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Observational Analysis of Lateral Preference in Kumite Initiation: A Starting Point in the Longitudinal Programming of Formative Karate

Vanessa Sastre[1], Daniel Lapresa[1], Javier Arana[1], Rafael Ibáñez[2], and M. Teresa Anguera[3]

Abstract

We used observational methodology to analyze lateral conditioning in the technical-tactical performance of high level 8–9-year-old karatekas, specifically in relation to the guard action that supports the technical action and the body segment with which it is performed. We designed an *ad hoc* observation instrument to analyze lateral preference in the technical-tactical actions that take place during the *kumite*. We relied on LINCE software for data registration, and we found good inter-observer reliability, calculated with Cohen's Kappa coefficient. Generalizability Theory supported the homogeneity of the behavior deployed by these combatants. Our results represent a starting point in the longitudinal programming of karate. By relating our results and those of other studies that have addressed lateral performance in formative karate in the kumite modality, we are able to draw a roadmap of a karateka's path towards the equilaterality that is inherent in an elite competitor: (a) the 8-9

[1]Department of Educational Sciences, University of La Rioja, Logroño, Spain
[2]Royal Spanish Karate Federation, Spain
[3]Faculty of Psychology, Institute of Neurosciences, University of Barcelona, Spain

Corresponding Author:
Daniel Lapresa, Edificio Vives, Universidad de La Rioja, C/Luis de Ulloa s/n, 26004, Logroño, La Rioja, Spain.
Email: daniel.lapresa@unirioja.es

year old karateka must overcome a conditioned lateral prevalence by adopting a forward non-dominant leg guard so as to then attack with the dominant body segment; (b) the eqilateral use of the right or left fist must occur later, between the 12–13 year age group and the senior category; and (c) there will then be less decisive lateral conditioning in the execution of offensive leg techniques.

Keywords
laterality, karate, observational methodology, combat analysis, children

Introduction

The development of body laterality affects different facets of a child's development, such as the integration of the body scheme, spatial-temporal organization and motor coordination. This development process conditions the learning processes of motor skill (Bernabéu, 2016; Dean & Reynolds, 1997). Definitions of corporal laterality include both the predominant use of a cortical hemisphere, as well as the superior aptitude or ability to use one side of the body over the other (Scharoun & Bryden, 2014). Left-sided or right-sided lateralization never occurs radically (Boltanski, 1984; Martin & Porac, 2007; Mayolas, 2003); and it is less pronounced in the legs than in the upper limbs, as can be seen from differences in the size of lateral cortical surfaces representing these motor systems (Mayolas et al., 2015; Tichy & Belacek, 2009; Zverev, 2016).

From the age of 3–4 years, there is a strong genetic lateral conditioning (prevalence) evident in an individual's lateral performance in the environment (preference); this lateral conditioning is characterized by consolidated lateral preferences and the corresponding development of neural circuits (Bernabéu, 2016; Kinsbourne, 2009; McManus, 2002; Scharoun & Bryden, 2014). Body laterality takes hold firmly between 7-12 years of age (Michel et al., 2006; Scharoun & Bryden, 2014; Tichy & Belacek, 2009; Whittington & Richards, 1987).

Sports training with children should occur whenever lateral organization is certain, and it is normal for lateral preference to coincide with the genetic prevalence from about age 6-10 years (Ferré et al., 2008; Mayolas, 2003; Mayolas & Reverter, 2015). Once a child has defined laterality, lateral prevalence and preference coincide, and it is time to reinforce the use of the non-dominant side in order to seek the equilaterality required of a high-level athlete (Dopico et al., 2016; Lapresa et al., 2020). Lateral preference is a dynamic developmental process that involves interaction with the environment, and it can be modified through training (Del Valle & De la Vega, 2007; Gabbard & Hart, 1995, Mikheev et al., 2002). In martial arts, the competitor's lateral preference can

be conditioned to execute certain motor skills not only unilaterally but also in more complex bilateral or interlateral movements (Dopico et al., 2016).

In karate, many combat analyses have been conducted that have not considered lateral preference in the execution of various techniques (Laird & McLeod, 2009, Koropanovski et al., 2008; Paz & Miño, 2000; Vidranski et al., 2015). In their characterization of elite athletes, Koropanovski and Jovanovic (2007) studied the front leg in the adoption of the guard action. In a separate work that should be highlighted, Ibáñez et al. (2018) conducted combat analyses in which they incorporated the question of how laterality is used, observing that elite karate athletes integrate the body segment guard action (right or left) that supports the body segment offensive action (right or left).

