**FACULTY OF PSYCHOLOGY AND EDUCATION SCIENCES OF THE
UNIVERSITY OF COIMBRA**

**Manual for Qualitative Dynamical Coding of Individual of Dyadic Coordination
Trajectories**

Ana Teixeira de Melo
Madalena Alarcão

Coimbra
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I. Introduction

This manual reports a coding scheme aimed to produce synthetic qualitative descriptions of the overall patterns and dynamics of the trajectories (sequences of states) of one or more selected dimension of interest of a dyadic interpersonal system. The coding scheme was developed for the purpose of investigating the coordination of the positions of adult caregivers of families with children, undergoing assessment and intervention due to child protection concerns. The authors wanted to investigate the extent to which the coordination of the parents' positions throughout assessment and/or intervention related to therapeutic outcomes and to inspect the evolution of that coordination during that time period. For that purpose, simple information was collected in the form of quantitative "diaries" which included Likert-based rating scales for each parent to assess their perception of family functioning, change and their assessment of the professional's intervention. The data collected was translated into graphics which could be then inspected regarding the transformations in each parent individual position for a variety of dimensions and their coordination. We used data from four families as a basis for the development of the coding scheme.

The coding scheme was developed to characterize different types of trajectories according to features pertaining to the most salient states occupied by a dyad throughout a given time period, their coordination and changes.

A similar version focused individual change and the coordination of different dimensions of individual changes was developed hand-to-hand to this version, showing significant overlap of codes and instructions, which is described elsewhere.

The current version was specifically constructed for dyadic systems and is suited to code both each individual trajectory in regard to some target dimension (e.g. the individual's own functioning or his/hers perceptions of some dimension or variable of interest) and the dyadic coordination between the individual states. The examples provided in this manual apply to dyadic family systems, namely two members of a couple or co-parental dyad. It can, however, be applied to other dyadic human systems. The coding scheme was originally developed to be applied to self-reported data, on 5-points Likert scales. They may be applied to other sorts of data produced by any external observer about a given individual. For other sorts of scales the coding procedure may demand adaptations.

The coding scheme transforms ordinary categorical hierarchical or ordinal data, collected at multiple time-points, for example, from repeated self-reported evaluations on Likert scales, into qualitative information. The codes applied afford a description of salient features of a trajectory, corresponding to time sequence of self-reported states, by identifying patterns and describing basic dynamical information based on the analysis of the stability and change (fluctuations) of the states of the selected variables through time.

The coding scheme provides a basic qualitative process level description of *how* a given variable of interest changes through time, and the overall characteristics of the trajectory not only in terms of the states (concerning the levels/categories of the dimension or variable of interest) but also their change or stability.

The application of the codes is relatively independent of the content of the data and could be applied to different sorts of reports. The coding system permits describing an individual trajectory, created by organizing observations of scorings in a graphic with time on the x axis and the level of the variable observed, in the y axis. The states may

correspond to the individual perception of individual or collective system(dyadic)-level functioning regarding some dimension/variable of interest. Additionally, it affords descriptions of the patterns and overall basic dynamics of a relational system by creating a collective level variable, through the transformation of the individual reports into a coordination variable. Through the concept of Coordination, inspired in the Sciences of Coordination (Kelso & Ensgrøm, 2006), the coding scheme proposes a simple form of converting individual information into family, collective-level information, overcoming a limitation of much measures of family functioning based on individual reports (Cox & Payley, 2003).

The qualitative dynamical coding scheme can be combined with methods suited for case-based analyses that allow the identification and description of types, profiles or particular configurations of features of the trajectories (e.g. cluster analyses; correspondence analyses; qualitative comparative analyses, etc.) (Byrne & Ragin, 2009) as related to outcomes or other traces of interest in a given system.

Several of the coding outputs regarding individual and collective trajectories can be used as inputs to other dynamical analysis such as those allowed by the use of state space grids (Hollenstein, 2013), for example to compare the coordination of trajectories pertaining to different dimensions of family functioning. Their coordination and its dynamics can be explored in different other ways with the complementarity of other dynamical approaches, particularly those that have been adapted and predominantly used in the social sciences.

II. Development of the coding scheme

The coding scheme here presented was developed in the context of a study aiming to explore change processes and factors facilitating and inhibiting change in multichallenged

families with children participating in an assessment/intervention for child protection purposes. The adult caregivers (also couples), mothers and fathers, were asked to weekly assess their perceptions of family functioning, in a given number of dimensions, inside and outside sessions with professionals as well as their perceptions of change. For such purpose, they filled an weekly diary, at the beginning and end of each session with the professionals reporting, in a 5-point likert scale their perception of family functioning during the antecedent week, and inside the session, as well as perceived changes, also assessing a number of dimensions pertaining to the professional services received. The resultant data was organized in the form of graphics reporting each participant's perception on a number of dimensions. The graphics were the core material to be investigated.

For the elaboration of a coding scheme, Complexity's and Dynamic Systems Theories' concepts (Érdi, 2008; Kelso, 1995) such as state-spaces, attractors, transitions, bifurcations, fluctuations, self-organization, coordination dynamics were used heuristically, as sensitizing tools in a preliminary exploration of the data. These concepts also informed some transformations of the original data, as reported below. We wanted to avoid imposing a framework that did not fit the data or forcing it into pre-existing theory. Therefore, while keeping those concepts in the background, we approached the data with a bottom-up, inductive and discovery-oriented stance. We explored it relying on the contribution of methods from grounded theory, albeit under a Complexity-informed approach (Thornberg, 2012). We relied on open coding and made constant comparisons within and between codes and subjects (Charmaz, 2006; Strauss, 1987). The first author inspected graphics asking herself "How to describe the participants' reports? What do they show about what changes and how it changes? What is similar and different within and between cases?". The

sensitizing concepts from Complexity theory also helped to interrogate the data and raise new questions. Since we had no opportunity for theoretical sampling (Glaser & Strauss, 2008) we filled in the unsaturated categories with properties that seemed theoretically plausible and resulted from a combination of the properties already observed in our sample. This is why, for some categories, there are properties that were not applicable to initial sample.

