

# Classification of judo motor skills: tactical and motor criteria approach

## Authors' Contribution:

- ☑ **A** Study Design
- ☑ **B** Data Collection
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## Abstract

The so-called combat sports involving a grip in general, and judo in particular, represent a complex reality of disciplines with common structural features. Such sports, particularly judo, require a great number of skills and techniques, which are used for sporting objectives; to facilitate understanding and simplify their organization, numerous classifications have been proposed. Studying a sport through the analysis of its motor skills involves, in the first place, organizing and classifying its different movements based on relevant and pertinent criteria, and relating them to the main objective. This work aims to present a proposal for the classification and organization of specific judo skills, based on the establishment of motor and tactical criteria, to analyse and optimize learning and training processes, and applied research, enabling a new perspective on sporting analysis. Our main intention is to organize judo motor skills in order to: a) facilitate the acquisition of a large amount of movements (techniques) and to design a tool for acquiring a significative learning through a classification based on motor criteria; b) use this proposal as a resource to design, control and optimize the training process; and c) analyse the sport of judo from a tactical perspective by studying the relationship between the different components of the struggle.

Criteria used for classification were: a) Movement structure (with turning, without turning or supine position), b) Sustentation base (one support, two supports or back support), c) Space where the opponent is thrown (forward throw or backward throw), d) Direction of the dynamic leg (ipsilateral direction or contralateral direction), and e) Spatial zone of the dynamic leg (inner zone or external zone).

Nine groups of specific judo techniques, with common motor features, are presented through the combination of these criteria to organize and optimize learning, training and analysis of the bout.

**Key words:** judo analysis • judo learning • laterality • fight structure • judo techniques

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**Tori/uke** – the person who applies a technique in *jūdō* training. The receiver of the technique is referred to as *uke* [31]

**Technique** – noun a way of performing an action [32]

**Posture** – noun the position in which a body is arranged, or the way a person usually holds his or her body when standing [32]

**Position** – noun 1. the place where a player is standing or playing 2. the way in which a person's body is arranged [32]

**A positive/negative position** (in *agonology*) – “An acting subject places itself in a positive position towards an action's aim if it does not need to strain in realization of this aim (...) in a negative position (...) in it must strain in achieving it because an automatic course of events without its interference is tending to a discordant to intended state of matter” [33, p. 131; see also 34]

## INTRODUCTION

Jigoro Kano, a Japanese born in 1860, established the basis of modern judo as we currently know it. He moved to Tokyo at the age of 17 to enrol at the Faculty of Arts. He is remembered as a man with a high cultural level who spent most of his life dedicated to the development of the education sector and, especially, physical education and judo. This sport has evolved remarkably from its birth to the present day (just over 100 years) along a path where mysticism, culture and politics mix with sport and educational training to become a global sporting movement and a competitive event that is widely studied.

Today, the so-called combat sports involving a grip in general, and judo in particular, represent a complex reality of disciplines with common structural features, but with specific competitive models, which show their functional demands (conditional, coordinative and cognitive). These demands are characterized by high muscle involvement and complex coordinative requirements (global and intersegmental), which determine the specificity of their motor skills; furthermore, the decision-making processes are continuous and constant, and their principal aim is to adjust the athlete's movements to the specific situation through perceived environmental information (exteroceptive information, such as the posture of the opponent, spatial placement, muscular tension, direction of displacement, imbalance, etc.), or based on his/her own movements (proprioceptive information, such as the angles and speed of involved joints, motor control, upper and lower limb control, gripping tension, etc.).

Such sports, particularly judo, require a great number of skills and techniques, which are used for sporting objectives; to facilitate understanding and simplify their organization, numerous classifications have been proposed. The purpose of this paper is a proposal for the classification and organization of specific judo skills, based on the establishment of motor and tactical criteria, enabling a new perspective on teaching, training and sporting analysis.

## JUDO CLASSIFICATIONS

Studying a sport through the analysis of its motor skills involves, in the first place, organizing and classifying its different movements based on relevant and pertinent criteria, and relating them to the main objective.

In general, classifying implies distributing; in sports such as judo, this is very useful in order to simplify and understand the large number of movements, and we think that it would be highly significant that classification criteria were connected to motor criteria. Educational needs and didactic requirements have encouraged classifications of judo motor skills to be designed in a simpler way, with the objective of facilitating their understanding, but the criteria used have been quite varied and the classifications substantially different.

