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FROM DISORDERED TO ORDERED MOVEMENT: ATTRACTOR CONFIGURATION AND DEVELOPMENT

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Attractor Configuration and Development.

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RUNNING HEADS:

LHP: Pedrosa, Carvalho, Império-Hamburger

RHP: From disordered to ordered movement.

INTRODUCTION

In this chapter, we analyze psychological phenomena within the framework of attractor configurations resulting from a self-organization process in a group of children playing in a room. The epistemological framework of Perrin's 1909 analysis of the Brownian movement of small particles in suspension in a fluid as due to the incessant and irregular movements of the molecules in the medium is adopted as an heuristic tool to account for some of the common features in physical and psychological phenomena: indeterministic and deterministic interactions, disordered and ordered movements, coherent and noncoherent movements, and discontinuous and continuous transformations.

A free-play group of young children, ages 2;6 (2 years, 6 months) to 3;0, is considered here as a system whose ordered states are a product of the interactive, coregulating actions of the component individuals. Interactions are sources of group and interindividual actions and, at the same time, constitute the individuals as unique developing systems, evolving in time.

This kind of analysis is already recognized as useful for physical, chemical, and biological systems (Haken, 1978; Prigogine & Nicolis, 1971) and, more recently, in the field of psychological development (Fogel, 1993; Fogel & Thelen, 1987; Vallacher & Nowak, 1994). Fogel (1993) used the concept of *attractor* to refer to repeated patterns that appear in behavioral observational data, and then, from a dynamic systems perspective, derived the model of consensual frames formation in a complex system; he found "*dynamic systems models extremely heuristic for the purpose of understanding relationships development because they suggest that complex systems can converge toward a stable pattern of behavior without a prescription or plan, merely by the mutually constraining influences of the components. The concept of attractor suggests that it is mathematically possible to model a system in which such convergence occurs spontaneously*" (Fogel, 1993, p.105).

In our analysis, the subjects' actions are construed as being performed in a field of interactions, where information is exchanged and collective configurations emerge through a self-organization process. This perspective allows for the definition of a *space of information* (signification or meaning), a theoretical concept, analogous to the several concepts of space used in Physics, defined as places (loci) where the objects of thought and experience are situated. The space of information has *"the role of a 'medium' to whose existence the individual parts of a system contribute and from which they obtain specific information on how to behave in a coherent, cooperative fashion"* (Haken, 1988, p. 23). In our context, the space of information is a supraindividual or interindividual locus where information is created and exchanged, and shared attributions of meaning take place. It defines the psychological scope of social phenomena, in a line of thought we believe is fruitful to frame the analysis of individual - social relationships (Carvalho, 1992).

Meanings are constructed when two or more individuals share them; with them, a new quality emerges in the system, through a process where there is a compression of the available information, and new information activates more complex collective states. The space of meanings is constituted by linguistic expressions, such as body movements, gestures, sighs, laughs, and other manifestations besides verbal language; it includes cognitive and emotional features (Fogel et al.,1992).

Freedom and constraints

The present analysis considers the dynamics between deterministic (causal) laws manifested by the *correlations* that lead to collective wholes through coregulation processes and the indeterministic spontaneous manifestations at the "free" individual level: the deviations from the deterministic law in Epicure's "clinamen" (Serres, 1977) .

The concept of correlation is central in our analysis. Correlations are the exercise or actualization, in the form of actions, of a common property or potentiality of the components of the system - in the present case, properties such as "sociability" (Carvalho,

1992) or "attribution of meanings" (Pedrosa, 1989). It may be realized by any interacting agents, and it occurs in such a way that coherent collective states emerge through the abbreviation of the information present in current noncoherent actions. As Haken puts it, *"although ... the exchange of information may initially occur at random, a competition or cooperation between different kinds of signals sets in, and eventually a new collective state is reached which differs qualitatively from the disordered or uncorrelated states present before"* (Haken, 1988, p. 27).

As this *self-organizing* process takes place in the system, correlated actions (actions that actualize common properties of the components) can converge into *quasi*stable configurations or recognizable patterns, the *attractors* (Haken, 1988). The concept of attractor refers to the mathematical properties of curves in a system of equations that allow them to converge at specific points or trajectories as a function of time (Fiedler-Ferrara & Prado, 1994; Fogel, 1993). It is an order parameter that serves a double role: *"it informs the atoms (the systems' components) how to behave, and, in addition, it informs the observer about the macroscopic ordered state of the system"* (Haken, 1988, p. 25).

