

'BREATHING' AS A METAPHOR FOR INDIVIDUAL CONTRIBUTING TO ORGANIZATIONAL COORDINATION: A CONCEPTUAL MODEL

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Keywords: coordination, social-cognitive theory, High Reliability Organizations, mental models.

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Suggested track: D Knowledge sharing (feel free to change if you think otherwise)

1 Introduction and Theory

Organizational coordination¹ is the glue that makes collaborative performance possible, and important to researchers and practitioners (Mintzberg, 1979; Nonaka & Konno, 1998). It is commonly defined as the process of achieving concerted action (Thompson, 1967), or the managing of interdependencies (Crowston, 1997). Coordination resolves dependencies that result from work division. When tasks exceed individuals' mental, emotional and/ or physical capabilities, they become split up and assigned to different individuals.

The questions *how organizational coordination is achieved*, and *why and how organizational coordination can break down* are important yet complicated. They have

¹ The term 'organizational' differentiates coordination in this study from purely individual coordination processes like planning tasks.

triggered considerable debates amongst social cognition and organization researchers. Theories developed so far can be roughly divided into two categories (Donnellon, Gray, & Bougon, 1986): structure² and process (or structuring) based perspectives. On one hand, organizations can rely on coordinating structures like knowledge and instruments (Hutchins, 1990), scripts (Gioia & Poole, 1984), shared knowledge (Grant, 1996a, 1996b), categories (Bowker & Star, 2002), knowledge structures (Walsh, 1995), plans and procedures (Burns & Stalker, 1961; Snook, 2000), and shared mental models (Levesque, Wilson, & Wholey, 2001). As individuals deploy similar or coherent structures, their individual activities blend in a coordinated fashion. On the other hand, coordination can emerge from interpersonal interactions and stimuli from the environment (Weick, 1979). Exchange of individual perspectives (e.g., narratives) leads to mutual understanding and coordination (Boland & Tenkasi, 1995; Donnellon et al., 1986; Orr, 1996; Van de Ven, Delbecq, & Koenig Jr, 1976).

While these two approaches built the field of organizational coordination, some problems remain. The theories seem in their present state not capable of satisfactorily explaining coordination aspects of organizational improvisation (Zack, 2000), and organizational breakdowns, like the Tenerife disaster (Weick, 1993b), friendly fire disasters (Snook, 2000), the Mann Gulch disaster (Weick, 1993a), midair collisions (ARAIC, 2002; BFU, 2002), aircraft carrier operations failures (Weick & Roberts, 1993), and remote (spacecraft) communications failures (NASA, 1999; Vaughan, 1997). These examples often concern High Reliability Organizations (HRO) that operate under stringent quality requirements. Coordination breakdowns have visible and serious consequences in these types of operations (Schulman, 1993), making them a useful starting point for research.

The examples of breakdowns show limitations of structure and process perspectives that have dominated social cognitive theory. First, the structure perspective has a tendency to think in terms of stable structures that people apply to situations they encounter. It remains unclear how individuals connect situations to structures, how they connect to other people, and why they apply similar structures differently over time (and sometimes unpredictably (McCreary, Pollard, Stevenson, & Wilson, 1998)). Second, the process perspective extends the structural view by emphasizing social interactions and polycentric (inclusive) decision making (Clark, 1996; Polanyi, 1975). However, by focusing on interactions as unit of analysis, these theories treat individuals contributing to organizational coordination as a black box. Third, structure and process

² Structure is commonly defined in terms of rules and resources (Giddens, 1984; Sewell, 1992).

views seem to conceive of individuals as information processors. This paradigm simplifies human functioning, and reduces our capability to explain organizational improvisation and coordination breakdowns. Fourth, the distinction between structure and process based coordination shrouds the interrelationship between the two. Recent studies suggest that programmed coordination relies on processes, while unprogrammed coordination cannot function without some structure (Feldman & Pentland, 2003; Weick, 1998). Finally, coordination is often defined in terms of 'mechanisms' or modes. This gives the impression of a toolbox from which people can select and use mechanisms depending on contingency factors like task uncertainty, interdependence, and diversity. However, research has shown that this simplistic perspective cannot explain accidents in which people have mechanisms at their disposal but fail to coordinate (Snook, 2000).