Sacripanti [1], for instance, had already proposed a unified theory of fighting styles (based on mechanical criteria) to classify the techniques and organize a learning sequence. Much earlier, around 1885, a classification of judo techniques, also based on common criteria, had already been designed by Jigoro Kano [2]; for this purpose, he used an anatomical criterion, i.e. the part of the body, or contact point, with which the action is performed, or energy is transferred. He proposed four groups: *te waza* (hand, arm or shoulder techniques), *koshi waza* (hip techniques), *ashi waza* (foot or leg techniques) and *sutemi waza* (by sacrificing one's own body balance). This classification seems simple, understandable and almost perfect (and it is still in use after more than 100 years), but some problems remain. One of them (in reference to a learning or training context) is that the techniques are only performed through the arm, leg or hip, and another one is that the criterion is not homogeneous for all groups (*sutemi waza*); moreover, the groups include techniques that are rather different from each other (for instance, *ashi waza* involves a variety of techniques, such as *ashi guruma*, *de ashi harai* or *hiza guruma*, which are structurally and coordinatively quite different from the standpoint of motor learning).

Koizumi [3] also organized and classified judo techniques but, in this case, based on *uke's* body movements. He simplified them into three groups (*kuruma waza*, *tenbin waza* and *tsumazukase waza*). More recently, Geesink, through a *biokinematic* proposal, and Gleeson [4], according to *tori's* actions, developed other classifications based on similar criteria to the above ones. Despite not having been extensively used, these classifications meant new attempts to organize the specific motor skills in judo. Kolychkin [5] also proposed an anatomical classification (i.e. the part of the body that executes). His main contribution was a didactical orientation based on the proposal of main movements and affine movements, and

this was justified by the fact that the former would facilitate the learning of the latter (i.e. *significant learning*).

A new approach to classifying judo techniques was proposed by Sacripanti [1, 6]; in this case it was through a mechanical analysis based on dividing the movement into phases, and linking between physical principles and throw techniques. Thus, he defined two groups: judo techniques in which *tori* makes use of a couple of forces, and techniques in which *tori* uses a physical lever (with a minimum, maximum, medium or variable arm) for throwing *uke*. This approach shows very interesting similarities between techniques not evidenced up to now, e.g. a couple of forces between *o soto gari* and *uchi mata*, or a physical lever between *sasae tsuri komi ashi* and *tai otoshi*, although, from the point of view of motor learning, any link between them seems not to exist.

Finally, Adams [7] also presented a classification but, in this case, to facilitate the understanding of grips, and not to classify the judo throw techniques. The presence of some of the criteria used is striking, for example the throw space (forward, backward, lateral...), the control of *uke*'s head, or *tori*'s placement with respect to the opponent's arms.

In summary, these judo classifications did not usually use criteria to organize the techniques based on learning or training processes, therefore they had little impact, either from the sporting perspective or its analysis.

Recently, a large and growing number of remarkable research studies based on judo analysis and starting from actions and techniques [8-11] or through indexes that measure the activity or effectiveness of judokas (and/or of the bout) [12] have been published. However, we still lack a more specific classification system, based on pertinent criteria, which facilitates planning and programming a significant learning process, coordinative training and the investigation of specific judo skills, and the relationship with the other elements of the struggle (relationship between techniques, placement of judokas, relative positions and structure of the bout, management of relative spaces, direction of displacements and throw space, grips, etc.).

#### TACTICAL AND MOTOR CRITERIA

Currently there should not be any doubt that the execution of a foot/leg technique (*ashi waza*) is not

performed only with the leg, or that its effectiveness depends solely on that limb.

Taking this into consideration and searching for a new proposal to analyse and optimize learning and training processes, and applied research, our main intention is to organize judo motor skills in order to: a) facilitate the acquisition of a large amount of movements (techniques) that characterize the specific motricity of this sport through a classification based on motor criteria; b) use this proposal as a resource to design, control and optimize the training process; and c) analyse the sport of judo from a tactical perspective by studying the relationship between techniques, placement of judokas, relative positions and structure of the bout, management of relative spaces, direction of displacements and throw space, grips, etc. Therefore, we need to reorganize and classify the specific motor skills (judo techniques) according to new and pertinent criteria in order to carry out significant research; as a result, these criteria, the novel classification and the obtained findings may be used as an alternative proposal for teaching and training.