From this perspective, the tasks of developmental researchers would be: a) to identify the constraining influences or deterministic correlation laws that are present in the developing system they are focusing on; b) to develop an understanding of how the chaos, freedom, or uncertainty that are intrinsic to dynamic, open systems can produce ordered or recognizable stable states within the continuous transformation that constitutes the ontogenetic process; and c) to identify stable states and changes in this process (FN1). Each of these tasks implies overcoming strictly causal or deterministic explanations through the exercise of new logical reasonings (Haken, 1988; Império-Hamburger, 1990a), as pointed out by Wallon, as early as 1942: *"The effect is not exterior to the act: it is simultaneously its result and its regulator"* (Wallon, 1979, p. 83).

Development: Change and Stability

The ontogeny of a system is a process through which functions and temporarily stable states are constituted and transformed. Functions and stable states can be thought of as products that mark the process in the sense of becoming recognizable by the interactants or developing beings (Nadel & Fontaine, 1989). An observer can frame these products as significant events in the flow of observations, create concepts about them, and relate these concepts in theories (Império-Hamburger, 1990b).

In agreement with the evolutionary epistemological perspective that guides our analysis, when a product arises, it doesn't appear as completely new. It is as if it were already contained in the previous processes - but this doesn't mean it is preformed. When it is methodologically possible to go back in time and analyze how the product emerged, clues or signs of its future realization can sometimes be recognized, although this existence can seldom be predicted beforehand.

A possible metaphor for developmental processes is the behavior of water vapors in the atmosphere: they move randomly, but, under certain conditions, they group together and form clouds – a recognizable product; they can then condense and form rain, or they can also disperse and return to a state of random movement. Clouds and rain are *products, recognizable moments* of a continuous process of transformation. They are not more evolved or more developed than other moments. They are also part of the process, but they have a quality of momentary stability that makes them recognizable.

Everything that happens in a dynamic system is the actualization of possibilities already present in the system: its properties, processes, and available information. The system contains its own future. Development involves transformation and conservation, change and stability, to be and being, product and process. Development can thus be defined as a dialectical process through which the system transforms itself while maintaining its identity as a system.

Human development, as well as other self-organizing systems' development, can be thought of as an intrinsically nonpredictable chain (in a classical sense) of manifested states or functions of species-specific potentialities; of these, the most primary is that development can only happen in a *social environment* (Wallon, 1979; Vygotsky, 1978; Valsiner, 1991). This reciprocally constitutive social - individual relationship appears as a fundamental law of human interaction, a basic rationality expressed, in a mathematical sense, as a ratio between part and whole (Império-Hamburger, 1996). In the following analysis of a play episode involving young children, we try to discern how the social whole constitutes, and is constituted by, individual actions that exhibit both deterministic and indeterministic dynamic aspects.

DATA AND ANALYSIS

The episode to be analyzed was selected from a videorecording of free-play activities in a group of 2;6 to 3;0-year-old children in a low-income daycare center in São Paulo, Brazil. This record is part of a longitudinal study in which the children were observed weekly over 12 months in the same settings (indoor or outdoor free-play). The episode involves seven children, two boys and five girls, mean age 2;9. The only adult present in the room was the observer. The room was empty, except for the shelves along the walls, where toys and other objects were kept. The total duration of the episode was 6 minutes, 34 seconds; the analysis divides it into seven sequences of variable duration, according to the changes in the interactional dynamics and in the spatial structure of the group. These sequences are depicted in Fig. 1, using an abstract drawing intended to represent the group configuration in each sequence. The lines depict the observer's apprehension of the group's configurations, arrows indicating the direction of the trajectories. Triangles represent individual children's positions. A synthesis of the episode is presented next.

Insert Fig 1 here

Running in the room

Previous setting: *Five children enter the room coming from lunch. There are no adult caretakers with them. The children are very excited; they run around randomly, laugh, and vocalize, making a lot of noise. One of them (Dani, a girl, 3;0) is heard calling out: "Eu cai!" ("I fell down!").*

Synthesis of the episode: *The children run across the room with varied rhythms, following routes that are organized and modified along the way: running from one wall to the opposite; falling down; running in circles; two children whirling, hand-in-hand; running in circles around other children who are squatting and pretending to be dogs. There are very few verbal exchanges, but a lot of vocalizations follow the rhythm of the movements. Six other children arrive while the record is made, and two of them engage in the ongoing game. The sequence is interrupted by the arrival of a caretaker, who offers the children a box of toys. The episode reveals dynamic transformations of the group, in which some moments of organization can be recognized through the group's spatial and social configuration; but they cannot be predicted from the prior state of the group or from the individual actions of its members.*

Group Configuration and the Shared Attribution of Meanings.

