Tarragó, R., X. Iglesias, D. Lapresa, & M. T. Anguera (2016)

A Complementary Study of Elite Fencing Tactics Using Lag Sequential, Polar Coordinate, and T-Pattern Analyses

in G. Ritschard & M. Studer (eds), Proceedings of the International Conference on Sequence Analysis and Related Methods, Lausanne, June 8-10, 2016, pp 339-348.

A Complementary Study of Elite Fencing Tactics Using Lag Sequential, Polar Coordinate, and T-Pattern Analyses

Rafael Tarragó [(1)], Xavier Iglesias [(1)], Daniel Lapresa [(2)] and M. Teresa Anguera [(3)]

[(1)] Institut Nacional d'Educació Física de Catalunya (INEFC), Universitat de Barcelona, Spain

[(2)] Facultad de Letras y de la Educación, Universidad de La Rioja, Spain

[(3)] Facultad de Psicología, Universidad de Barcelona, Spain

Introduction

The aim of this study was to perform a diachronic analysis, using three complementary techniques, of behaviors in fencing, a sport in which the exchange of actions between two fencers is determined by a series of decisional processes (Iglesias, Gasset, González and Anguera, 2010; Tarragó, Iglesias, Michavila, Chaverri, Ruiz-Sanchis and Anguera, 2015). The study was performed within the context of systematic observation (Portell, Anguera, Chacón and Sanduvete, 2015; Sánchez-Algarra and Anguera, 2013).

The continuous interchange of actions and reactions during a fencing bout, the aim of which is to gain a touch, is known as a fencing phrase and can be analyzed sequentially from two perspectives. In the first case, the objective is to determine what happens within each fencing phrase, i.e., to identify actions-reactions triggered by the techniques employed by the two fencers; each phrase is characterized by an internal logic that determines the tactics used and in which the different actions executed influence the result (i.e. gain or loss of a touch). In the second case, the objective is to determine how these fencing phrases evolve throughout the bout, i.e., to analyze the diachronic relationships underlying the tactics employed (succession of actions in time), as this can shed light on strategic and tactical decisions that lead fencers to use or modify a certain behavior (technical action), giving rise to the repetition or diversification of sequences of actions, or fencing phrases, during the bout.

We employed an observational methodology design as the actions to be studied were perceivable, regular (i.e. performed repeatedly by professional fencers), and held in a setting that lends itself particularly well to observation. Systematic observation is also an ideal method for collecting data for subsequent analysis of whether behaviors that occur throughout episodes or periods of time have an internal sequential structure (Abbott, 1990, 1995; Abbott and Hrycak, 1990; Abbott and Tsay, 2000).

This internal structure can be analyzed using different data analysis techniques, each with its own algorithms and analytical rules. In our case, we chose lag sequential analysis, polar coordinate analysis, and T-patterns (temporal patterns) detection:

A) Lag sequential analysis (Bakeman and Quera, 2011) was used to detect communication patterns and investigate associated relationships between categories based on the calculation of observed and expected probabilities, and to compare them using a corrected binomial test. This method is applicable to datasets of behaviors that occur in a certain order; the data can be type I or type II (where the parameter of interest is sequence) or type III or IV (where the parameter of interest is duration). Data types I and III are sequential (unidimensional), i.e., behaviors can never overlap, while data types II and IV are concurrent (multidimensional), i.e., behaviors from different dimensions may overlap (Bakeman, 1978). Sequential analysis can be used to analyze a single dimension within an observation instrument (type I or type III data) or several dimensions simultaneously (type II or type IV data).

We used here an observation instrument with six dimensions. The data were analyzed using a binomial test with a level of statistical significance of $p < .05$ to statistically compare observed or conditional probabilities (which are computed according to the order of occurrence of the recorded behaviors) with expected or unconditional probabilities (which reflect only the number of occurrences and correspond to the likelihood of chance). Adjusted residuals were calculated to determine the strength of association between behaviors, as we applied the correction established by Allison and Liker (1982) to the binomial test. Lag sequential analysis was performed in both the prospective (positive lags) and retrospective (negative lags) modes to investigate sequences of behaviors that occurred before and after the criterion behavior. Drawing from the experience of many studies conducted in the behavioral and social sciences (Lapresa, Arana, Anguera and Garzón, 2013), it was decided to use just ten lags (lag -5 to lag -1 and lag +1 to lag +5), as patterns appear to become diluted when more are used.