All this involves designing groups of techniques with strong cohesion from a motor control viewpoint that are easy to analyse according to those criteria; therefore, the point of departure should be motor criteria and not anatomical or mechanical criteria. The main objective of the new proposal is to define global movements, taking into consideration the *Theory of Schema* [13], to develop groups of skills with a common basis, which enable facilitation of their analysis and subsequent applications.

#### THE CONCEPT OF A GLOBAL SCHEME OF MOTOR SKILL

The notion of a *Global Scheme of Motor Skills* refers mainly to the description of a series of global movements that characterize the implementation of certain specific motor skills with common features. The novelty is not the existence of a schema that could be the basis for learning various technical actions, as Kolychkine [5] or Sacripanti [1] had already presented; the main purpose of this new concept is to organize the specific judo skills based on common motor foundations, and on criteria linked to learning and motor control, to be used in teaching, training and research. Thus, it is necessary to determine *common motor features* in order to know common motor coordinations [14]. For this, knowledge of the similitude between sensorimotor mechanisms of coordination is required, i.e. the *affinity*

between movements, and not only their external similarity. Automatic movement should not imply muscular stiffness while the actions are being executed, but the ability to reorganize their implementation at any time (*plasticity of movement*) and, therefore, that the same motor programme can be modified despite the decision-making speed [15].

Thus, we think that the judoka needs a motor programme that facilitates the acquisition of an intelligent learning and, in this way, there would be a particular motor programme that could facilitate the learning of *o soto gari*, *o soto otoshi*, *o soto guruma* and *o soto gaeshi*. In judo, this motor programme should be based on a comprehensive *postural programme* involving placement, relative positions, grips, execution area, throwing direction, displacement direction, imbalance direction, functional dominance while executing motor skills, etc. According to Schmidt [13], the athlete would store in his/her motor memory elements such as:

- *Initial conditions*, i.e. body positions, structure of the movement, grips, features of the situation, stances, relative positions based on functional laterality, etc.
- *Response specifications*, i.e. the judoka's execution conditions, such as spatial criteria of the placement, functional dominance of the execution, displacement direction, throw direction, tactical objectives, etc.
- *Sensory consequences*, i.e. the actual feedback stimuli (sensory information) received by the judoist after the movement, mainly through proprioceptive analysers.
- *Response outcome*, i.e. knowledge about the success of the response in relation to the outcome.

The organization of learning and training based on a classification involving motor criteria will enable the judoka to perform a *wide range of motor responses*, even supposedly new, as an adaptation of a known motor programme, through the intervention of the *recall schema* and the *recognition schema* proposed by Schmidt [13].

Therefore, the classification criteria should involve *motoric criteria* (structural and coordinative, mainly), *spatial criteria* (related to dynamic leg direction and the relative positions) and *cognitive criteria*

(associated with perception, processing of information and decision-making processes), and it would be linked to the judoka's *tactical requirements* (on the basis of their specific fighting style).

### A) Movement structure

The first motor criterion refers to the structure of skills, i.e. *what* the judoka can do, according to the general structure of the technique. We categorize three different *movement structures* based on whether the technique is executed through a turn (opponent in back), without a turn (opponent in front) or by passing to the supine position (opponent above), i.e. regarding the presence (or not) of rotation, or by passing to supine; therefore, we defined three groups of techniques: *with turning*, *without turning* and *supine position*.

Some research studies [12] have already analysed the use of judo techniques based on two groups, namely, throwing techniques with a rotation of the trunk and without a rotation of the trunk, and with, or without, body rotation [11]; or regarding the way of performing the throw, i.e. with or without body pivots [16].

Focusing the analysis on techniques with turn, we consider some differences between executions, which are determined by the location of grips (enabling higher or lower freedom of movement and control). For instance, the location of the two grips in the *seoi nage* group of techniques is in the anterior part of *uke*'s body, which helps and facilitates *tori* to execute a wide and complete turn and a greater freedom of movement, although with less control; conversely, other techniques are executed through only one anterior grip and another posterior one, which enables higher control, but with less freedom of movement and less uncertainty.

Therefore, this first criterion organizes most judo techniques as follows:

1. *Techniques of turning* prior to the execution: *o goshi*, *uki goshi uchi mata*, *harai goshi*, *soto makikomi*.
2. *Techniques without turning* prior to the execution: *o soto gari*, *ko uchi gari*, *hiza guruma*, *de ashi harai*, *tani otoshi*, etc.
3. *Techniques of supine position* prior to the execution: *tomoe nage*, *sumi gaeshi*, *yoko tomoe nage*, *hikikomi gaeshi*, etc.

