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Networked Flow
Towards an Understanding of Creative Networks

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ISSN 2211-1921
ISBN 978-94-007-5551-2
DOI 10.1007/978-94-007-5552-9
Springer Dordrecht Heidelberg New York London

ISSN 2211-193X (electronic)
ISBN 978-94-007-5552-9 (eBook)

Library of Congress Control Number: 2012948633

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

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Chapter 1
Introduction from Creativity to Creative Networks

Abstract This chapter introduces the concept of "creative networks" as an object of study, discussing how it relates to individual and group creativity. In particular, the following questions are addressed: how do creative networks emerge? How do they evolve? Why are some creative networks more successful and productive than others? To answer these issues, we introduce a framework—"Networked Flow"—which is based on three conceptual pillars. First, we theorize that creative collaboration is enhanced when the members of the team experience high levels of social presence. In this context, we regard social presence as a process that leads the group to develop a "we-intention", in which actions of the individuals and those of the collective are in balance, and a sense of mutual trust, sharing, and empathy is established. Further, we argue that when such optimal collective experience is reached, group-level emotions are shared and embodied in novel and useful ideas, which are able to produce a long-term change relevant both for the team and for the individual members. Second, we describe the development of creative networks as a staged process, which begins with the co-construction of a shared frame and culminates with the creation of a novel artifact or concept. In our view, the relationship between the process (group collaboration) and the product (the emergence of a novel artifact or idea) is a bi-directional one; the creative product affects the structure of the frame, which in turns affects the unfolding of meaning. Similar to stigmergic interaction, in which agents coordinate actions by making and sensing changes to a shared environment, the creative product provides an extra-somatic memory of group interactions and emotions, which ultimately shapes the complex dynamics of team interaction. Third, we speculate that the emergence of optimal group experience is associated with structural changes in group dynamics, which can be effectively investigated using social network analysis techniques. The article is organized as follows. The first part provides a thorough analysis of the key theoretical concepts and terms. In the second section, the Networked Flow model is summarized in its cognitive, psychological, and methodological components, which will be further discussed throughout this book.

Keywords Creativity • Group creativity • Creative networks • Group collaboration • Flow theory • Group flow • Social network analysis

A. Gaggioli et al., *Networked Flow*, SpringerBriefs in Education,
DOI: 10.1007/978-94-007-5552-9_1, © The Author(s) 2013

1.1 Creativity as a Complex Sociocultural Phenomenon

A theory which revolutionizes the way we think about a certain subject. Technology which simplifies the production of an item. A treatment which saves human lives. A piece of music, a painting, a sculpture, a poem… All of these examples are the result of a creative process. In the scientific world, the concept of creativity has been interpreted in a number of ways. Amabile (1983) identifies creativity with the production of new and useful ideas. Getzels and Jackson (1962) define creativity as the capacity to combine things in new ways; for Bruner (1962, p. 37) it is the production of something which provokes effective surprise. More generally, creativity can be defined as the ability to create objects, artifacts, or thoughts which may be defined and recognized as original and unexpected, high in quality, and appropriate (Sternberg and Lubart 1996). For many years research into creativity focused on the psychological characteristics of the innovators. The studies based on this outline attempted to examine the peculiar features of creative individuals, such as personality traits, cognitive abilities, motivation, developmental experience, and culture (Barron and Harrington, 1981; Mumford and Gustafson 1988; Sternberg and Lubart 1999). In the last 20 years, however, there has been a growing interest in the social and contextual aspects of the creative process (Amabile 1996; Csikszentmihalyi 1999; John-Steiner 2000; Sawyer 2003, 2009; Glăveanu 2012). Increasingly, it was recognized that individuals are situated in social environments, which can either facilitate or obstacle their creative potential. This led researchers to shift the emphasis from the "internal" to the "external" determinants of creativity (Amabile 1983). As one of the pioneers of this approach, Mihaly Csikszentmihalyi puts it:

"We cannot study creativity by isolating individuals and their works from the social and historical milieu in which their actions are carried out. This is because what we call creative is never the result of individual action alone; it is the product of three main shaping forces: a set of social institutions, or *field*, that selects from the variations produced by individuals those that are worth preserving; a stable cultural *domain* that will preserve and transmit the selected new ideas of forms to the following generations; and finally the *individual*, who brings about some change in the domain, a change that the field will consider to be creative… Creativity is a phenomenon that results from interaction between these three systems" (1988, pp. 325–326).

In the sociocultural approach to the study of creativity, the role of the individual is not diminished, but incorporated in a specific social context which acts as a "cognitive breeding ground" for the development of ideas (Di Maggio 1997). From this point of view, it is not enough for an individual to be endowed with wits and originality in order to bring about radical change; it is also necessary to have a social organization that supports and values his work. This point is illustrated by the notion of "heterogeneous engineer" introduced by Law (1987). This concept identifies particular individuals who are intellectually gifted and who succeed in getting their ideas accepted in a specific social context, thanks to their ability

to understand the interests of those who are able to promote their ideas. A heterogeneous engineer is characterized by advanced technical competency, and also by even greater social competency. This is the case with particularly innovative figures in the scientific field of the late nineteenth and early twentieth centuries. For example, Thomas Edison's scientific knowledge was strengthened by his ability to find financial and political support; suffice it to say that Thomas Edison is remembered as the inventor of the incandescent light bulb, though few have noted the political skill he used to ensure that the electrification of the United States took place according to his plans for domestic electrical energy (Hughes 1983).

In order for a creative idea to be adopted, recognition from qualified individuals is required. This step, however, is not always automatic. The psychologist Simonton (1984, 1988) has emphasized that creative people are capable of producing a large amount of ideas in various fields, but only a small number of these ideas are recognized and accepted by the community of reference. For example, the innovative importance of Gregor Mendel's studies on heredity was recognized only many years after his death, when a group of English geneticists realized the implications of his research for the theory of evolution. Similarly, the music of Johann Sebastian Bach was considered outdated by his contemporaries and was ignored for several generations (Csikszentmihalyi 1996). Innovative ideas are not truly useful if they remain confined 'within the mind' of their creators; they must be communicated to others so that other people can judge them and, if necessary, modify them. Finally, there is a dimension of social evaluation relating to recognition from the community, which can motivate (or discourage) further creative activity (Fischer et al. 2005, 2007).

Research into sociocultural nature of creativity has also contributed to underlining the importance of financial, economic, and historic factors in the development of creative progress. These studies have, in particular, highlighted that great innovations do not crop up randomly through history, but they tend to surface in specific periods, which constitute the moments in which creative movements are most likely to develop. For example, based on the analysis of various case studies, Simonton (1994) has noted that phases of social upheaval (such as periods of civil rebellions and oppressive regimes) are often followed by phases of great creative progress which tend to begin approximately 20 years after the revolutionary events.