B) Polar coordinate analysis is an elaborate data reduction technique that facilitates the interpretation of data, precisely because of the reduction in the volume of data. It also produces a vectorial image of the complex network of interrelations between categories that make up the different dimensions of an observation instrument. Polar coordinate analysis complements prospective and retrospective sequential analysis (Bakeman, 1978). The first step is to select the main behavior of interest, known as the *focal* behavior, and a series of *conditional* behaviors from among the categories in the observation instrument. The purpose is to investigate the relationships between this central element, the focal behavior, and the other behaviors selected. To do this, it is necessary to have previously calculated the retrospective and prospective adjusted residuals for the focal and conditional behaviors using lag sequential analysis. The retrospective, or "backward" perspective, which incorporates what Anguera (1997) referred to as the concept of "genuine retrospectivity", reveals significant associations between the focal behavior and behaviors that occur *before* this behavior (i.e., negative lags). In our study, this retrospective analysis produced a "mirror-like" image of associations between observation units that occur before the focal behavior; the sequence followed is last, second-last, third-last, etc. In other words, patterns obtained through retrospective sequential analysis reveal patterns formed by categories that lead up to the occurrence of the behavior of interest.

The main objective of polar coordinate analysis is to reduce the volume of conditional probability values calculated previously in the lag sequential analysis, but without losing their significance and interpretative potential. These "results" are processed as data in the polar coordinate analysis and are reduced to a manageable number of significant variables that are presented in an easy-to-interpret vector format that reveals the associations between the different behaviors that make up, in the case at hand, each fencing phrase.

Because the variables produced must adequately reflect the versatility of the situation, the data need to be processed using a powerful data reduction measure. The recommended measure is the Z_{sum} statistic described by Cochran (1954) and subsequently developed by Sackett (1980); it is based on z scores corresponding to relative indices of sequential dependence (Bakeman, 1978). This Z_{sum} is calculated using the following formula $Z_{sum} = \frac{\sum Z}{\sqrt{n}}$, which measures the strength (or associative consistency) between different behaviors. Prospective and retrospective Z_{sum} scores can have a positive or a negative sign, depending on whether the relationship between behaviors is excitatory or inhibitory. These relationships, in turn, can be symmetric or asymmetric, i.e. the focal behavior may be associated with the conditional behavior (or vice versa) in one or both directions. Each conditional behavior is represented by a vector, which, in turn, is located in one of four quadrants (I, II, III, or IV) depending on whether the prospective and retrospective Z_{sum} scores carry a positive or a negative sign. These quadrants indicate whether the focal and conditioned behaviors activate or inhibit each other (see below).

The relationships between behaviors can be represented graphically, with prospective Z_{sum} values on the X axis and retrospective Z_{sum} values on the Y axis. The fact that the conditional behaviors are located in different quadrants according to the relationship with the focal behavior means that it is possible to measure the distance between the origin (0,0) of the Z_{sum} coordinates and the intersection point (or radius), which corresponds to $\sqrt{X^2 + Y^2}$, where X^2 and Y^2 correspond to the Z_{sum} values for the focal and conditioned behavior, respectively. The associated φ angle, $\arcsin e\varphi = \frac{Y}{Radius}$, is calculated based on the number of degrees that are added or subtracted depending on the quadrant in which the conditional behavior is located. The meaning of each vector can then be interpreted objectively as follows:

Quadrant I – The focal and conditional behaviors activate each other.

Quadrant II – The focal behavior inhibits and is activated by the conditional behavior.

Quadrant III – The focal and conditional behaviors inhibit each other.

Quadrant IV – The focal behavior activates and is inhibited by the conditional behavior.

C) Detection of T-Patterns. The assumption underlying the T-pattern detection method is that complex human behaviors have a temporal structure that cannot be fully detected through traditional observational methods or mere quantitative statistical logic. The T-pattern emerges as the fruit of a mathematical process that is automated in the form of an algorithm in the THEME software program, first developed by Magnusson (1988, 1989, 1993, 1996, 2000, 2005, 2006, 2016) around thirty years ago and progressively improved up to the current version (Theme v. 6 Edu). By detecting T-patterns, or "temporal patterns", this method can detect structural analogies across very different levels of organization and enable an important shift from quantitative to structural analysis.