It seems about time to further unpack the complexity of organizational coordination in order to improve our answers to the questions *how organizational coordination is achieved*, and *why and how organizational coordination can breakdown*. This research continues and extends a few studies that focus directly or implicitly on the individual dimension of organizational coordination. Nonaka (1998) moves beyond considering individuals, groups and organizations as separate units of analysis by proposing spiral evolutionary loops that connect these levels. In his analysis of the Tenerife disaster, Weick (1993) draws attention to the combination of stressful conditions and individual inclinations of the KLM aircraft captain. Weick and Roberts (1993: 357), drawing on Asch (1952), developed the idea of heedful interrelating in terms of collective mind: "Collective mind is conceptualized as a pattern of heedful interrelations of actions in a social system. Actors in the system construct their actions (contributions), understanding that the system consists of connected actions by themselves and others (representation), and interrelate their actions within the system (subordination)". Weick and Roberts' (1993) perspective complements common process theory in two ways. First, the relating aspect of heedful interrelating sketches some aspects of how individuals function internally while participating in a social setting (e.g., representing). Second, the heedful construct refers to an individual level construct. "People act heedfully when they act more or less carefully, critically, consistently, purposefully, etc." (Weick & Roberts, 1993: 361). This illustrates a mode of individual behavior that impacts coordination.

This paper is a first step towards explaining organizational coordination as a function of structure, process, and individual functioning – with an emphasis on the latter. So far it

remains unclear how individuals contribute to organizational coordination in terms of their *Auseinandersetzung* with others and their situational task environment. The objective of this paper is to contribute to that question. I adopt a metaphorical approach for developing theory (Pondy, 1983; Tsoukas, 1991), using the process of human breathing. The remaining of this paper starts with an expose on using a metaphorical approach, followed by an example to illustrate the research topic, and an introduction to the human breathing process. Next, I elicit a conceptual model that is then applied to the phenomenon of individual contributing to organizational coordination. The paper concludes with contributions, limitations, and suggestions for further research.

2 Using Metaphors for Theory Development

With metaphors, people claim that 'A is B, where A and B belong to two very different categories' (Pondy, 1983: 159). Metaphors enable us to interpret a topic (e.g., organizations) in the light of a vehicle (e.g., a biological system) (Donnellon et al., 1986; Tsoukas, 1991). Researchers draw on the identifiable properties of metaphors (vehicle in terms of Fig. 1) to describe and analyze unknown aspects of a phenomenon under investigation (topic).

Metaphors are a mode for disciplined imagination (Weick, 1989). In this research, human breathing is used as a metaphor for analyzing individual contributing to organizational coordination. Breathing can be considered a live metaphor, referring to a biological system³. Tsoukas (1991) outlines a method for letting metaphors inform scientific theory. Fig. 1 depicts these consecutive stages as insight, analogy, and isomorphism, leading towards scientific models.

³ Another example of a live metaphor is an organic organization or strategy, as if it were a biological entity (Burns & Stalker, 1961; Farjoun, 2002).