Especially relevant for this article are two comparative studies (Lapresa, Ibáñez, Arana, Amatria, et al., 2011; Lapresa, Ibáñez, Arana, Garzón, et al., 2011) of combat actions in elite karate practiced by 12–13-year-old children. From their results, we can deduce that the elite senior competitor can shape lateralization to the circumstances of the competition, while the elite 12–13 year old competitor has not yet overcome conditioned lateral prevalence. Thus, we sought to analyze lateral conditioning in the technical-tactical karate performance of 8–9-year-old children in relation to the guard action and the body segment that performs it. We studied how laterality in the initiation of combat (*kumite*) is addressed among these young competitors who stand out for their high level of competence within their age category. In this way, we intended to generate a relevant starting point in the longitudinal programming of karate skills and mark a series of developmental milestones in formative karate related to the role that *kumite* should assume in the competitors' lateralization process.

Method

We developed the present work with filmed observational methodology (Anguera, 1979). The observational design we used is, according to Anguera et al. (2011), nomothetic, an intra-session follow-up and multidimensional, since we analyzed the lateral prevalence of the technical-tactical performance of 30 individual competitors, *frame* to *frame*, within the same championship. The conditions of the observation were non-participant and direct, based on filmed combats. There should be no reactivity bias, as observation through filming did not affect the competitor's spontaneous behavior; filming karate fights by coaches, family members, and others is now a common practice (Ibáñez et al., 2018).

Participants

The fights we analyzed took place in the National Karate Tournament (LNK J-1), held in Pamplona (Spain), on February 22, 2020. We chose this tournament

because it is one of the few "national" tournaments that include children between 8-9 years of age in the competition, assuring that the participants we selected would have sufficient skill levels to be considered fit for combat. Participants born in 2011–2012, belong to the 8–9-year-old age group ($M = 8.57$, $SD = 0.50$). Of the 37 such participants in the tournament, 30 were right-handed and right-legged, two were right-handed and left-legged, two were left-handed and right-legged, and three had homogeneous left laterality. Our observational sampling comprised 30 data packages that corresponded to each of the 30 karateka, all of whom had homogeneous right hand-foot laterality and were in their first tournament fight. Thus, these data provide evidence of how lateral preference was manifested in executing technical-tactical actions and show if the participants were able to overcome their lateral conditioning. This methodology allowed us to relate our data to data obtained by Lapresa, Ibáñez, Arana, Amatria et al. (2011) and Lapresa, Ibáñez, Arana, Garzón et al. (2011) in their studies of 12–13 year-olds who also had right-hand-foot laterality.

To film the fights, we requested authorization from the Royal Spanish Karate Federation and the Organizing Committee of the Championship. We obtained informed consent from the parents and/or legal guardians of each competitor for their participation in this research through filmed fights. Also, at the time of the informed consent agreement, we collected information regarding the participants' lateral preference (hand-foot). This work had the approval of the Research Ethics Committee of the University of University of La Rioja (file no. CE-12-2020).

Observation Instrument

We based the structure of the record of the observation instrument on Ibáñez et al. (2018) in which each combat-competitor's data package was made up of sequences that consisted of guard positions and actions (minimum unit of the record). Thus, the observation instrument was designed *ad hoc* for the analysis of lateral preference in the technical-tactical actions that children develop during the *kumite*. The observation instrument (see Table 1) was a combination of a field format and a system of categories.

Recording and Coding

Our observational sampling was comprised of 30 data packages, one generated for each of the 30 participants in their 25 fights. The recording of the data packages (competitor-combat) was carried out using the LINCE software, version 1.2.1 (Gabin et al., 2012). The data obtained in the record were of type IV, concurrent and time-based (Bakeman, 1978). Figure 1 presents a captured segment of the recording process in the coding software.

Table 1. Observation Instrument.