The analysis of the social dimension of creativity has been significantly stimulated by research on organizational settings (Woodman et al. 1993; Amabile 1996), which has investigated, in particular, the role of creative collaboration in work groups and its importance for an organization's ability to cope with the demands of a rapidly changing world (Paulus and Nijstad 2003). An influential model of organizational creativity has been proposed by Woodman et al. (1993), who argue that individual creative behavior is input for group creative behavior, which in turns informs the organizational creative behavior that together with environmental and contextual influences (such as reward systems, organizational culture, etc.) can eventually result in the creative product.

From a theoretical viewpoint, a significant contribution toward the shift of emphasis from individual to collective accounts of creativity has been given by

the rise of the distributed cognition framework in the mid-1980s. This approach is concerned with how cognitive activity is distributed across human minds and how intelligent behaviors emerge from the interactions with external cognitive artifacts (Hutchins 1995; Salomon 1993; Sawyer and DeZutter 2009). In line with this theoretical stance, Sawyer and DeZutter (2009) introduced the concept of "distributed creativity" to refer to "situations where collaborating groups of individuals collectively generate a shared creative product" (p. 82). Within the distributed cognition perspective, creativity is the result of the transactions and interactions occurring between the individual and the environment, which includes the physical space in which the work is carried out and the various kinds of artifacts that are used. Take the example of jazz improvisation: this type of creative activity does not only involve the musicians who make up the ensemble, but also the musical instruments, the record companies, the recording studios, and the concert halls. The availability and quality of these structures influence the musicians' creative performance (Borgo 2006). As noted by Becker (1982):

"Artists use material resources and personnel. They choose these out of the pool of what is available to them in the art world they work in. Worlds differ in what they make available and in the form in which they make it available…. What is available and the ease with which it is available enter into the thinking of artists as they plan their work and into their actions as they carry out those plans in the real world. Available resources make some things possible, some easy, and others harder; every pattern of ability reflects the workings of some kind of social organization and becomes part of the pattern of constraints and possibilities that shapes the art produced" (p. 92, quoted in Uzzi and Spiro 2005).

These resources can also encompass the tools that creative people use to express themselves and collaborate to generate new knowledge. Examples include computer-supported collaborative work and computer-mediated communication tools. Fischer and colleagues (2005) define the sum of these material and social resources as the "socio-technical environment". For these authors, socio-technical resources, such as computer tools, increase a community's creative potential through a process of externalization, which allows its members to (a) create an external record of their thoughts; (b) pass from the abstract conceptualization of an idea to its concrete representation; (c) make thoughts and intentions accessible for personal reflection; and (d) provide a medium through which other individuals can interact, negotiate concepts, and develop new ideas (p. 28).

Looking at these definitions, it becomes clear that creativity is increasingly regarded as a complex phenomenon, which does not take place in the mind of a single person, but arises in the dynamic transactions among individuals and the environment in which they are situated. Consistent with this view, in this book we will refer to a "*creative network*" as a socio-technical system which self-organizes to generate new knowledge through the interactions between the individuals and artifacts of which it is made up. We use the term "network" instead of "group" to emphasize the intrinsic socio-technical nature that characterizes a creative system. To understand how complex creative production may be within such creative networks, it is useful to refer to the concept of the "art world", defined by Becker as

"the network of people whose cooperative activity, organized via their joint knowledge of conventional means of doing things, produce(s) the kind of art works that art world is noted for" (1982, p. x). According to this notion, the artist is not a special individual who creates meaning through his work, but he is instead a professional who has made use of certain conventions of the sector in which he works, and who carries out only a part of the collective work necessary to produce a piece of art. One of the key elements in describing the art world is the idea that it is the result of a process involving the division of tasks and other productive activities. In fact, the production of a work of art requires the collaboration of a considerable number of people and the diversification of roles. Think of the role played by the gallery manager in figurative arts, or of the importance of the music producer. From what has thus far been said, it is clear that the artist himself, traditionally considered as someone who creates with absolute freedom, is in fact only one tessera in the much greater mosaic which represents the world of art. This view is particularly appropriate for describing the creative processes underway in the modern world. In our culture the majority of artistic, scientific, and technological production is the result of collaborative activity involving experts and often requiring the integration of knowledge from different fields. The challenge then becomes how to develop an approach that is able to embrace the inherently complex nature of creative networks as an object of study. In particular, the following questions arise: How do creative networks emerge? How do they evolve? Why some creative networks are more successful and productive than others? In this chapter, we will attempt to address these issues by introducing a framework—"Networked Flow"—which is based on three conceptual pillars. First, we theorize that creative collaboration is enhanced when the members of the team experience high levels of "social presence". In this context, we regard social presence as a process that leads the group to develop a "we-intention", in which actions of the individuals and those of the collective are in balance, and a sense of mutual trust, sharing, and empathy is established. Further, we argue that when such collective intentionality is reached, group-level positive emotions are shared, and embodied in novel and useful ideas, which are able to produce a long-term change relevant both for the team and for its individual members.

Second, we describe the development of creative networks as a staged process, which begins with the co-construction of a shared frame and culminates with the creation of a novel artifact or concept. However, the group is not necessarily able to promote and share these new products outside its boundaries. In order for this to happen, two things are required: (i) the existence of interactions between group members and people outside the group—characterized by high levels of social presence—which make use of the new concept/artefact (ii) the creation of narratives which link the new artefact/product to old ones allowing people outside the group to make sense of it (internalization). In our view, the relationship between the process (group collaboration) and the product (the emergence of a novel artifact or idea) is a bi-directional one: the creative product affects the structure of the frame, which in turns affects the co-creation of meaning. Similar to stigmergic interaction, in which agents coordinate actions by making and sensing changes to a shared environment (Elliot 2006), the creative product provides an extrasomatic

memory of group interactions and emotions, which ultimately shape the complex dynamics of team interaction.

Third, we argue that the emergence of optimal group experience is associated with structural changes in group dynamics, which can be effectively investigated using social network analysis techniques.

The rest of the chapter is organized as follows. The first part provides a thorough analysis of the key theoretical concepts and terms. In the second section, the Networked Flow model is summarized in its cognitive, psychological, and methodological components, which will be further discussed throughout the book.