For some codes, we established ad-hoc operational definitions, because of the constraints related to the type of data used on the definition of the properties or when they did not naturally emerge from the data. For example, the definition for a type of Pattern is reliant on the identification of Predominance or a given state or expression of it. However, the criteria to code for Predominance (explained below), is somehow imposed on the data in the sense that it relies on a more or less arbitrary choice from the researcher regarding the cut-off value or relative frequency to be used to define the category. Other researchers may wish to use more loose or strict criteria than the ones here proposed.

We constructed the coding scheme through a preliminary in-depth analysis of the data produced for with four cases (families) based on 5-point Likert scales, and a minimum of 15 data collection points and a maximum of 24 for each dimension. Emergent codes were progressively integrated and refined into categories and properties (see attachment-code list).

The coding scheme can, and in some cases must, be adapted, depending on the nature of the researchers' objectives, the variables under study, the type of scale used and the number of data collection time points.

III. Data and data preparation

The coding scheme can be used with any time series of data where the data can be arranged into levels (hierarchical or ordinal data, or internal data converted into ordinal data). The coding scheme could be adapted for categorical data, where some codes would not be applicable (e.g. size of fluctuations). The levels are specific and determined by the measures or intents of the researcher.

The data must be arranged in graphics where the y-axis represents the selected levels of the variables of interest and the x-axis represents time.

Data pertaining to the level of coordination also needs preparation since individual information must be transformed into collective/systems-level information. We propose one simple form of assessing coordination based on the computation of the differences between the scores of family/dyad member 1 and family/dyad member 2 (the numeration should keep the same classification across variables so the results can be compared). A new graphic should be created using the values of the difference as stated, as values of coordination that can take a negative or positive sign.

IV. Overview of the coding scheme and process

The coding schemes serves the qualitative description of trajectories. A *Trajectory* is defined as a sequences of states (pertaining to a given dimension or variable under inspection) assessed throughout a given time interval. An individual trajectory represents sequences of individual states while a coordination trajectory represents a sequence of collective-level interpersonal states of a system (representing a relationship between members of a system). For the purpose of these coding schemes, the states are defined by

the classification of the individual or dyad at a given time point concerning a dimension of interest, using a given rating scale, from which a particular description of the individual or dyadic behaviour is obtained. It corresponds to the position of the system or individual at a given time in a space of possibilities. The states are constrained by the measures in a given study and the nature of the dimensions under inspection. In our studies, the states corresponded to the ordinal levels of the dimensions/variables under investigation.

The coding scheme produces two broad categories of information concerning the trajectories: qualitative information about *Patterns through time*, namely patterns of levels of the dimensions of interest, and patterns of coordination and qualitative information about these *Pattern Dynamics*, namely their change through time.

Information on *Patterns of States* emerges from the comparison of the relative frequencies of the levels/categories of a given dimension as well as their combination, throughout a given period of time. Information on dynamics relies on the analysis of change, by inspecting the difference of levels/scores between two consecutive time points and its properties, and the sort of variation that occurs through time.

The coding of most categories and properties requires simple counting procedures. The counting pertaining patterns is made directly from the graphics or from the transformation of the information of the graphics into synthetic grids where the basic units for coding are listed as well as the properties of each categories under analysis, in order to facilitate the counting.

For most codes, it is necessary to analyse the difference of the scores between a first data point and the following one. Figure 1 and 2 represent, respectively, the individual trajectories of two parents, from our original study, regarding their perceptions of changes

in the family or family members outside the sessions (during the week) and the trajectory of their coordination in that dimension.

Figure 1- Graphical representations of individual trajectories of mother and father of family X regarding perceived changes during the week (outside sessions)

Figure 2- Graphical representation of the trajectory of coordination of family X regarding the perception of changes during the week (outside the sessions)

Table 1 and 2 represent a coding support grid used to facilitate the counting and distribution of codes, which was used to code Figure 2. The table presents the counting of events and the corresponding coding outcomes for different properties of patterns and dynamics.

Table 1- Example of a supporting coding table for family X regarding their perceptions of change during the week (outside the session)

Dimension/variable: Family change					
States/levels		High	x x x x x x x (M) x x x x x x x x x x x x x (F)		
		Moderate	x x x x (M) x x x (F)		
		Low	x x x x x x x (M) x (F)		
		PATTERNS OF LEVEL OF INTENSITY			
		M: Mixed pattern F: Predominance of high levels with secondary levels (low and moderate)			
Identification of fluctuations (two consecutive sessions)	Size	Small	x x (M) x x x x x x x x x (F)		
		Moderate	x x x (M) x (F)		
		Large	x (M)		
	Direction	Increase of level	x x (M) x x (F)		
		Decrease of level	x x (M) x x x x (F)		
		Level maintenance	x x (M) x x x x (F)		
		Duration	Isolated periods	x x (M) x x (F)	
			Short periods	x (F)	
			Moderate periods		
	Long block periods		x (M)		
	Very long block periods		x (F)		
	Pattern of fluctuations		M: Mixed pattern of predominant isolated periods of mixed size fluctuations F: Mixed pattern of duration of predominant high fluctuations		
	Identification of Stability (two consecutive sessions)		Level	Low	x x x x (M)
		Moderate		x (M)	
		High		x x x (M) x x x x x x (F)	
		Duration	Isolated periods	x x (M) x x (F)	
Short periods			x x x (M) x x (F)		
Moderate periods					
Long block periods					
Very long block periods					
Patterns of stability			M: Mixed pattern of isolated and short periods of stability at mixed levels F: Mixed pattern of isolated and short periods of stability at high levels		
PATTERN DYNAMICS			M: Balanced simple intermittent trajectory F: Fluctuant trajectory		
Legend					
M: Mother; F: Father; x: one event corresponding to the applicable code					

Table 2- Example of supporting coding table for different properties of patterns and dynamics of coordination for family X regarding their perceptions of change during the week (outside the session)

