T-patterns, lag sequential analysis and polar coordinate analysis: observational study in fencing

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Introduction & Aim

Few scientific publications are devoted to the analysis of the technical and tactical determinants in fencing. To apply various actions (offensive, defensive and counter-offensive) successfully fencers should use preparatory actions. The aim of this study was to analyze the different tactical actions in competition fencing and to establish possible diachronic relationships in the strategic analysis of bouts in male and female fencing using three complementary techniques: lag sequential analysis, polar coordinate analysis and detection of T-patterns.

Method

We employed a nomothetic, point, multidimensional observational design (Anguera et al., 2011). We recorded and analysed twenty-four bouts by the six World Champions Fencing (Kazan 2014) in six disciplines of fencing (Epee, Foil & Sabre, Men & Women: ME, MF, MS, WE, WF, WS). The ESGRIMOBS observation instrument was used (Tarragó et al. 2015; Table 1).

Table 1: Observation instrument

Criteria	Category systems	Code
Pressure	No pressure	np
	Champion pressure	pc
	Opponent pressure	po
Preparation	No preparation	nx
	Champion preparation	xc
	Opponent preparation	xo
	Both preparation	xoc
1st Action	1st action: champion defensive	idc
	1st action: opponent defensive	ido
	1st action: champion offensive	ioc
	1st action: opponent offensive	ioo
2nd Action	2nd action: champion defensive	iidc
	2nd action: opponent defensive	iido
	2nd action: champion offensive	iioc
	2nd action: opponent offensive	iioo
	2nd action: champion counteroffensive	iicc
	2nd action: opponent counteroffensive	iico
3rd Action	3rd action: champion defensive	iiidc
	3rd action: opponent defensive	iiido
	3rd action: champion offensive	iiioc
	3rd action: opponent offensive	iiioo
	3rd action: champion counteroffensive	iiicc
	3rd action: opponent counteroffensive	iiico
4th Action	4th action: champion defensive	ivdc
	4th action: opponent defensive	ivdo
	4th action: champion offensive	ivoc
	4th action: opponent offensive	ivoo
	4th action: champion counteroffensive	ivcc
	4th action: opponent counteroffensive	ivco
Touch	No touch	nt
	Champion touch	tc
	Opponent touch	to
	Double touch	td

A total of 1239 fencing phrases (uninterrupted exchange of fencing actions, ending either with a hit or with the fencers breaking off) were recorded and coded in LINCE v.1.1 (Gabín et al. 2012). The methodological analysis was performed with the software THEME v.6 Edu, GSEQ5 and HOISAN. This complementary analysis provided interesting tactical and strategic insights.

Results & Discussion

The results of the study show behavioral profiles of the 6 world champions, men and women, in epee, sable and foil. In the three female weapons are more significant patterns in the analysis of polar coordinates, while the T-patterns this happens in epee and saber. The tactical analysis (intra-phrase analysis) established links between tactical thinking and technical execution (and efficacy).

Table 2: Example of lag sequential analysis (Subject: women's foil world champion; Behavioral criterion: Champion Touch)

Women's foil (TC - Champion Touch)

PREPARATION	nx	L-2 (-2,10)		
	xc	L-1 (2,63)	L+2 (-2,00)	
	xo	L+2 (2,03)		
1st ACTION	ioc	L-1 (2,63)	L0 (2,46)	L+5 (-1,99)
	ioo	L-1 (-2,63)	L0 (-2,46)	L+5 (1,99)
2nd ACTION	iicc	L-2 (-2,13)	L0 (-3,09)	I+1 (-2,17)
3rd ACTION	iiidc	L-1 (2,33)	L+4 (-2,71)	
	iiico	L-2 (2,23)		
4th ACTION	ivoc	L+5 (2,45)		
	ivcc	L+3 (-3,00)		
	ivco	L-1 (2,58)		

This analysis was performed by lag sequential analysis at lag 0 (co-occurrences) and T-pattern analysis. The strategic analysis (inter-phrase analysis) provided information about the bidirectional relationship (prospective and retrospective) between fencing actions in relation to their efficacy. The inter-phrase analysis was performed by lag sequential analysis at lags -1 to -5 and +1 to +5 (Table 2) , analysis of T-pattern clusters (Table 3), and polar coordinate analysis (Figure 1).

The above tools allowed us to identify direct relationships between different tactical actions and their efficacy (in terms of score) and provided information on successful strategies used by fencers during competitions. Information of this kind could help fencers to take better decisions during assaults.