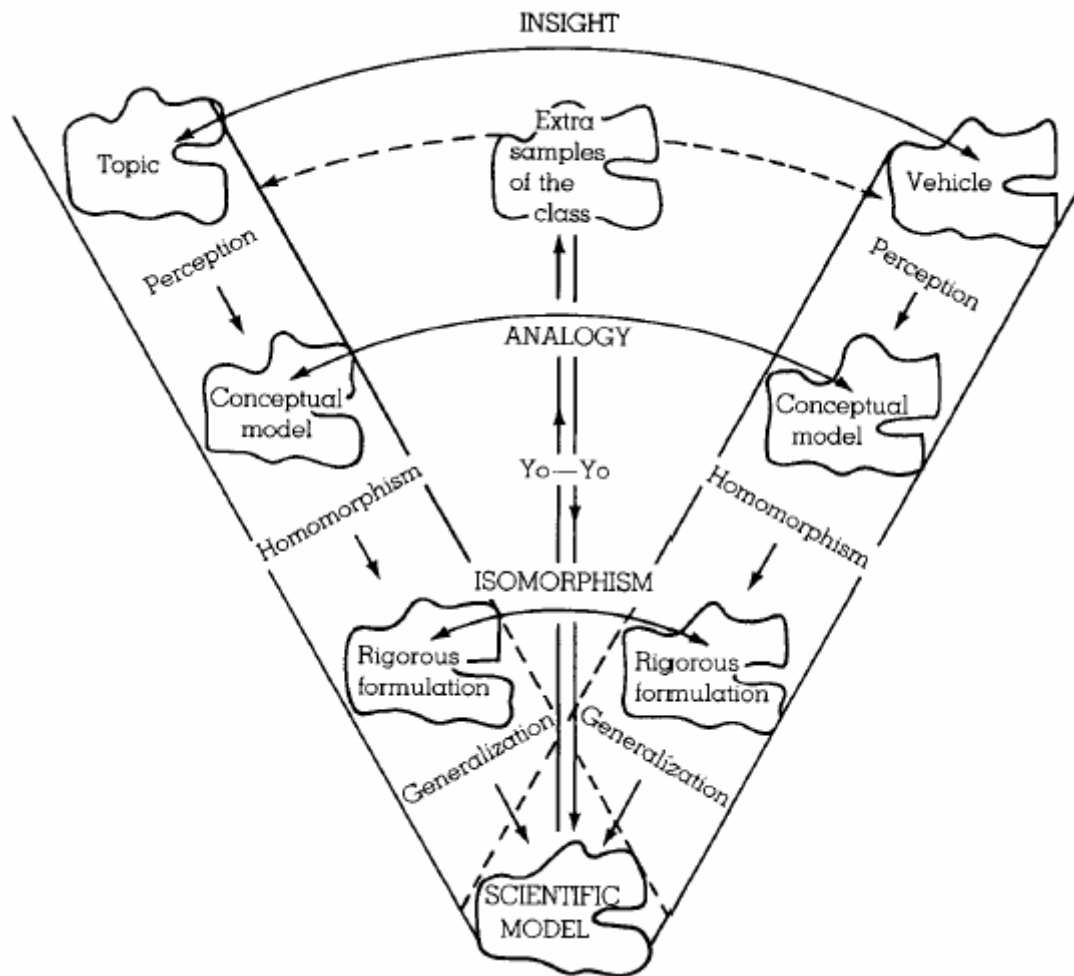


Fig. 1. Metaphorical insights and scientific models (Tsoukas, 1991)

As a first step, insight refers to an initial awareness that a metaphor (vehicle) may contribute to the understanding of a phenomenon (topic). A key reason for adopting breathing as a metaphor (vehicle) is the fact that research stresses internalizing, processing and externalizing aspects of individual contributing to organizational coordination (Weick & Roberts, 1993). Another reason is the similarity in terms of continuity of processes as will be explained later. As far as the topic is concerned, I use an example of a soccer match to illustrate individual contributing to organizational coordination.

Second, analogy encompasses the development of a conceptual model that connects the topic and the vehicle. I develop a conceptual model in terms of principles of breathing that seem relevant to understanding individual aspects of organizational coordination. This development process relied on interpreting the factual properties of breathing, and considering how these might be relevant to explaining organizational coordination from an individual perspective.

And third, isomorphism denotes a more precise formulation of findings that illustrate the linkage between topic and vehicle. This could lead to a scientific model that applies to both the vehicle and the topic. The Yo-Yo effect depicted in Fig. 1 refers to the ongoing process of moving between scientific models as end results, and the analogy and insight (top of figure). Isomorphism and the scientific model are not necessarily reached in all metaphorical studies. This conceptual paper proceeds until the stage of the conceptual model.

3 An Example of Individual Contributing to Organizational Coordination: Moments in a Soccer Match

Before introducing the metaphor, I depict an example of intense interpersonal coordination during a soccer match. The objective of this example is to illustrate the topic as indicated in the method section. The metaphor is applied to the example in a later section. The moments (Fig. 2 - Fig. 5) illustrate the phenomenon of interpersonal coordination in the following manner. A brief sequence of events is shown in a soccer match between the Dutch and the Czech national team during the Euro Soccer Cup 2000 in Belgium and The Netherlands (Strengholt, 2000)^{4, 5}.

During the few seconds represented in the figures, the Dutch player with number 15 on his shirt (Fig. 2, on the left) briefly looks up and observes the Dutch player with number 9 on his shirt (an attacker). Surrounded by Czech defenders with shirt numbers 5 and 16, he shoots (Fig. 3) towards Dutch player 9, who anticipates the ball. Finally, player 9 prepares for receiving the ball (Fig. 4) and scoring (Fig. 5).

The example will be used for illustrating the implications of the breathing metaphor. Before doing that I expand on the biological facts of the human breathing system.