Dimension/variable : Family change			
States of Coordination		Absolute synchronization	x x x x x x
		Relative synchronization	x x x x x
		Relative unsynchronization	x x
		Absolute unsynchronization	x x x x
PATTERN OF COORDINATION		Mixed pattern with relative predominance of absolute and relative synchronization	
Orientation of coordination		Positive	x x
		Neutral	x x x x x x
		Negative	x x x x x x x x
Pattern of orientation of coordination		Mixed pattern with predominance of negative and neutral orientation	
Fluctuations of coordination	Size	Small	x x x x x x
		Moderate	x x
		Large	x x
	Direction	Away from absolute synchronization	x x x x x
		To absolute synchronization	x x x x
	Duration	Isolated periods	
		Short periods	x x
		Moderate periods	
		Long block periods	
		Very long block periods	x
Pattern of fluctuations of coordination		Predominance of small fluctuations with mixed direction and duration	
Stability of Coordination	Level	At absolute synchronization level	x x
		At relative synchronization	x
		At unsynchronization	x x
	Duration	Isolated periods	
		Short periods	x x x x
		Moderate periods	
		Long block periods	
		Very long block periods	
Patterns of stability of coordination		Dominance of short periods at mixed levels	
TRAJECTORY OF COORDINATION CHANGE		Fluctuant trajectory	

V. Coding Instructions for Patterns of States and Pattern Dynamics

1. Patterns of states

States can be defined according to the different levels or categories of the dimensions/variables under analysis. In our sample of families/dyads, a state corresponds to a position of the family in any of the different levels in which they can classify their perception functioning pertaining the different that were posed for assessment.

1.1. Levels of states

According to the purposes of a given research study, different ordered levels of states may be defined and the original data can be recoded accordingly, if necessary. In the original study, we considered three overall levels or states, namely *Low* (values of 1 and 2 in the Likert-scale), *Moderate* (values of 3), *High* (values of 4 and 5), but sub-levels are taken in consideration when analysing *Fluctuations* or *Stability* (cf.). States corresponding to the levels of a dimension/variable under inspection, which, in our studies, had correspondence to the orders of a variable. States corresponding to categories can also be adopted, but the procedures to code for dynamics must be adjusted (cf.).

1.2. Patterns of states

Patterns of states describe the overall organization of the trajectory concerning the most visited states and their relation to other experienced states. Patterns of states can be characterized according to the *Dominance*, *Predominance* of a given state or, on the contrary, by a *Mixture* of types of states or levels of states.

The coding of patterns is based on a simple counting of the types of states or levels of state visited throughout a selected trajectory. The outcome of the comparison of the frequencies of states informs the selection of a code. A trajectory may be coded according as showing a *Pattern of Dominance* of X of a state when there is only expression of one

type of state X (the type/category/level of state). A *Pattern of Predominance* is applicable to trajectories where one type of state stands out compared with others. The threshold for coding for predominance is defined by the researcher. In our studies we have coded for Predominance when one or two states show a difference of at least two events more compared to others. A trajectory is coded for Predominance and labelled as presenting a *Pattern of Predominance of X* or *Pattern of Predominance of X and Y* when there are two predominant states that show a difference of a minimum of two events. A Pattern of Predominance is labelled with a secondary code when there are *Punctuations* of another state (*Punctuations* of Y), namely when there is expression of just one other state, which does not reach the threshold for classification as a primary state or Predominant pattern. When there is a Pattern of Predominance of a given X state but there are several other experimented secondary states, that don't reach the threshold, the label can include a secondary code that classifies the Pattern as a *Pattern of Predominance of X with Secondary States/Levels*.

When there more than two predominant states that differ by a difference of less than two events, the trajectory pattern is coded as a *Mixed Pattern or Mixed Pattern of Predominance*.

1.3 Patterns of temporal organization/distribution of states

For a given level of interest of a particular dimension, *Patterns of temporal organization* qualify the temporal organization, namely the distribution of that state throughout the trajectory.

A trajectory can show different types of temporal organizations or distributions of the events of interest (a given state, level or category of the dimension or variable being

investigated) depending on the *Duration of States*, that are coded, sequentially, from the beginning to the end of trajectory, according to the following:

- i. An *Isolated Period* corresponds to the recording of one isolated event (an event is one counting of a selected state in the trajectory, before it changes to a different state);
- ii. A *Short Period (short block)* is identified through the counting of two consecutive events;
- iii. A *Moderately Long period* is identified through the counting of two consecutive events;
- iii. *Long Periods (long blocks)* correspond to the counting of 4 consecutive events;
- iv. *Very Long Periods (very long blocks)* to the counting of 5 consecutive events.

A trajectory is coded for *Patterns of Temporal Organization of States* as of a *Predominant* type when:

- i. a certain type of duration of certain states is present at least two times more than any other pattern, throughout the trajectory, OR
- ii. corresponds to at least twice the total time period occupied by any other pattern, or both.

A *Mixed Pattern of organization of X and Y* is applicable when:

- i. there is only a difference of 1 counting between two types of forms of temporal distribution, OR
- ii. when there is a difference between two types of forms of temporal distribution, bigger than 2 events, but one of them corresponds to very long periods, which occur at least twice, or long periods, which occur at least three times.

A *Pattern of Temporal Organization of States of Dominance* is applicable when there is only one type of temporal distributions of the events of interest.

2. Patterns of fluctuations

The coding scheme was developed with the aim purpose of capturing, in a relatively simple way, the general features or traces of how a given trajectory unfolds through time. The coding scheme was intended to descriptively categorize the change processes of a given dimension or variable of interest. The minimal unit for the analysis of change corresponds to two consecutive time points. It is by comparison between the states/levels occupied in two consecutive points in a trajectory, that Fluctuations of Stability of states are identified.

A *Fluctuation* represents the minimal expression of change and corresponds to the identification of a difference of level/category between two consecutive data collection moments. Stability corresponds to the absence of change.

