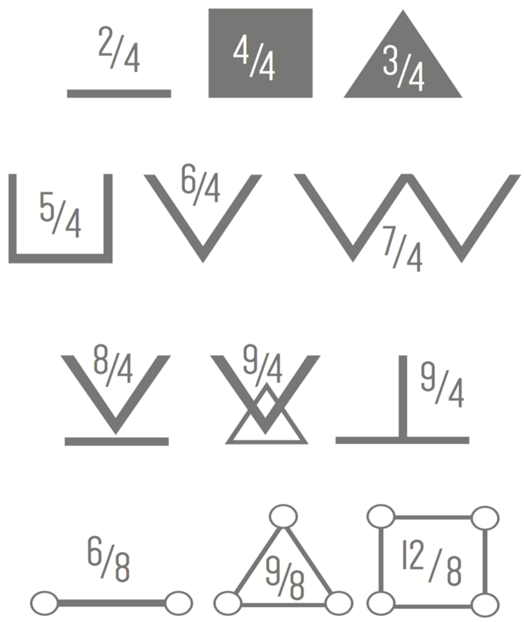


Figure 8. Geometric movement of the feet in neuromotor skills.

Conclusions

In conclusion, we would like to emphasize that we have proposed the 10 fundamental pillars that justify the use of neuromotor skills. To this end, we have provided not only the theoretical and bibliographical justification that supports it, but also various practical resources that show that neuromotor skills have clear differences with the classic activities from psychomotor skills (Table 5).

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Table 5.
Benefits and contents of the BAPNE method

Benefits and contents attached to Neuromotricity - BAPNE method I			
Kinesthetic / Anatomical	Psychological	Neurological / Cognitive	Etnomusicologic
Body Scheme: Postural Control / Attitude Spatial Structuring Temporal Structuring Balance Coordination Learning by biomechanical planes Learning by biomechanical axes Manual and pedal coordination (audio/visual/motor) Motor dissociation Development of the proprioceptive system Development of the vestibular system Strength work Resistance work Power work Work on laterality Knowledge of joints and bone structures in relation to neuromotor skills. Learning of different types of timbres and sounds with the body. Learning of clapping games and their modification to bring them to the classroom. Movement technique / Motor coordination technique. BAPNE FIT program. BAPNE BODY EXPRESSION Program.	Emotions CASA Emotions TRAM (Roberto Aguado) Rooting: gaze, hands, feet (Lowen). Increased motivation Improvement of self-concept Improvement of self-esteem Acceptance of error as a vital learning process Bonding work Frustration management Management of socioemotional aspects Stimulation of play in learning Sense of belonging to the group (tribe) Learning theories and models Forms of learning in BAPNE: Imitation Reverse reaction Variable Circular Coordination Real-time signalin Learning in values Evolutionary stages of neuromotor learning.	Cognitive functions work: Memory Language Praxis Gnosias Spatial orientation Visuospatial ability Attentional network Social cognition Executive functions Executive functions work: Processing speed Working memory Inhibition Verbal fluency Dual Task Cognitive flexibility Planning Branching Decision Making Frontal lobe Parietal lobe Temporal lobe Occipital lobe Hormones in Neuromotricity (Serotonin, Cortisol, Oxytocin…) Possible stimulation of the cerebellum Amygdala Motor learning Motor control Motor programming BDNF Attentional network (Sohlberg and Matter, 1989). Work of the various types of memory (procedural, etc).	Learning of work songs and their relationship with movement and body percussion. Knowledge of chroniclers, travelers and explorers. Introduction to the learning of the TALA of India. Learning of the dances percussed by geographical zones: Verbunk Schuhplattler Esku dantza Haka Gumboots Kecak Stepping Balls dels Moretons Flamenco, etc. Types of clapping by geographical zones:: Gnawa Somalí Deaf Bright Cameroon, etc. Learning urban rhythms Learning African rhythms Learning Latin rhythms Learning Asian and Oceanian rhythms

It is true that many researchers have lent themselves to terminological confusion by linking neuromotor skills to any type of movement, but simply adding a justification of the possible areas involved in its execution. Neuromotricity is a completely independent discipline that since the BAPNE method was first linked to executive functions. In the first instance, the voice, as we have argued above, is a differentiating element with a broad neurological justification in terms of cognitive stimulation. Since 1974, when the term neuromotor skills was first announced at the academic level by Lapierre, little has been written about this new field in a serious way. Proof of this is the bibliographic review of this terminology in academic search engines, which shows few studies with control and experimental groups (Figure 9).

