Dancing with complexity: Observation of emergent patterns in dance improvisation

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Abstract

Dance is presented as a context in which to study emergent and nonlinear behaviour. Manipulating the task constraints and the agent/environment and agent/agent interactions is used to enhance the divergent production of motor responses. In this paper this is studied using observational methodology. Our aim is to test an observation instrument capable of detecting synchronisations and spontaneous interactions in a group of dancers. Seven dancers improvised during four, five-minute trials involving four different constraints (Free movement; Free movement, but previously they had spent one minute breathing at the same time; Only walking and moving one's arms; Free movement, but if one dancer stops, they must all stop at the same time) . The recording instrument was the MatchVision Studio Software, and data were analysed using THEME v.5 software (Magnusson, 1996; 2000). The results, as reflected by the T-patterns detected (twenty in Trial 1, eleven in Trial 2, twenty-one in Trial 3 and eight in Trial 4) and the frequency of the recorded events, show the following with these dancers: (1) the observational instrument developed has enabled us to analyse synchronisation and interaction of dancers, as well as to detect repeated sequences of events; (2) the most frequent event is the interaction in pairs using physical contact; (3) very strong constraints limit the emergence of varied patterns; and (4) a previous synchronisation of breathing enhanced the group's synchronisation and the use of physical contact between members while dancing.

***Key words**: Observational methodology, synchronization, constraints, nonlinear behaviour*

1. Introduction

The uniqueness of dance arises out of the juxtaposition between human motion and art. Dance as an 'art object' has a dynamic dimension (motion) not present in other art forms, while dance as physical activity has an emotional dimension which requires consideration not only of technical but also of creative features of the dancer's movement. The evolution of dance has been determined by the need to experiment and create new ways of moving, as well as by the exploration of new forms of human movement that are not based on the need to win or do better than an opponent. During the last century, choreographers and dancers, as artists, were attracted by new trends in contemporary art and sought a more natural and free way of dancing. Science also influenced dance, and systemic and complex systems approaches have been present in the research process of different artists. Indeterminacy, improvisation, chaos and breaking with cause-effect relationships were key concepts in a number of important dance works, such as those of Cunningham, many years before the complex systems approach was applied to motor control and learning. Principles such as equifinality, (neg)entropy and morphogenesis were all considered in an attempt to understand human motion in dance (Castañer and Camerino, 2003). Dance paid attention to complex phenomena many years before sport did, and it is this which makes dance an interesting context in which nonlinear sport scientists can study emergent and nonlinear behaviour. Furthermore, Dance needs to be based on creative processes,. At all events, we cannot move forward on the basis of stereotypes, and following a single map — as if it were an algorithm — prevents us from discovering other routes in a heuristic way.

Dance improvisation is "an innovative dance process that takes the dancer beyond habituated patterns of movement and modes of comportment into a realm of unknown possibilities where new ways of moving can be discovered and experienced" (Clark-Replay, 1999). This process is mainly based on creative games, playing with one's own movement, the rhythm, the space, the dancers and the equipment. All of these constitute constraints on the emergence of coordinated behaviour between dancers or on the discovery of new ways of dancing.

In line with certain trends in nonlinear pedagogy (Chow et al. 2006), methods of teaching contemporary dance and improvisation are focused on exploration, play and discovery. Traditionally, teachers of dance improvisation have used a constraints-led methodology, manipulating the task constraints and the agent/environment and agent/agent interactions. Studies of these interactions have shown the influence of dancing with a partner in terms of enhancing the divergent production of motor responses (Torrents et al. 2010).

The proposal here is to study complex behaviour in dance by means of observational methodology. The latter is a scientific procedure that can reveal the occurrence of perceptible behaviours, allowing them to be formally recorded and quantified. It also enables the analysis of relationships between these behaviours, such as sequentiality, association and covariation.

In all settings one finds a range of behaviours which form a pyramidal structure. Starting from the top of the pyramid, everyday dance in a natural context can be broken down into different levels (such as leisure, motor behaviour, etc.), revealing a tree structure with a hierarchical subdivision of situations in which behaviours that tend towards molarity interact with their natural contexts (Anguera et al.

1999). Towards the base of the pyramid the perceptible behaviours become increasingly molecular.