2.1 Patterns of size of fluctuations

When the data are ordinal and classified in levels, fluctuations may be coded for *size*. The following codes were developed for a scale of 5 ordinal points, corresponding to three levels (low, moderate, high), the lowest and highest containing two sub-levels. According to this, fluctuations are coded as:

- i. *Small*, when there is a difference of one order in the scale, namely when there is a difference equivalent to that between sub-levels. This may correspond to the ordinal distance between two-sub levels within a level (from one sub-level to the other) or between levels, when the change occurs to lowest, proximal sub-level of the following level;
- ii. *Moderate* when the difference corresponds to two sub-levels, namely when there is a change of level, from the lowest (or only) ordinal position in one level to the lowest ordinal position in the next level, or from the highest position in one level (when there are two sub-levels) to the lowest position in the next level;

iii. *Large* when there is a difference equivalent to the ordinal distance between three sub-levels, which may correspond to a change from the lowest level to the highest level, or vice versa.

The patterns of fluctuations can be characterized by *the Patterns of Size* of their fluctuations, namely for the *Dominance* or *Predominance* of different types of fluctuations. The criteria are the same as those applicable to patterns of types of states (cf.1).

2.2 Direction of fluctuations

When variables are ordinal and the states correspond to levels, the fluctuations can be classified by their *Direction*, as corresponding to an *Increase* or *Decrease* of level. When the states correspond to categories, the direction can be described as *From state X to state Y*.

2.3 Duration of fluctuations

As for patterns of states, the fluctuations can also be characterized according to their *duration*, namely as:

- i. *Isolated fluctuations*: a single fluctuation (2 time points) between a two periods of stability
- ii. *Short period of fluctuations*: two consecutive fluctuations (3 time points)
- iii. *Moderately long periods of fluctuations*: three consecutive fluctuations (4 time points)
- iv. *Long periods of fluctuations*: four consecutive fluctuations (5 or more data points)
- v. *Very long block periods of fluctuations*: Five or more fluctuations (6 or more data points)

2.4 Patterns of temporal organization/distribution of fluctuations

A *Pattern of temporal organization or distribution of fluctuations* can be defined based on the identification of the dominance or predominance of one of more patterns of duration of fluctuations or mix of patterns. The criteria for the definition of *Dominance*, *Predominance* or *Mixed Patterns* are the same as used to code for the Patterns of temporal distribution of states (cf. 3).

2.5 Patterns of Fluctuations

The combination of the different properties of fluctuations result in different Patterns of Fluctuations which are defined by the combination of the properties of fluctuations, in the form of a: *Pattern of A (pattern of duration) of B (pattern of size of fluctuations) and, eventually, of C (direction)*. An example can be seen in table 1, where the pattern of fluctuations was classified, for the mother as a Mixed pattern of predominant isolated periods (duration) of mixed size fluctuations (pattern of size). In this example, the direction was not coded.

3. Patterns of stability

Stability represents the absence of fluctuations or the maintenance of a state between two consecutive data collection time points.

3.1 Level/state of stability

A trajectory can be coded for patterns of levels of stability providing indication of the dominance, predominance of mixture of the states at which the trajectory stabilizes. Stability is then coded for a given X level of state, as *Stability at Level/State X*.

3.2. Duration of stability

The *Duration of stability* is coded with similar criteria as defined for fluctuations (cf. 4) , namely:

- i. *Isolated period of stability*: the same state/level is present in two consecutive time data collection points;
- ii. *Short period of stability*: the same state/level is present in three consecutive time data collection points;
- iii. *Moderately long periods of stability*: the same state/level is present in four consecutive time data collection points;
- iv. *Long periods of stability*: the same state/level is present in five consecutive time data collection points;
- v. *Very long block periods of stability*: the same state/level is present in six or more consecutive time data collection points.

3.3 Pattern of temporal organization/distribution of stability

A pattern of temporal organization or distribution of stability is coded according to *Predominance, Dominance* or *Mixture* of the duration of the periods of, according to the same criteria as defined for patterns of states.

The combination of the different properties of stability result in different *Patterns of Stability* which are composed by the pattern of organization of stability, the level or states at which it occurs and duration, such as Pattern of A (pattern of duration) of B (pattern of level of states at which stability occurs). In the example provided in Table 1 the father's (F) trajectory was coded for a *Mixed pattern of isolated and short periods of stability at high levels*.

4. Pattern Dynamics of Trajectories of States

A trajectory can be classified for the dynamical features of its patterns of states. Pattern dynamics result from a combination of the patterns of fluctuations and stability and represent the processes underlying change or the evolution of the trajectory.

The *Pattern Dynamics of the Trajectories of States* can be divided into balanced or unbalanced according to the relationship between the patterns of stability and fluctuations.

A trajectory is coded as *Balanced* when there is a small difference between the number of events of stability and fluctuations, without predominance of any. Balanced trajectories are divided into *Balanced Sequential Trajectories*, when the periods of stability and fluctuations occur mainly in sequences of long or very long periods, or *Balanced Intermittent Trajectories* when the periods of stability and fluctuations alternate and take the form of isolated or short periods. *Balanced Trajectories are Mixed Type or Complex* when there is a variety of forms and periods of fluctuation and stability. When the last part of the trajectory corresponds to long or very long periods of stability or fluctuations, it is, additionally coded as *Ending in stability or fluctuations*, respectively.

Fluctuant trajectories show a predominance of fluctuations but also some punctuations of moderate or long periods of stability and some short term periods of stability.

Unstable trajectories, on the other hand show a dominance or predominance of fluctuations with one few, if any, isolated or short periods of stability.

Stable trajectories show a predominance of stability but also some punctuations of moderate or long periods of fluctuations or some short periods of fluctuations.

Static trajectories show a dominance or predominance stability with only a few if any isolated periods or short periods of fluctuation.

VII. Coding Patterns of Inter-individual dyadic Coordination and Coordination Dynamics

Coordination is defined as the relation between two elements, regarding their differences and is operationalized in terms of the degree of synchronization of their states. In our study

we were interested in investigating the coordination between individuals in a family, namely between the parents or adult caregivers regarding their perceptions of family functioning and change in a number of dimensions.

Coordination is defined as the relation between the position of two elements of a dyad regarding any given variable or dimension of interest. In our investigations we have operationalized coordination as the degree of synchronization between the positions of the two adult caregivers in a family (usually a mother- family member 1- and a father- family member 2) regarding a number of family dimensions. We asked parents to rate their position for a series of dimensions pertaining to family life and their perception of change. In order to define a state of coordination we calculated the difference between the scores of family member 1 and 2, subtracting the latter to the former. The difference obtained was then attributed a code concerning the level of coordination as next described.