⁴ The Dutch team plays in orange shirts, the Czech team in blue ones. On a black-white print, the Dutch players can be identified by their solid black shorts, the Czech players wear white shorts with stripes.

⁵ If you received a black/ white print, ask the author for the original file with color figures.



Fig. 2. Example: Dutch player with number 15 (facing) observes the Dutch player with number 9 (seen on the back)



Fig. 3. Example: Dutch player with number 15 observes the Dutch player with number 9 and gets ready to shoot



Fig. 4. Example: Dutch player with number 15 shot; Czech defender with number 5 misses the pass. Dutch player with number 9 gets ready to receive the ball



Fig. 5. Example: Dutch player with number 15 observes as Dutch player with number 9 receives the ball (and proceeds to score seconds later). Czech defender with number 16 cannot win the ball back.

4 Breathing: The Facts

'Breathing' as a biological system is used as a live metaphor for analyzing individual contributing to organizational coordination (Tsoukas, 1991). After introducing the objective of the human respiratory system, its structure and process are explained⁶. The next section applies the metaphor to the phenomenon of this paper.

Breathing is an involuntary, instinctive, indispensable, ongoing process that connects humans to the airspace associated with their natural surroundings, or to artificially supplied air (deep sea, airspace, space). Humans can alter their breathing process by engaging in different types of activities (resting, sports), and by selecting to move to other physical space or switching to alternative sources of air. As explained in more detail later, breathing involves a rapid exchange process of gases whereby oxygen enters the organs and cells through the blood, and carbon dioxide leaves the body. Oxygen is a gas needed by cells to extract energy from food. Carbon dioxide is a waste output product that is transported by blood from the cells to the lungs and then expelled from the body.

The structure of breathing depends on the coordinated functioning of the lungs, the heart, the central nervous system, the diaphragm and chest wall musculature, and the circulatory system. I expand on the lungs where the gas exchange takes place. Fig. 6 represents the key elements of the respiratory system. When we inhale, air enters our body through our nose and/ or mouth, and is transported via the windpipe (= trachea). (The esophagus as shown in Fig. 6 is only used for transporting food and drink). From the windpipe, air is distributed to the left or right lung via the right or left bronchi, which connects to bronchial tubes, and then onwards to multiple bronchioles. The bronchioles are tied to tiny sacs (alveoli) of which there are about 600 million, equaling 160 m² (adult body). The alveoli are surrounded by blood vessels (capillaries) of which about 3 million networks exist. The gas exchange takes place here in about 0.25 seconds with oxygen being diffused into the blood, and carbon dioxide leaving the blood through the veins into the lungs. In the alveoli, the blood in the alveolar capillaries is separated from air by about 0.6* (1* = one thousandth of a mm). Carbon dioxide is exhaled following the same path as the incoming oxygen. Pumped by the heart, red blood cells transport

⁶ Sources accessed February 25, 2004: <http://www.lungusa.org>, <http://www.bbk.ac.uk/eh/eng/skc/breath.htm>, http://edcenter.med.cornell.edu/CUMC_PathNotes/Respiratory/Respiratory.html, http://www.lung.ca/children/index_kids.html, <http://sin.fi.edu/biosci/systems/systems.html>, <http://www.saburchill.com/chapters/bio.html>, <http://www.leeds.ac.uk/chb/humbmods.html>

gases between the lungs and the human body. The lungs process 5 liters of blood per minute, which equals the entire blood volume of the body (when people rest). The lungs bring inhaled air to the proper body temperature, and moisturize it for the necessary level of humidity. Air is filtered for dust, micro organisms, and debris.