Criterion or dimension	Categories and codes
Fist technique	Direct fist technique (DF); circular fist technique (CF); unusual fist technical actions (F00).
Leg technique	Front leg Technique (FL); circular leg techniques (CL); lateral leg technique (LL); back leg technique (BL); unusual leg technical actions (L00).
Guard	Left guard (LG); right guard (RG); position taken by the competitor before an order (YOI); the competitor does adopt a guard (G00).
Segment	Right (RG); left (LT).
Combat situation	Start of combat (SC); end of combat (EC); start of sequence (SS); end of sequence (ES); start of round (SR); end of round (ER).
End of sequence	Exit from the competition area (EC); grab the opponent without intention of attack (GO); point in favor (PF); penalty (PY); point against (PA); anomalies in infra-structure or equipment (IE00).
Contact of the offensive technique on the opponent	High zone contact (HZ); middle zone contact (MZ); low zone contact (LZ); high zone no contact (HN); middle zone no contact (MN); low zone no contact (LN).

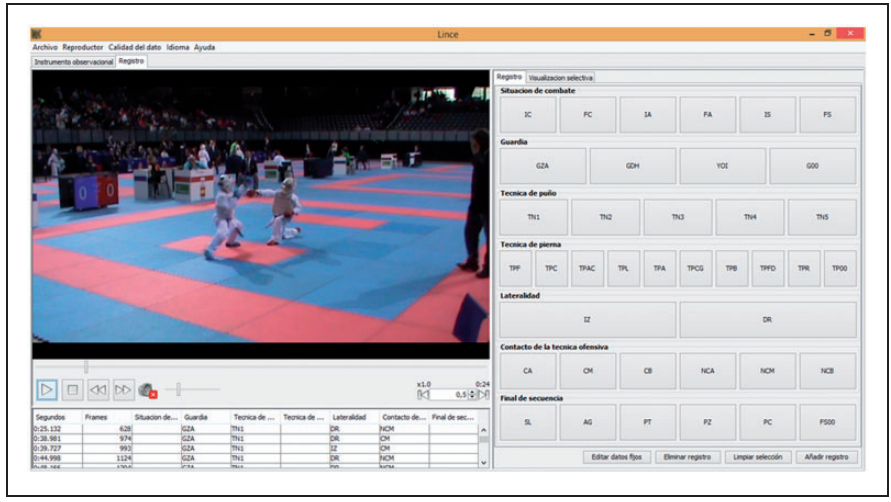

Figure 1. A Captured Moment of the Observational Record Using LINCE Software.

Data Quality Control

Agreement and Concordance Between Observations. Two observers were tasked with recording the data, but only after both had passed a training process based on Anguera (2003). The second observer recorded three data packages, representing 10% of the total number of data packages. We calculated inter-observer reliability Cohen's (1960) Kappa coefficient and percentage of agreement. With the use of the Generalized Sequential Querier (GSEQ) software (Bakeman & Quera, 1995) and to strengthen data quality, we determined that point-by-point agreement had occurred when all the events of the multi-event were recorded identically by the two observers; that is, if one of the events of the multi-event differed, we assumed that the complete multi-event did not match. The values of the Cohen's Kappa coefficient for each of the compared data packages were: participant 5-combat 3 (percentage of agreement, 81%; Kappa, 0.79); participant 6-combat 3 (percentage of agreement, 81%; Kappa, 0.78); participant 12-combat 11 (percentage of agreement, 87%; Kappa, 0.86).

Generalizability of the Results. Using Generalizability Theory (Cronbach et al., 1972) and the SAGT software (Hernández-Mendo et al., 2016), we conducted a generalizability analysis based on recommendations proposed by Blanco-Villaseñor and Escolano-Pérez (2017). We carried out a measurement plan, [Category]/[Participants], to evaluate the generalizability of the results, based on the number of participants. Both facets had 30 levels (30 participants and 30 categories) and were arranged in a "cross" manner to estimate an infinite population. Table 2 shows the results obtained, revealing that the variability was associated with the [Category] facet 60.47, and the interaction facet [Category]/[Participants] 33.21, with a value of 6.32 for the [Participants] facet. Analysis of the generalizability coefficients in this design structure determined that precision on the generalization reliability was achieved: relative generalizability coefficient $(e^2) = 0.98$ and absolute $(\Phi) = 0.97$. This result allowed us to verify the homogeneity of the behavior displayed in combat by the right-handed participants we selected for this study.

Table 2. Results of the Generalizability Analysis Corresponding to the Observation Plan [Category]/[Participants].