5. Patterns of dyadic coordination

5.1. Levels of coordination

In cases of ordinal or interval variables, states of coordination are classified according to the difference between the scores of the two members of the dyad. The following codes are applicable:

- i. *Absolute synchronization*- corresponds to a state where both members have the same position and the subtraction of their positions is null.
- ii. *Relative synchronization*- corresponds to a state where there is a small difference between the positions of the individual family members concerning a family dimension of interest, expressed by a small negative or positive value resulting from the subtraction of their individual positions. In our study, using five points Likert scale we considered relative synchronization when the difference of ± 1 .

iii. *Absolute unsynchronization*- corresponds to a state where there is maximum difference between the positions of the individual family members concerning a dimension of interest, expressed in the maximum value resulting from the difference of their individual positions. In our study, this maximum difference was ± 4 .

iv. *Relative unsynchronization*- corresponds to a state stands between the difference found in relative synchronization and absolute Unsynchronization. In our studies, states of relative synchronization correspond to differences of $\pm 2-3$.

5.2 Orientation of dyadic coordination

It represents the orientation of the difference between the individual positions of the members of the dyad. It is defined as positive when the individual considered as element 1 has a stronger position than element 2. It is defined as negative when the position of element 2 is stronger than element 1. It is coded according to the sign of the difference from subtracting the position (rating) of element 2 from element 1. According to this, orientation can be coded as:

- i. *Neutral* (corresponding to states of absolute synchronization)
- ii. *Positive*- dyad member coded as 1 presents a state in a "higher" level or position than dyad member 2
- iii. *Negative*- dyad member coded as 2 presents a state in a "higher" level or position than dyad member 2

5.3 Patterns of orientation of coordination

According to the predominance or dominance of the orientation of coordination across a trajectory, a *Pattern of Orientation of Coordination* is defined. The following can be coded:

- i. *Maintenance of a neutral orientation tendency of coordination*- when there is complete absolute synchronization throughout the specified time period of the trajectory.
- ii. *Maintenance of an absolute positive orientation tendency of coordination*- when throughout the trajectory the orientation of coordination is always positive and even when there are fluctuations there is no inversion of the sign of the difference between the positions of the family members, so that element 1 maintains a higher level (higher rated) position than element 2 in regard to a specific dimension of interest.
- iii. *Maintenance of an absolute negative orientation tendency of coordination*- the opposite of the former, when element 2 has a higher level (higher rated position) than element 1, which is maintained throughout the trajectory.
- iii. *Pattern of predominant orientation of X with punctuations of Y (no more than two) of positive orientation*- when there are two instances of an X orientation in a trajectory of a Y orientation of coordination
- iv. *Pattern of fluctuation of orientation of coordination*- when the orientation of the coordination changes more than two times along the trajectory but there is no predominant orientation
- v. *Pattern of fluctuation of orientation of coordination with predominance of X*- When there are some moments of fluctuation of the orientation but the predominant orientations shows a X orientation

6. Patterns of fluctuations of coordination

Just as the individual positions of family members along a trajectory may show fluctuations, corresponding to changes in their states, so can the coordination of their positions. The same codes and rules for coding applicable to code for *Patterns of*

fluctuation of individual trajectories, apply to the trajectory of coordination. In particular, the following codes are used.

6.1 Size of fluctuations of coordination

In regard to *size*, the fluctuations are coded as:

i. *Small*: when there is a difference of only one point between the coordination level of variables in the two consecutive data collection points or periods

ii. *Moderate*: when there are changes of two points between the coordination level of variables in the two consecutive data collection points or periods

iii. *Large*: when there are changes of three or more points between the coordination level of variables in the two consecutive data collection points or periods, or

iv: *Absence of fluctuations: stability*

Fluctuations can also be defined according to an *Orientation*. The fluctuation corresponds to a move from one state to another, or close by. It can be coded as moving:

i. *Away from absolute synchronization*- when the fluctuation drives the system away from a state of absolute synchronization or zero difference between the members of a dyad

ii. *Towards absolute synchronization*

iii. *Level maintenance*

When fluctuations occur in succession they can be defined by their *Duration*, considering the number of fluctuations events (one change between two consecutive time points that occur, between periods of stability). The *Duration of fluctuations* is classified according to one of the following codes:

i. *Isolated fluctuation* (1 fluctuation/change, 2 time points)

ii. *Short periods of fluctuations* (2 fluctuations, 3 time points)

iii. *Moderately long periods of fluctuations* (3 fluctuations, 4 data points)

iv. *Long blocks of fluctuations* (4 fluctuations, 5 data points)

iv. *Very long blocks of fluctuations* (5 fluctuations, 6 data points)

6.2 Patterns of temporal distribution of fluctuations of coordination

The coding of patterns of temporal distribution or organization of the fluctuations of coordination follows similar rules for the coding of patterns of states. A *pattern of the temporal organization or distribution of fluctuations* can be defined based on the identification of the dominance or predominance of one of more patterns of duration of fluctuations or mix of patterns. The criteria for the definition of *Dominance*, *Predominance* or *Mixed Patterns* are the same as used to code for the Patterns of temporal distribution of states. A *Pattern of Predominance* is applicable when there are at least two more events of one type compared to others.

The following codes are applicable:

i. *Predominance of isolated fluctuations*

ii. *Predominance of short periods of fluctuations*

iii. *Predominance of moderately long periods of fluctuations*

iv. *Predominance of long periods of fluctuations*

v. *Predominance of very long periods of fluctuations*

vi. *Mixed pattern of predominance of X and Y*

vii. *Mixed pattern of predominance of X and Y with secondary patterns*

viii. *Mixed pattern without predominance*

ix. *Dominance of isolated periods of fluctuations*

x. *Dominance of short periods of fluctuations*

xi. *Dominance of moderately long periods of fluctuations*

xii. *Dominance of long periods of fluctuations*

xiii. *Dominance of very long periods of fluctuations*

6.3 Pattern of fluctuations of coordination

The coding of *Patterns of Fluctuations of Coordination* follows similar rules for the coding of patterns of states and results from the analyses of the defining features of fluctuations and their relative dominance of predominance. The rules are equal to the patterns of states and fluctuations of states. The combination of the different properties of fluctuations result in different *Patterns of Fluctuations* which are composed by the pattern of temporal organization of fluctuations, its type and duration. A trajectory will then be classified joining this codes as presenting a *Pattern of A (pattern of duration) of B (pattern of size of fluctuations) and, eventually, of C (direction)*.