Observational methodology can be used here due to the habitual nature of human behaviour and the fact that the context is a naturalistic one. Indeed, the flexibility and rigour of this methodology makes it fully consistent with the characteristics of our research on body movement and dance (Castañer et al. 2009b). More specifically, our research approach is based on sequential and real-time patterns, known as T-patterns, which, in conjunction with detection algorithms, can describe and detect behavioural structure in terms of repeated patterns (Magnusson, 2000). It has been shown that such patterns, while common in behaviour, are typically invisible to observers, even when aided by standard statistical and behaviour analysis methods.

In order to improve the scenarios to be managed in body movement and dance practices it is important to identify the essential constraints of specific motor skills, space (such us axes, planes and volumes or the use of the total space), time, and interaction between partners. Our intention is not to explore unobservable aspects such as feelings or emotions that are always implied in dance but, rather, to study what is directly observable from an objective point of view.

We have previously applied observational methodology to study the influence of different instructions and dancing with partners as a way of enhancing motor creativity in creative dance and contact improvisation, as well as for studying the sequence of motor actions in folklore dance (Castañer et al. 2009a, 2009b; Torrents et al. 2010). However, this research was focused on the individual responses of dancers and creativity was studied by paying attention to the variety of motor skills performed according to the teacher's instructions or the partner of the dance duet. The category system used for the analysis (OSMOS- Castañer et al. 2009b) classified motor skills and the variations that dancers could use while dancing. However, in order to study further the way in which patterns emerge in contemporary dance we were interested in creating an observation instrument capable of detecting synchronisations and spontaneous interactions within a group of dancers. In this paper we test the instrument by studying the effect of constraints-led proposals for improvising and composing, especially as regards enhancing interactions and spontaneous synchronisation in a performance or in training sessions. Improvised dance was observed using different instructions in order to analyse how these may affect attention to the group and the interaction among its members.

2. Methods

Seven students (five females and two males; mean age 21.5 ± 2.5 years) of Physical Activity and Sport Sciences with more than one year of experience dancing in a contemporary dance group participated voluntarily in this study. Their task was to improvise dancing in a space of (8 x 8) m during four, five-minute trials in which they received no specific instruction regarding how to interact, synchronise or *listen* (in dance terminology, being aware of the other dancers) within the group. Each trial was focused on different constraints:

1) Free movement, without specific instructions.

2) Free movement, but previously they had spent one minute breathing at the same time while sitting in a circle and holding hands. The synchronisation of breathing might enhance the synchronisation of the dancers' free movement afterwards.

3) Only walking and moving one's arms were allowed. Simplifying the instructions might also enhance attention to the group rather than to one's own movement.

4) Free movement, but if one dancer stops, they must all stop at the same time. This instruction forces the dancers to *listen* to the group, which might also enhance their interaction and spontaneous synchronisation.

The four trials were video recorded and video images were analysed by two expert observers using an instrument based on changing criteria (time, interaction, contact and space), each of which gives rise to a category system that is exhaustive and mutually exclusive (see Table 1). The recording instrument used was the MatchVision Studio software, an interactive video coding program which allows effective recording of the time of occurrence of behavioural events, i.e. their beginnings and endings (see Figure 1.). Data quality was assessed by calculating the kappa coefficient (Blanco-Villaseñor and Anguera, 2000) and data were analysed using THEME v.5 software (Magnusson, 1996; 2000). The THEME software enables complex repeated temporal patterns to be detected even when a large number of unrelated events occur in between components of the patterns, which typically makes them invisible to the naked eye. The basic assumption is that the temporal structure of a complex behavioural system is largely unknown, but may involve a set of a particular type of repeated temporal patterns (T-patterns) composed of distinguishable event-types, which are coded in terms of their beginning and end points (such as "dancers begin by interacting in pairs using contact" or "dancers end by interacting with the whole group"). The kind of behavioural record (as a set of time-point series or occurrence time series) that results from such coding of behaviour within a particular observation period (here called T-data) constitutes the input to the T-pattern definition and detection algorithms. Essentially, if two actions, A and B, occur repeatedly within a given observation period in that order or concurrently, they are said to form a T-pattern (AB) if they are found more often than expected by chance. More complex T-patterns are gradually detected as patterns of simpler, already-detected patterns through a hierarchical bottom-up detection procedure (Magnusson, 1996; 2000).

The design for this study is N/P/M (nomothetic/point/multidimensional- Anguera et al. 2001). It is nomothetic since, as a whole, the participants can be considered at a nomothetic level due to the high level of motor interaction. It is point because we consider a single session with all the participants, and multidimensional because it combines a category system with a field format that enables us to manage four criteria that include fifteen exhaustive and mutually exclusive categories. The data are Type IV (Bakeman, 1978).