The identified sequences frame the flow of activities that were recorded. The duration of the sequences varies: some of them last a few seconds (e.g., the first sequence) and others last about 2 minutes (e.g., the fifth). The precise temporal limits of the sequences cannot be established, because the transition from one sequence to the other is a result of the observer's recognition of a pattern or a new configuration. The representation

that characterizes a sequence, thus, does not include its whole duration: It is, rather, a scheme of the various and detailed related actions of the children.

The configuration is the result of a set of properties of a situation that leads to part of it being perceptually or conceptually highlighted, like a figure against a background. The recognition of a configuration is, in itself, an act of signification. If the attribution of meaning occurred only at the individual level, the process could not be identified, either by the observer or by the play partners; but if the actions of two or more individuals are seen as related through similarity, complementarity, or reciprocity (Camaioni, 1980), a shared act of signification can become recognized and can thus acquire a regulating potential – both for the partners and for the observer whose task is to frame and to build an understanding of the situation.

The shared attributions of meaning originate the correlations that organize the activity in the direction of new meanings – a deterministic aspect of the process. There is, however, an inherent uncertainty in the process of signification. The attributed meaning may not correspond exactly to the other person's attribution; the actions may express correlations in which the correspondence is only partial. This uncertainty and the occurrence of random activities that do not adjust to the configurations constitute a state of disorder that may function as an *activating principle* of the interactional process, because it is a source of potential meanings that can eventually (though not necessarily) be actualized in shared configurations. This potentiality can be considered as an indeterministic aspect of the process, because meanings emerge as novelties regarding the present state of organization of the system, even if their emergence can be related to other levels of organization (e.g., the individual agent's).

In the next item, our analysis is targeted at following the transitions from one sequence to the next in the episode and making explicit the constitution of attractor configurations, that are understood here as manifestations of the property of convergence in the system. We look both for deterministic correlation laws inherent to young children's

interactions, and to the aspects of the situation that "escape" the attractors and characterize *disorder* or *chaos* as a moment in which no correlated actions, no organization, and no direction can be discerned.

Spatial attractors: Sequences 1 to 4.

Sequence 1: *Alex (a boy, 2;9) runs from one side of the room to the other and falls down on all fours when he reaches the wall. Dani (girl, 3;0) follows him and runs back to the opposite wall. Alex joins her and they run together across the room; Dani reaches the wall and bends down as if she were falling, with one of her hands against the wall. From the center of the room, Telma (girl, 2;8) looks at them.*

By running together along the same route, these two children create a configuration in the previously disordered movement of the group. In this configuration, Alex unexpectedly incorporates a new element: An intentional fall, possibly related to Dani's previous accidental fall, which was highlighted by her verbal comment ("*I fell down!*"). Dani, in her turn, confirms this incorporated element when she enacts a partial fall, which simplifies the movement and reduces its physical cost, but clearly preserves the shared configuration. The facts that a shared activity (running along the same route and falling down) is chosen by the children and that this configuration attracts the attention of a third child (Telma) can be attributed to laws of human sociability, such as recognizing, creating, and sharing information; the particular *form* of this information, however, has emerged from accidents of the context, as when Alex chose to incorporate Dani's fall to the game and thus endowed it with a new meaning.

Sequence 2: *Telma runs toward Alex and Dani and joins them in their route across the room. As they reach the wall, they meet Vânia (girl, 2;10) who has been watching them. Telma displays a pretend fall in front of Dani and Vânia, bending her body, and then runs to the center of the room in a circular route. Vânia follows her. From the center of*

the room, Paola (girl, 2;11) looks at them and slowly introduces herself in the same route.

Two different sequences are thus formed by the group of five children: Alex and Dani running across the room and "falling down" on reaching the wall; and the three other girls running in circles in the center of the room. Although their paths are different, it can be inferred from the direction of the gazes that the two groups are aware of each other. The cooccurrence of these two attractors is followed by a brief moment of dispersion of the group:

Dani abandons her route, introduces herself partially to the circular route, then goes to the wall and leans against it with both hands, still looking at the others. The other children stop running. Telma walks around the room; Paola and Vânia walk toward a shelf where a sixth child (Vivi, girl, 2;6) can now be seen playing with pacifiers; Alex joins Dani near the wall.