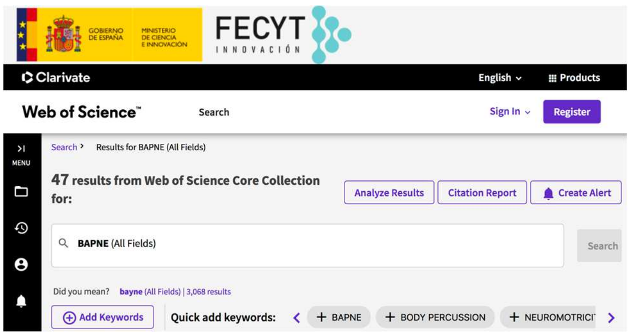

Figure 9. Web of Science publications of the BAPNE method.

In the same way we can have an overview of the publications in the Web of Science of the classical methodologies (Figures 10,11,12,13 and14).

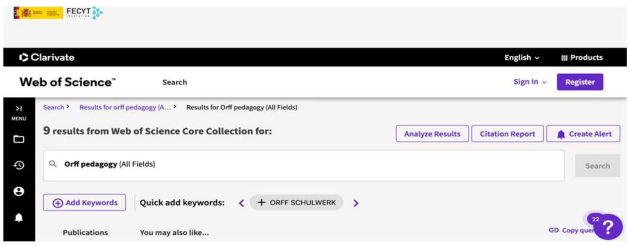

Figure 10. Web of Science publications about Orff.

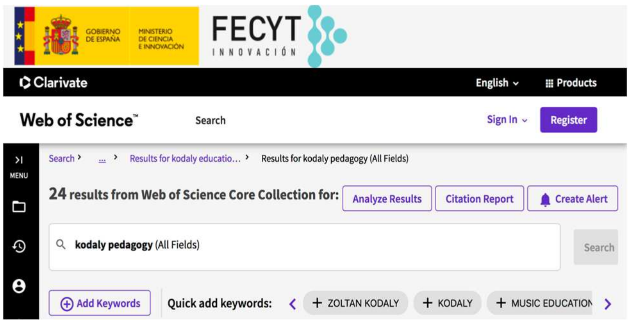

Figure 11. Web of Science publications about Kodaly.

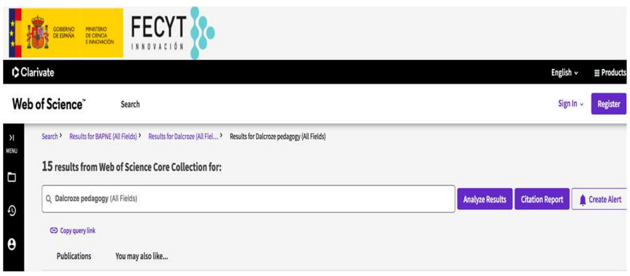

Figure 12. Web of Science publications about Dalcroze.

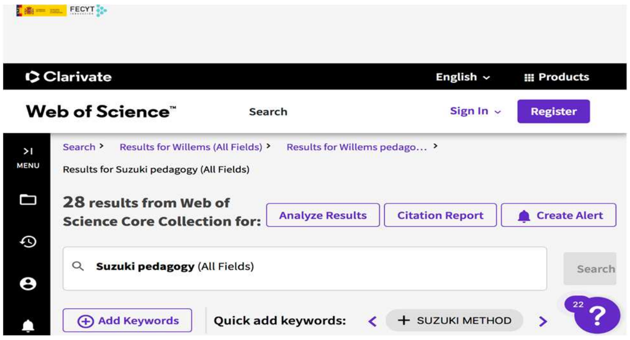

Figure 13. Web of Science publications about Suzuki.

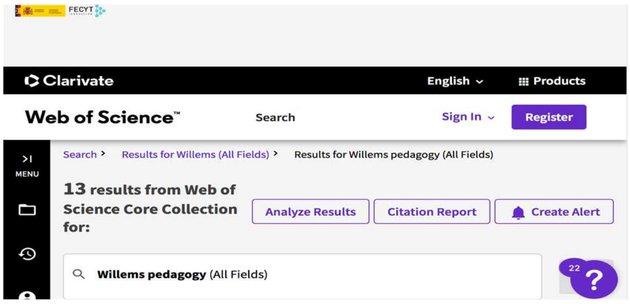

Figure 14. Web of Science publications about Willems.

Regarding the BAPNE method, future perspectives should be linked to new intervention studies with validated tests and where motor aspects are combined with executive functions to observe if there is not only a motor improvement but also an improvement in inhibition, cognitive flexibility, working memory, planning, decision making, etc.

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