Sources of variation	Sum of squares	gl	Mean square	% variance	Standard error
[CATEGORY]	12486.329	29	430.563	60.466	3.645
[PARTICIPANTS]	1505.796	29	51.924	6.318	0.440
[CATEG][PARTICI]	6511.338	841	7.742	33.216	0.377

Data Analysis

We conducted statistical analyses using the Statistical Package for the Social Sciences (SPSS, version 26; IBM corp. 2019) program. We aimed to determine whether the participant's lateral preference (right or left) in executing a technique had a higher probability of occurrence than the opposite laterality. To do this, we first analyzed whether the sample data fit a certain distribution; that is, if the data were proportionally distributed in the lateral execution of the technique. For this, we applied the goodness of fit χ^2 test (Balakrishnan et al., 2013), comparing the observed frequencies with those expected under the hypothesis that the lateral execution of a technique would be distributed uniformly. We set statistical significance at $p < 0.05$. In the event that the null hypothesis was rejected (i.e., the data were not equally distributed) we next calculated the odds (i.e., the number of favorable events divided by the number of unfavorable events) for those techniques on which lateral preference was not proportionally distributed so as to determine the advantage of one category over another (i.e., how many times one category was more likely to occur than another). Finally, we determined the Confidence Interval (CI) to assess whether the odds were outside the values set by the CI with a probability of 95%. If the CI considers a value = 1, the odds obtained were discarded, since this result did not reflect any advantage of one category over another.

Results

Table 3 shows that the right or left lateral preference used in the execution of guard positions in the performance of techniques grouping fist and leg techniques, fist techniques, leg techniques, and the direct fist and circular leg techniques, were not distributed proportionally, having registered a significantly uneven presence of the laterality involved with the technique. However, the laterality of the execution in the circular fist technique and the set of non-circular leg techniques were distributed proportionally.

Next, in Table 4, we calculated the odds, taking as a reference the category that had the greatest presence in each criterion, to indicate how many times it was more likely that one category occurred over the rest of the categories that made up the criterion in question. Specifically, the following criteria or categories were analyzed: (a) guard (left/right); (b) segment (right/left); (c) fist (right/left); d) leg (right/left); (e) direct fist technique (right/left); (f) circular leg techniques (right/left); and (g) guard adopted (right/left) and segment that executed the technique (right/left). Finally, the 95% CI was calculated to ensure that the result obtained reflected the advantage of one category over another.

Table 3. Goodness-of-Fit Test of Lateral Performance in Technical Execution.

Technique	Laterality	Frequency	%	χ^2	p
Guard	Left guard	377	82.314	191.301	$p < 0.001$
	Right guard	81	17.686		
Segment	Left	148	32.314	57.301	$p < 0.001$
	Right	310	67.686		
Fist technique	Left	91	31.379	40.221	$p < 0.001$
	Right	199	68.621		
Leg technique	Left	57	33.929	17.357	$p < 0.001$
	Right	111	66.071		
Direct fist technique	Left	89	31.228	40.172	$p < 0.001$
	Right	196	68.772		
Circular fist technique	Left	2	40.000	0.200	$p = 0.655$
	Right	3	60.000		
Circular leg techniques	Left	38	32.479	14.368	$p < 0.001$
	Right	79	67.521		
Non-circular leg techniques	Left	19	37.255	3.314	$p = 0.069$
	Right	32	62.745		
Guard and segment	Left Guard/ Right Segment	248	54.148	261.214	$p < 0.001$
	Left Guard/ Left Segment	129	28.166		
	Right Guard/ Right Segment	62	13.537		
	Right Guard/ Left Segment	19	4.149		

Table 4. Odds and 95% Confidence Interval of Lateral Performance in Technical Execution.

Technique	More frequent laterality	Compared laterality	Odds	95% CI
Guard	Left	Right	4.654	3.663–5.914
Segment	Right	Left	2.095	1.723–2.547
Fist technique	Right	Left	2.187	1.708–2.801
Leg technique	Right	Left	1.947	1.417–2.677
Direct fist technique	Right	Left	2.022	1.715–2.827
Circular leg techniques	Right	Left	2.079	1.415–3.054
Guard and segment	Left guard/ Right segment	Left guard/ Left segment	1.922	1.555–2.377
		Right guard/ Right segment	4.000	3.031–5.279
		Left guard/ Left segment	13.053	8.220–20.727

Discussion

The observational tool we designed allowed us to obtain data that would permit us to establish conclusions in drawing a roadmap in the competitor's lateralization process in the formation of *kumite*. The quality (reliability and generalizability) of the data on which the analyses were conducted was guaranteed to satisfy these objectives in terms of concordance and generalizability. All the combats that constituted our observational sample involved karateka with homogeneous right hand-foot laterality. Thus, we examined lateral preference in the execution of technical-tactical actions while considering the specific lateral prevalence of the competitors (Whittington & Richards, 1987).