7. Stability of coordination

Just as the states of individuals can be characterized by their stability, or absence of change between two consecutive time points, so can the coordination of their positions. The same codes apply (Cf.).

7.1 Level of stability of coordination

Stability can occur at different levels of coordination and show be coded accordingly with the following codes.

- i. *Stability at absolute synchronization*
- ii. *Stability at relative synchronization*
- iii. *Stability at absolute unsynchronization*
- iv. *Stability at relative unsynchronization*

7.2 Duration of stability of coordination

The stability of states of coordination may occur for just a minimal time period (an isolated period of stability between two consecutive time points) or extend in time. The criteria for coding the duration of stability are the same as for coding the stability of states (cf. 5). The following codes are applicable.

- i. *Isolated periods of stability*
- ii. *Short periods of stability*
- iii. *Moderately long periods of stability*
- iv. *Long block periods of stability*
- v. *Very long block periods of stability*

7.3 Patterns of temporal distribution/organization of stability of coordination

Again, the same criteria apply as before to code for *the Patterns of temporal organization of stability* as for the patterns of states (cf.):

- i. *Predominance of isolated stability*
- ii. *Predominance of short periods of stability*
- iii. *Predominance of moderately long periods of stability*
- iv. *Predominance of long periods of stability*
- v. *Predominance of very long periods of stability*
- vi. *Mixed pattern of predominance of X and Y*
- vii. *Mixed pattern of predominance of X and Y with secondary patterns*
- viii. *Mixed pattern without predominance*
- ix. *Dominance of isolated periods of stability*
- x. *Dominance of short periods of stability*
- xi. *Dominance of moderately long periods of stability*
- xii. *Dominance of long periods of stability*

xiii. Dominance of very long periods of stability

7.4 Patterns of stability of coordination

As before, the *Pattern of Stability of Coordination* is dependent on the properties of the stability of coordination, which together define a *Pattern of A (pattern of duration) of B (pattern of level of states at which stability occurs)*.

8. Pattern dynamics of trajectories of coordination

Likewise, trajectories of patterns of states, trajectories of coordination are classified and coded for the dynamical features of the patterns of coordination, resulting from a combination of the patterns of fluctuations and stability and representing the processes underlying change or the evolution of the trajectory.

The same codes apply as for patterns dynamics of states, namely the following:

Trajectories can be defined as:

- i. Balanced Trajectories
 - a. Balanced Sequential Trajectory
 - Balanced Sequential Trajectory ending in Stability
 - Balanced Sequential Trajectory ending in Fluctuation
 - b. Balanced Intermittent Trajectory
 - Balanced Intermittent Trajectory ending in Stability
 - Balanced Intermittent Trajectory ending in Fluctuations
 - c. Balanced Complex or Mixed Type Trajectory
 - Balanced Complex or Mixed Type Trajectory ending in Stability
 - Balanced Complex or Mixed Type Trajectory ending in Fluctuations
- ii. 18.2 Fluctuant Trajectory

- iii. 18.3 Unstable Trajectory
- iv. 18.4 Stable Trajectory
- v. 18.5. Static trajectory

9. Coordination-related Influence effects and other forms of coordination effects

The coordination between individuals and its patterns and evolution may resemble, reflect or result from some form of Influence Effects of the position of one individual over the other. We have mapped different types of Influence Effects identified as sort of dragging effect in a trajectory as represented by a graphic with individual scores, through time. In the graphics the position of one individual seems to be dragged or "pulled" to meet that of the other. We have defined operational criteria for the identification of Influence Effects.

Influence Effects (IF) appear in a trajectory as a “dragging” effect, when the position of one family member is “pulled” to meet that of the other. They are identified over a minimum of three consecutive time points (t1, t2, and t3).

9.1. Type of Influence and Other Coordination Effects

The type of fluctuations in this interval defines a type of effect. Dyadic sequences of fluctuations, over a minimum of three consecutive time points can be characterized by their Type, namely as *Proper Influence Effects*, *Quasi-effects* or *Failed effects*, or *Other Types of Coordination Effects*. *Failed effects* fulfil t1 and t2 but not t3. While in *Proper Influence Effects* there is at t3 a meeting of the positions of element 1 and 2, *Quasi-effects* reflect a common tendency regarding the progression of positions, as assessed in t3, but not a full meeting. Therefore, *Quasi-effects* reflect a sort of partial synchronization.

Figure 3 and 4 present schematic operational representations of the different types of Influence effects and other types of dyadic coordination in time.

Figure 3. Types and graphical operational definitions of Proper Influence Effects (PIE)

Figure 4. Types and graphical operational definitions of Quasi-Influence Effects (PIE) and Other Non-Proper Influence Coordination Effects (OCE)

9.2 Rapidity of influence and other coordination effects

Influence effects can be characterized In terms of *Rapidity*. They are coded as *Quick* when occurring between t1, t2 and t3, as in figure 1, or *Slow* when the result at t3 equals t2, and the final effect expected at t3 is only seen in t4, or *Very Slow*, beyond that.

9.3 Duration of influence and other coordination effects

Duration of influence and other coordination effects may vary.

Short-term (ST) effects end in t3, *moderately long term* (MLT) effects prolong the result to t4 and *long* (LT) and *very long term* (VLT) go beyond t4. T

9.4 Direction of influence effects

The influence effects can occur in different directions. Some are *neutral* as in the case of Third Position Effects (Figure 1) or follow *from Element A to Element B* ($A \rightarrow B$) or *Element B to Element A* ($B \rightarrow A$). But it may correspond to a *decrease* or *increase* of the influenced element's position. In that case, for a graphical representation the horizontal arrow could be replaced by a descendent ( ) or ascendant ( ) arrow, respectively, or the direction of influence can be said to correspond to *Leading to Maintenance* of Level/State, *Increase* of Level/State or *Decrease* of Level/State.

