

### 3. **Microanalysis of T-patterns. Analysis of Symmetry/Asymmetry in Social Interaction**

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**Abstract.** This chapter analyses the relationships between the structure of data gathered from a recorded of an interactive situation and the temporal patterns (T-patterns) obtained through use of the THEME software. Various simulated interactive situations are presented, along with hypothetical data that invite reflection; an initial micro-analytic study that enables the structure of the T-patterns to be better understood is carried out also. Each of the aspects addressed in the microanalysis requires further, more specific studies. As at least two interacting subjects are involved in every social interaction, the analysis of symmetry and asymmetry relationships is particularly relevant; it has to be considered the classical concept and its adaptation to the T-patterns also.

Analysis of the T-pattern structure is argued to be of special interest, the relationship between the characteristics of the codes that comprise the recording (with real or simulated data) and the patterns obtained being taken into account.

**Keywords:** Nonverbal social interaction; symmetry/asymmetry relationship; T-pattern microanalysis; simulated interactive situations.

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### 3.1 Introduction

Social interaction is a complex phenomenon for various reasons. The most important of these are the inevitable multiplicity of individuals involved (dyadic, triadic, tetradic, etc. interaction), the diversity of existing interactive structures, the effect of the context and interactive content, and both inter- and intra-session permanence and changeability, among many others. As was pointed out 25 years ago by Cairns [1] and Lamb, Suomi and Stephenson [2], the study of social interaction is undoubtedly difficult from a methodological point of view, and in this regard the contribution of Sackett [3, 4] to observational methodology proved decisive at that time.

The assumptions underlying social interaction may be considered as a basic perspective for the study of social relationships, although there is no unified theory for the study of such processes [5, 6]. Although some authors [1] argue that the social interaction is a broad discipline in which several different methodologies may be applied, the present chapter refers solely to social interaction that is produced spontaneously and in a non-restrictive context; consequently, it adopts the approach of observational methodology [7].

However, there are many specific questions that may be researched in the context of social interaction, as the latter constitutes an extensive framework from which varied elements may be selected. Among the various aspects studied in recent years, there are some issues of clear interest as the search for interactive patterns by means of lag sequential analysis [8-10], the detection of interactive intensity through the analysis of polar coordinates [4, 11-13], the improved understanding of the symmetrical (or asymmetrical) nature of the participative relationship using *log-linear* or *logit* analysis [9, 14], and the incorporation of the temporal dimension in macro form into social care programs [15].

One of the specific questions that is proving to be highly fruitful, and which constitutes the *leitmotif* of the present chapter, is the study of the hidden structures underlying an interactive situation, in other words, the way in which temporal patterns are able to reveal those aspects of social interaction which are not immediately observable. Every interactive flow is governed by behavioural structures of varying stability that can be visualized by obtaining temporal patterns (T-patterns). These temporal patterns, detected by means of the powerful algorithm of the THEME software, developed by Dr. Magnus S. Magnusson (University of Iceland, Reykjavík), constitute the object of the present study.

Given the relevance of T-patterns in terms of their appearance, structure, modifiability, aggregation of sub-patterns, effect of temporal units considered, etc. this chapter focuses on T-patterns microanalysis, with special emphasis on the analysis of their symmetry/asymmetry.

### 3.2 Analysis of social interaction by means of T-patterns

When, in the 1980s, observational methodology became more widely developed as a discipline it also became clear that the detection of temporal patterns would play an important role. As Bakeman & Gottman [16] stated in their study of interaction, “We believe that great conceptual clarity can be obtained by thinking about temporal patterning, and we believe that anyone who has collected observational data over time and ignores time is missing an opportunity” (p. 201).

In any observational study, and naturally in those dealing with social interaction, the observation instrument, whether this is category system or field format, or a combination of the two [7], has to be developed in accordance with the research objective, the corresponding codes being defined in the process. Once this important stage of the process

has been completed, the recording can begin; although the recording stage faces a number of difficulties regarding notational decisions [17], in recent decades it has benefited greatly from the computerized coding that is possible once the recordings have been digitalized [18]. Moreover, it should be remembered that there are many computer programs that enable temporal recording in conventional units of time, whether these are general programs, such as the Excel spreadsheet, or more specific tools such as some of the data types of the SDIS-GSEQ [8], CODEX [19], THEMECODER [20] or THE OBSERVER [21], among many others.

The data gathered through the recording of an interactive situation are subjected to a quality control in order to filter out potential errors and, provided this control is passed, they are then analyzed in accordance with the corresponding observational design. Among many possible statistical analyses, whether conventional or not, the present chapter is concerned exclusively with the detection of temporal patterns.

Over the last twenty years the progressive possibilities opened up by the THEME software [22-29] have made what was once impossible a reality. Although, given the numerous research reports that have used this program in recent years, it may seem unnecessary to restate its possibilities it is worth reiterating that the THEME constitutes a powerful research tool. Indeed it's able to explore behavioural structures in detail by revealing stronger connections between successive recorded behaviours than would be expected by chance; the *critical interval* is the key concept which enables the admissible temporal distances between successive identical or similar occurrences to be delimited in order to consider the existence of a temporal pattern. Obtaining T-patterns is of great importance both theoretically and empirically, and deriving their algorithm has involved the development of new and powerful analytic techniques based on probability theory and, more specifically, the binomial distribution [26].

Obtaining T-patterns proves to be extraordinarily productive and fruitful in the study of any of the multiple facets or fields of social interaction's application, for example, in situations concerning non-verbal behaviour [30] or those where the focus is on proxemic behaviour, as in the case of sport [31-34]; however, as recent research has shown [27, 35] it is equally useful in many other areas, even when their field of action is not restricted to this area of social interaction.

### 3.3 The T-pattern as product of analysis and research datum: Micro-analytic variability in its development

As Duncan [36] points out, THEME patterns are not in themselves the results, rather these patterns provide the information necessary to formulate structures which must then be fitted and consolidated on the basis of the temporal patterns obtained.

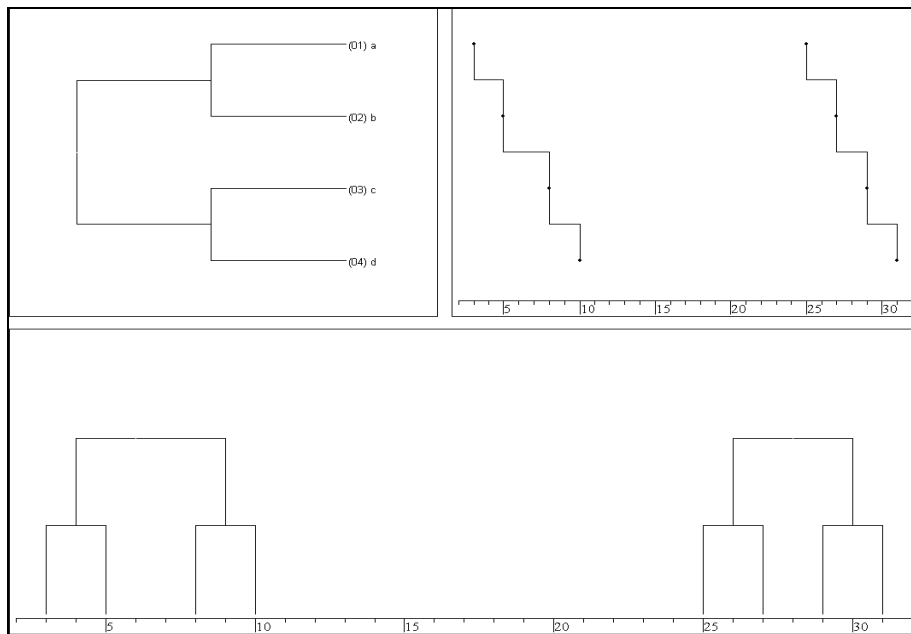
The example proposed by Magnusson [26, p. 25] in Figure 3.1 has been chosen as the starting point for the microanalysis. If we consider solely codes *a* and *b*, and naturally the same applies if we only consider codes *c* and *d* (if we are interested in taking them all into account the distribution must be considered as multinomial, which is beyond the scope of the present chapter), it can be seen that episodes of *a* occur at 2 and 24 and those of *b* at 4 and 26. The probability of the occurrence of *b* is  $p(b) = N_b/N_T = 2/31 = .129$ , and  $p(\sim b) = 1 - p(b) = 1 - 0.129 = .87$ .

Following Magnusson [27, Appendix A and Appendix B] we then check to see if any significant patterns are detected between *a* and *b*, whether these are free or fast T-patterns:

In the free T-pattern the critical interval is (2,2) and its length is  $d = d_2 - d_1 + 1 = 1$ , giving  $p = 1 - \Sigma \text{binomial}(2, i, 1 - 0.87^1) = 1 - 0.9831 = .0169$  (where  $i = 0 \dots N_{ab} - 1$ ). This is significant at the level  $p = .05$ .