Grip location is not included into this classification as some specific judo skills can be performed with different grips and a general patron is still identified, furthermore, this global criterion will allow specific observations to be designed through the definition and analysis of different elements, such as the general location of grips (rear or front), their specific location (superior, medial, axial, distal, etc.) or the specific type of the grip (flap-sleeve, two different sleeves, two grips at same flap, etc.).

### B) Sustentation base, i.e. supporting base

The second criterion is directly related to the one above, and is determined by the support used while executing a judo technique, i.e. *how* the technique is performed (single-leg support, bipodal support or back support):

- *One support (uchi mata, harai goshi, o soto gari, ko uchi gari, etc.).*
- *Two supports (o goshi, seoi nage group, etc.).*
- *Back support (tomoe nage, sumi gaeshi, etc.).*

Some advantages and disadvantages of these different ways of balancing, based on the type of support, are associated with the learning, training and performance of judo techniques. They are mainly linked to problems of motor control (anatomical, functional, structural, mechanical, etc.) as a consequence of the requirements of speed, reflex adjustments of lower limb joints, postural adjustments, dissociation and/or solidarity between joints (pelvis and trunk, lower and upper limbs, etc.), muscular tone of support and dynamic leg, etc.

Some movements (trained and practised on one or two legs) induce specific postural adaptations in competition-level judokas. The importance of this criterion has already been evidenced in judo after a relationship between practised judo techniques and the postural capabilities was observed [17]. García et al. [18] also showed that some judo techniques, executed by both feet, were easy to perform, and others, such as *okuri ashi harai* or *tomoe nage*, presented problems in terms of performance and posture control.

### C) Space where the opponent is thrown, i.e. projection area

This third fundamental criterion is spacelike and it refers to the main direction of technique projection,

i.e. *towards where*. In a judo bout (contest situation) this criterion will also involve 1) the relationship between *uke's* displacement direction and *uke's* imbalance direction, which is related to *tori's* upper-limb actions (the main problem for teachers is achieving the correct direction in pushing and pulling actions) [18], and 2) the specific direction of technique projection. In general, we define two main spatial areas regarding the opponent:

- *Forward throw (projection) area: uchi mata, harai goshi, sasae tsuri komi ashi, eri seoi nage group, etc.*
- *Backward throw (projection) area: o soto gari, o soto guruma, ko soto gake, o uchi gari, ko uchi gari, etc.*

Many authors [7, 12, 13, 19-22] have defined more precisely different spatial throw areas, for instance, forward-right, forward-left, backward-right and backward-left [12, 22], as well as many attack directions. It was concluded that it would be necessary to master at least three throw techniques in different directions to create uncertainty [19]; Segedi [23], for instance, points out that some *uke's* movements (particularly, forward, diagonally forward, and sideward) are most suitable for attacking, and backwards movements are more suitable for defending.

In order to classify the techniques in a simple manner, we have limited the proposal to two spaces (forward and backward) according to broad-line projection. Other authors [12, 16, 24] also considered these two directions (front and rear) to simplify their classification; however, we agree with the need for and relevance of the more detailed contributions above. The level of uncertainty and the chances of success are enhanced when the judoka uses different and varied attack directions, as these are a useful parameter for conducting specific analyses of fight situations; in fact, using a great number of directions correlated significantly with the number of victories, points and ippons achieved [21]. All these reasons justify the inclusion of this criterion as an important and suitable element for learning, training and research.

In addition to these three common criteria, we defined two specific criteria to organize the techniques *without turning*, which are executed through a dynamic leg (*o soto gari, hiza guruma, ko soto gari/gake, ko uchi gari/gake, etc.*).

**D) Direction of the dynamic leg**

Techniques without turning and with one support demand the performing of an action with the dynamic leg headed toward the lower limbs of the opponent. In this regard, we can classify dynamic leg movement as (Figure 1):

*Ipsilateral direction.* The dynamic leg heads toward the ipsilateral leg of the opponent (i.e. right leg toward opponent’s right leg; left leg toward opponent’s left leg).