1.2 From Creative Genius to Creative Networks

It is widely known that the people who surround innovators play a fundamental role in contributing to the realization and the diffusion of their ideas. By analyzing the history of great creations in different fields—science, art, politics, literature—it is possible to see that most great innovators are part of an intellectual community in which they can share their thoughts and discoveries. At the center of this creative network are charismatic and visionary leaders who are able to tune themselves into the times and culture in which they live, and to make the most of challenges and opportunities. It is, for example, well known that Leonardo da Vinci had a key role in supporting artists' and sculptors' organizations, as well as other artists who worked to help him produce his masterpieces. In this sense, it can be affirmed that da Vinci was the "engine" of a network of talented artists and scientists who shared his vision and assisted him in communicating it, also benefiting from the "creative chaos" which characterized Renaissance Italy (Gloor 2006). The people who surround these leaders form the "creative network" which helps them to develop and spread their innovations. Psychoanalysis developed, thanks to group meetings and impassioned discussions that regularly took place on Wednesday evenings at Freud's home. Initially, restricted to a limited group which included Stekel, Adler, Kahane, Reitler, and Freud himself, the *Mittwochsgesellschaft* was progressively extended, leading to the widespread and influential psychoanalytic movement. At more or less the same time, Albert Einstein and some friends founded a club named "The Olympia Academy", which used to meet at Einstein's house in Bern to discuss philosophy and physics. Other well-known examples of creative networks can be drawn from the history of art. Pissarro and Degas enrolled themselves in the Ecole des Beaux Arts at the same time, then Pissarro met Monet and Cézanne at the Académie Suisse, and the circle was later enlarged to include Renoir. Their meeting place was the Café Guerbois, where the heated discussions of these artists gave birth to the Impressionist movement. According to the sociologist Randall Collins, who has studied creativity in groups of intellectuals and philosophers, a creative network attracts new members through a mechanism of "emotional contagion" which comes into action in situations of confrontation and debate, such as an academic lecture, a seminar, or a conference.

These group interactions—defined by Collins as "interaction rituals"—are able to "charge up" the participants "like an electric battery, giving them a corresponding degree of enthusiasm toward ritually created symbolic goals when they are out of the presence of the group" (Collins 1998, p. 23). The term "interaction ritual" was proposed by Goffman (1967), but the way in which Collins employs it was mainly inspired by Durkheim's religious rituals (1965). The religious rituals described by Durkheim are "archetypes of interactions which bind members into a moral community, and which create symbols that act as lenses through which members view their world, and as codes by which they communicate" (Collins 1998, p. 21). Through ritual interaction, the participants develop a reciprocal "moral link", which is symbolized by any object on which the group focuses its attention during this ritual interaction; the store of collective symbols can be regarded as a type of cultural capital. Collective symbols facilitate successive ritual interactions, as they can transmit emotional energy to groups of people who attach value to the same symbols. For example, when there is strong consensus in a community about an intellectual leader, he or she will then become a sacred object for the group. Creative intellectuals such as Hegel, Marx, and Aristotle thus become "brands" which symbolize entire thought systems (*ibid.*). Interaction rituals can reaffirm pre-existing truths or create new ones, and whether they are reverent or iconoclastic, they are able to create a chain which connects previous interactions with future ones. Due to the cumulative effect of these chains of interaction rituals, the participants acquire a personal stock of cultural capital (which can be defined as the sum of experiences, knowledge, and relationships that an individual acquires in the course of their life), which is loaded with collective meaning. The members of the network also acquire a certain emotional energy which provides them with the motivation to make use of their cultural capital. Since emotional energy is embodied in symbols like words and images, experiences such as reading and even reflecting upon others' thoughts have the power to influence an individual's emotional energy. In this sense, both reading and reflection can be seen as "empathetic" ritual interactions, in as much as the individual can participate and be exposed to emotional contagion. In Collins' opinion, the flow of emotional energy within a creative network helps to explain a recurrent phenomenon in the lives of innovators; the people who become leading figures in a given field are often linked to one another from their early education. For example, Hegel, Schelling, and the poet Hölderlin were all schoolmates in Tübingen, and so they met each other long before any of them made any intellectual achievements. It is well known that the group of friends often took part in heated discussions, which at times had an explicitly ritualistic character, such as on occasion of the enthusiastic celebrations of the French Revolution.

But why do all collaborating groups not reach the same creative potential of the *Mittwochsgesellschaft* or the Impressionist group? What are the factors that affect collaborative effectiveness? Is it really true that in creative collaboration, the group is "more that the sum of its parts"?

These issues have been investigated from different perspectives and by different areas of study, including cognitive psychology, organizational psychology, and

information systems. The reflection on the added value of collaboration to creativity dates back to 1957, when Alex Osborn developed brainstorming as a technique to support idea generation in groups. Over the following years, the development of this approach has generated a number of studies which have investigated the key factors that support brainstorming, under the general assumption that group brainstorming is associated with higher creative performance than individual brainstorming. However, the bulk of evidence suggests that this superiority is not proven, and group brainstorming can even lead to less ideas produced. A well-accepted explanation of this phenomenon is the "production-blocking effect", which is due to the fact that group members must take turns expressing their ideas and this results in a cognitive interference that hinders the generation of ideas (Nijstad and Stroebe 2006; Nijstad et al. 2003).

Paulus and Brown (2003, 2007) have developed a cognitive-social-motivational model, which provides a basis for understanding group creative processes for ideational tasks. They argue that the creative process occurring in groups has two key dimensions: a social dimension, since it results from the interaction with other individuals; and a cognitive dimension, because group members share each other's ideas, views and information. The model holds that in order to achieve high levels of creativity, group members need to focus their attention deeply on the activities of the other participants. By focusing on others' ideas, new insights can be stimulated, new knowledge can be accessed, and more elaborated combinations can be generated. However, allocating attention and avoiding distractions is only the first step; the shared ideas must be further processed and elaborated by participants, and this involves the ability to understand, remember, evaluate, and integrate the shared information. These abilities, in turn, can be affected by group context factors, such as the structure and the motivation of the task.

Amabile's componential theory (1983, 1988, 1996) suggests that team creativity encompasses the same stages of individual creativity, namely (a) Problem presentation and task identification, (b) Preparation (which involves the team developing or reactivating relevant knowledge), (c) Response generation (in which the team generates several novel ideas), (d) Response validation and communication (where ideas produced by the team are evaluated against factual knowledge or other criteria), and (e) Idea selection (the outcome of the process, which can be the selection of the idea or the restart of the process).

Another influential conceptualization of group creativity was proposed by Taggar (2002). This model posits that group creativity is affected by personality variables (such as conscientiousness, agreeableness, and extraversion) and general cognitive ability. These variables affect group-level processes through their effects on individual creativity; on the other hand, group-level creativity relevant processes (i.e., inspiring group members to elevate their goals, providing feedback and individualized consideration, asking for and recognizing different ideas) affect the way in which individual contributions lead to group creativity.