In the fast T-pattern the critical interval is (0,2) and its length is  $d = d_2 - d_1 + 1 = 3$ , giving  $p = 1 - \Sigma \text{binomial}(2, i, 1-0.87^3) = 1 - 0.7484 = 0.25$  (where  $i = 0 \dots N_{ab} - 1$ ). This is not significant at the level  $p = .05$ . This is shown graphically in Figure 3.1.

Although this approach does not consider a multinomial distribution it is nevertheless possible to check for the hypothetical presence of temporal patterns between any of the pairs of codes. Thus, if we want to check between  $b$  and  $c$  we know that episodes of  $b$  occur at 4 and 26 and those of  $c$  at 7 and 28. The probability of the occurrence of  $b$  is  $p(b) = N_b/N_T = 2/31 = 0.129$ , and  $p(\sim b) = 1 - p(b) = 1 - 0.129 = 0.87$ . In order to detect if there is a free T-pattern we delimit the critical interval, which is (2,3) and of length  $d = d_2 - d_1 + 1 = 2$ , giving  $p = 1 - \Sigma \text{binomial}(2, i, 1-0.87^2) = 1 - 0.9424 = 0.0576$  (where  $i = 0 \dots N_{ab} - 1$ ). A free T-pattern, not significant at the level  $p = .05$ , is detected.

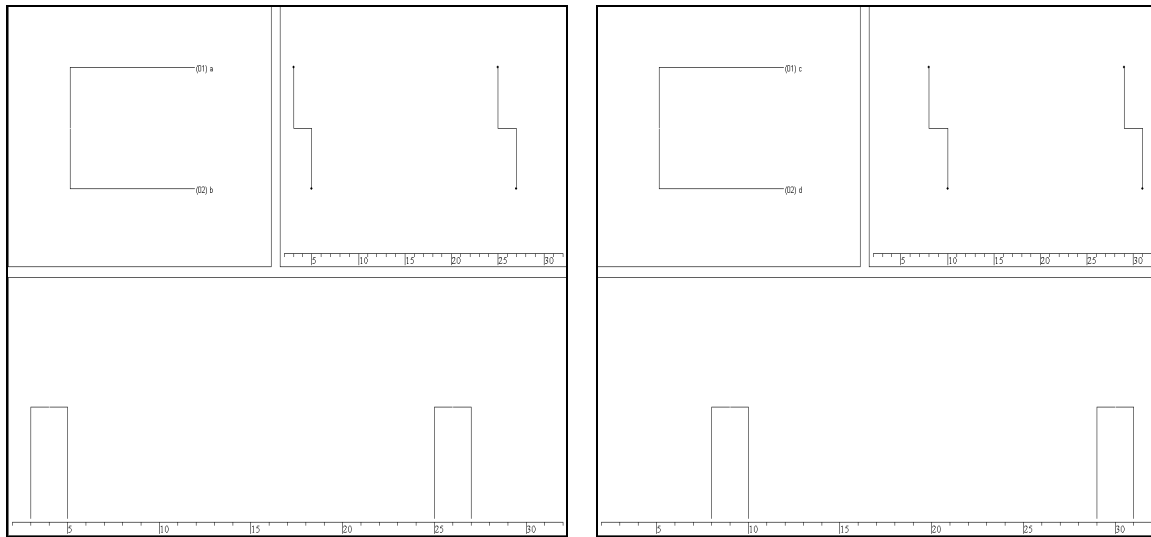


**Figure 3.1** Graphical representation of the pattern obtained with the data from the example proposed by Magnusson (2000, p. 95, in Figure 1). The possible binary trees are the one shown ((ab)(cd)), along with ((a(bc))d), (a(b(cd))) and ((ab)c)d), the significance level being  $p = .05$  (no T-pattern with a significance level of  $p = .005$  is obtained).

If we check between  $b$  and  $d$  the episodes of  $b$  occur at times 4 and 26, and those of  $d$  at 9 and 30. The probability of the occurrence of  $b$  is  $p(b) = N_b/N_T = 2/31 = 0.129$ , and  $p(\sim b) = 1 - p(b) = 1 - 0.129 = 0.87$ . In order to detect if there is a free T-pattern we delimit the critical interval, which is (4,5) and of length  $d = d_2 - d_1 + 1 = 2$ , giving  $p = 1 - \Sigma \text{binomial}(2, i, 1-0.87^2) = 1 - 0.9424 = 0.0576$  (where  $i = 0 \dots N_{ab} - 1$ ). A free T-pattern, not significant at the level  $p = .05$ , is detected.

Is this significance related to the structure of the tree obtained using THEME? Indeed it is, for if, in the example of Figure 3.1, we obtain the graphical representation of the T-pattern obtained using THEME at a significance level of  $p = .04$  then the single four-branch pattern is transformed into two binary patterns (ab) and (cd); this indicates that the connection between the two binary patterns is weaker than that between their respective components ( $a$  and  $b$  on the one hand, and  $c$  and  $d$  on the other).

Given the effect of the critical interval it is worth considering whether microanalysis of the T-pattern would provide a better understanding of the different aspects affecting it.



**Figure 3.2** Graphical representation of the binary patterns obtained with the data from the example proposed by Magnusson (2000, p. 95, in Figure 1) and with the significance level set at  $p = .04$ . The binary trees obtained are (ab) and (cd), which are sub-patterns of that shown in Figure 3.1.

As the present chapter forms part of the book's theoretical section, it does not seek to carry out an empirical study or take any of psychology's theoretical frameworks as a reference point. However, it does aim to analyze how temporal patterns behave at the micro-analytic level in particular cases, without any attempt at generalization being made. Different subsequent studies with real data would be able to develop specifically the various aspects that are here only suggested.

### 3.3.1 *Microanalysis according to the unequal duration of behavioural episodes*

Let us consider an interactive situation involving the actors  $s1$ ,  $s2$ ,  $s3$ ,  $sf$  and  $sg$ , who participate on a turn-taking basis. Consequently, our proposed starting point is a schematic observation instrument (coding system) which will be adopted as the operational basis of simulated data (Table 3.1).

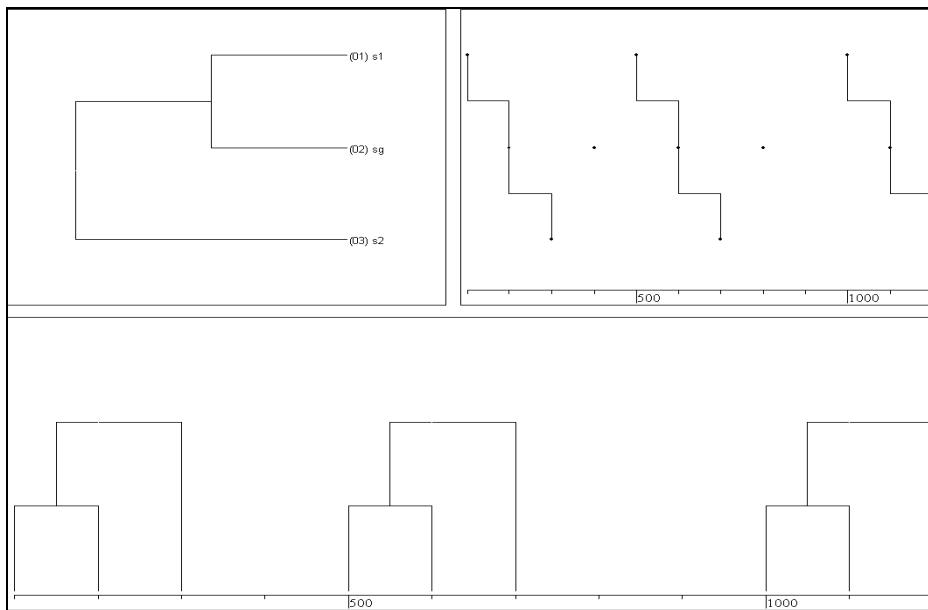
Category Table				
	ACTOR	BE	ACTIVITY	VERBALBEHAVIOR
	s1	b	a1	v1
	s2	e	a2	v2
	s3		a3	v3
	sf			
▶	sg			

**Table 3.1** Observation instrument

Table 3.2 shows the recording and illustrates the uniform separation between the turn-taking of the interacting subjects,  $s1$  and  $s2$ . Figure 3.3 presents the graphical representation of the only T-pattern obtained using THEME, with a significance level of  $p = .05$ .