Although Dani's action contained elements of the previously shared configurations, as if juxtaposing them (running in the circular route, then back to the wall and touching it as in previous pretend falls), and although the children were mutually oriented, this action was not incorporated to a new shared configuration. Instead, a new fact – Vivi's arrival – interfered in the organization of the group.

Sequence 3: *Dani resumes running in a circular route, followed by Alex. They come near Telma, who looks at them and walks away. Dani turns to Alex and puts out her hands, and they start whirling, hand-in-hand. Telma approaches them, followed by João (boy, 2;8) who has just arrived. Telma bends her body. Dani and Alex keep whirling around the room. Other children turn their attention to the whirling dyad. After Dani and Alex stop whirling, Paola puts her hand out to Alex; he falls down near her, then stands up, holds her hand, and offers his other hand to Dani, inviting her: "Vamo!" ("Let's go!"). Dani ignores him. He holds Paola's hands, and they start whirling. The other children watch them and run around the room randomly. Telma puts her hands out to Vânia, who*

laughs and doesn't take them. Telma runs away. Dani runs in the same direction. Paola and Alex keep whirling, then fall down. Laughing and play noises can be heard throughout the sequence.

The whirling movement seems to be highlighted and functions as an organizing pole toward a new spatial attractor. It is displayed by two different dyads (although Alex is part of both), which indicates that the configuration belongs to the group and not only to individual members. It is observed and is clearly shared by most of the children - but it is not performed by all, perhaps because it is a difficult motor act at this age. It contains several elements of the previous group organization (running, making a circular route and falling down), but it incorporates an innovation (circular movements holding hands) which is lost further on in the sequence.

Sequence 4: *Two girls (Telma and Vivi) run together in a mutually oriented way from one side of the room to the other and touch the wall with both hands on reaching it. This same route is repeated several times with slight changes and increasing synchronization. João runs to the back wall, trying to engage in the same route; the girls refuse his participation, saying "não, João, não!"("no, John, no!"), and he turns his attention to the other children (Dani, Paola and Alex), who are running in different routes across the room. Dani starts to walk around the room, dangling her head, and Alex imitates her. Paola, João, and Vivi, who has strayed away from her route with Telma, watch them and get closer. Dani sits down and is immediately followed by Vivi, Paola, Alex, and João. Dani, Alex, and Paola stand up and run around João and Vivi, who stay seated.*

Once again, some aspects of a previous form of organization of the group are selected by individual children: Telma and Vivi running from one wall to the other and touching the walls with their hands, their rhythms mutually adjusted, like Dani and Alex in the first sequence. The rest of the group is dispersed and does not engage in this proposal, or in Dani's entirely new activity -- walking around dangling her head, which is followed only by Alex. But their mutual attention and their readiness to create a joint activity -- a

shared meaning – becomes apparent when Dani sits down (which is possibly an elaboration of the previously shared action of falling down) and is instantly followed by the others. A new configuration is beginning at this moment, as is evident from the description of the next sequences of the episode.

A symbolic attractor, and coupled attractors: Sequences 5-7.

Sequence 5: *Vânia approaches the running children. Vivi, still seated, singsongs and claps her hands. João crouches on all fours and "barks" at the other children, making moves toward them as if he were an attacking dog. Vânia crouches beside him and barks. Vivi crawls on fours and moves around the room barking, followed by João and Vânia. The three other children laugh and keep running around them. The seventh child, Telma, joins the running group in the circular route around the "dogs". The circle is enlarged in order to include the moving "dogs". The children's movements are rhythmic and are accompanied by loud laughs and cries. Vivi stands up and joins the circular route. The "dogs", Vânia and João, make moves as if attacking the children who come closer to them. An adult caretaker arrives, but does not interfere with the game. Vânia stands up and joins the running group, leaving only João in the dog role. João barks and pretends to attack. The caretaker calls João to change his clothes. As soon as João leaves, Vivi squats on her fours, "barks" and turns her body, following the children who run around her. Then she stands up, and Vânia takes her place.*