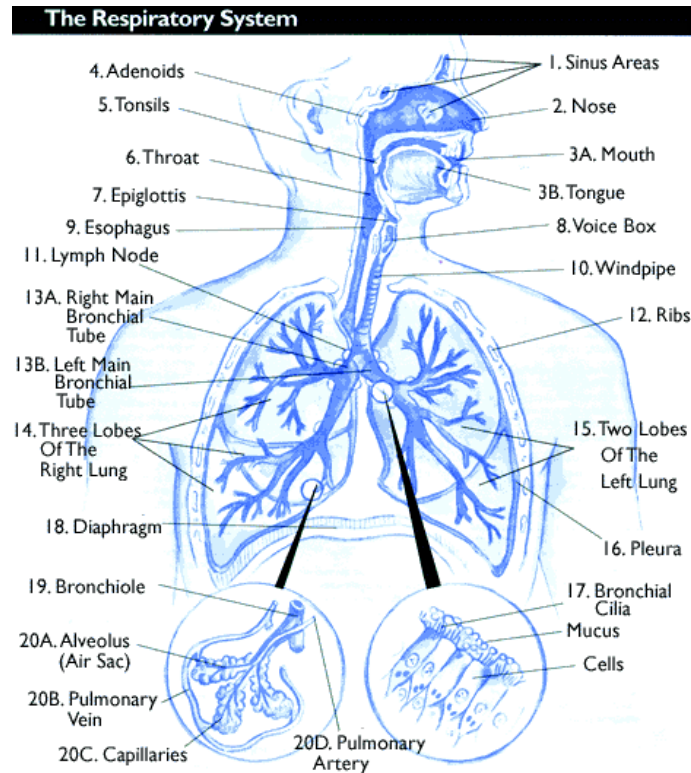


Fig. 6. Human Respiratory System⁷

Inspired air contains about 78% nitrogen, 21% oxygen, 0.03% carbon dioxide, and varying levels of water vapor. Expired air consists of 78% nitrogen (similar to inhaled air), 16% oxygen (slightly less), 5% carbon dioxide (substantially more), and is saturated with water vapor.

While resting, people breath about 15 times a minute, or five to seven dm³ of air per minute. This can increase to 25 times per minute (up to 120 dm³ of air per minute) with heavy exercising. The ventilation of the lungs is mainly regulated by the concentration

⁷ Source accessed Februaru 2004: American Lung Association, <http://www.lungusa.org>

of carbon dioxide. With rising levels, the body responds by increasing the intensity of the breathing process.

5 Conceptual Model

This section develops a conceptual model of individual contributing to organizational coordination. From the breathing metaphor I distill principles that help us frame this phenomenon. The principles extend the information processing paradigm (Galbraith, 1981; Tushman & Nadler, 1978). They are considered in the context of the soccer match example, and compared with structure and process views on organizational coordination.

5.1 Principle 1. Breathing is an ongoing activity

Breathing is an ongoing activity as long people live. People function in a sense continuously (Tsoukas, 1991). They think, feel and/ or act all the time (to some extent even when they sleep). Humans cannot switch off themselves like computers. They cannot persist as structures without processes. In terms of coordination, this implies that people keep on contributing to social situations. The nonstop pace extends the process view on coordination. Usually process theorists think of processes in terms of deliberate feedback loops, group meetings, mutual adjustment (Van de Ven et al., 1976), exchanges (Weick & Roberts, 1993), conversations, and narratives (Boland & Tenkasi, 1995). Breathing adds to this notion the idea that as long as people are somehow connected to others, they contribute as individuals. Transposed to the metaphor, people could deliberately breathe the same air (resembling intentional communications). But usually they just use the same airspace without intentionally inhaling of a specific other person. In other words, coordination (breathing) does not require communication (explicit attention to mutual expressions).

In terms of the soccer match events, coordination occurs as long as people continue at least 'inhaling' the situation and processing it internally. Even people not involved in the heat of the moment coordinate with their peers by watching and listening. (Here the action involving Dutch attackers and Czech defenders.) In fact, the event figures show that while the core coordination process evolves between the two Dutch players, the Czech defenders are also closely tied to the situation. They watch the ball and other players carefully, trying to intervene to their team's advantage.

5.2 Principle 2. Breathing connects individuals with their surroundings

As people inhale, outside air enters their body through an intricate network of pipes. Then, the air enters the lungs, and through the alveoli the blood. Oxygen is then transported to any part of the body. Conversely, waste gas is carried off by the blood to the lungs, and from there exhaled to the outer world. How can this be mapped to the topic of individual contributing to organizational coordination? When one thinks of the soccer example, the players continuously internalize the surroundings using their senses. They listen to yelling and movement, they can watch with an almost 180 degrees angle. The figures show how concentrated players watch while they are playing as every second – literally – counts (Weick & Roberts, 1993). The metaphor suggests that players internalize impressions in a continuous and intense manner. They process these impressions in an intricate manner, and respond with the next move (Pentland, 1992). Externalized communications and moves become part of feedback loops with other players. The quality of organizational coordination thus depends on the completeness and ongoing nature of feedback loops between individuals and their surroundings.