Taking a sociocultural perspective on the study of group creativity, Sawyer (2007) analyzed in detail the behavior of several improvisational teams in various creative areas (theater, jazz), and observed that the majority of successful

teams are distinguished by their ability to reach a state of "*group flow*", defined as "a peak experience, a group performing at its top level of ability" (p. 43). For example, in communities of jazz improvisers, it is not unusual for musicians to talk about the importance of developing a "group mind" during a group session (Sawyer 2003). This calls for the musicians to cultivate a feeling of trust and empathy toward the other members of the band, and to reach a state in which the actions of the individuals and the group are in harmony with each other. The concept of flow was originally introduced by Csikszentmihalyi (1975, 2000), who described it as a state of consciousness characterized by global positivity and a high level of complexity, in which the perception of a higher-than-average opportunities for action (challenges) is coupled with the perception of appropriate skills. Other peculiar characteristics of this experience include high levels of concentration and involvement in the task at hand, enjoyment, a positive affective state, and intrinsic motivation. Furthermore, during flow there is a complete fusion between action and awareness, and the individual feels complete control over his own actions and environment. A number of studies indicate that flow shows constant features at the cross-cultural level, and it can be associated with various daily activities, provided that individuals perceive them as complex opportunities for action and involvement (Massimini and Delle Fave 2000). While Csikszentmihalyi investigated flow mainly at the individual level, Sawyer (2003, 2007) extended this concept to the study of group collaboration, with the purpose of understanding which features facilitate optimal group experience and its relationship with creative performance. Sawyer identified several conditions which facilitate the occurrence of this optimal state (pp. 44–57):

- the group's goal: group flow develops more easily if the group members share an understanding of the objectives to be achieved together;
- close listening: it is important to develop good listening skills in order to harmonize with team members: this requires focusing on the content of what the others are saying, and reviewing the relevant information;
- complete concentration: group flow is facilitated when the group is able to draw a boundary between its activities and everything else occurs;
- being in control: optimal group experience is likely to increase when team members feel autonomy, competence, and mutual connection;
- blending egos: to reach group flow, participants must have the ability to submerge their egos to the group mind, to balance their own voices with deep listening; this is the key moment when the group is in perfect harmony and the barriers between individual intention and collective intention disappear;
- equal participation: optimal group experience is more likely to occur when all participants play an equal role in the creation of the final performance;
- familiarity: a group is more likely to reach a state of flow if members of the team know the performance styles of their teammates and their opponents. This characteristic, which is necessary to develop implicit knowledge, is acquired as the experience continues through time;
- communication: in order for group flow to come about, constant communication is required, preferably spontaneous and informal;

- moving it forward: this condition calls for the ability to build on the ideas of others, making the most of the ideas and abilities of all group members in order to tackle and overcome any difficulties;
- the potential for failure: group flow is more likely to occur when there is the potential for failure, whereas it is less likely in 'safe' situations where mistakes do not affect the consequences.

According to Sawyer, group flow is a collective state of mind which "cannot be reduced to psychological studies of the mental states or the subjective experiences of the individual members of the group" (2003, p. 46). In other words, group flow cannot be broken down into the work of individuals; it is a phenomenon which emerges from the interactions occurring within a group, and which is able to positively influence the overall performance. Furthermore, Sawyer holds that the achievement of group flow involves a balance between the extrinsic/intrinsic nature of the goal and pre-existing structures shared by the team members (for example know-how, instructions, repertory of cultural symbols, set of tacit practices etc.). An extrinsic goal, according to Sawyer, is characterized by a specific and well-defined objective (i.e., how to fix a bug in a software) and therefore requires more shared structures to be achieved. In contrast, an intrinsic goal is largely unknown and undefined (i.e. the task faced by an improvisation group in theater) and therefore it requires less shared structures to be achieved (2003, p. 167). Sawyer suggests that the group flow concept can be applied in several collaborative settings, including those occurring in educational contexts (2003).

1.3 The Role of Social Presence in Creative Networks

According to Sawyer, group flow is the key to understand group creativity in collaborative settings (2003, 2007). However, the concept of group flow has been analyzed mainly from a phenomenological perspective, whereas there is lack of discussion about its cognitive underpinnings. Actually, Sawyer argues that group flow is an emerging property of creative groups, which cannot be reduced to the analysis of the mental processes or subjective experiences of the individual members. For this reason, the concept of group flow is not easily studied at empirical level. From the methodological viewpoint, group flow has been mostly studied in face-to-face collaboration settings. However, the application of this model for studying collaboration in mediated communication environments presents new challenges and questions for researchers. According to the group flow theory, the synchronization of action and thoughts (i.e., physical closeness, echoing of gestures and phrases) is an important dimension of the group flow experience. How is this synchronization achieved within virtual collaborative environments? Is physical co-presence a pre-requisite for optimal experience? And what happens to group flow when members of the team are not physically, but only virtually

present, such as in a chat room? The concepts of "presence" and "social presence" provide a useful starting point to address these issues. According to Riva and Waterworth (2003), presence is a selective and adaptive neuropsychological process that allows the definition of the boundries of action by means of the distinction between "internal" and "external" within the sensory flow. More specifically, from an evolutionary perspective, presence has three functions:

- To permit the subject to position himself in a space—real, virtual, or social—through the distinction between "internal" and "external" and the definition of a boundary;
- To check the efficacy of the subject's actions through the comparison of intention and the result of the action;
- To allow its own evolution through the identification of "optimal experiences" (flow) and the incorporation of the artifacts—physical and social—linked to it.

In other words, thanks to presence, an individual is able to situate himself in a physical and social space by defining his own boundaries. The concept of presence concerns the subject and his or her ability to act in the world: I am present in a real or virtual space if I manage to put my intentions into action. But how does one connect to the Other? How does the Other become "present" for the subject? To answer this question, in Chap. 2 we will analyze the implications of the recent discovery of the "mirror" neurons. These neurons, located in the ventral pre-motor cortex of apes (area F5), have, among other qualities, that of activating not only when the animal performs a given action, but also when the animal sees another animal—man or ape—performing the same action (Rizzolatti and Sinigaglia 2006; Rizzolatti et al. 1996). Therefore, the observer is able to put himself "in the shoes of the actor": I am able to understand what another is doing because when I am watching him I experience, completely intuitively, the same neuron activity as when I perform that action. This means that at neural level, the action performed and the action observed are codified in a multi-subjective format, which does not recognize actor or observer. This process is, however, effective if the subject is capable of distinguishing between an action performed and an action perceived. This suggests the existence of a second selective and adaptive mechanism, social presence, which enables the Self to identify and interact with the Other by understanding his intentions. In other words, from an evolutionary point of view, social presence has three functions:

- To enable the subject to identify the Other and to attribute to him an ontological status—"the other similar to the self"—different from the other objects perceived;
- To allow interaction and communication through the understanding of the Other's intentions;
- To permit the evolution of the intentionality of the Self (from the body, to the external world, to the possible world) (Damasio 2010) through the identification of group-based "optimal experiences" and the incorporation of artifacts—physical and social—linked to them.

Starting from these premises, we theorize that group flow is the result of the association between a situation of "liminality" (definable as a state of transit, of "being about to") and maximum level of social presence. In order to reach this optimum collective status, it is necessary that group members experience a high level of social presence; the feeling of sharing one's own goals and emotions with others. On the other hand, it is also necessary that the members of the group also experience a situation of liminality and that within the group, they find the means to overcome it. It is during this experience that the group creates and shares new meanings and new intentions.