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Appendix- List of codes

[The code names/tags which are applied to define specific aspects of the trajectories are presented in italic]

1. Dimensions/variables

The dimensions/variables are defined by the researcher.

Examples from our studies include: Perception of positive family functioning (e.g. satisfaction, well-being), Perception of need to change; Perception of changes inside/outside sessions.

2. Patterns of states/levels

2.1 States

[The definition of states may be purposeful or ad-hoc and depends on dimensions/variables of interest and ordinal levels of categories. Examples of states based in a five point Likert scale where 5 = Very much, 4 = A lot, 3 = more or less; 2 = A little, 1 = Nothing]

2.1.1 *Low levels* (with 2 sub-levels corresponding to ratings of 1 and 2)

2.1.2 *Moderate level*

2.1.3 *High levels* (with 2 sub-levels corresponding to ratings of 4 and 5)

2.2 Patterns of states/levels

2.2.1 *Pattern of Dominance of X* (state)

2.2.2 *Pattern of Predominance of X* (state), *with punctuations of Y or/*
with/without secondary states

2.2.3 *Pattern of Predominance of X* (state) *and Y, with/without secondary*
states

2.2.4 *Mixed Patterns*

2.3 Patterns of temporal organization of states

3.5.1 *Predominance of isolated periods*

3.5.2 *Predominance of short periods*

3.5.3 *Predominance of moderately long periods*

3.5.4 *Predominance of long periods*

3.5.5 *Predominance of very long periods*

3.5.6 *Mixed pattern of predominance of X and Y*

3.5.7 *Mixed pattern of predominance of X and Y with secondary patterns*

3.5.8 *Mixed pattern without predominance*

3.5.9 *Dominance of isolated periods*

3.5.10 *Dominance of short periods*

3.5.11 *Dominance of moderately long periods*

3.5.12 *Dominance of long periods*

3.5.13 *Dominance of very long periods*

3. Patterns of Fluctuations

3.1 Size of fluctuations

3.1.1 *Small*

3.1.2 *Moderate*

3.1.3 *Large*

3.2 Patterns of size of fluctuations

3.2.1 *Pattern of Dominance of X* (size of fluctuation)

of Y 3.2.2 *Pattern of Predominance of X* (size of fluctuation), *with punctuations*

3.2.3 *Pattern of Predominance of X* (size of fluctuation) *and Y, with/without secondary states*

3.2.4 *Mixed Patterns/Pattern of Mixed Sizes of fluctuations*

3.3 Direction of fluctuations

3.2.5 *Increase of level* (ordinal variables) or *From state X to Y* (categorical variables)

3.2.6 *Decrease of level* (ordinal variables) or *From state X to Y* (categorical variables)

3.4 Duration of fluctuations

3.4.1 *Isolated fluctuations*

3.4.2 *Short period of fluctuations*

3.4.3 *Moderately long periods of fluctuations*

3.4.4 *Long periods of fluctuations*

3.4.5 *Very long block periods of fluctuations*

3.5 Patterns of temporal organization of fluctuations

3.5.1 *Predominance of isolated fluctuations*

3.5.2 *Predominance of short periods of fluctuations*

3.5.3 *Predominance of moderately long periods of fluctuations*

3.5.4 *Predominance of long periods of fluctuations*

3.5.5 *Predominance of very long periods of fluctuations*

3.5.6 *Mixed pattern of predominance of X and Y*

3.5.7 *Mixed pattern of predominance of X and Y with secondary patterns*

3.5.8 *Mixed pattern without predominance*

3.5.9 *Dominance of isolated periods of fluctuations*

3.5.10 *Dominance of short periods of fluctuations*

3.5.11 *Dominance of moderately long periods of fluctuations*

3.5.12 *Dominance of long periods of fluctuations*

3.5.13 *Dominance of very long periods of fluctuations*

3.6 Pattern of Fluctuations

3.6.1 *Pattern of A* (pattern of duration) *of B* (pattern of size of fluctuations) *and (eventually) of C* (direction).

4. Patterns of Stability

4.1 States/levels of stability

4.1.1 *Stability at states/level X*

4.2 Duration of stability

4.2.1 *Isolated period of stability*

4.2.2 *Short period of stability*

4.2.3 *Moderately long periods of stability*

4.2.4 *Long periods of stability*

4.2.5 *Very long periods of stability*

4.3 Patterns of temporal organization of stability

4.3.1 *Predominance of isolated stability*

4.3.2 *Predominance of short periods of stability*

4.3.3 *Predominance of moderately long periods of stability*

4.3.4 *Predominance of long periods of stability*

- 4.3.5 *Predominance of very long periods of stability*
- 4.3.6 *Mixed pattern of predominance of X and Y*
- 4.3.7 *Mixed pattern of predominance of X and Y with secondary patterns*
- 4.3.8 *Mixed pattern*
- 4.3.9 *Dominance of isolated periods of stability*
- 4.3.10 *Dominance of short periods of stability*
- 4.3.11 *Dominance of moderately long periods of stability*
- 4.3.12 *Dominance of long periods of stability*
- 4.3.13 *Dominance of very long periods of stability*

4.4 Patterns of stability

4.4.1 *Pattern of A (pattern of duration) of B (pattern of level of states at which stability occurs).*

5. Pattern Dynamics

5.1 Balanced Trajectory

- 12.1.1 *Balanced Sequential Trajectory*
- 12.1.2 *Balanced Sequential Trajectory ending in Stability*
- 12.1.3 *Balanced Sequential Trajectory ending in Fluctuations*
- 12.1.4 *Balanced Intermittent Trajectory*
- 12.1.5 *Balanced Intermittent Trajectory ending in Stability*
- 12.1.6 *Balanced Intermittent Trajectory ending in Fluctuations*
- 12.1.7 *Balanced Complex or Mixed Type Trajectory*
- 12.1.8 *Balanced Complex or Mixed Trajectory ending in Stability*
- 12.1.9 *Balanced Complex or Mixed Trajectory ending in Fluctuations*