Regarding the guard action that supported the execution of the offensive technical action, in this 8-9 year-old category of competitors with homogeneous right laterality, we found an evident predominant use of the forward left leg guard over the right leg guard. Koropanovski and Jovanovic (2007) obtained a greater preference in the use of the right guard among adult elite karate fighters (right guard = 49.78%; left guard = 35.91%; clinch = 14.31%). Lapresa, Ibáñez, Arana, Amatria et al. (2011) and Lapresa, Ibáñez, Arana, Garzón et al. (2011) found significant differences in relation to the use of the left or right guard between elite karate and that of the 12–13-year-old group; all the karateka in their study had homogeneous right hand-leg laterality. It is very interesting to note that while adult competitors adopted both guards in a balanced way −51.40% right guard, 48.60% left guard, our 12–13 year-old competitors showed a clear preference for the use of a forward left leg guard (74.52%). These differences denote a clear evolution in the karateka's path toward the equal use of right and left guards in combat. In relation to the body segment used, unifying offensive techniques of the fist and leg, our results confirm that 8–9 year-old karateka with homogeneous right laterality typically use the right versus the left limb.

Regarding the guard/segment combination, the left guard with right body segment use (fist or leg) predominated over the following other combinations: left guard with left body segment use, right guard with right body segment use and, finally, right guard with left body segment use. This strong lateral conditioning in the use of the guard, with a non-dominant leg forward, to attack with the dominant body segment, was also detected by other investigators in studies of 12–13-year-old children (Lapresa, Ibáñez, Arana, Amatria, et al., 2011; Lapresa, Ibáñez, Arana, Garzón, et al., 2011). However, in elite adult karate, confirmed a preference to carry out the attack with the right segment, first in *Gyaku* mode (Funakoshi, 1988; Nakayama, 1977), with a left forward leg guard and a right body segment attack (41.81%) and in *Oi* mode, with a right forward leg guard and right body segment attack (odd = 1.74; CI 95% = 1.33–2.28). To a lesser extent, the elite competitor resorted to techniques performed with the left body segment in the *Gyaku* mode, with forward right leg guard and attack with left body segment

(odd = 2.04; CI 95% = 1.53–2.71) and in *Oi* mode with a forward left leg guard and a left body segment attack (odd = 3.04; CI 95% = 2.19–4.22).

Regarding the preference shown in performing fist techniques by our 8-9-year-old competitors with homogeneous right laterality, our participants predominantly used the right fist over the left fist. Lapresa, Ibáñez, Arana, Amatria et al. (2011) and Lapresa, Ibáñez, Arana, Garzón et al. (2011), found that senior competitors, with homogeneous right hand-foot laterality, had a more balanced use of right and left fists (right fist, 31.40% of total offensive actions; left fist, 26.84% of total offensive actions) than did 12–13-year-old children (right fist, 45.30% of total offensive actions; left fist, 3.40% of the total of offensive techniques) for whom the lateral prevalence clearly coincided with their preferred use of the fist versus leg in combat. Thus, the path to equilaterality in the performance of fist techniques occurs between the 12–13-year-old age group category and the senior category. The residual use of the circular fist technique mirrors these, with the right fist showing dominance over the left.