Data name	T	Event
Episode1	1	.
Episode1	100	s1
Episode1	200	sg
Episode1	300	s2
Episode1	400	sg
Episode1	500	s1
Episode1	600	sg
Episode1	700	s2
Episode1	800	sg
Episode1	900	s3
Episode1	1000	s1
Episode1	1100	sg
Episode1	1200	s2
Episode1	1300	&

**Table 3.2** Recording of the turn-taking interactive situation

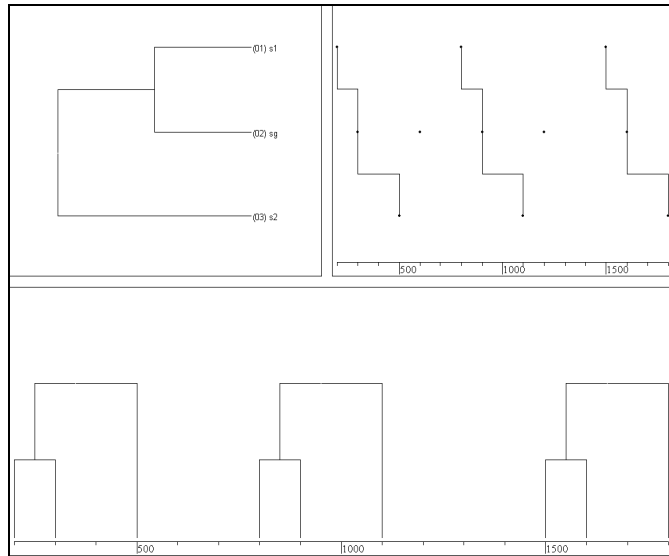


**Figure 3.3** Graphical representation of the only primary pattern found with the data from Table 3.2, with  $p = .05$ . The only tree obtained is ((s1 sg) s2).

Now let us modify the data of the previous recording in order to observe the effect on the T-pattern. If the duration of the behavioural episodes s1, sg and s2 increases homogeneously the T-pattern is not altered, as can be seen when the duration is doubled (Table 3.2 and Figure 3.4) and tripled (Table 3.3 and Figure 3.5.). However, the same does not occur when the duration of the behavioural episodes is modified irregularly, which is to be expected given that the structure of the T-pattern is developed according to time.

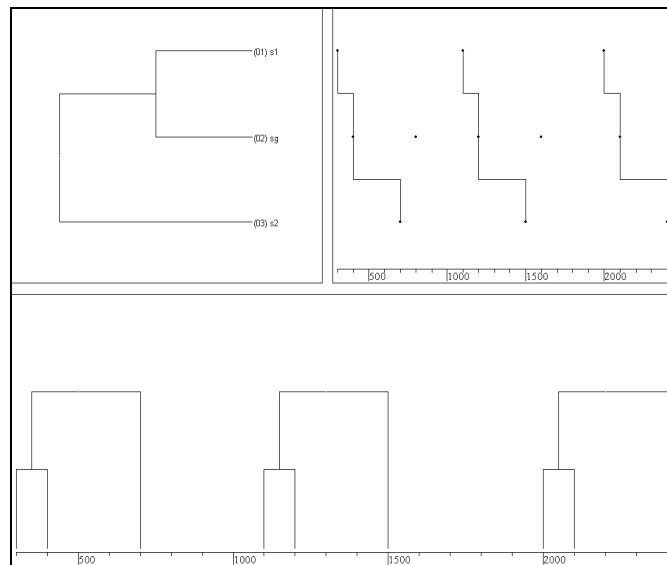
As can be seen in Table 3.4 and Figure 3.6, the only T-pattern obtained (s1 sg) is modified. In this case, the duration of s1 and s2 is, progressively, 100, 200 and 300 time units in each one of the successive episodes.

Data name	T	Event
Episode2	1	:
Episode2	200	s1
Episode2	300	sg
Episode2	500	s2
Episode2	600	sg
Episode2	800	s1
Episode2	900	sg
Episode2	1100	s2
Episode2	1200	sg
Episode2	1300	s3
Episode2	1500	s1
Episode2	1600	sg
Episode2	1800	s2
Episode2	1900	&



**Table 3.2 and Figure 3.4** Doubling the duration of the episodes of s1, sg and s2, and the nature of the T-pattern obtained ((s1 sg s2))

Data name	T	Event
Episode3	1	:
Episode3	300	s1
Episode3	400	sg
Episode3	700	s2
Episode3	800	sg
Episode3	1100	s1
Episode3	1200	sg
Episode3	1500	s2
Episode3	1600	sg
Episode3	1700	s3
Episode3	2000	s1
Episode3	2100	sg
Episode3	2400	s2
Episode3	2500	&



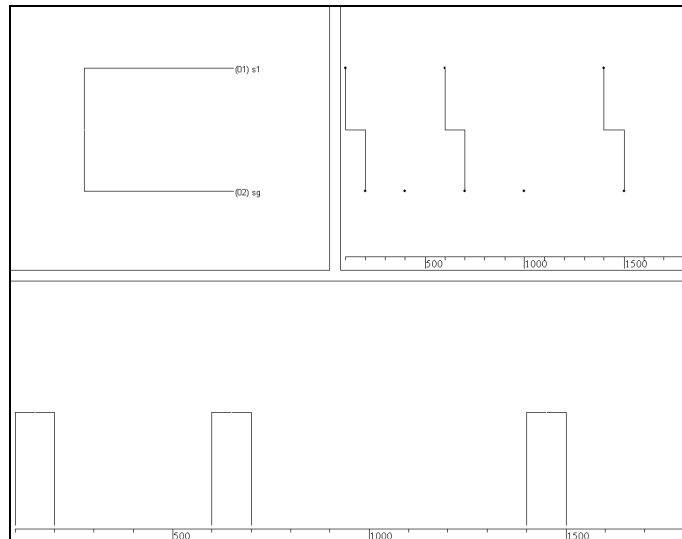
**Table 3.3 and Figure 3.5** Tripling the duration of the episodes of s1, sg and s2, and the nature of the T-pattern obtained ((s1 sg s2))

### 3.3.2 Microanalysis of the T-patterns according to the recording of their duration (begin/end) and/or only beginning and/or only end.

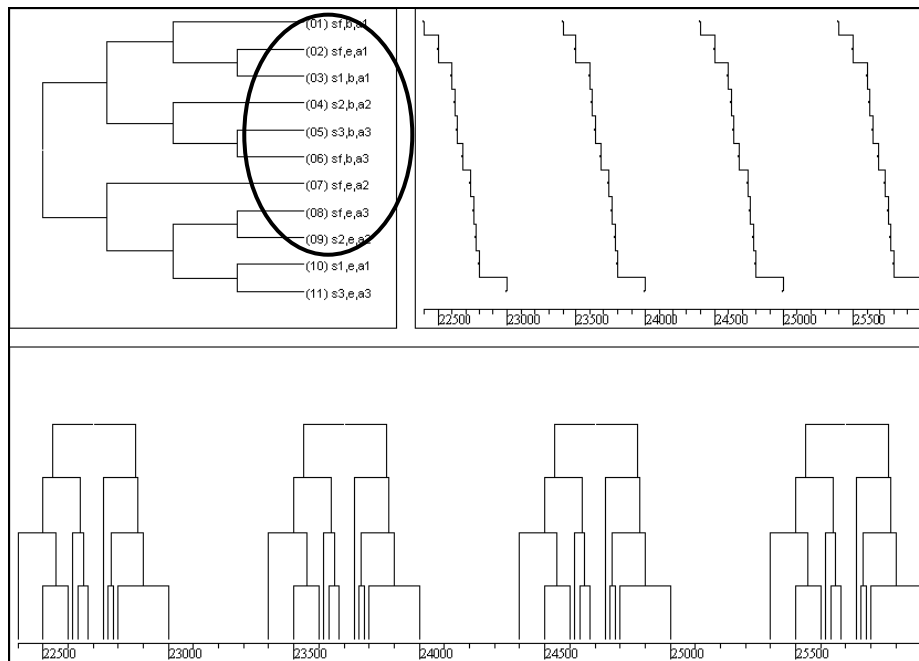
The THEME software includes, by default, an observation instrument criterion: BE (*begin-end*). This is logical because the common aim of detecting temporal patterns requires markers that delimit the beginning and end of each behavioural episode.

Therefore, we are interested in knowing whether the T-patterns vary when the relationship and the order of the codes are maintained but only the beginning rather than the duration of each action is recorded. Using the observation instrument from Table 3.1, hypothetical data that produce the single pattern shown in Figure 3.7, are proposed.