Table 1. Category system used to analyse the spontaneous interaction and synchronisation of dancers.

Criteria	Categories
Time Synchronisation of the rhythm between dancers	**Ts:** Simultaneous action. The group performs the same movement and at the same time.
	Tcn: Canon. The group performs the same movement in sequential time.
	Trs: The group synchronises the rhythm of the movement, but without performing the same movement.
	Tc: Combination of any of the three previous categories.
Group Interaction between dancers	**Gd**: Dyad. Interaction of two dancers.
	Gmg: Microgroup. Interaction of three or more dancers (fewer than seven).
	Gg: Macrogroup. Interaction of all the dancers together.
	Gs: Different dyads or different microgroups at the same time.
	Gc: Combination of any of the four previous categories.
	NG: The seven dancers do not interact.
Contact Physical contact between the groups	**C**: Physical contact is used in the group.
	Cc: Different dyads or microgroups are dancing at the same time, and some of them use physical contact while others do not.
Space Dancers interact while paying attention to spatial features	**SG**: Dancers use a geometrical form while dancing.
	St: All the space is occupied (four corners and centre).
	Sc: Combination of both the above categories.

Figure 1. Screen capture of the MatchVision Studio Software showing the category system codes. Three girls are interacting (microgroup) using physical contact.

3. Results

Analysis of the number of occurrences of each category in the four trials (see Table 2) shows that during the second trial (where dancers breathed simultaneously before improvising) the dancers interacted more often (65 times) and with more people involved (11 in microgroups and 22 in various dyads or microgroups). In the fourth trial (with stops) there were more interactions of the whole group, but they all occurred during the stops (and therefore were not spontaneous interactions at all). In the second trial, contact was also much more frequent (57 times) and there were more geometrical spatial forms between dancers (11). Stops produce more synchronisation of rhythms, but this is also not spontaneous. Figure 2 shows these results, excluding the synchronisations of rhythm and the interaction of the whole group in the fourth trial. Contact and interaction was much more frequent in Trial 2, while synchronisation of time was more frequent in Trial 3 (walking and moving arms). However, it is important to note that in Trial 2 there was a common rhythm to the dance between dancers, as during the five minutes they maintained a slow movement, as if they were still following the breathing rhythm.

Table 2. Number of occurrences of each category and criteria depending on the trial. Vertically appear all the category system codes, and horizontally the four trials

	Free	Breathe	Walk	Stops
Ts	8	4	23	1
Tcn	2	5	3	1
Trs	2	0	0	21
Tc	0	0	0	0
Gd	32	21	38	29
Gmg	8	11	3	1
Gg	0	0	0	21
Gs	16	22	18	4
Gc	1	11	2	0
NG	11	7	18	20
C	36	48	32	26
Cc	7	9	6	3
SG	3	11	3	10
St	0	0	2	0
Sc	0	0	0	0
Total T	12	9	26	23
Total G	57	65	61	55
Total C	43	57	38	29
Total S	3	11	5	10

The second trial is also when dancers spent less time without interacting (7 times during 31”, compared to 11 times during 1’20” of frames in Trial 1, 18 times during 1’36” in Trial 3, and 20 times during 1’36” in Trial 4).

Scores related to spatial criteria are the lowest, but it is interesting to note that the second trial is again when more geometrical forms were detected.

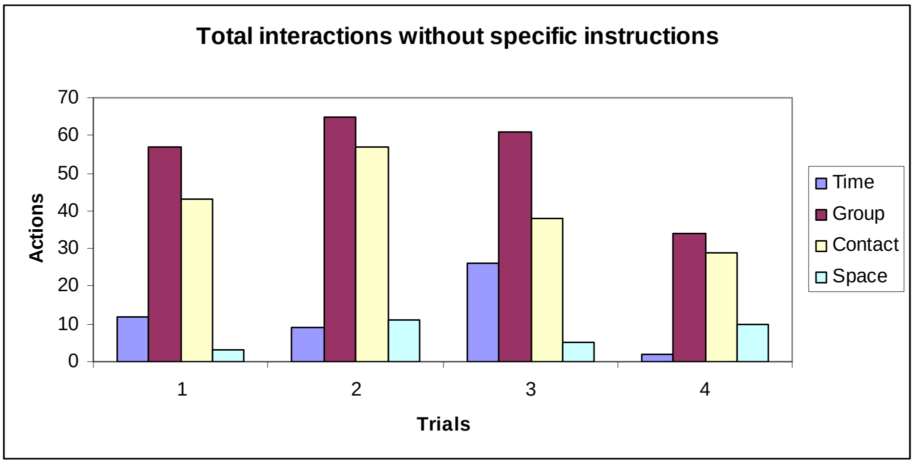

Figure 2. Frequency of occurrence of the different criteria, excluding those produced by the instruction of synchronising the stops.