1.4 The Emergence of a Creative Network: Networked Flow

We have argued that the experience of high level of social presence is an important pre-condition of group flow. The result of this optimal experience is the creation of new products, concepts or artifacts. However, the group is not necessarily able to promote and share these new concepts outside its boundaries. In order for this to happen, two things are required: (i) the existence of interactions between group members and individuals outside the group who are willing to adopt the new concept/product; (ii) the creation of narratives which link the new concept to existing ones, allowing non-members to attach meaning to it (internalization). In Chap. 3, we argue that this process (that we call "networked flow") is achieved through different stages, each characterized by specific processes:

Phase 1: Meeting (Persistence)
The first phase in the emergence of networked flow, Persistence, can take place in any social environment in which there are a certain number of individuals who share an interactive context. Referring to Goffman (1974), we can define this interactive context as a frame, that is, an area of inter-subjective expression shared by participants. Each person in the frame has her own unique intentional structure, which can be represented as a vector pointing to any direction. In rare cases, the directions of the intentionality vectors of different individuals overlap, leading to the emergence of a potential subgroup. In order for this subgroup to be formed effectively, a number of conditions must be satisfied, including, for example, frequency of interaction, sharing of rules, assignment of roles and the recognition of a common objective. Therefore, this phase is characterized by the identification of the other's intentions directed towards the present: at this stage, future-oriented intentions do not come into consideration.

The frame—in this phase—is not called into question, not it is possible to foresee any element for a possible transformation of the shared context into something else; we must wait for the second phase in the emergence of networked flow for this to happen.

Phase 2: Reducing the Distance
In this second phase something new happens; the perception of similarities among the individuals who share the same direction of the intention-vector.

The perception of similarities triggers an important dynamic which we have defined "reducing the distance". Individuals, who perceive these similarities, tend to preferentially interact with each other and to become aware of more and more similarities between them and in their motivations.

In this phase, the individual still perceives a certain dissatisfaction regarding his personal present intention, caused by the perception of non-compliance regarding intentions directed toward the future. The subject recognizes that the other individuals he comes across in Phase 1 are experiencing the same sense of dissatisfaction, and this mutual dissatisfaction leads—on a structural level—to the creation of a sub-group which finds itself in a situation of liminality. People start to get close to one another and to form a sub-group: self-definition enhances the identity-making process and it is likely that the feeling of involvement in the subgroup increases as well. As noted by Searle (1995), social groups are able to express their so-called "collective intention"; they are not only guided by cooperation, but also by the genuine sharing of mental states such as beliefs, wishes, intentions. It is therefore probable that among the members of the new subgroup there is a growing perception of a common finality, although this may not be immediately transformed into a goal. However, at this stage the sub-group does not yet put itself in direct contrast with the group (or better, with the frame) of reference; instead, it acts in terms of minority influence and draws on its persuasive skills (see O'Keefe 2002, for a summary) in order to influence and to affect the general direction of the frame.

Phase 3: The Liminality-Parallel Action

In this phase, the new subgroup starts consolidating its boundaries with respect to the pre-existing frame and to position its common "intention-vector" towards a direction that enables the subgroup to close in on the limits of the pre-existing frame. In terms of Goffman's theory, the members of the original frame diminish in importance in the eyes of the new group's members, and they therefore begin to lose importance for the frame's boundaries. Returning to Goffman's theory, we can say that the members of the new subgroup (supported by satisfying interactions, a perception of a common goal and a sharing of same intentions) begin to transform their group (or better, the potential structure of their group) into something resembling a new frame. Participants structure their experience according to a common interpretative pattern, establish conventions to indicate the boundaries of their transformation and thanks to this process, they are finally able to transform the meaning of the previous experience.

On the one hand, it is necessary that the group members experience a high level of social presence, the perception of shared objectives and emotions with others. On the other, it is also necessary that group members experience the situation of liminality and identify within the group the means to overcome it. This allows for the emergence of a collective intention, which, moreover, becomes the group's first creative act in potential networked flow at the moment when they break with the pre-existing frame and advance toward the new one. The previous balance is upset, and the subgroup completely redefines its state, thus creating the basis for

a new and completely innovative frame with respect to the previous. The group is therefore freed from the control of the pre-existing social reality and is balanced internally. In this phase a leader has not yet emerged, the parameters for a common goal have not yet been defined and the group is still working toward finality as opposed to goal.

Phase 4: Networked Flow
In this phase we enter into what we have defined as networked flow: an "optimal" collective experience (Sawyer 2003, 2007), which defines members of a group and guides their actions. The new group identifies one or more leaders, who we can define, in this context, as the individual or individuals who are better able than the others to transform what was previously only finality, into goal. The leader/s exercises his influence over the group and thus helps clarifying the group's objectives and enhancing its internal cohesion. The pre-existing frame is abandoned, and a new frame, which provides a more suitable background to support the group's creative activity, is established. It is important to note that in this phase, the defining feature of networked flow is the optimal experience perceived by the participants: a state of mind characterized by a high level of concentration, involvement, control of the situation, clarity of objectives, intrinsic motivation and a positive emotional state.

Several key events can facilitate the onset of networked flow:

- The transformation of the collective intention into a collective action;
- The internalization of the collective intention directed toward the future;
- The balance between the resources available to the group and those required by the common action;
- The identification of one or more leaders;
- The new frame must be made explicit.

Phase 5: Networked flow—Creation of the Artifact
Once the group has reached the state of networked flow, it affords the possibility of reifying its shared intentionality in the form of a product. This may be artifact, a concept, a piece of art which did not exist before. The group in networked flow is therefore characterized by the adoption (or use) of the new product, and this aspect represents a further distinguishing feature from the previous frame. Individual intentions directed toward the future are fully recognized in the collective action of the group in networked flow. At this stage, however, the artifact is solely and exclusively relevant to the group itself: this is not network sharing since the artifact has not yet been applied outside the frame.

Phase 6: Networked flow—The Application of the Artifact in a Social Reality
Once the artifact has been created the group enters into the sixth and last phase, in which the artifact is taken into the pre-existing social network. At this point, the group in networked flow must make itself known to the world (which means it must take up a position in the network); as consequence, the new product must be recognized too.

In this stage, the creation of links with other individuals/groups/communities is crucial. Although stages 4 and 5 can be defined as networked flow, it is only in this phase that we are able to speak specifically in terms of network, since:

- The artifact embodies the collective intention directed toward the future, and is able to inform other groups, leading them to adopt the same collective intention as the original group in networked flow. This process can be understood in the light of the stigmergy mechanism theorized by Pierre-Paul Grasse in 1959 (Grasse, 1959) to explain how insects manage to coordinate themselves in order to produce highly complex structures.
- At this point, logical progression takes us back to phase 1 of this model, with the difference that the focus of analysis is now directed toward the group and no longer toward the individual: the "circles" with the vector are no longer individuals but groups, and the surrounding "frame" is no longer the boundary of the social group, but of the extended network of reference.