Data name	T	Event
Episode4	1	:
Episode4	100	s1
Episode4	200	sg
Episode4	300	s2
Episode4	400	sg
Episode4	600	s1
Episode4	700	sg
Episode4	900	s2
Episode4	1000	sg
Episode4	1100	s3
Episode4	1400	s1
Episode4	1500	sg
Episode4	1800	s2
Episode4	1900	&



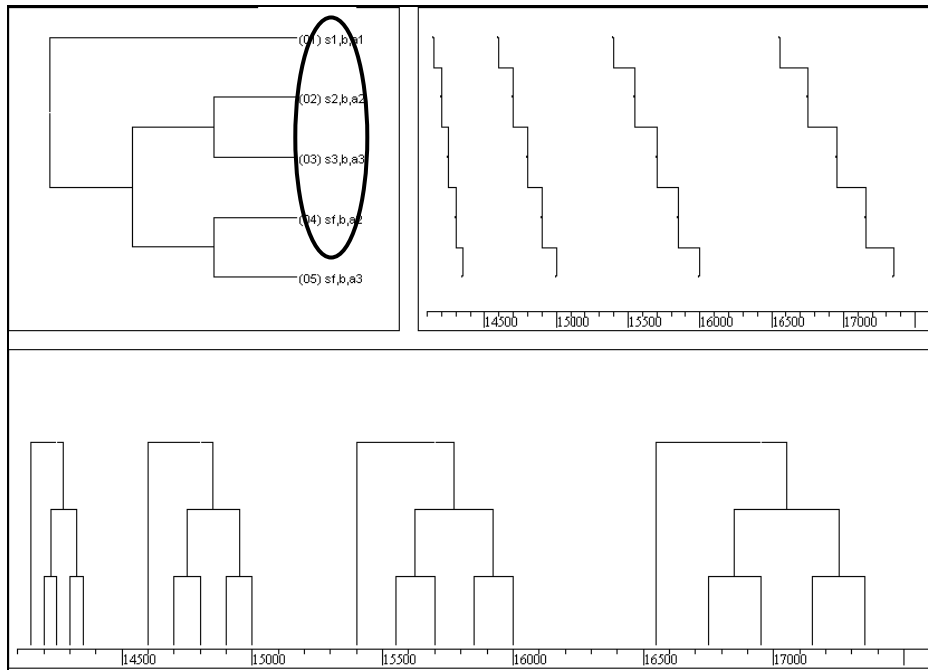
**Table 3.4 and Figure 3.6** Non-homogeneous modification of the duration of episodes of s1, sg and s2, and alteration of the previously obtained T-pattern, which now has the structure (s1 sg).



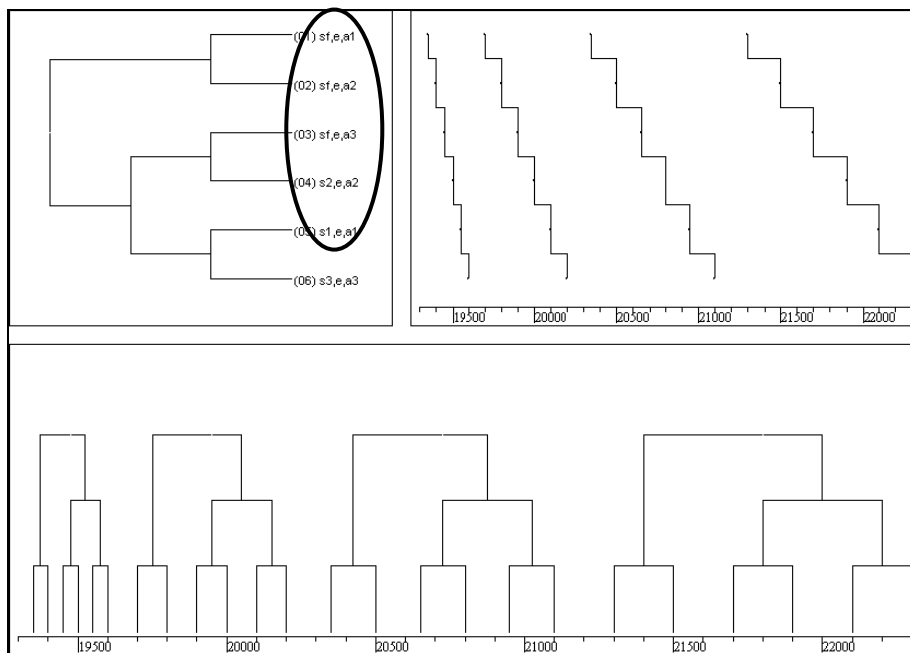
**Figure 3.7** T-pattern obtained from a recording in which the beginning and end of each behavioural episode is recorded

The recording has been modified by eliminating the configurations corresponding to the end of each action; it can be seen in the resulting pattern that the configurations including the beginning of the action are maintained, except for *sf,b,a1*, and the new configuration *sf,b,a2* appears. The graphical structure of the pattern is also modified, as illustrated in Figure 3.8.

The recording corresponding to Figure 3.7 is then also modified by eliminating the configurations concerning the beginning of each action (Figure 3.9). Comparing the two T-patterns it can be seen that all the code configurations which include the end are maintained, the sole exception being that of the code *sf,e,a1*. Once again, the graphical structure of the pattern is modified.



**Figure 3.8** T-pattern obtained from the recording corresponding to Figure 3.7 in which the ends of each behavioural episode have been eliminated.



**Figure 3.9** T-pattern obtained from the recording corresponding to Figure 3.7 in which the beginning of each behavioural episode has been eliminated.

As a single T-pattern is obtained the structures shown in Figures 3.8 and 3.9 are comparable. If all the configurations forming part of these two T-patterns had been identical a second example would have been used to check this finding further. However, as they were not identical (Figure 3.8) the decision to record solely the beginning or the end of behavioural episodes should not be taken lightly, bearing in mind that this may alter the T-pattern(s).

### 3.3.3 Variability of the T-patterns according to temporality (units of time assigned to each code)

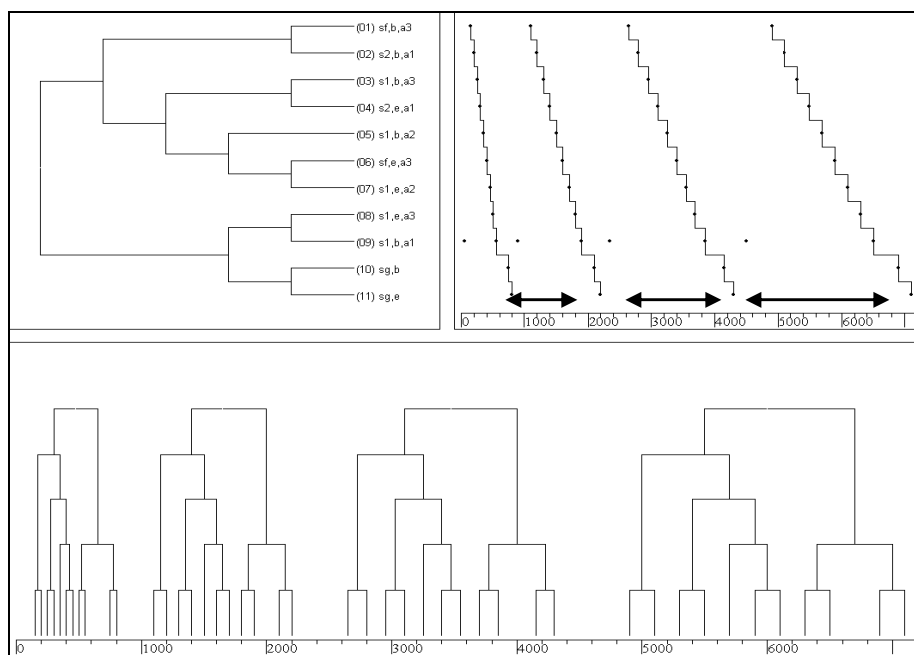
Section 3.3.1. dealt with the duration's effect those codes of *a priori* interest (the interacting subjects s1 and s2). In this section we are interested in knowing the margin of variability and constancy of the behavioural patterns, in other words, the sensitivity of the temporal pattern(s) with respect to the modifications produced in the recording.

Figure 3.10 shows the graphical representation of a T-pattern in which the same recording has been carried out in four successive blocks, but where the number of time units has been modified, this increasing regularly. This example considers a separation between codes of the same block that is identical to the duration in frames of each behaviour and which, respectively, is 50, 100, 150 and 200 in each of the four successive recording blocks. The upper left window (Figure 3.10) shows the pattern obtained, while the upper right and lower windows show the progressively increasing distances in the four patterns.

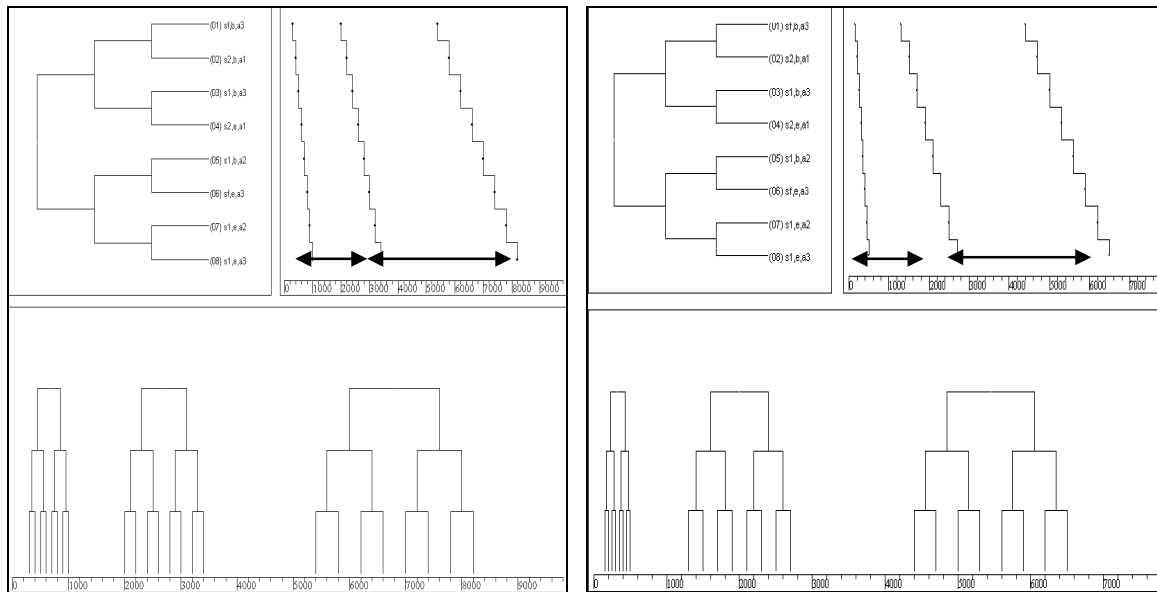
In this case, the difference in duration of the actions recorded in the successive episodes is constant across the four patterns. However, we can see below what happens when the variability between the different episodes is not constant (Figure 3.11).