Sequence 6: *Vânia suddenly stands and "walks" on her knees; she loses her balance and sits on her feet. This new posture seems to modify the perceived configuration: The running group gets closer to her. Dani pats Vânia's head and is imitated by the other children. Vânia leaves her "dog role" and complains verbally "Oh, Dani! Oh, Telma!..." The children run faster, and touch Vânia's head more frequently, often more than one at the same time. Vânia suddenly gets up on all fours and barks, creating a configuration similar to that in Sequence 5.*

Sequence 7: *The circular route is enlarged to include Vânia, who crawls around and pretends to be a menacing dog. João, his clothes changed, introduces himself into the middle of the circle, goes on his fours, and makes menacing moves. Vivi approaches the two "dogs". Vânia stands up and joins the running group. Vivi looks at João close up, and then runs away. Telma falls down near João. The caretaker offers the children a box full of toys; all the children move toward her, and the game is suspended.*

These three sequences are characterized by correlations in the two groups of children engaged in different activities, but composing a coupled configuration: Some children run around the others, who are squatting and pretending to be dogs. In the preceding sequence (Sequence 4), several actions were performed by different children, casually oriented toward each other. When the children squat together, they create the possibility of a unified direction of action, which is still not predictable. The foregoing description makes clear that some individual actions are integrated in the new configuration, whereas others are discarded. Dani, Alex, and Paola's coordinated running around the squatting children persists as a collective action; the similarity of their individual actions, creating a unity, seems to engender time persistence. On the other hand, the two squatting children take different courses of action: Vivi singsongs and claps her hands, while João stands on all fours and barks. One of these proposals is confirmed as part of the configuration by Vânia's engagement in the game by taking the role of a second "dog".

The sequences described show that the spatial circular attractor configuration frames the inner scenery constituted by the dog representation attractor. The coordinated running of the children sets spatial limits that adjust themselves to the collective movements – as when the circle is enlarged in order to include the moving "dogs". Actions that result from correlations can be identified in both intragroup and intergroup interactions, defining a coupling of the two attractors.

The representations of a dog that each of these children have emerge as meanings that are incorporated by the group as the actions are being performed. The "dog" barks and makes menacing moves toward its "preys", which move away, but not so far as to destroy the spatial configuration that represents a dog surrounded by its prey and/or being teased by them. The menacing posture and the barking, the simulated fear expressed in cries and moves, and the playful mood expressed in laughter, are also components of the configuration and give it an emotional intonation that strongly endorses its symbolic meaning.

The replacement of João by Vivi in the role of dog and the later replacement of Vivi by Vânia indicate that no previous plans were required to maintain the shared configuration. Although many different actions were possible for each child and for the group, *the shared meaning that emerged from the interactional situation seemed to operate as a mutually constraining influence* (Fogel, 1993) that led the group to delimit and select pertinent meanings, and favored certain further actions.

Shared meanings are a result of correlations that tend to reinforce their own actions, that is, tend to create new meanings and strengthen the tendency for other correlations. This defines the process leading to attractor configurations as a dialogue between deterministic and indeterministic aspects of the interactional system, and as a self-organization process presenting moments *"of stability and instability, where new qualities, traits, and characteristics emerge over time"* (Allen, Engelen & Sanglier, 1984).

EMERGENT CONCEPTS AND PRINCIPLES

Field of interactions – Novelty

It was possible to recognize in this play episode some developments of group organization in a flow of spontaneous individual activities. We can now examine the nature of some principles that lead to the correlation of these activities and potentiate the

emergence of collective configurations. *Principles* refer to specific forms (either structural or dynamic) of organization of the system.

It is apparent from the description of the episode that the system we are taking as a unit of analysis is the group, defined by interacting individuals in a delimited spatial setting. At another level of analysis, each individual could be taken as a unit – a system in itself – which would engender other sorts of questions. When individual actions are labeled as spontaneous, we do not imply that they are not subject to correlations, which they probably are – e.g., personal history, relationships in the group, etc. Our question here *is not why* particular actions are performed by particular individual at particular times, but, rather, *how* the group as a system moves over short time spans from disordered to collectively ordered states constituted by the coordination of spontaneous individual activities without any previous plans or prescriptions.

The micro-transformations in the system are taken as *instances* of the events that constitute the ontogenetic process, at both the group and the individual levels: Development takes place through the concrete moment-to-moment events in a *field of interactions:* self-self, self-other, or self-group interactions.