Also, in relation to leg techniques, our observational sampling discovered a characteristic homogeneous right fist/leg laterality in the predominant use of the right versus the left leg among our 8–9-year-old participants. Lapresa, Ibáñez, Arana, Amatria et al. (2011) and Lapresa, Ibáñez, Arana, Garzón et al. (2011), showed that, in elite adults, contrary to what happens with fist techniques, there was a even more disproportionate use of the right leg (22.60% of all offensive techniques in comparison with 8.70% with the left leg) than was evident in 12–13 year old children (22.80% actions with the right leg of the total offensive techniques; in comparison to 11.9% with the left leg). In other words, for the use of the leg, there was not a relevant lateral conditioning to consider in training an elite kumite karateka for two reasons: (a) the movement of the leg is slower than that of the arm, as well as that of the non-dominant segment compared to the dominant segment (García-Manso et al., 1998), which fits with the strategy to minimize risks typical of high-performance kumite; and (b) there is a lower need to condition genetic prevalence in the lateral preference of the leg segment, due to its lower representation in the cerebral cortex (Tichy & Belacek, 2009). This finding can also be extended to circular leg techniques, the most used in combat both by elite competitors (Ibáñez et al., 2018; Koropanovski & Jovanovic, 2007; Koropanovski et al., 2008; Laird & McLeod, 2009) and children (Lapresa, Ibáñez, Arana, Amatria, et al., 2011; Lapresa, Ibáñez, Arana, Garzón, et al., 2011).

Limitations and Direction for Future Research

The major limitation of this work was that we only recruited and analyzed competitors with homogenous right hand/leg laterality. We are working to obtain an observational sample of competitors with homogeneous left hand/leg laterality and of competitors with lateral crossing in order to add these observational data.

Conclusion

This work is a relevant starting point in the longitudinal programming of laterality in formative karate. We characterized lateral conditioning in the technical-tactical performance of the 8-9-year-old karateka in relation to the guard that supports the action and the karate segment with which the offensive technical-tactical action is carried out. Relating these data to other works that have addressed lateral performance in formative karate in the modality of kumite, we have been able to draw a roadmap for others interested in the developmental of elite karate skills. Specifically, in the karateka's path towards equilaterality that is inherent in an elite competitor, there is an early progression in the use of guards such that there emerges an adoption of a guard with a non-dominant forward leg in order to attack with the dominant segment. On the other hand, the performance of equilateral fist techniques occurs between the 12-13 age group and the senior category.

Declaration of Conflicting Interests

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ORCID iD

Daniel Lapresa https://orcid.org/0000-0003-2228-7631

References

Anguera, M. T. (1979). Observational typology. Quality & Quantity. *European American Journal of Methodology*, *13*(6), 449–484.

Anguera, M. T. (2003). La observación [The observation]. In C. Moreno Rosset (Ed.). *Evaluación psicológica. concepto, proceso y aplicación en las áreas del desarrollo y de la inteligencia* (pp. 271–308). Sanz y Torres.

Anguera, M. T., Blanco-Villaseñor, A., Hernández-Mendo, A., & Losada, J. L. (2011). Diseños observacionales: Ajuste y aplicación en psicología del deporte [Observational designs: Their suitability and application in sports psychology]. *Cuadernos de Psicología Del Deporte*, *11*(2), 63–76.

Bakeman, R. (1978). Untangling streams of behavior: Sequential analysis of observation data. In *Observing behavior, Vol 2: Data collection and analysis methods* (pp. 63–78). University of Park Press.

Bakeman, R., & Quera, V. (1995). *Analyzing interaction: Sequential analysis with SDIS and GSEQ*. Cambridge University Press

Balakrishnan, N., Voinov, V., & Nikulin, M. S. (2013). *Chi-squared goodness of fit tests with applications*. Academic Press.

Bernabéu, E. (2016). Programas de desarrollo de la lateralidad, mejora del esquema corporal y organización espaciotemporal. Intervención en dificultades de aprendizaje [Programs for the development of laterality, improvement of the body scheme and spatio-temporal organization. Intervention in learning difficulties]. In P. Martín-Lobo (Ed.), *Procesos y programas de neuropsicología educativa* (pp. 77–90). Ministerio de Educación, Cultura y Deporte.

Blanco-Villaseñor, A., & Escolano-Pérez, E. (2017). Observational data analysis using generalizability theory and general and mixed linear models: An empirical study of infant learning and development. *Anales of Psychology*, *33*(3), 450–460. https://doi.org/10.6018/analesps.33.3.271021

Boltanski, E. (1984). *Dislexia y dislateralidad [Dyslexia and dyslaterality]*. Presses Universitaires de France.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, *20*(1), 37–46. https://doi.org/10.1177/001316446002000104

Cronbach, L. J., Gleser, G. C., Nanda, H., & Rajaratnam, N. (1972). *The dependability of behavioral measurements: Theory of generalizability for scores and profiles*. Wiley.