Taking into account the recorded configurations of each episodes considered in the two cases (Table 3.5) and comparing the structures obtained (Figure 3.10, on the one hand, and Figures 3.11(a) and 3.11(b) on the other) it can be seen that the only primary pattern that disappears as such in 3.11(a) and 3.11(b) is precisely (sg,b sg,e), which is situated at the end of each episode (sub-stage of maximum difference between the time units), and that part the t-pattern's structure is modified.

Obviously, this is a hypothetical case, which is also particular and, therefore, not generalizable. However, it is worth noting both that the T-patterns appear to be highly versatile with respect to temporality, and that the recordings in which the distribution of time units in the successive episodes is irregular and different maintain the same structure.



**Figure 3.10** T-pattern with regular temporal differentiation and a significance level of  $p = .0001$ . The structure obtained is ((( (sf,b,a3 s2,b,a1) (s1,b,a3 s2,e,a1) (s1,b,a2 (sf,e,a3 s1,e,a2) )) (s1,e,a3 s1,b,a1) (sg,b sg,e)))



**Figures 3.11(a) and 3.11(b)** Graphical representation of the T-pattern corresponding to the same recorded configurations (simulated data that gave rise to the T-pattern in Figure 3.10), with a temporal differentiation corresponding to an arithmetical progression of durations in the three successive episodes (100, 200 and 400 time units) in Figure 3.11(a), and with an irregular differentiation of 50, 200 and 300 time units in Figure 11(b). Significance is  $p = .001$ , and the tree structure is identical in (a) and (b): ((( sf,b,a3 s2,b,a1 )( s1,b,a3 s2,e,a1 ))( s1,b,a2 sf,e,a3 )( s1,e,a2 s1,e,a3 ))).

Data name	T	Event
Episode5	1	:
Episode5		s1,b,a1
Episode5		s1,e,a1
Episode5		sf,b,a3
Episode5		s2,b,a1
Episode5		s1,b,a3
Episode5		s2,e,a1
Episode5		s1,b,a2
Episode5		sf,e,a3
Episode5		s1,e,a2
Episode5		s1,e,a3
Episode5		s1,b,a1
Episode5		s1,e,a1
Episode5		sg,b
Episode5		sg,e
Episode6		s1,b,a1
Episode6	...	...

**Table 3.5** Recording configurations corresponding to each of the episodes giving rise to the T-patterns in Figures 3.10 and 3.11. The time units are not shown in column T as they are different in the two cases.

### 3.3.4 Microanalysis according to the repeatability of behavioural sequences through the aggregation of progressively incomplete blocks of data from initially identical episodes

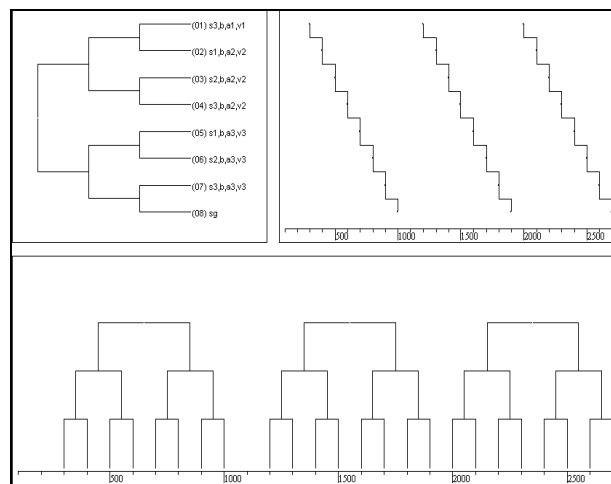
The detection of T-patterns is inextricably linked to the repeatability of homogeneous behaviours. Although at times these may be identical, on most occasions it is more correct

to refer to a similar ‘core’ surrounded by ‘layers’ of varying degrees of malleability, and it is within this wide range of possible cases that the T-pattern occupies an important place, its special mission being the detection of stable structures, no matter how hidden they are by the overlap with other behaviours, individuals or contextual features.

The previous figures have illustrated the simulation of consecutive interactive episodes, either identical ones (Figures 3.3, 3.7, 3.8 and 3.9) or those modified in certain aspects (Figures 3.4, 3.5, 3.6, 3.10, 3.11(a) and 3.11(b)). In the present section the aim is to consider a question of fundamental importance in the detection of hidden behaviour patterns, namely, on what aspects does the consistency of the various behaviours enacted depend. Although there are undoubtedly many such aspects, the attention will focus on the key role played by temporality.

In order to illustrate this point, let us use a hypothetical recording made with the observation instrument from Table 3.1. The recording comprises three episodes beginning with that indicated in Table 3.6 and separated from one another by the code *sg*; each one of the successive episodes (2<sup>nd</sup> and 3<sup>rd</sup>) omits the first piece of recorded data (see 2<sup>nd</sup> row of Table 3.7). Figure 3.12 shows the only T-pattern obtained, with a significance level of  $p=.001$  and the structure  $(( (s3,b,a1,v1 \ s1,b,a2,v2) (s2,b,a2,v2 \ s3,b,a2,v2) ) (s1,b,a3,v3 \ s2,b,a3,v3) (s3,b,a3,v3 \ sg) )$ . The temporal pattern is not affected by the modification of the 2<sup>nd</sup> and 3<sup>rd</sup> episodes as indicated.

Data name	T	Event
Episode7	1	:
Episode7	100	s1,b,a1,v1
Episode7	200	s2,b,a1,v1
Episode7	300	s3,b,a1,v1
Episode7	400	s1,b,a2,v2
Episode7	500	s2,b,a2,v2
Episode7	600	s3,b,a2,v2
Episode7	700	s1,b,a3,v3
Episode7	800	s2,b,a3,v3
Episode7	900	s3,b,a3,v3
Episode7	1000	sg
Episode8	1100	...



**Table 3.6** and **Figure 3.12** First episode of a hypothetical recording used as a module into which subsequent modifications are introduced (in this case, omission of the episode’s first piece of data) (Table 3.6), and the graphical representation of the only T-pattern obtained (Figure 3.12).

Table 3.7 proposes various recording characteristics. Obviously, there are a very high number of possible modification profiles, which could be applied regularly to all the episodes or in a different way to each one of them: eliminate data (code configurations) randomly or systematically, introduce new codes, change the order of the codes, etc. Here, for the purposes of illustration, some of these modifications are shown in order to see the effect on the structure of the T-pattern.

### 3.4 Symmetry/asymmetry in T-patterns

In every interactive situation the issue of symmetry must be considered from various perspectives: roles of the interacting subjects, initiative taken, uni- or bi-directional effect between the interacting subjects, crossed situations in cases of  $n (>2)$  interacting subjects