1.5 Using Social Network Analysis to Model the Evolution of Creative Networks

In the previous sections, we have proposed "networked flow" as a conceptual framework for integrating the concepts of group creativity, group flow and social presence. The challenge is to identify an appropriate methodology that which can be used to describe how creative networks are generated and how they evolve, analyzing the role of the micro-interactions between their constituent elements. Social Network Analysis (SNA) provides a useful approach for addressing this objective. The main advantage of SNA is that it considers individuals as interdependent units as opposed to autonomous elements, and thus it is particularly appropriate for studying group dynamics, as well as for investigating the role played by the individuals within these dynamics (Wasserman and Faust 1994; Scott 2000). In particular, the adoption of SNA can provide a deeper understanding about the factors that shape the interplay between individual creativity and the larger sociocultural context, as well as to identify discernable social network characteristics associated with different levels of creativity (Guimerà et al. 2005; Cattani and Ferriani 2008). SNA focuses on various aspects of the relational structures and the flow of information which that characterize a network of people, by using two types of interpretations (Wasserman and Faust 1994; Mazzoni and Gaffuri 2009a): graphs (or sociograms) which plot the dots (people) and their social relationships (edges); and structural indices, which depict quantitatively the network of social relations, analyzed on the basis of a variety of characteristics (e.g. neighborhood, density, centrality, centralization, cohesion, etc.). SNA is based upon the flow of messages being sent and received by each pairs of individuals of the network, which are conceived ad mutually dependent entities (i.e., each

message sent by X to Y is also a message received by Y from X). For each structural characteristic of a relational network, SNA provides two types of indices: individual indices (i.e. based on relations and exchanges characterizing each actor of the networks) and group indices (i.e. based on relations and exchanges characterizing the network as a whole). Studies that have applied SNA to creativity research have mainly focused on the relationship between group performance and indices such as centrality and density (Gloor et al. 2010). For example, Perry-Smith and Shalley (2003) investigated the relationship between individual creativity and social relationships. They suggested that creativity is more facilitated by weaker ties than by stronger ties, and that the position within the network plays a crucial role. In particular, according to these authors, individuals who have a more peripherals position but hold many connections are more likely to produce innovative insights. The more one becomes creative, the closer he/she gets to the center of the network: on the other hand, however, the acquisition of a central position in the network is also associated with the adoption of more conservative attitude, which tends to reduce the creative potential of the individual, unless "external" connections are maintained that allows the person to be exposed to fresh knowledge and ideas. In a more recent study, Cattani and Ferriani (2008) applied SNA to investigate the network of collaborations within the Hollywood motion picture industry over the period 1992–2003. To reconstruct individual and team-level networks, these authors used archival sources listing every professional involved in the movies included in the sample and created variables at the individual, team and project levels. Results of this longitudinal analysis indicated two key mechanisms that regulate the relationship between socio-relational systems and individuals' creative performance. The first concerns the relative position of individuals in the larger social system. According to Cattani and Ferriani, individuals who span the boundaries between the core and the periphery of the social system are in a vantage position to enhance their creative performance. On the one hand, the closeness to the core allows them to be directly exposed to sources of social legitimacy and support, which are crucial factors to sustain creative performance. On the other hand, by mixing with the periphery of the network, they can gather fresh and new inputs that are more likely to be generated on the border of the social system, while avoiding the conformity pressures that are typical of an established and consolidated field. The second aspect highlighted by Cattani and Ferriani's study is that occupying intermediate position is a useful, but not necessary condition for enhancing individual creativity. Extreme positions (core or periphery) can be balanced by participating in teams that combine core and peripheral actors. To illustrate this mechanism, the authors consider the example of two individuals—one closer to the core and the other closer to the fringe of the network—that decide to collaborate. In this situation, the two individuals are exposed both to the core and the periphery and therefore have a higher chance of enjoying the benefits accruing to that position by working together rather than remaining separate. Another example of application of SNA to creativity research is provided by Kidane and Gloor (2007), who used this approach for investigating the temporal communication patterns of online communities of developers and users of an open source

software. These results resonate with findings from another study by Guimerà et al. (2005) who investigated the mechanisms by which creative teams self-assemble. The authors used two data sources: the archives of a century of musical production on Broadway, and publications in various scientific fields (social psychology, economics, ecology, astronomy) taken from several decades. These data sets allowed the authors to reconstruct the history of the collaboration between the people who contributed to a particular show or scientific publication. The authors then introduced and tested a model for the self-assembly of creative teams that considers three parameters: the dimension of the team (m), the fraction of newcomers involved in new productions (p), and the tendency of incumbents to repeat previous collaborations (q). In their analysis, Guimerà and colleagues distinguish between "veterans", who have participated in previous collaborations, and "novices", who have never taken part in a creative project. According to the hypothesis of these authors, the distribution of connections between novices and veterans within the group indicates their creative potential. For example, teams which have a prevalence of connections between veterans have less innovative potential, as the experiences that they share tend to standardize their pool of knowledge. On the other hand, teams in which mixed connections between novices and experts predominate have greater chances of producing creative ideas because they can count on a more diverse base of knowledge. To test these hypotheses, Guimerà's team examined the topology of the collaboration networks in the relevant disciplines. The results of this study show that when few veterans are present, the network fragments into lots of little teams which are effectively different schools of thought with few overlaps. However, when more veterans are recruited, by virtue of their connections to previous collaborators, the network experiences a sharp transition from a multitude of small clusters to a situation in which one large cluster—the so-called "invisible college"—emerges. The authors noted that this phase transition occurs when a crucial limit of the value of the parameters (p, m, q) is exceeded. Interestingly, the formation of the invisible college is independent of the average number of individuals <m> involved in the collaboration, although this parameter determines the exact value of the crucial limit. The authors therefore proceeded to examine the effects of the teams' compositions on their creative performance. To analyze this aspect, Guimerà and colleagues used the impact factor index of the journals to determine the quality of each team's scientific production. The results of the analysis highlighted the crucial roles of the levels of experience and diversity. The groups which publish in journals with a high impact factor have a high proportion of members who already belong to the network. Furthermore, the teams characterized by a high number of past collaborations are also characterized by an inferior performance. These findings suggest that the secret of successful collaboration is quite simple: when constructing a new team it is important to include people with experience, irrespective of whether one has collaborated with them in the past or not. On the other hand, diversification within a group is a fundamental ingredient for favoring creativity: the tendency to collaborate exclusively with one's own equals can significantly reduce the team's innovative potential.