12.2 Fluctuant Trajectory

12.3 Unstable Trajectory

12.4 Stable Trajectory

12.5. Static Trajectory

13. Patterns of coordination

13.1 States of coordination

- 13.1.1 *Absolute synchronization*
- 13.1.2 *Relative synchronization*
- 13.1.3 *Absolute unsynchronization*
- 13.1.4 *Relative unsynchronization*

13.2 Orientation of coordination

- 13.2.1 *Neutral*
- 13.2.2 *Positive*
- 13.2.3 *Negative*

13.3 Pattern or orientation of coordination

- 13.3.1 *Maintenance of a neutral orientation tendency of coordination*
- 13.3.2 *Maintenance of an absolute positive orientation tendency of coordination*
- 13.3.3 *Maintenance of an absolute negative orientation tendency of coordination*
- 13.3.4 *Pattern of predominant orientation of X with punctuations of Y (no more than two) of positive orientation*
- 13.3.5 *Pattern of fluctuation of orientation of coordination*

13.3.6 *Pattern of fluctuation of orientation of coordination with predominance of X*

14. Patterns of fluctuations of coordination

14.1. Size of fluctuations

- 14.1.1 *Small*
- 14.1.2 *Moderate*
- 14.1.3 *Large*
- 14.1.4 *Absence of fluctuations: stability*

14.2 Direction of orientation of fluctuations

- 14.2.1 *Away from absolute synchronization*
- 14.2.2 *Towards absolute synchronization*
- 14.2.3 *Level maintenance*

14.3 Duration of fluctuation

- 14.3.1 *Isolated fluctuation*
- 14.3.2 *Short periods of fluctuations*
- 14.3.3 *Moderately long periods of fluctuations*
- 14.3.4 *Long blocks of fluctuations*
- 14.3.5 *Very long blocks of fluctuations*

14.4 Patterns of temporal distribution/organization of fluctuations of coordination

- 14.4.1 *Predominance of isolated fluctuations*
- 14.4.2 *Predominance of short periods of fluctuations*
- 14.4.3 *Predominance of moderately long periods of fluctuations*
- 14.4.4 *Predominance of long periods of fluctuations*
- 14.4.5 *Predominance of very long periods of fluctuations*
- 14.4.6 *Mixed pattern of predominance of X and Y*
- 14.4.7 *Mixed pattern of predominance of X and Y with secondary patterns*
- 14.4.8 *Mixed pattern without predominance*
- 14.4.9 *Dominance of isolated periods of fluctuations*
- 14.4.10 *Dominance of short periods of fluctuations*
- 14.4.11 *Dominance of moderately long periods of fluctuations*
- 14.4.12 *Dominance of long periods of fluctuations*
- 14.4.13 *Dominance of very long periods of fluctuations*

14.5 Patterns of Fluctuations of Coordination

14.5.1 *Pattern of A (pattern of duration) of B (pattern of size of fluctuations) and (eventually) of C (direction).*

15. Patterns of stability of dyadic coordination

15.1 Level of stability of coordination

- 15.1.1 *Stability at absolute synchronization*
- 15.1.2 *Stability at relative synchronization*
- 15.1.3 *Stability at absolute synchronization*
- 15.1.4 *Stability at relative unsynchronization*

15.2 Duration of stability

- 15.2.1 *Isolated period of stability*
- 15.2.2 *Short period of stability*
- 15.2.3 *Moderately long periods of stability*

15.2.4 *Long periods of stability*

15.2.5 *Very long block of stability*

15.3 Patterns of temporal distribution/organization of stability

15.3.1 *Predominance of isolated stability*

15.3.2 *Predominance of short periods of stability*

15.3.3 *Predominance of moderately long periods of stability*

15.3.4 *Predominance of long periods of stability*

15.3.5 *Predominance of very long periods of stability*

15.3.6 *Mixed pattern of predominance of X and Y*

15.3.7 *Mixed pattern of predominance of X and Y with secondary patterns*

15.3.8 *Mixed pattern without predominance*

15.3.9 *Dominance of isolated periods of stability*

15.3.10 *Dominance of short periods of stability*

15.3.11 *Dominance of moderately long periods of stability*

15.3.12 *Dominance of long periods of stability*

15.3.13 *Dominance of very long periods of stability*

15.4 Patterns of stability

15.4.1. *Pattern of A (pattern of duration) of B (pattern of level of states at which stability occurs).*

16. Pattern dynamics of coordination

16.1. Balanced Trajectories

16.1.1 *Balanced Sequential Trajectory*

16.1.1 *Balanced Sequential Trajectory ending in Stability*

16.1.1 *Balanced Sequential Trajectory ending in Fluctuations*

16.1.2 *Balanced Intermittent Trajectory*

16.1.2 *Balanced Intermittent Trajectory ending in Stability*

16.1.2 *Balanced Intermittent Trajectory ending in Fluctuations*

16.1.3 *Balanced Complex or Mixed Type Trajectory*

16.1.3 *Balanced Complex or Mixed Trajectory ending in Stability*

16.1.3 *Balanced Complex or Mixed ending in Fluctuations*

16.2 Fluctuant Trajectory

16.3 Unstable Trajectory

16.4 Stable Trajectory

16.5. Static Trajectory

17. Influence effects and other Coordination effects

17.1 Type of Influence Effects

17.1.1 *(Proper) Influence Effects*

17.1.2 *Quasi-Influence Effects*

17.1.3 *Failed Influence Effects*

17.1.4. *Other (Non-Proper Influence) Coordination Effects*

17.2. Rapidity of Influence Effects

17.2.1 *Quick*

17.2.2 *Slow*

17.2.3 *Very slow*

17.3. Direction of Influence Effects

17.3.1 *Neutral*

17.3.2 *From A to B* ($A \rightarrow B$)

17.3.3 *From B to A* ($B \rightarrow A$)

17.4 Direction regarding outcome

17.4.1 *Neutral or Leading to Maintenance* of Level/State

17.4.2 *Increase* of Level/State (ordinal variable) or *From State X to Y*
(categorical variable)

17.4.3 *Decrease* of Level/State or *From State X to Y* (categorical variable)