The THEME analysis, in the form of event frequency charts, shows that the most frequent event is the interaction in pairs using physical contact. The number of T-patterns obtained in each trial was as follows: twenty in Trial 1, eleven in Trial 2, twenty-one in Trial 3 and eight in Trial 4. In this last trial the patterns are more frequently repeated, showing that a very restrictive instruction (stops) can enhance the repetition of event sequences (see Figure 3)

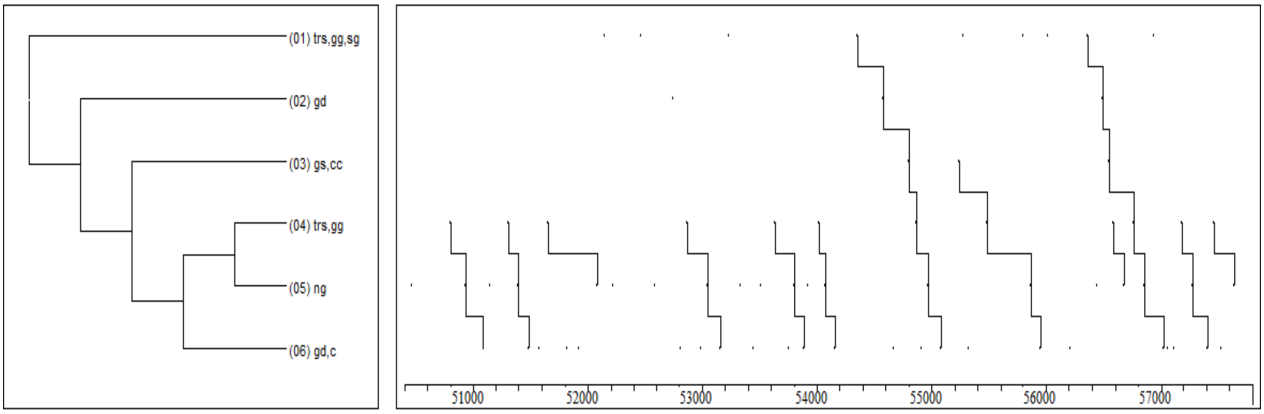

Figure 3. First T-pattern obtained for the fourth trial. There is a repeated sequence of events that begins with a stop (the whole group synchronising the rhythm) and which results in a geometrical form (trs,gg,sg). This is broken by a dyad interaction (gd), which is followed by different dyads or microgroups that interact with physical contact (gs,cc), followed in turn by another stop (trs,gg). The stop is then broken by the whole group (ng) and a dyad begins a new interaction using physical contact (gd,c).

4. Discussion

The proposal to synchronise breathing during one minute prior to dancing was found to enhance the interaction between dancers, the physical contact between them and the use of a common dance rhythm. Simplifying the dance (in the third trial) enhanced the synchronisation of movement and rhythm, while the use of stops led to an impoverished performance, at least in terms of the interactions between dancers and the repetition of T-patterns. It seems that a very restrictive constraint, such as the obligation to stop if somebody else stops, limits the emergence of varied patterns. On the basis of this study alone it is not possible to affirm that the synchronisation of breathing will always have this effect, but the instrument developed has enabled us to detect this interesting phenomenon. Further research is needed in order to study the effect of synchronising breathing on other dancers or situations.

The constraints used in these trials did not enhance at all the attention paid by the dancers to space. However, as space is one of the dimensions that dancers have to control (Laban, 1991) it would be very useful to find constraints that do direct their attention to the possibility of occupying the whole available space. It would also be interesting to constrain the interaction between all the dancers, as they frequently repeat interactions in dyads by using physical contact. These results are likely due to the influence of practices associated with contact improvisation or related tasks in the dancers' experience.

5- Conclusions and perspectives

The observational instrument developed has enabled us to analyse the synchronisation and interaction of dancers, as well as to detect repeated sequences of events (T-patterns). Testing different constraints by means of this observational instrument may help to identify the most suitable instructions and conditions for enhancing the emergence of rich and varied patterns in a group of dancers, thereby fostering their self-expression and creativity.

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