T-patterns detection studies have been conducted in very different scientific domains and also in the field of sport (Aragón, Lapresa, Arana, Anguera and Garzón, 2015; Borrie, Jonsson and Magnusson, 2002; Chaverri, Camerino, Anguera, Blanco-Villaseñor and Losada, 2010; Gutiérrez-Santiago, Prieto, Camerino and Anguera, 2013; Lapresa, Alsasua, Arana and Garzón, 2013; Lapresa, Álvarez, Arana, Garzón and Caballero, 2013; Tarragó et al, 2015; Zurloni, Cavalera, Diana, Elia and Jonsson, 2014). Since observational records of human behavior have a temporal and sequential structure, an analytical tool that can describe this structure can only enhance the understanding of the target behavior(s). In fencing, for example, T-pattern analysis can reveal the hidden yet stable structures that underlie the interactions that determine what occurs in a competition. The discovery of hidden T-patterns could help fencing coaches to better predict the behaviors of both competitors in a fencing bout thanks to an integrated system that allows for an increased depth of analysis.

For the T-pattern analysis in this study, we used the software program THEME v. 6 Edu, and assigned a constant duration (=1) to each event-type (Lapresa, Alsasua, et al., 2013), as what was important in our analysis was not the duration of each fencing phrase, or the distance between phrases (which is very similar), but rather their internal sequentiality.

The calculations for the methods employed in this study were made using the following software programs, which are all freely available: GSEQ5 (lag sequential analysis) (Bakeman and Quera, 2011), HOISAN v.1.6.3. (lag sequential analysis and polar coordinate analysis) (Hernández-Mendo, López-López, Castellano, Morales-Sánchez and Pastrana, 2012), and THEME v.6 Edu (T-Pattern detection) (Magnusson, 1996, 2000).

The ultimate aim of this empirical study was to analyze the confluence of results from three complementary methods to identify direct relationships between different tactical actions and their efficacy (in terms of score) and to also shed light on successful strategies that could help fencers take better decisions during competitions.

Method

We employed a nomothetic, point, multidimensional observational study design (Anguera, Blanco-Villaseñor, Hernández-Mendo and Losada, 2011) in which we analyzed eight bouts from the Men's Individual Saber Finals of the World Fencing Championships in Budapest, Hungary (2013) and Kazan, Russia (2014). The data were recorded using LINCE v.1.1. (Gabin, Camerino, Anguera and Castañer, 2012), and a total of 407 fencing phrases were recorded using the type II data modality. The images were obtained from broadcasts made available by the *Fédération Internationale d'Escrime* (FIE) and Televisora Venezolana Social (Tves) through the Internet (YouTube).

The study formed part of a larger fencing study approved by clinical research ethics committee of the Catalan Public Sports Authority (2005). According to the ethical requirements specified in the guidelines of the American Psychological Association (American Psychological Association, 2002), the informed consent of the fencers was not required because the study was an observational study of a publicly broadcast event held in a natural setting.

The observation instrument ESGRIMOBS (Tarragó et al., 2015) was adapted for the purpose of the study. The data for the study were systematically recorded and coded using the following instrument (Table 1):

Tabla 1. ESGRIMOBS Observation Instrument (Tarragó et al., 2015)

Dimensions or criteria	**Category systems**	**Code**
Pressure	Right pressure	PD
	Left pressure	PI
	No pressure	NP
Preparation	Right preparation	XD
	Left preparation	XI
1st Action	1st action: right offensive	OD
	1st action: left offensive	OI
	1rt action: right defensive	DD
	1st action: left defensive	DI
2nd Action	2nd action: right offensive	DOD
	2nd action: left offensive	DOI
	2nd action: right counteroffensive	DCD
	2nd action: left counteroffensive	DCI
	2nd action: right defensive	DDD
	2nd action: left defensive	DDI
3rd Action	3rd action: right offensive	TOD
	3rd action: left offensive	TOI
	3rd action: right counteroffensive	TCD
	3rd action: left counteroffensive	TCI
	3rd action: right defensive	TDD
	3rd action: left defensive	TDI
Touch	Left touch	TI
	Right touch	TD
	No touch	NT
	Double touch	DT

Each of the six criteria in the observation instrument (shown in the left column of Table 1) corresponds to a dimension of fencing, and each of these dimensions is further broken down into a system of exhaustive and mutually exclusive categories.

The data were recorded by applying the observation instrument to each observation unit. Given the complexity of analyzing fencing tactics, we based our analysis on observation units drawn from concepts described in fencing rules published by the FIE (FIE, 2014). Each unit was formed by a fencing phrase, the aim of which is to gain a touch, and each phrase was analyzed by applying the different criteria that formed the observation instrument.