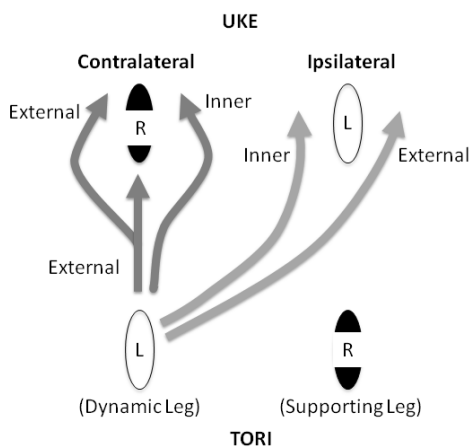
*Contralateral direction.* The dynamic leg heads toward the opponent’s contralateral leg (i.e. right leg toward opponent’s left leg; left leg toward opponent’s right leg).

**E) Spatial zone of the dynamic leg**

As well as the opponent’s leg toward which the action of the dynamic leg (ipsi or contralateral) is oriented, it can be differentiated whether the movement is performed toward the inner (*ko uchi gari, ouchi gari*) or external area (*o soto gari, de ashi harai*). Thus, the following can be distinguished (Figure 1):

*Inner zone.* The dynamic leg is moved toward the inner area of the opponent’s leg.

*External zone.* The dynamic leg is moved toward the external area of the opponent’s leg.



**Figure 1.** Directions and spatial zones of the dynamic leg

**Proposal for classification**

New groups of judo techniques, with common motor features, are presented through the combination of these

criteria and, thus, the organization of learning, training and bout analysis should be facilitated.

Our intention is not so much to distribute actual/existing techniques into new groups, but to organize specific judo motricity on the basis of tactical and motor criteria, which also allow us to classify variants or even new movements, in order to facilitate significative learnings and sport analyses.

The final groups based on tactical and motor criteria are as follows (Table 1):

1. *Techniques of turning, forward throw, 2 supporting legs*
2. *Techniques of turning, forward throw, 1 supporting leg*
3. *Techniques without turning, ipsilateral leg direction, external zone, backward throw, 1 supporting leg*
4. *Techniques Without turning, ipsilateral leg direction, inner zone, backward throw, 1 supporting leg*
5. *Techniques without turning, contralateral leg direction, inner zone, backward throw, 1 supporting leg*
6. *Techniques without turning, contralateral leg direction, external zone, backwards throw, 1 supporting leg*
7. *Techniques without turning, contralateral leg direction, external zone, forward throw, 1 supporting leg*
8. *Techniques without turning, forward or backward throw, 2 supporting legs*
9. *Techniques of supine position, forward throw, back support*

It is also important to determine laterality while executing judo skills (i.e. functional dominance, or laterality determined by the execution of specific techniques). We use two criteria: 1) if the action (typically a projection) involves a turn before the execution (*seoi nage, uchi mata, harai goshi*, etc.) then laterality is defined by the direction of rotation (when the right shoulder turns to the left – anticlockwise – it is defined as a right execution, and when the left shoulder is directed to the right – clockwise – it is a left execution); 2) when the movement is executed without a previous

**Table 1.** Groups of judo techniques, and criteria

Acronym	Movement structure	Dynamic leg direction	Dynamic leg zone	Throw space	Supporting base	Some Specific Judo Motor Skills	
1	Turn_F2	turn		forward throw	2 supporting legs	o goshi, uki goshi, koshi guruma, tsuri goshi, utsuri goshi, seoi nage, sode tsuri komi goshi, uchi makikomi, soto makikomi, tsuri komi goshi, seoi otoshi, tai otoshi	
2	Turn_F1	turn		forward throw	1 supporting leg	uchi mata, uchi mata makikomi, harai goshi, hane goshi, ashi guruma, o guruma, yama arashi, harai makikomi, uchi mata makikomi, hane makikomi	
3	WT_IpExB1	without turn	ipsilateral leg direction	external zone	backward throw	1 supporting leg	o soto gari, o soto gake, o soto otoshi, o soto guruma, o soto makikomi, o soto gaeshi
4	WT_IpInB1	without turn	ipsilateral leg direction	inner zone	backward throw	1 supporting leg	ko uchi gari, ko uchi gake, ko uchi makikomi
5	WT_ClaInB1	without turn	contralateral leg direction	inner zone	backward throw	1 supporting leg	o uchi gari, o uchi gake, o uchi makikomi
6	WT_ClaExB1	without turn	contralateral leg direction	external zone	backward throw	1 supporting leg	ko soto gake, de ashi harai, tsubame gaeshi, yoko gake, okuri ashi harai, o uchi gaeshi, ko uchi gaeshi, harai goshi gaeshi, uchi mata gaeshi, hane goshi gaeshi, tani otoshi
7	WT_ClaExF1	without turn	contralateral leg direction	external zone	forward throw	1 supporting leg	sasae tsuri komi ashi, hiza guruma, harai tsuri komi ashi
8	WT_2	without turn		forward or backward throw	2 supporting legs	ura nage, ushiro goshi, yoko otoshi (as kata guruma), sumi otoshi, obi otoshi, daki wakare	
9	SP_FwBack	supine position		forward throw	back support	Tomoe nage, sumi gaeshi, hikikomi gaeshi, yoko tomoe nage, uki waza, yoko guruma, yoko wakare	