Dean, R. S., & Reynolds, C. R. (1997). Cognitive processing and self-report of lateral preference. *Neuropsychology Review*, *7*(3), 127–142. https://doi.org/10.1023/B:NERV.0000005948.00009.ed

Del Valle, S., & De la Vega, M. (2007). Lateralidad en el deporte de full contact. Cambios en diferentes condiciones [Laterality in the sport of full contact. Changes in different conditions]. *International Journal of Medicine and Science of Physical Activity and Sport*, *7*(25), 32–51.

Dopico, X., Iglesias, E., Morenilla, L., Giraldez, M. A., Santos, L., & Arda, A. (2016). Laterality and performance in combat sports. *Archives of Budo*, *12*, 167–177.

Ferré, J., Casaprima, V., Catalán, J., & Mombiela, J. V. (2008). *El desarrollo de la lateralidad infantil. Niño diestro-niño zurdo* [The development of infantile laterality. Right-handed child-left-handed child]. Lebón.

Funakoshi, G. (1988). *Karate-do Nyumon: The master introductory text*. Kodansha International Ltd.

Gabbard, C., & Hart, S. (1995). Foot performance of right- and left-handers: A question of environmental influence. *Perceptual and Motor Skills*, *80*(2), 671–674. http://dx.doi.org/10.2466/pms.1995.80.2.671

Gabin, B., Camerino, O., Anguera, M. T., & Castañer, M. (2012). Lince: Multiplatform sport analysis software. *Procedia—Social and Behavioral Sciences, 46*, 4692–4694. http://dx.doi.org/10.1016/j.sbspro.2012.06.320

García-Manso, J. M., Navarro-Valdivielso, M., Ruiz-Caballero, J. A., & Martín-Acero, R. (1998). *La velocidad* [Speed]. Gymnos.

Hernández-Mendo, A., Blanco-Villaseñor, A., Pastrana, J. L., Morales-Sánchez, V., & Ramos-Pérez, F. J. (2016). SAGT: Aplicación informática para análisis de generalizabilidad [SAGT: Computer application for generalizability analysis]. *Revista Iberoamericana de Psicología Del Ejercicio y el Deporte*, *11*(1), 77–89. https://doi.org/10.4321/s1578-84232012000100006

Ibáñez, R., Lapresa, D., Arana, J., Camerino, O., & Anguera, M. T. (2018). Observational analysis of the technical-tactical performance of elite karate contestants. *Cultura, Ciencia y Deporte*, *13*(37), 61–70. http://dx.doi.org/10.12800/ccd.v13i37.1039

IBM Corp. (2019). *IBM SPSS statistics for windows, version 26.0*.

Kinsbourne, M. (2009). Development of cerebral lateralization in children. In C. R. Reynolds & E. Fletcher-Janzen (Eds.), *Handbook of clinical child neuropsychology* (pp. 47–66). Springer.

Koropanovski, N., Dopsaj, M., & Jovanovic, S. (2008). Characteristics of ponting action of top male competitors in karate at world and European level. *Brazilian Journal of Biomotricity*, *2*(4), 241–251.

Koropanovski, N., & Jovanovic, S. (2007). Model characteristics of combat at elite male karate competitors. *Serbian Journal of Sports Sciences*, *1*(3), 97–115.

Laird, P., & McLeod, K. (2009). Notational analysis or scoring techniques in competitive menś karate. *International Journal of Performance Analysis in Sport*, *9*(2), 171–187. https://doi.org/10.1080/24748668.2009.11868475

Lapresa, D., Arana, J., & Garzón, B. (2020). *Iniciación temprana al fútbol: Pautas para orientar la formación* [Early initiation to football: Guidelines to guide training]. Fútbol de Libro.