The reliability of the dataset was duly analyzed prior to subsequent analyses (Blanco-Villaseñor and Anguera, 2000). The construct validity of ESGRIMOBS was guaranteed by the consistency and robustness of the concepts on which it was based, which were drawn from the theoretical framework of fencing and the critical evaluation of the observation instrument by 17 fencing masters. A pilot run of the instrument, with coding by the 17 fencing masters, produced a canonic agreement of 0.81 (Krippendorf, 2004), allowing us to consider the instrument valid.

Results

In view of the primary aim of this study, which was to analyze diachronic relationships underlying the tactics employed by two of the world's top fencers using three complementary techniques, we have created a table (Table 2) summarizing "favorable" and "unfavorable" tactical sequences shown by each technique for the two fencers. In the T-pattern analysis, a behavior was considered favorable when the set of event-types contained the event "touch", and in the lag sequential and polar coordinate analyses, it was considered favorable when it activated a touch for the fencer or inhibited a touch by his opponent. It should be noted that in the case of antagonistic significances for the different lags in the sequential analysis, lag values of 0 or close to 0 were prioritized.

To our knowledge, this study is the first to undertake a complementary analysis of this type, and it is of particular interest that our interpretation was focused entirely on the analysis of the strategies and tactics employed by the fencers analyzed.

The summary table (Table 2) and the analyses described partially in the results and discussion sections provide detailed insight into the tactics used by the two fencers in each bout, as each of the techniques provides a distinct yet complementary interpretation. Each dataset corresponds to a fencing phrase, which could be considered as a "co-occurrence" of behaviors or actions but that actually presents internal or intra-phrase sequentiality (left-right sequentiality based on the order of transcription). In other words, our analysis shows how behaviors influence other behaviors within each fencing phrase. This relationship links tactical behaviors with specific technical executions, analyzed by sequential analysis at lag 0 and T-pattern analysis.

The strategical analysis is also based on between-phrase relationships, i.e., relationships between each fencing phrase (or datasets arranged from top to bottom). This shows how co-occurrences or events (fencing phrases) influence each other (via T-patterns described in each dendrogram that links two or more phrases with significant associations), and it also shows how different behaviors (actions) influence previous or subsequent behaviors (using sequential analysis of lags -1 to -5 and +1 to +5 and polar coordinate analysis).

The main conclusion of this study is that the complementary use of the three observational methodology techniques—lag sequential analysis, polar coordinate analysis, and T-pattern detection—can provide extremely useful insights that can be used to guide tactical and strategic training in fencing. Our analysis shows that significant conclusions regarding tactical behavior in fencing can be reached using objective analytical techniques. This and similar studies could help to guide training strategies for fencing masters by providing objective data to complement largely subjective judgements based on experience.

Table 2 Complementary evaluation of tactical sequences for fencers 1 and 2 shown by technique

T-Patterns	Lags		Polar coordinate	
Behaviors that FAVOR participant 1 (Fencer on the left)				
(NP,XD,OI,DDD,TI PD,XD,OI)	PD	DDD	PD	OD
(PI,XD,OD,DCI,TD PI,XI,OI,DCD,TI)	XD	DCD	PI	DCD
	OI	TOI	XD	DDI
Behaviors that DO NOT FAVOR participant 1 (Fencer on the left)				
(NP,XI,OD,DCI,TD NP,XI,OD,DDI,TDD)	NP	DDI	NP	
(PD,XD,OI,DDD PD,XD,OD,DCI,TD)	XI	DOI	PI	
(PI,XD,OD,DCI,TD PI,XI,OD,DDI)	DI	TDD	DDD	
(PI,XD,OD,DCI,TD PI,XI,OI,DCD,TI)	OD	TOD	DOD	
	DCI			
Behaviors that FAVOR participant 2 (Fencer on the right)				
((NP,XI,OI,DDD NP,XI,OD,DCI) PI,XI,OD,DCI,TD)	NP	DDI	NP	
(NP,XI,OD,DCI PI,XI,OD,DCI,TD)	PD	DOI	DOI	
(NP,XI,OD,DDI,TD PI,XI,OD,DDI)	OD	TCD	TCD	
(NP,XI,OI,DCD,TDI PI,XI,OD,DDI,TD)	DCI			
(PI,XI,OI,DCD,TI NP,XI,OD,DCI,TD)				
(PI,XI,OI,DDD PI,XI,OD,DCI,TD)				
Behaviors that DO NOT FAVOR participant 2 (Fencer on the right)				
(NP,XI,OI,DDD PI,XI,OI,DCD,TCI,TI)	PI	DDD	NP	
(PD,XD,OD,DCI PI,XI,OI,DOD,TI)	XI	TCI	PI	
	OI	TOD	PD	
	DCD		TOD	

References

Abbott, A. (1990) A primer on sequence methods, *Organization Science.* **1**, 373-392.