Characteristics of the recording	Structure of the T-pattern
3 identical episodes (reference recording)	$(( (s_{3,b,a1,v1} \ s_{1,b,a2,v2} ) (s_{2,b,a2,v2} \ s_{3,b,a2,v2} )) (s_{1,b,a3,v3} \ s_{2,b,a3,v3} ) (s_{3,b,a3,v3} \ sg ))$ (Significance $p = .005$ )
2 <sup>nd</sup> and 3 <sup>rd</sup> episodes omit the first piece of recorded data	$(( (s_{3,b,a1,v1} \ s_{1,b,a2,v2} ) (s_{2,b,a2,v2} \ s_{3,b,a2,v2} )) (s_{1,b,a3,v3} \ s_{2,b,a3,v3} ) (s_{3,b,a3,v3} \ sg ))$ (Significance $p = .005$ )
2 <sup>nd</sup> and 3 <sup>rd</sup> episodes omit the first and last recorded data	$(( s_{3,b,a1,v1} \ s_{1,b,a2,v2} ) (s_{2,b,a2,v2} \ s_{3,b,a2,v2} ) (s_{1,b,a3,v3} \ s_{2,b,a3,v3} ))$ (Significance $p = .005$ )
2 <sup>nd</sup> and 3 <sup>rd</sup> episodes omit the first two recorded data	$(( (s_{3,b,a1,v1} \ s_{1,b,a2,v2} ) (s_{2,b,a2,v2} \ s_{3,b,a2,v2} )) (s_{1,b,a3,v3} \ s_{2,b,a3,v3} ) (s_{3,b,a3,v3} \ sg ))$ (Significance $p = .005$ )
2 <sup>nd</sup> and 3 <sup>rd</sup> episodes omit the first two and last two recorded data	$(s_{2,b,a3,v3} \ (s_{3,b,a3,v3} \ sg ))$ (Significance $p = .05$ )
2 <sup>nd</sup> and 3 <sup>rd</sup> episodes omit the first three recorded data	$(( s_{1,b,a2,v2} \ (s_{2,b,a2,v2} \ s_{3,b,a2,v2} )) (s_{1,b,a3,v3} \ s_{2,b,a3,v3} ) (s_{3,b,a3,v3} \ sg ))$ (Significance $p = .005$ )
2 <sup>nd</sup> and 3 <sup>rd</sup> episodes omit the first three and the last three recorded data	$(( s_{1,b,a2,v2} \ s_{2,b,a2,v2} ) (s_{3,b,a2,v2} \ s_{1,b,a3,v3} ))$ (Significance $p = .005$ )
2 <sup>nd</sup> and 3 <sup>rd</sup> episodes omit the first four recorded data	$(( s_{2,b,a2,v2} \ (s_{3,b,a2,v2} \ s_{1,b,a3,v3} )) (s_{2,b,a3,v3} \ (s_{3,b,a3,v3} \ sg ))$ (Significance $p = .005$ )

**Table 3.7** Relationship between recording characteristics and the structure of the only T-pattern obtained in each case.

(triadic, tetradic, pentadic interaction, etc.), dissonance between the interaction and the activity performed, temporal symmetry of interactive interventions, etc.

As the aim of this chapter is to discuss key issues consideration should also be given to a certain ‘isomorphism’ between the nature of each interactive situation, reflected in the recording, and the possible symmetry of the T-patterns; it should, of course, be remembered that there are syntactic rules which determine the appearance of T-patterns, as in the vertical reading of the pattern (upper left window), and this has a bearing on the issue of symmetry.

Symmetry has been studied from within various disciplines, including mathematics, physics, philosophy and law, and has been of interest from the time of Aristotle to the present day. As Van Fraassen [37] points out, the symmetries of time, space and movement determine the structure of modern science. However, very little research has addressed, from the empirical perspective, the issue of ‘interactive symmetry’ or, from a more conceptual angle, a ‘symmetry in interactive models’; although this situation invites researchers to adopt a novel approach to the area it also places them in a somewhat lonely and challenging position due to the lack of prior reference points.

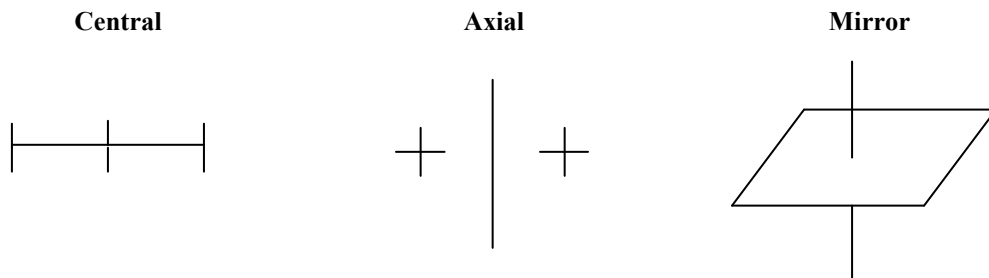
There are three basic kinds of symmetry: central, axial and mirror (Figure 3.13).

In what is an exploratory discussion the approach here presented merely seeks T-patterns that correspond to one or more types of symmetry, and reflects upon the possible correspondence with interactive symmetry. Furthermore, it offers an opportunity to study whether the breakdown of sub-patterns is also governed by one of the types of symmetry. Let us turn once again to the observation instrument from Table 3.1.

Firstly, it should be borne in mind that although a dyadic interaction (and, therefore, an  $n$ -adic one) may be symmetrical (or asymmetrical) according to various criteria, the initiative in interactive intervention is unquestionable. Does symmetrical initiative (in a

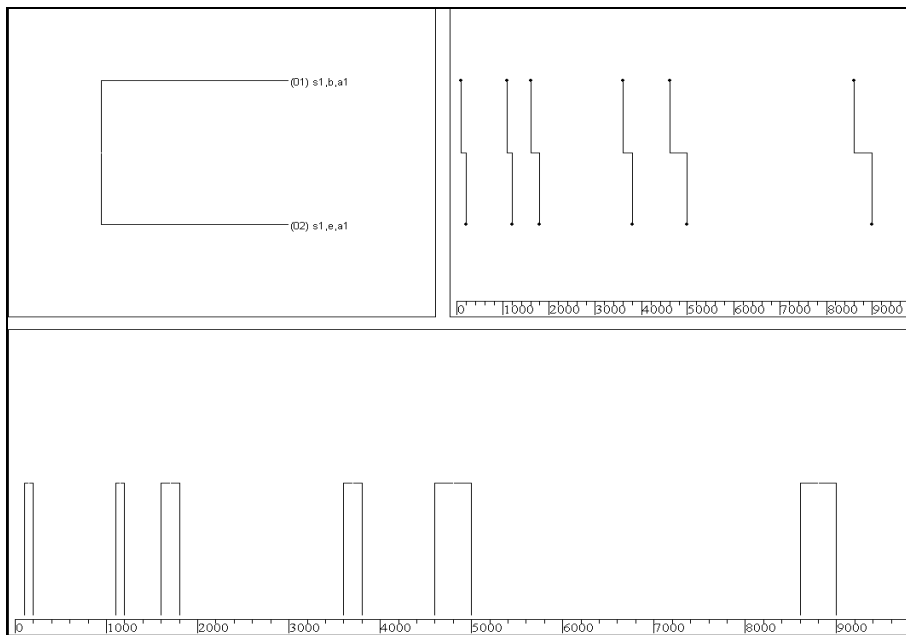
real or simulated situation) correspond to a symmetrical T-pattern? What is understood by a symmetrical T-pattern? What different kinds of symmetry may be reflected in a T-pattern?

The simplest case would be that of central symmetry, which appears in primary patterns corresponding to situations that refer merely to the beginning and end of a given action. In this case, axial and mirror symmetry would also be present. Figure 3.14 shows an example. Its structure is  $(s1,b,a1 \ s1,e,a1)$ , although it is not in itself an interactive situation (as it corresponds to the beginning and end of the activity  $a1$  carried out by participant  $s1$ ).



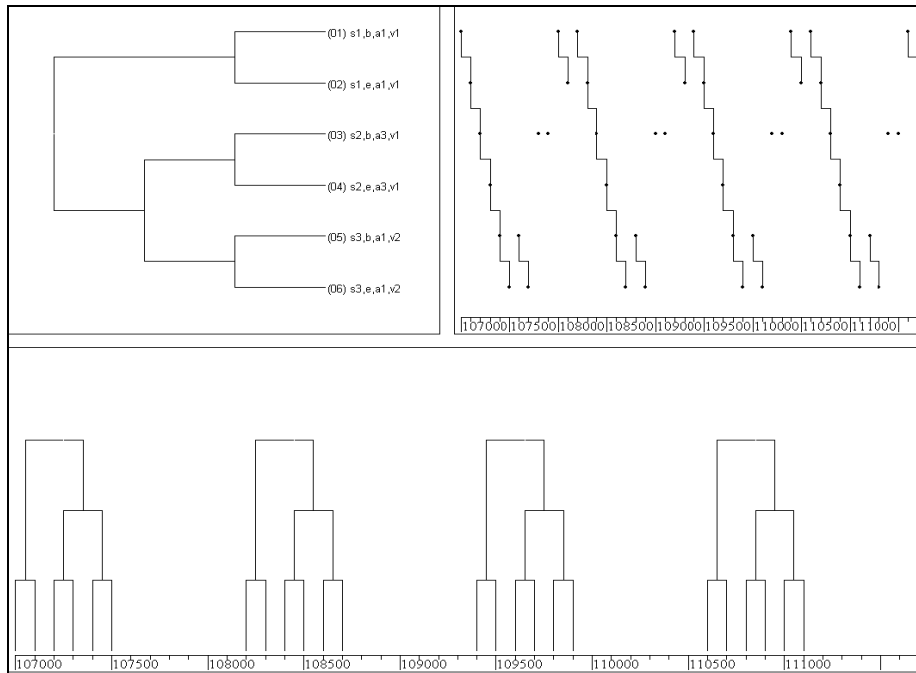
**Figure 3.13** Basic kinds of symmetry

With several interacting subjects the approach is repeated for each one of them. Figure 3.15 illustrates a case of  $n$ -adic interaction.