turn (i.e. with one supporting leg, such as *o soto gari*, *ko uchi gari*, *hiza guruma*, or back supporting, like *tomoe nage*), the laterality of the athlete is based on the dynamic leg (i.e. the opposite to the supporting leg, or the leg that performs the action).

Finally, we point out that *relative position* (stances) among judokas or *fight structure* is another important element to consider in the teaching-learning judo process, and in its analysis. This element is based on *tori's* placement with respect to *uke's* placement; therefore, it is a spatial and tactical element determined by interaction between the athletes (grip, spaces and stances). Grosser & Neumaier (14) had already noted that in the learning process, and to acquire a motor skill, it is necessary, in the first place, to determine the spatial structure. In judo, this structure involves knowing the opponent's position (and one's own in regard to him), the projection space, the projection direction, etc. (even the chronological order or *timing*, i.e. the setting between space and time). García et al. (18) showed that the element of precision posed difficulties while executing some judo

techniques due to the space and time parameters, and that there was no reason to use the current system of teaching (the sequence in which judo techniques are taught) with regard to the difficulty of learning.

This spatial element might also be linked to the tactical analysis, through the relationship between techniques and relative positions and, therefore, between judo skills and laterality (*functional dominance*) [25]. This analysis would allow us to design patterns and models of learning, training and research, since this is a key factor in understanding and succeeding in judo. Many authors have associated laterality with judo in their research studies, e.g., attending grip, orientation of stance in the bout [26], postural adaptations [17], the direction of the attacks [9, 12, 19-21, 25], technical and tactical behaviour [11, 22, 25], sporting success [10, 12, 19-22, 25, 27-29], cerebral hemispheric specialization [30], the relationship between motoric and functional dominance [25], the symmetry and asymmetry of a fight while executing judo techniques [25, 27, 28], etc., which justifies the description and attention drawn to this element.

The following *confrontation structures* are defined for the judokas' position in which the technique is executed:

- Symmetrical fight (symmetrical structure). This is defined by a symmetrical position regarding uke, i.e. right-execution vs. right-position, or left-execution vs. left-position.
- Asymmetrical fight (asymmetrical structure). This is defined by an asymmetrical position, i.e. right-execution vs. left-position, or left-execution vs. right-position.
- In this way, we could analyse, for instance, the laterality in judo while executing specific techniques (such as right-dominant, left dominant, or symmetrical, i.e. functional dominance) [16], or the opponents' positions (right or left position) in a bout, and we can also analyse relative positions among judokas (symmetrical structure or asymmetrical structure) while executing specific motor skills.

## CONCLUSIONS

In our opinion, a classification based on common criteria and linked to motor control is appropriate and necessary to justify, support and strengthen the processes of learning and training and sporting analysis in judo. For instance, if we consider the criterion of *turning* (movement structure), we can differentiate between judokas that perform right-turn techniques or

left-turn techniques, i.e. right- or left-dominant judokas while executing those kinds of judo skills; or if we consider the criterion of *sustentation base*, we can distinguish between right-footed and left-footed judokas while executing specific judo techniques, according to their dynamic leg; also, if we consider the criterion of *projection space*, we will be able to establish links between *uke's* displacement direction and the coincidence (or not) of his/her throw space (since, in some cases, the performance is linked to success when the displacement or imbalance of *uke* and throw space are coincident, but in other cases it is the opposite).

In summary, we can confirm that this classification will also allow us to develop the analysis concerning elements linked to the structure of the bout, because different positions and performances (right-handed or left-handed) can be defined in order to know situations that are somewhat or not favourable for achieving a successful action (projection with score), and are based on the performed technique, the used laterality, the opponent's stance, etc.

We believe that the classification and organization of specific content (judo techniques) based on these novel criteria is an alternative to existing categorizations, and that it provides a new opportunity for research in judo.

## Competing interests

The authors declare they have no competing interests.

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