Table 3: Example T-pattern clusters (Subject: women's foil world champion)

| T-patterns in women's foil bouts	Occurrences	Bouts	Interspersed fencing phrases
((po,xo,ioo,iicc (po,xo,ioo,iidc po,xo,ioo,iicc,to)) pc,pc,xc,ioc,iico,to)	2	1	/-6-1
		4	/-4-1
(pc,xc,ioc,iido,iiicc (pc,xc,ioc,iido,to pc,xc,ioo,iidc,iiico))	2	2	7-9
		4	8-10
(po,xo,ioo,iidc (po,xo,ioo,iicc,to po,xo,ioc,iido,tc))	2	1	3-5
		4	3-5
(np,xc,ioc,iico,tc np,xc,ioc,iico,tc)	2	3	8
		3	8
(pc,xc,ioc,iido,iiicc pc,xc,ioc,iido,to)	2	2	7
		4	8
(pc,xc,ioc,iido,iiidc,ivdo np,xc,ioc,iico,tc)	2	3	18
		4	19
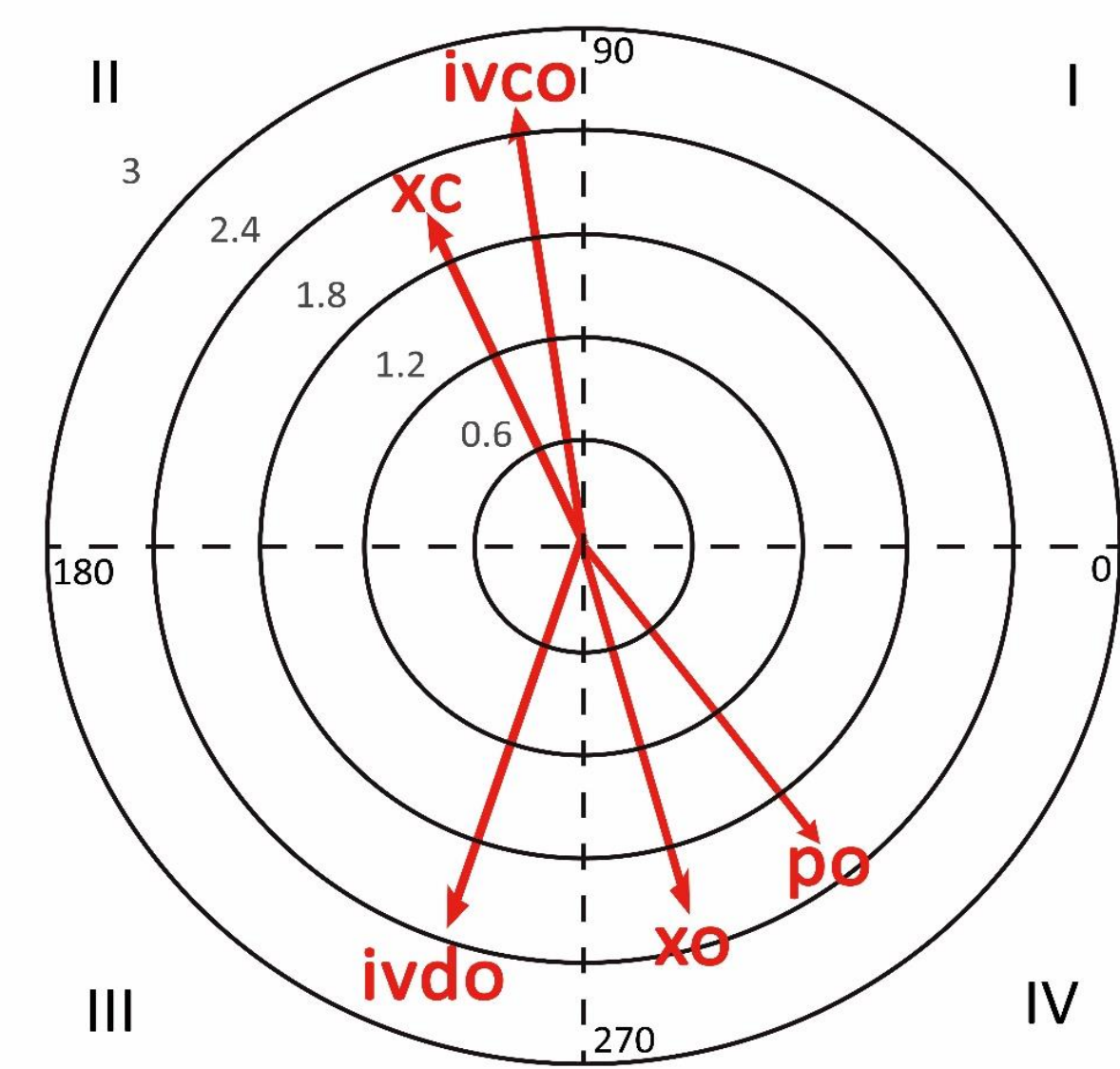
Figure 1: Example of Polar coordinate analysis

(Subject: women's foil world champion; Focal behavior: Champion Touch)

Conclusions

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.

References

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