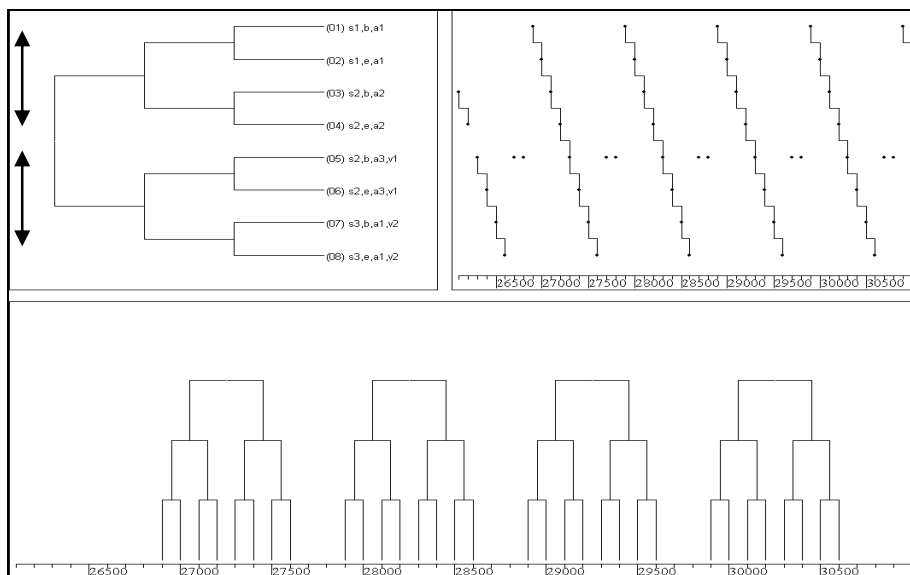
**Figure 3.14** T-pattern showing central symmetry, with the structure  $(s1,b,a1 \ s1,e,a1)$  and significance level of  $p = .005$ .

Axial symmetry is reflected in the graphical representation of the dendrogram corresponding to the T-pattern, its structure being irrelevant. An example is shown in Figure 3.16. Mirror symmetry is revealed in the interactive structure of the code configurations, regardless of the graphical representation of the dendrogram (Figure 3.17).

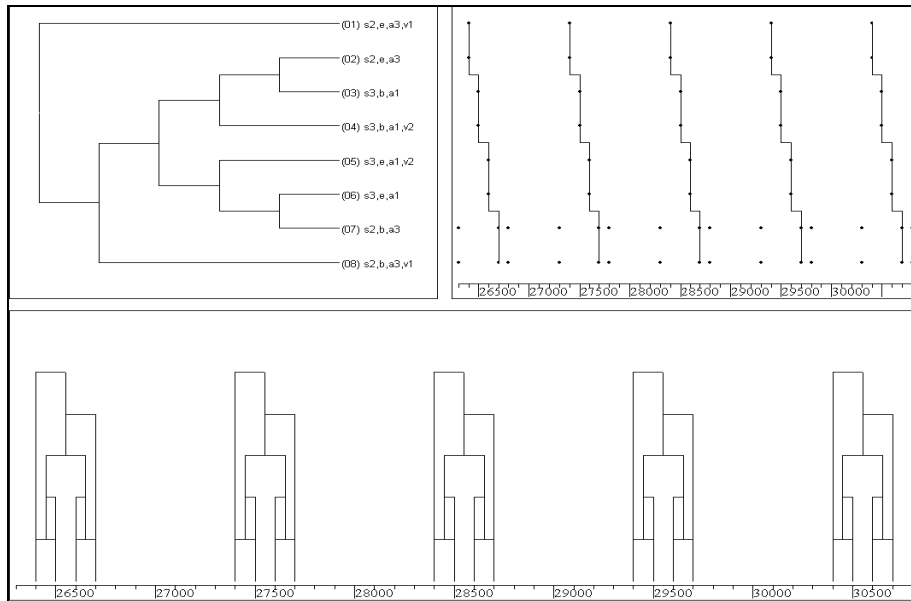


**Figure 3.15** Asymmetric T-pattern (see Figure 3.21) corresponding to a triadic central symmetry at the primary level, with the structure  $((s1,b,a1,v1 \ s1,e,a1,v1) ((s2,b,a3,v1 \ s2,e,a3,v1) (s3,b,a1,v2 \ s3,e,a1,v2)))$  and significance  $p = .005$ .

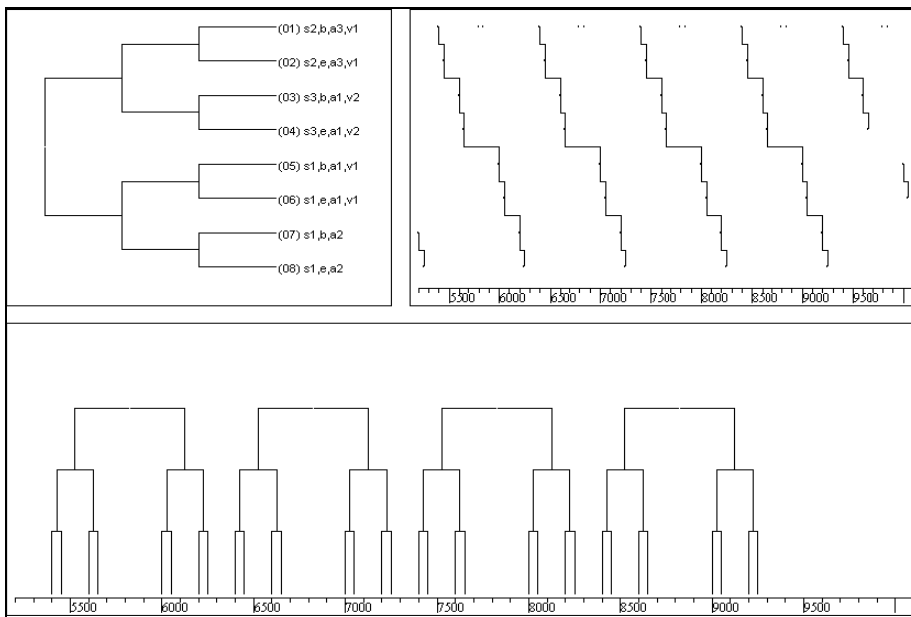
Mirror symmetry does not imply a correspondence with axial symmetry. Figure 3.17 shows a T-pattern corresponding to mirror symmetry, with the structure  $(s2,e,a3,v1 (((s2,e,a3 \ s3,b,a1) \ s3,b,a1,v2) (s3,e,a1,v2 (s3,e,a1 \ s2,b,a3))) s2,b,a3,v1))$ , although graphically it does not appear as symmetrical. Inversely, Figure 3.18 shows a case of axial symmetry that also does not correspond to interactive symmetry, as the structure of the T-pattern is  $((((s2,b,a3,v1 \ s2,e,a3,v1) (s3,b,a1,v2 \ s3,e,a1,v2)) ((s1,b,a1,v1 \ s1,e,a1,v1) (s1,b,a2 \ s1,e,a2))))$ .



**Figure 3.16** T-pattern showing axial symmetry in a triadic interaction, with the structure  $(s1,b,a1 \ s1,e,a1)$  and level of significance  $p = .005$ . The dendrogram is symmetrical with respect to one axis.



**Figure 3.17** Mirror symmetry in the T-pattern with the structure  $(s2,e,a3,v1 (((s2,e,a3 s3,b,a1) s3,b,a1,v2) (s3,e,a1,v2 (s3,e,a1 s2,b,a3))) s2,b,a3,v1))$  and significance  $p = .005$ .

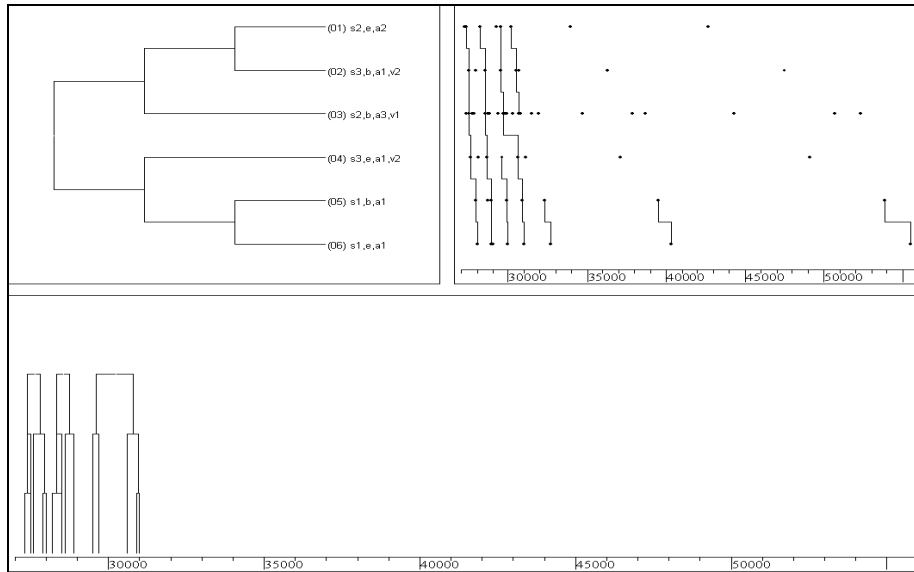


**Figure 3.18** Axial, but not mirror, symmetry in (b), giving the T-pattern  $((s2,b,a3,v1 s2,e,a3,v1) (s3,b,a1,v2 s3,e,a1,v2)) ((s1,b,a1,v1 s1,e,a1,v1) (s1,b,a2 s1,e,a2))$  and with level of significance  $p = .005$ .