5.3 Principle 3. Breathing is a complex, individual activity

Coordination means that individual contributions blend in a concerted fashion (Donnellon et al., 1986; Thompson, 1967). Coordination is therefore a mixture of individual functioning (thinking, deciding, acting, communicating), and the fitting in of that contribution in a larger collective. Structure-based theories claim that shared structures drive individual functioning such that coordinated action results (Chwe, 2001). Process-based theories emphasize the interlocking of individual processes. As people exchange, they incorporate other people's worlds while sharing their own (Boland & Tenkasi, 1995). This 'transfusion' process molds individual functioning and results in concerted outputs.

The breathing metaphor principle described here contributes to these insights by emphasizing the individual unit of analysis. Breathing is primarily an intra-individual process. Outside humans, only gases exist like oxygen and carbon dioxide. The complex processes of exchanging, modifying, and moving gases occur *within* a person. This complex internal process is connected to people's outer world through inhaling and exhaling.

In the soccer example, at the core it is the players who make the game interesting. Apart from these individuals, only artifacts like the ball, the grass field, and two goals characterize the environment. The individual players are at the center of processes. They have been trained to coordinate adaptively as a team within ex ante structures like regulations and the physical surroundings. The flux of action looks like a team activity, but ultimately boils down to individuals. These people are capable of creative internal processing that is externally connected.

5.4 Principle 4. Breathing involves multiple aspects of a human

Over the past decades, paradigms underpinning theories of organizational coordination have broadened. Initially, people were conceived of as information processors. This emphasized the cognitive dimension of individual contributing. More recently, organizational researchers have recognized the role of human energy (Quinn & Dutton, Forthcoming), moods (Ciborra, 1991), and emotional and physical aspects of individual functioning in collaborative settings (Hatch, 1999).

Breathing builds upon and extends these insights. It is primarily a physical process that functions non-stop. In addition, we (can) influence and modify our breathing by our emotional state (like when we are shocked), our mind (we can imagine strategies like holding our breath for a while, or moving to another space in order to inhale different air), and our intention (we can decide to enact these strategies). Similarly, the soccer players draw upon a multitude of resources as they cooperate. They use their mind (trained concepts, knowledge about the opponent), their body (moving, sensing, adrenaline), their intention (motivation), and emotion (togetherness with team mates, maybe some antagonistic feelings towards the opponent). These different aspects operate in close connection and to a certain extent in parallel.

5.5 Principle 5. Breathing relies on multiple interrelated structures, and it blends structure and process

Researchers usually define structures in a variety of terms like mental models (Day & Kovacs, 1996; Levesque et al., 2001), frames, schematas (Walsh, 1995), categories (Bowker & Star, 2002), scripts (Gioia & Poole, 1984) and the like. Structures operate separately from processes and at different levels (individual, group, organization) (Sewell, 1992; Walsh, 1995). This perspective can be complemented by the breathing metaphor in two ways.

First, breathing illustrates that coordination involves multiple interrelated structures. Breathing structures can be identified as a complex apparatus including the mouth and nose, pipes, lungs, the heart, and blood transportation means. These are interrelated and interdependent. Without the pipes, the mouth would not be connected to the lungs, without the alveoli no gas exchange could take place.

Second, this apparatus only functions and survives through processes. *Structure and process could be distinguished for analytical purposes, but not operationally.* Structures have emerged through processes, processes need structures as carriers. Structure without process deteriorates. Process without structure is impossible. This means that we must study structures in the light of processes, and processes in the light of structures.

Translated to the soccer match example, the first contribution – interrelated structure – suggests that the players bring together a variety of structures as they play. Grant (1996a, 1996b) already suggested that people rely on multiple structures for coordination. Some examples of structures relevant to a soccer match include:

- The soccer game with its generic concepts, rules and regulations
- The event organization (here Euro Soccer Cup 2000)
- The match organization (time/ space configurations, organizational details)
- The team organization, with all regulations, routines, and resources
- The team itself with its structure for operating
- Language structures used in the team and used for interacting with opponents and arbitrators
- The structure of the particular game being played
- Internal mental structures (like tactics, techniques, perceptions, strategies), emotional structures (patterns of response to events), and physical structure (a trained body)

These generic and individual-specific structures contribute to a platform for organizational coordination. During the heat of the play, players draw upon and extend these structures continuously.