On a retrospective analysis of the episode, it can be observed that the actions of running and crouching were performed by every member of the group in different forms. João, who came in later and, from Sequence 5 on, performed the "dog" role, had tried to engage in Vivi and Telma's running route in the preceding sequence; and in Sequence 2, Telma did not really crouch, but bent her body as if enacting a fall. The running trajectories created a stable scenery against which other activities could be performed. The whole episode can be framed as variations on the running and crouching actions. The particular nature of each variation could not be anticipated from the analysis of the group as a system. It is a novelty: It emerges as a new activity, although to a certain extent it can be traced back to previous variations (e.g., squatting from falling down) or can be related to other contexts (e.g., personal history) at the individual level of analysis.

Disorder as an activating principle of order

In the course of the episode, ordered and disordered moments were identified. Disordered moments are more difficult to frame: Mutual orientation may be present, but the nature and the direction of the activities seem to be disordered or unrelated, and do not allow the observer to highlight a pattern or a configuration. It must be pointed out that children can share a physical environment while engaged in different independent activities and still not configure disorder or disorganization in the system, even if they periodically inspect the surroundings (Carvalho, 1989). It is when new activities of short duration are performed and are accompanied by changing or unstable mutual orientation, that a moment of disorder can be identified. The specific future course of actions in the system cannot be predicted from the analysis of these moments; but, when retrospectively analyzed, *disorder appears as the activation principle of order*: self-organization requires a situation in which many chaotically manifested possibilities exist, out of which correlations can develop. Correlations occur on the basis of a multiplicity of available choices. Ordered states are reorganizations of random states in which novelties (spontaneous individual actions and surrounding events, such as the arrival of a caretaker) are continuously taking place. Which principles underlie these re-organizations?

Organizing principles: Attention, sharing meanings and meaning persistence

The first organizing principle is *attention orientation*. This acts as a prelude indicating the children's disposition to engage in the various activities and their monitoring of the other children's actions. Engagement in a particular course of action was always preceded by the orientation of attention in its direction.

It should be noticed that attention orientation does not describe only an individual's action, but also its relationship to a part of the system to which the individual belongs at that particular moment. What constitutes this relationship? In our case, it is two or more children acting jointly, apparently on the basis of shared meanings, that functions as a

scaffold and strengthens the activity, which is recognized and accepted as a proposal. There is no need to resort to intentions or plans in order to describe and analyze this process.

This leads us to a second organizing principle: *Sharing meanings.* Some of the novel actions initiated by an individual child are "lost" if their performance is isolated from a collective action. An action can acquire a different status in the group when it is confirmed by more than one child – by imitation, by complementary, or by reciprocal actions. A nonshared activity is not strengthened and tends to be replaced: In Sequence 2, Alex abandoned his previous wall-to-wall route and joined Dani, who had changed to the circular route; and Telma stopped running when Paola and Vânia reoriented themselves toward Vivi. In Sequence 3, Alex turned his attention to Dani after she refused to whirl with Paola and him. In Sequence 4, Vivi stopped running when her partner Telma abandoned their common route and joined another group. In a different form, the same sharing principle is exemplified when Vivi instantly resumed João's role as a dog after he left to change his clothes, and when Vânia replaced Vivi in this role shortly after. In both cases, the game required a "dog" role correlated to the running group role in order to maintain its shared meaning.

Shared actions express a consensual meaning, which is achieved through a coregulation process. The individual actions are built jointly through moment-to-moment adjustments. Several parts of our episode offer beautifully clear examples of these adjustments: The nature and rhythm of the actions (running, falling down, squatting, circling) are increasingly synchronized; the spatial relations, the postures, and the expressive actions are kept within limits that preserve and strengthen the shared meaning; and roles are exchanged within the same limits, or *constraining influences.*

Jointly, these two principles – attention and sharing – bring about group cohesion and the identification of which children belong to the collective construction (the four other children present in the room during the episode did not engage in it).

A third organizing principle emerges from the different ways in which the transition to a new sequence occurs. In some cases (sequences 1 to 2, and 3 to 4), there is a discontinuous transition, where the limits are obscured by chaotic activities, that is, by a disordered moment. But the transition can also occur in a more continuous way, and the elucidating clue in these cases seems to be the symbolic nature of the configuration, as in the transitions from sequences 5 to 6, and 6 to 7: Vânia's leaving the "dog" role, and then resuming it, and the related changes in the group's running behavior.

It is interesting to notice that in the first case, the discontinuous transition, there is a concurrent activity that at first appears as part of the background against which the already structured activity is a figure. However, as other partners engage in the newly suggested action (sharing principle), the background becomes a figure. It can coexist with the former figure (Sequence 2) or replace it (Sequence 5).