Abbott, A. (1995) Sequence analysis, *Annual Review of Sociology.* **21**, 93-113.

Abbott, A. and Hrycak, A. (1990) Measuring resemblance in sequence data: An optimal matching analysis of musicians' careers, *American Journal of Sociology.* **96**(1), 144-185.

Abbott, A. and Tsay, A. (2000) Sequence analysis and optimal matching methods in Sociology, *Sociological Methods & Research.* **29**(1), 3-33.

Allison, P. D. and Liker, J. K. (1982). Analyzing sequential categorical data on dyadic interaction: A comment on Gottman. *Psychological Bulletin,* **93**, 393–403.

American Psychological Association (2002) Ethical principles of psychologists and code of conduct, *American Psychologist.* **57**(12), 1060-1073.

Anguera, M.T. (1997) From prospective patterns in behavior to joint analysis with a retrospective perspective, in *Colloque sur invitation «Méthologie d'analyse des interactions sociales»,* Paris: Université de la Sorbonne.

Anguera, M.T., Blanco-Villaseñor, A., Hernández-Mendo, A. and Losada, J.L. (2011) Diseños observacionales: ajuste y aplicación en psicología del deporte, *Cuadernos de Psicología del Deporte.* **11**(2), 63-76.

Aragón, S., Lapresa, D., Arana, X., Anguera, M.T. and Garzón, B. (2015) Tactical behaviour of winning athletes in major championship 1500-m and 5000-m track finals, *European Journal of Social Sciences*. DOI: 10.1080/17461391.2015.1009494.

Bakeman, R. (1978) Untangling streams of behavior: Sequential analysis of observation data, in G.P. Sackett (ed.), *Observing Behavior*, vol. 2, pages 63-78, Baltimore: University of Park Press.

Bakeman, R. and Quera, V. (2011) *Sequential analysis and observational methods for the behavioral sciences*: Cambridge University Press.

Blanco-Villaseñor, A. and Anguera, M.T. (2000) Evaluación de la calidad en el registro del comportamiento: Aplicación a deportes de equipo, in E. Oñate, F. García-Sicilia and L. Ramallo (eds.), *Métodos numéricos en ciencias sociales*, pages 30-48, Barcelona: Centro Internacional de Métodos Numéricos en Ingeniería (CIMNE).

Borrie, A., Jonsson, G.K. and Magnusson, M.S. (2002) Temporal pattern analysis and its applicability in sport: an explanation and preliminary data, *Journal of Sport Science.* **20**(10), 845 - 852.

Chaverri, J., Camerino, O., Anguera, M.T., Blanco-Villaseñor, Á. and Losada, J.L. (2010) Interaction contexts in soccer: Detection of T-Patterns, *Gymnasium. Revista de Educação Física, Desporto e Saúde.* **2**(1), 69-92.

Cochran, W.G. (1954) Some methods for streghning the common χ^2 test, *Biometrics.* **10**, 417-451.

Comité de ética de investigaciones clínicas de la Administración deportiva de Cataluña (2005) DOGC 4347 de 21/3/2005, orden PRE/99/2005, March 10, pages 6998-6999. Retrieval: http://portaldogc.gencat.cat/utilsEADOP/PDF/4347/417073.pdf

FIE (2014). Reglamentos. Retrieval 2014, June 20: http://www.fie.ch/Fencing/Rules.aspx

Gabin, B., Camerino, O., Anguera, M.T. and Castañer, M. (2012) Lince: multiplatform sport analysis software, *Procedia-Social and Behavioral Sciences.* **46**, 4692-4694.

Gutierrez-Santiago, A., Prieto, I., Camerino, O. and Anguera, M.T. (2013) Sequences of errors in the judo throw Morote Seoi Nage and their relationship to the learning process *Journal of Sports Engineering and Technology*. **227**(1), 57-63.