1.6 Toward an Integrated Model for the Study of Creative Networks

As we have seen, social network theory can be a useful tool for studying creative collaboration as it allows us to interrelate the characteristics that we observe at a structural level with specific features of the creative process. However, the main limit of this approach lies in the fact that in social network analysis, the characteristics of the individual are less relevant than the relationships (and the dynamics of the relationships) that the individual has with the other members of the network. By favoring the analysis of structural properties over psychological features, social network analysis enables us to describe the characteristics of a creative network in a strictly mathematical way, but at the same time it places limits on the explanation of the factors which affect this evolution. For example, social network analysis permits us to identify the structural differences between two teams which have different creative skills, but it does not provide an explanation for such differences. The reason is that, by definition, the unit of measurement in social network analysis is not the individual, but the relationship between individuals, which can be defined in a variety of ways (as a communicative act, an acquaintance, friendship, family, etc.). Nonetheless, as we have pointed out in the introductory sections of this article, the investigation of psychological dynamics involved in optimal group collaboration is not less important than the understanding of the interactional dynamics. Studying these elements allows us to highlight which factors promote effective creative collaboration within a team. The challenge is to succeed in developing a framework which can integrate the "structural" dimension (determined by the sum of the formal-morphological characteristics) with the "functional" dimension (determined by the sum of the psycho-social processes) in the study of creative networks. Other scholars have emphasized the need to develop multilevel models of creativity, linking individual-, group- and organizational-level variables to creative outcomes (Woodman et al. 1993; Glynn 1996; Drazin et al. 1999). Our work aims to respond to this challenge, by proposing a new conceptual and methodological framework to study the psychological dynamics and structural evolution of creative networks.

1.7 Conclusions

The study of creative networks has the ultimate goal of linking creativity to the social, economic, and political context of the individuals and groups who create, as well as, on a more abstract level, of viewing creativity as the main force in bio-cultural evolution. This approach focuses on opportunity and the investigative advantages associated with a comprehensive and wide-ranging vision, and emphasizes the importance of the relationship between "levels of investigation" and the process of "defining the system". Our belief is that by studying the creative

process through the different lenses that constitute a bio-psycho-social model, it may be possible to obtain a more complete and more coherent definition of our subject. The main objective proposed is to overcome the greatest limit which, in our view, currently typifies network science: focusing one's attention on behavior at a macroscopic level, and tending to neglect the evidence that these large-scale behavioral patterns are essentially caused by the micro-interactions which take place between individuals, given that they are able to influence each other and modify their strategies depending on their actions and those of others. These "micro-dynamics", modeled using instruments of psychological and psychosocial analysis, are the motors that drive social systems to organize themselves into complex and kaleidoscopic shapes. The main objective thus becomes that of successfully integrating the analysis of creative groups' structural dynamics with the exploration of the subjective and inter-subjective cognitive processes involved in the formation of new knowledge. As Collins observes (1988), the "macro" level, which is concerned with social phenomena, must not be viewed as a layer built on top of the micro-layer, as if it were connected to a different space, but as an evolution of the micro-situation. Micro-situations are encompassed in macro-configurations which represent the way in which social micro-situations are connected to each other. Our theoretical analysis aims to overcome the contrast between methodological individualism, a position which explains macroscopic phenomena such as the sum of individual actions and decisions, and social holism, which assumes that social characteristics cannot be reduced to individual components, and that knowledge about social truths must therefore be obtained from the study of organizations, groups, bodies, and, finally, from collective processes.

Chapter 2
The Cognitive Foundations of Networked Flow: Intentions, Presence, and Social Presence

Abstract What makes a subject "present" within a group? Is to enough to physically be with the other group members in order to be "in"? And what happens when the others are not with me physically, such as in a chat room? Why are not all groups the same? Why are there groups in which people are able to make the most of their potential, while in others the subject feels closed in and crushed? Finally, what makes a group creative and productive? In this chapter, we will try to answer all of these questions, and the starting point of our analysis are the concepts of "presence" and "social presence":"Presence" is defined as the non-mediated (prereflexive) perception of successfully transforming intentions in action (enaction) within an external world;"Social Presence" is defined as the non-mediated perception of an enacting other (I can recognize his/her intentions) within an external world.Thanks to these two concepts, it is possible to demonstrate that not all groups have the same creative potential: it is above all those groups characterized by an optimal group experience—*networked flow*—that generate innovations which result as being particularly original. Specifically, an optimal personal experience—characterized by high levels of presence and social presence—produces memes that are used by the group to define its own culture (subculture). When these memes are internalized by most individuals, through imitation and communication, they modify and shape the culture and the behavior of the individuals.

What makes a subject "present" within a group? Is to enough to physically be with the other group members in order to be "in"? And what happens when the others are not with me physically, such as in a chat room?

Why are not all groups the same? Why are there groups in which people are able to make the most of their potential, while in others the subject feels closed in and crushed? Finally, what makes a group creative and productive?

In this book, we will try to answer all of these questions, and the starting point of our analysis is data concerning "presence" and "social presence" (Riva 2008b; Riva and Mantovani 2012a, b):

- "Presence" is defined as the non-mediated (pre-reflexive) perception of successfully transforming intentions in action (enaction) within an external world;

A. Gaggioli et al., *Networked Flow*, SpringerBriefs in Education,
DOI: 10.1007/978-94-007-5552-9_2, © The Author(s) 2013

- "Social Presence" is defined as the non-mediated perception of an enacting other (I can recognize his/her intentions) within an external world.

These concepts are the result of the most recent reflections from two emerging sectors of cognitive science: the movement of "*situated cognition*" and that of "*embodied cognition*".

Thanks to these two movements, it is possible to demonstrate that not all groups have the same creative potential: it is above all those groups characterized by an optimal group experience—*networked flow*—that generate innovations which result as being particularly original (Riva et al. 2010). But what is *networked flow*? It is possible to define it in cognitive terms as an "optimal" experience (Delle Fave and Bassi 2000): *at individual level, each subject experiences a state of conscience characterized by high levels of concentration, involvement, control of the situation, clarity of objectives, natural motivation*, *and a positive emotional state; at group level, all the members of the team share the same intention (collective intention) that is experienced as critical to produce a long-term change relevant both for the team and for themselves.*

This experience is the result of the association between a situation of *liminality* and maximum levels of presence and social presence. First, it is necessary that the members of the group experience a situation of *liminality* (a state of transit, of "being about to") and that within the group they identify a common strategy (collective intention) to overcome it. Second, it is necessary that group members experience a high level of social presence: the sensation of sharing one's own goals and emotions with others. Finally, it is needed that each subject experiences a high level of presence: the feeling of being able in the group of successfully transforming their intentions—both individual and collective—in actions. It is during this experience that the group creates and shares new meanings and new intentions.

The focus on optimal experience and its link with creativity is not a new concept. The seminal work by Mihaly Csikszentmihalyi in the mid-1970s identified in the optimal experience, or "Flow", a specific consciousness state experienced during challenging activities characterized by deep absorption and enjoyment (Csikszentmihalyi 1990). More, in his book "Creativity: Flow and the psychology of discovery and invention" (1997) Csikszentmihalyi, reporting the results of a series of interviews to 91 internationally recognized creative people, clearly described creativity as the result of three elements: a culture that contains meanings and symbols, a person who uses optimal experiences to bring novelty into the symbolic domain, and an external group who recognize and validate the innovation.