Continuity and discontinuity can be construed as different faces of the system's behavior in recovering and renewing the relations between its constitutive components in unpredictable spans of time. This is what we call the principle of *persistence of meanings*.

The transition from Sequence 4 to Sequence 5 exhibits an interesting feature: Sequence 4's configuration "melts away" while the new configuration is still being delineated. Several activities are tryed (running in different routes, running with a dangling head, squatting) before the new configuration is recognized. Sequence 5's configuration is more complex and lasting than any previous one: for the first time, the seven children engage in a single (and complex) activity. Coincidentally, it is in this configuration that a strictly symbolic aspect of the attractor can be clearly seen, although other forms of representations such as the recognition of spatial organizations are already present in earlier sequences.

As a side thought, it seems that a basic principle relates symbolic events and time. Every relation between events occurs in time and has a duration. Due to their potential supraindividual and interindividual nature, symbols allow a *new quality of sharing*, that

can overcome the constraints of the immediate situation and acquire regulating properties over a longer span of time and across spatial barriers. It is tempting to suppose that the complexity and the duration of Sequence 5 contain a hint of this time - space freedom that is so characteristic of human interactions in complex social situations.

SOCIAL INTERACTION AND INDIVIDUALITY

Like a molecule in incessant Brownian movement, a person, as a unique personality, has to submit to continuous changes while preserving individuality. At the same time, this individuality has its inherent constitutive reference in a complementary collective whole. What is usually called the *social environment* should be construed as a field of interactions, which is the founder of, and is founded by, the constitutive actions of human beings, and where information (meaning) creation and significant reciprocal communication take place. All the actions in this field appear as transformations at both the individual and the collective levels; they are the explicit expression of realized potentialities in regulated, self-organized states. The social nature of human beings expresses itself not as a sum of the actions of interacting individuals, but as collective, correlated, socially significant actions. Individuality is not opposite of sociability: It is its complementary face.

Human beings establish, and are established in, their individuality in a particular context: Their social field of interactions. This *law of human sociability* underlies the fact that young children are able to perform collective representations: Their correlated actions balance the indeterministic succession of spontaneous individual actions (which may or may not be meaningful at the individual level).

There is an inherent uncertainty in this interaction process, due both to the random and spontaneous character of individual actions and to the relative freedom that characterizes the attribution of meanings. This uncertainty is the source of innovation in the system: It generates novel actions and unfolded meanings. But the process of

collective construction (coconstruction) also requires deterministic organizing principles. Some of these can be construed as properties of the system and/or of its components, such as the law of sociability, the attention, the sharing and the meaning persistence principles; others are best described as process mechanisms such as coregulation (Fogel, 1993) (FN2). Free spontaneous action and novelty ensure *availability*; organizing principles ensure the *possibility of correlations and of coregulations* and set constraints, which guide the emergence of previously nonexistent collective states and meanings.

In the enchainment of these states, attractors are configured as privileged states of regulation, that relate individuals with one another and with the whole, expressing a trend toward convergence. Attractors result from communication: The exchange of reciprocally significant information made possible by coregulation processes. They are relatively stable, collective configurations, both in the sense of a sequence of regulated states in one individual, which manifests itself through correlated actions of this individual along time, and as a sequence of correlated actions of different individuals at a particular moment.

The attractor is a mathematical concept that we have used here in a metaphorical sense, aiming at an epistemological understanding. We are left with a methodological question: What sorts of measures and mathematical theories can be profitably used to characterize and to enhance our understanding of the geometry and dynamics of these interactional fields, where social wholes and individualities are simultaneously constructed through ontogeny?

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Footnotes:

1. For recent literature in the field of social psychology, see, for instance, Nowak & Lewenstein (1994), and Baron, Amazeen & Beek (1994).

2. The concept of regulation is further discussed in Carvalho, Império-Hamburger & Pedrosa (1996).

FIG. 6.1

Schematic representation of the group organization along the episode

Sequence1. Running across the room and falling down

Sequence 2. Two groups on different routes: across the room, and along a circular route

Sequence 3. Whirling, hand-in-hand

Sequence 4. Running to the end of the room and back to the opposite wall

Sequence 5. Running around squatting partners ("dogs")

Sequence 6. Running around a seated child and patting her head

Sequence 7. Running around the "dogs"