Iglesias, X., Gasset, A., González, C. and Anguera, M.T. (2010) Interacción competitiva y presión ambiental en deportes de combate: Aplicación de la metodología observacional. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte.* **5**(2), 267-282.

Krippendorff, K. (2004) *Content Analysis. An introduction to its methodology* (2a. ed.). Thousand Oaks, CA: Sage.

Lapresa, D., Alsasua, R., Arana, J. and Garzón, B. (2013). Comparative analysis of *T-patterns* using real time data and simulated data by assignment of conventional durations: the construction of efficacy in children's basketball, *International Journal of Performance Analysis in Sport.* **13**(2), 321-339.

Lapresa, D., Arana, J., Anguera, M.T. and Garzón, B. (2013) Comparative analysis of the sequentiality using SDIS-GSEQ and THEME: a concrete example in soccer, *Journal of Sport Sciences.* **31**(5), 1687-1695.

Lapresa, D., Álvarez, L., Arana, J., Garzón, B. and Caballero, V. (2013) Observational analysis of the offensive sequences that ended in a shot by the winning team of the 2010 UEFA Futsal Championship, *Journal of Sports Science.* **31**(5), 1731-1739.

Magnusson, M.S. (1988). Le Temps et les patterns syntaxiques du comportement humain: Modele, methode et programme THEME. *Revue des Conditions de Travail*, hors série, 284-314.

Magnusson, M.S. (1989). Structure syntaxique et rythmes comportementaux: Sur la detection de rythmes caches. *Science Technical Animal Laboratoire,* **14**(2), 143-147.

Magnusson, M.S. (1993). *THÈME user's manual: With notes on theory, model and pattern detection method*. Reykjavik, University of Iceland.

Magnusson, M.S. (1996) Hidden real-time patterns in intra- and inter-individual behavior: Description and detection, *European Journal of Psychological Assessment.* **12**(2), 112-123.

Magnusson, M.S. (2000) Discovering hidden time patterns in behavior: *T-patterns* and their detection, *Behavior Research Methods, Instruments, & Computers.* **32**(1), 93-110.

Magnusson, M. S. (2005). Understanding social interaction: Discovering hidden structure with model and algorithms. In L. Anolli, S. Duncan, M. Magnusson y G. Riva (Eds.), The hidden structure of interaction: From Genomics to Culture Patterns (pp. 4-24). Amsterdam: IOS Press.

Magnusson, M.S. (2006) Structure and communication in interaction. In G. Riva, M.T. Anguera, B.K. Wiederhold y F. Mantovani (Eds.) *From Communication to Presence: Cognition, Emotions and Culture towards the Ultimate Communication Experience* (pp. 127-146). Amsterdam: IOS Press.

Magnusson, M.S. (2016). Time and self-similar structure in behavior and interactions: From sequences to symmetry and fractals. In M.S. Magnusson, J.K. Burgoon and M. Casarrubea (Coords), *Discovering hiden temporal patterns in behavior and interaction* (pp. 3-35). New York: Springer.

Portell, M., Anguera, M.T., Chacón, S. and Sanduvete, S. (2015). Guidelines for Reporting Evaluations based on Observational Methodology (GREOM). *Psicothema,* **27**(3), 283-289.

Sackett, G.P. (1980) Lag Sequential Analysis as a data reduction technique in social interaction research, in D.B. Sawin, R.C. Hawkins, L.O.Walker and J.H. Penticuff (eds.), *Exceptional infant.*

Phychosocial risksin infant-environment transactions pages 300-340. New York: Brunner/Mazel.

Sánchez-Algarra, P. and Anguera, M.T. (2013). Qualitative/quantitative integration in the inductive observational study of interactive behaviour: Impact of recording and coding predominating perspectives. *Quality & Quantity. International Journal of Methodology*, **47**(2), 1237-1257.

Tarragó, R., Iglesias, X., Michavila, J.J., Chaverri, D., Ruiz-Sanchis, L. and Anguera, M.T. (2015) Análisis de patrones en asaltos de espada de alto nivel, *Cuadernos de Psicología del Deporte.* **15**(1), 149-158.

Zurloni, V., Cavalera, C., Diana, B., Elia, M. and Jonsson, G.K. (2014) Detecting regularities in soccer dynamics: A T-pattern approach, *Revista de Psicología del Deporte.* **23**(1), 157-164.