Lapresa, D., Ibáñez, R., Arana, J., Amatria, M., & Garzón, B. (2011). Estudio comparativo de las acciones de combate en el karate de categoría juvenil (12–13 años) y senior [Comparative study of combat actions in youth category (12–13 years) and senior karate]. *Apunts Educación Física y Deportes*, *104*(104), 66–77. http://dx.doi.org/10.5672/apunts.2014-0983.es.(2011/2).104.07

Lapresa, D., Ibáñez, R., Arana, J., Garzón, B., & Amatria, M. (2011). Spatial and temporal analysis of karate kumite moves: Comparative study of senior and 12–13 years old groups. *International Journal of Performance Analysis in Sport*, *11*(1), 57–70. http://dx.doi.org/10.1080/24748668.2011.11868529

Martin, W. L. B., & Porac, C. (2007). Patterns of handedness and footedness in switched and nonswitched Brazilian left-handers: Cultural effects on the development of lateral preferences. *Developmental Neuropsychology*, *31*(2), 159–179. http://dx.doi.org/10.1080/87565640701190734

Mayolas, M. C. (2003). Un nuevo test de valoración de la lateralidad Para los profesionales de la educación física [A new laterality assessment test for physical education professionals]. *Apunts. Educación Física y Deportes*, *71*, 14–22.

Mayolas, M. C., Legaz, A., Villarroya, A., & Reverter, J. (2015). Distribution of plantar pressures during gait in different zones of the foot in healthy children: The effects of laterality. *Perceptual and Motor Skills*, *120*(1), 159–176. https://doi.org/10.2466/26.10.PMS.120v15x8

Mayolas, M. C & Reverter, J. (2015). Influencia de la edad y el género en los fenotipos y coeficientes de lateralidad en niños de 6 a 15 años [Influence of age and gender on

phenotypes and laterality coefficients in children aged 6 to 15 years]. *Apunts Educació Física i Esports*, *120*(120), 11–18.
McManus, C. (2002). *Right hand, left hand: The origins of asymmetry in brains, bodies, atoms and cultures*. Harvard University Press.
Michel, G. F., Tyler, A. N., Ferre, C., & Sheu, C. F. (2006). The manifestation of infant hand-use preferences when reaching for objects during the seven-to thirteen-month age period. *Developmental Psychobiology*, *48*(6), 436–443. https://doi.org/10.1002/dev.20161
Mikheev, M., Mohr, C., Afanasiev, S., Landis, T., & Thut, G. (2002). Motor control and cerebral hemispheric specialization in highly qualified judo wrestlers. *Neuropsychologia*, *40*(8), 1209–1219.
Nakayama, M. (1977). *Best karate series*. Kodansha International Ltd.
Paz, G., & Miño, C. (2000). Predicting *kumite* strategies: A quantitative approach to karate. *Journal Asian Martial Arts*, *9*(4), 23–33.
Scharoun, S. M., & Bryden, P. J. (2014). Hand preference, performance abilities, and hand selection in children. *Frontiers in Psychology*, *5*, 82. http://dx.doi.org/10.3389/fpsyg.2014.00082
Tichy, J. & Belacek, J. (2009). Laterality in children: Cerebellar dominance, handedness, footedness and hair whorl. *Activitas Nervosa Superior Rediviva*, *51*(1-2), 9–20.
Vidranski, T., Maškarin, F., & Jukić, J. (2015). Differences in technical and tactical indicators of attacks and counterattacks in elite male karate fighters. *Acta Kinesiologica*, *9*(1), 19–24.
Whittington, J. E., & Richards, P. N. (1987). The stability of children's laterality prevalences and their relationship to measures of performance. *British Journal of Educational Psychology*, *57*(1), 45–55. https://doi.org/10.1111/j.2044-8279.1987.tb03060.x
Zverev, Y. (2016). Laterality and plantar pressure distribution during gait in healthy children: Comment on mayolas Pi, arrese, aparicio, and masià (2015). *Perceptual and Motor Skills*, *123*(1), 121–126. https://doi.org/10.1177/0031512516659883

Author Biographies

Vanessa Sastre, is a PhD student at the University of La Rioja. Her research interests are childhood education and martial arts.

Daniel Lapresa, PhD, is a Professor in the Department of Educational Sciences at University of La Rioja in Spain. His research interest focuses on adapting sport to children and observational methodology.

Javier Arana, PhD, is a Professor in the Department of Educational Sciences at University of La Rioja in Spain. His research interest focuses on observational methodology.

Rafael Ibáñez, PhD, has the seventh dan of karate. He is a nationally recognized coach. He is also a World Karate Referee.

M. Teresa Anguera, PhD, is an Emeritus Professor at Faculty of Psychology of University of Barcelona, Spain. Her research interests are observational methodology and mixed methods.