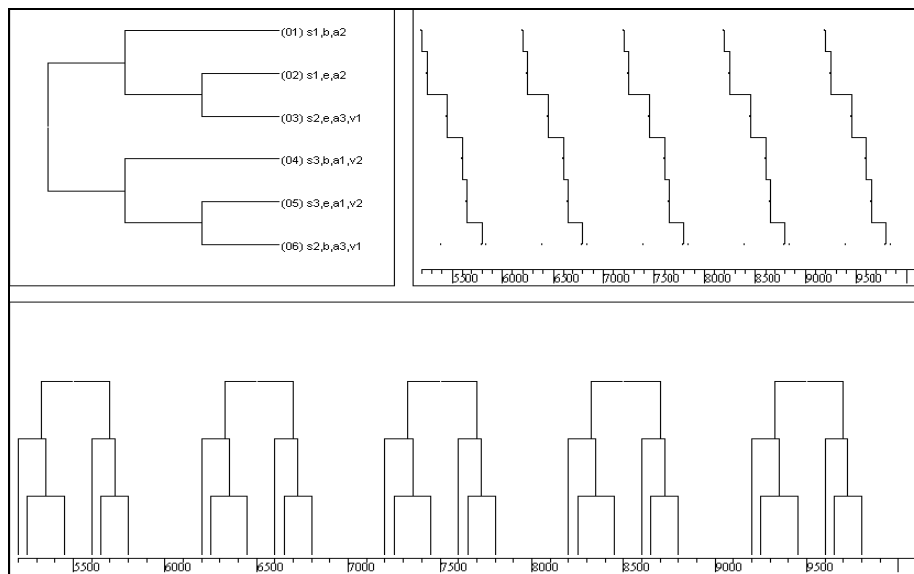
Another possibility is that there is mirror symmetry and that the interacting subjects participate with identical “weight” in the T-pattern but with asymmetrical initiative, as illustrated in Figure 3.19.

In asymmetrical T-patterns different prototypes may also appear, whether at the graphical or structural level, and these illustrate the wide range of possible cases which may arise. The present chapter only considers some of these, this issue requiring further, more specific study.

One of the most characteristic is asymmetry with repeatability of sub-patterns (primary, secondary, tertiary, etc.). Figure 3.20 shows the repeatability of primary and secondary sub-patterns, which may be graphical or structural.



**Figure 3.19** T-pattern with axial symmetry and rotational structure between the interacting subjects  $s_2$  and  $s_3$ , as well as identical interactive ‘weight’ of the three participants; however, there is no symmetrical interactive structure (mirror symmetry), it being  $((s_2,e,a_2 \ s_3,b,a_1,v_2) \ s_2,b,a_3,v_1) \ (s_3,e,a_1,v_2 \ (s_1,b,a_1 \ s_1,e,a_1))$ , with level of significance  $p = .005$ .



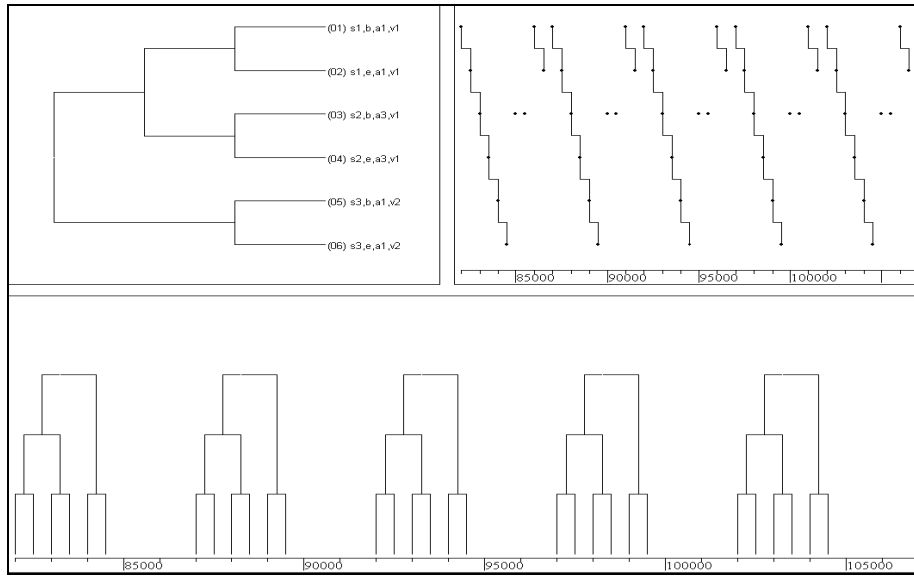
**Figure 3.20** Asymmetrical pattern with graphical repeatability of primary and secondary sub-patterns.

Figure 3.21 presents a T-pattern (identical to Figure 3.15) showing axial symmetry but which, however, is comprised of primary patterns with central symmetry, implying a formal repeatability as it corresponds to the different interacting subjects.

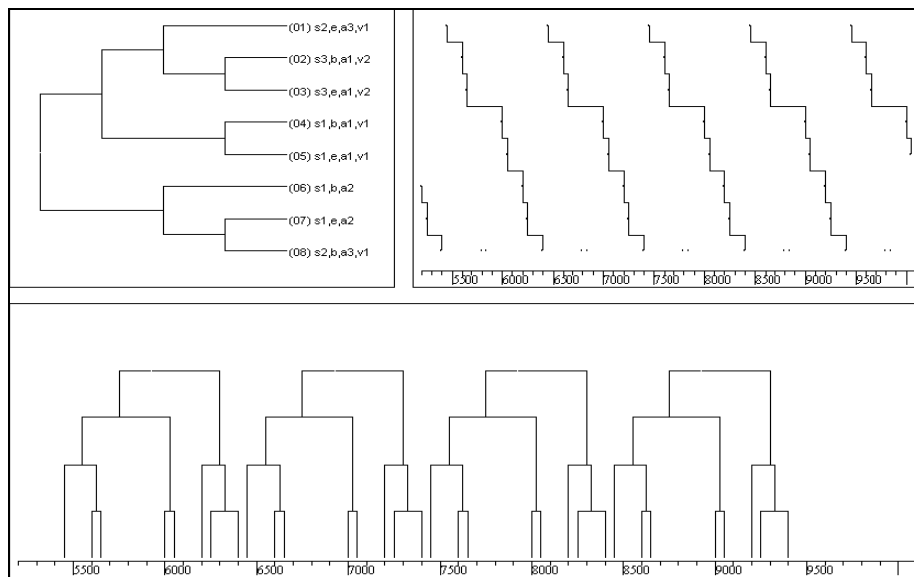
Finally, there are also T-patterns which show asymmetry with irregular sub-patterns, as can be seen in Figure 3.22.

These T-patterns constitute the majority of cases and analysis of their structure enables us to determine the nature of the interactive situation which they reflect. The study of symmetry/asymmetry in T-patterns is a highly suggestive field and its detailed development may lead not only to the identification, but also to the analysis of prototypes and pattern categories, in a given area and from a specific theoretical perspective, that

enable us to understand better how a temporal pattern is broken down into sub-patterns, or how different patterns become integrated into wider structures.



**Figure 3.21** T-pattern with axial symmetry and formal repeatability (corresponding to the three interacting subjects), with the structure  $((s1,b,a1,v1 \ s1,e,a1,v1) (s2,b,a3,v1 \ s2,e,a3,v1)) (s3,b,a1,v2 \ s3,e,a1,v2)$  and level of significance  $p = .005$ .



**Figure 3.22** Asymmetrical temporal pattern that does not fit any prototype.

### 3.5 Conclusions

This chapter has aimed to draw attention to a number of questions.

Firstly, the enormous wealth of information contained within every interactive situation and the great power of the THEME software in detecting hidden patterns, which are then visualized and analyzed through knowledge of their structure.

Secondly, the great versatility of T-patterns, which are subject to multiple recording contingencies such as the duration of behaviours in each episode and/or the type of recording, the aggregation of progressively incomplete blocks of data from initially identical episodes, etc.

Thirdly, it has been suggested that there is an ‘isomorphism’ between the symmetry/asymmetry which arises in each interactive situation and the T-patterns obtained.

This chapter has only sought to make an initial approach to each of these aspects on the basis of examples using simulated data. Naturally, more specific research is now required in order to provide a more detailed understanding of the field.

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