The second contribution – blending of structure and process – means that the structures only become relevant when they are used in action. The variety of structures in a match are operationalized and expressed through processes (Feldman &

Pentland, 2003). The process as flux refers to the dynamic and interconnected individual contributing to organizational coordination. When the quality of organizational coordination is explained from individual contributing, we must recognize both the structures individuals use, and how they use them (i.e., the process). Structural failures (like an inappropriate game plan) can be compensated by adaptive processes. With process flaws, organizational coordination could rely on structural backbones (like a common technique within the team).

5.6 Principle 6. Breathing is adaptive within bounds

Finally, breathing is a highly adaptive, elastic phenomenon yet within bounds. Its adaptiveness stems from the breathing system's growth over time, and the capability to accelerate processing capacity when people exercise. People can adapt their breathing to some extent to circumstantial demands. Prolonged training alters the capacity of the breathing system, like someone training for a marathon. In principle, the human body can handle this change of process pace. At the same time, the fundamentals of the breathing system itself hardly change. The way the system functions remains basically similar. The system is constrained by the human-internal (health) and human-external (availability of oxygen) conditions.

Likewise, individual contributing to organizational coordination is adaptive within bounds. It changes naturally on the long term, and might be deliberately changed through training and socialization. Individual contributing is by the same token path dependent – it must take the past into account (Kenney & von Burg, 1999). These properties of individual contributing translate to an organizational level. Organizational coordination is adaptive and constrained. Its adaptiveness depends on situational versatility of participants, while its constraints are defined by the path dependent nature of individual contributions.

In terms of the soccer example, on one hand individual contributing might change during the match and over the course of the season. People might become more experienced and improve their contributing. Or during a single game, they become tired towards the end of a match and become withdrawn. On the other hand, fluctuation of individual contributing (and thereby modification of organizational coordination) is expected to occur within certain bounds. A player's contributing will improve or deteriorate within a certain bandwidth. This suggests that organizational coordination could be compared to another metaphor: an elastic cord. It can be stretched to a

certain extent, but must return (inhaling) at some point to its original shape. Beyond these boundaries organizational coordination can breakdown.

6 Discussion and Conclusion

This paper contributes to a social cognitive theory perspective on individual contributing to organizational coordination. Breathing extends the human-as-machine paradigm that underpins many information-processing theories. Breathing in, people pay attention with their senses to cues and stimuli in their environment (looking at other players in a match). These perceptions are internally represented, interpreted and ordered using what is referred to as mental models, scripts, or frames of reference.

People construct interpretations and temporary structures of the world they participate in. Metaphorically speaking, they extract, add and change the gases in the air they breathe in. Breathing out could be understood in terms of shaping contributions for the outer world. In a situation of task interdependence, individuals subordinate their functioning to their external world, including other individuals.

By using human breathing as a metaphor for individual contributing, we extend structure and process views. First, we extend structural theories. These approaches commonly perceive organizational coordination in terms of common structures that lead to concerted action. With structures as unit of analysis, humans do not seem to play an explicit role in this context. Breathing stresses the mutual dependence of structure and process, and the internal complexity of the apparatus available for processing. It also emphasizes the adaptive nature of structure, and the multiple types of structure that interplay in collaborative activity.

Second, the paper complements process-based views of organizational coordination. Breathing emphasizes processes as not only exchanges, but as ongoing connectors of humans' inner and outer worlds. Confirming research on organizational improvisation, processing in the sense of breathing relies on multiple aspects of human functioning (mental, emotional, intentional, and physical aspects). Finally, the breathing metaphor proposes that individual contributing is an ongoing activity. This means that organizational coordination does not only depend on deliberate exchange processes (like swapping narratives). It also relies on people's ongoing – and maybe unconscious – inhaling of a situation and how other people act.

The result of this metaphorical research is that we know more about the internal functioning of individuals; about the interoperability of structures and process; and about an extension of the mechanisms perspective. People contribute with their internal and external functioning as they interrelate, interpret, and shape contributions. They breathe in and out, exchanging air as a common and individual resource.

Limitations of this study are, first, the lack of empirical research. We used the example merely as illustration. Second, we followed the metaphor method until the conceptual model stage (Tsoukas, 1991). Further research might counteract these limitations. We hope that this work leads to research on topics like organizational breakdowns, organizational change, elasticity of organizational coordination, knowledge sharing, knowledge integration, conflict resolution, and group collaboration by means of electronic media.

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