The main criticisms to this vision are three (Riva 2012). First, the lack of attention to the interpersonal context: we experience optimal experiences, like the "networked flow", that are the outcome of a social interaction. Second, linking the optimal experience to the balance between perceived high challenges/opportunities for action and high personal skills is too vague to be useful within a scientific research program: What is high and low for me and you?

Third, if creativity is a process linking the individual with a culture and a reference group, how does it work? No specific cues are offered by the author.

To address these issues, we will start from the concept of experience. According to the Merriam Webster Dictionary, it is possible to define experience both as "(a) the fact or state of having been affected by or gained knowledge through direct observation or participation" (personal experience), and "(b) direct observation of or participation in events as a basis of knowledge" (subjective experience).

These definitions underline the two connected faces of our experience: on one side, we can intentionally control the contents of our experience (subjective experience); on the other side, its contents define our future emotions and intentions (personal experience). In other words, we both shape and are shaped by it.

However, there is a critical difference between subjective experience and personal experience. If subjective experience is the experience of being a subject (experience as subject, the "I" described by William James), personal experience is the experience affecting a particular subject (experience as object, the "Me" described by William James). This simple shift suggests that, independently from the subjectivity of any individual, it is possible to alter the features of our experience from outside. In other words, personal experience becomes the dependent variable that may be manipulated and studied by external researchers. Specifically, we suggest that it is possible to manipulate the features of our experience in three separate but related ways (Riva et al. 2012):

- *By structuring it* using a goal/meaning, rules, and a feedback system.
- *By augmenting it* to achieve multimodal and mixed experiences.
- *By replacing it* with a synthetic/fictional one.

For example, as suggested by "Positive Technology", it is possible to use technology to manipulate the quality of experience, with the goal of increasing creativity and well being both in individuals and groups (Botella et al. 2012).

The other advantage offered by the concept of personal experience is that it allows the connection between the three levels originally identified by Csikszentmihalyi: the individual, the culture and the group. Specifically, an optimal personal experience produces memes that are used by the group to define its own culture (subculture). When these memes are internalized by most individuals, through imitation and communication, they modify and shape the culture and the behavior of the individuals.

In the following paragraphs, we will endeavor to justify this claim. In order to do so, we will begin with the analysis of the transformations which are characterizing cognitive sciences and which constitute the principal new element in the central question of action.

2.1 A New Model of Cognition

When one thinks about cognitive processes, the first thing which comes to mind is the brain–computer association. This association originated from cognitive psychology's traditional approach—the *symbolic approach*—(Johnson Laird 1988;

Newell and Simon 1972) which uses symbolic processors as its model of the mind.

In this view, by using symbolic language it is possible to represent a subject's complete knowledge (an explicit representation of knowledge). From this knowledge base, it is then possible to draw the conclusions necessary to make the agent act in an "intelligent" way.

In this view, the structural characteristics of human cognitive processes are largely independent from the type of *hardware* on which they *operate*, just as a piece of *software* is independent from the type of computer on which it is installed: the same piece of software can be used on very different computers. It is on this theoretical basis that the area of research concerning Artificial Intelligence has developed.

Nonetheless, the limits of Artificial Intelligence systems and the discoveries of neuroscience have thrown the brain–computer association into crisis, leading to the redefinition of the concept of cognition.

An early attempt at this redefinition was made within the situated cognition movement (Bara 2000; Carassa 2002; Clancey 1995, 1997; Lave 1988; Lave and Wenger 2006). This position begins with the observation that in the majority of situations, learning is not the result of an individual process, but of social interaction (Lave 1988; Lave and Wenger 2006). To be more precise, Lave and Wenger (Lave and Wenger 2006; Wenger 2006) maintain that members of a community, by means of common experience, come to share a culture, a language and a way of expressing themselves: a community of customs.

However, this process is only possible if all the subjects share a *common ground*, a range of beliefs, expectations and collective knowledge (Clark and Brennan 1991; Morganti and Riva 2006). This common heritage is continually updated through a process which Clark and Brennan (1991) define as *grounding:* the process of collaboratively establishing *common ground* during *communication*.

The second attempt came as the result of the embodied cognition movement. This position considers corporeity—the sum of an organism's motor-sensory skills which allow it to successfully interact in its environment—as being necessary for the development of social and cognitive processes (Clark 1997; Jeannerod 2006; Johnson 1987; Lakoff and Johnson 1999; Morganti and Riva 2006; Niedenthal et al. 2005; Noë 2004; Varela et al. 1991).

In this view, knowledge can be defined as a "capacity towards interactive action", resulting from the interaction which occurs in real time between a corporal organism and its environment directed toward an objective. Carassa (2002) uses the term "*conceptualization in action*" to underline a subject's capacity to segment and recompose an entire behavioral sequence in order to reach an objective. For this reason, knowledge is necessarily "situated" and "embodied": *it requires continual external feedback in order to coordinate perception and action*.

Although these two visions have been developed separately, a point of contact has been found in a recent discovery in the field of neurophysiology: bimodal neurons. A group of neurophysiologists from Parma, coordinated by Giacomo

Rizzolatti, discovered, first in the premotor cortex of apes, and then in that of humans, the existence of two groups of "bimodal" neurons in which sensory faculties are linked to motor faculties (Rizzolatti and Sinigaglia 2006):

- the first group of neurons (F5ab-AIP)—known as "*canonical*" neurons, are activated when a subject sees an object with which it can potentially interact;
- the second group of neurons (F5c-PF)—known as *"mirror*" neurons, are activated when the subject sees another individual performing the same action.

To justify the existence of these neurons, the Common Coding Theory has been developed; according to this theory perceptual representations (actions perceived) and motor representations (actions to be performed) are based on the same motor code (Knoblich and Flach 2003; Prinz 1997).

In practice, in each phase of a single action—*planning* (I want to move my hand to pick up an apple), *execution* (I move my hand and pick up the apple), and *interpretation* (I see another person move their hand to pick up the apple), the subject is activating the same motor code applied to the context in which the action is being, or will be, performed.

This theory leads us to presume the existence of a simulation system based on motor codes which permits the subject to organize and understand a given action (Barsalou 2003; Gallese 2005; Wilson and Knoblich 2005).

As Gallese points out (Gallese 2003a, b, 2005), during the simulation process, which he defines as "embodied simulation", *internal representations of corporal objects associated with given actions and sensations are generated within the subject, as if he or she were performing a similar action or experiencing similar emotions or sensations.*

For example, the sight of a red apple is believed to activate a simulation of the motor functions necessary to pick it up, while the sight of a person who reaches out to pick up the apple is believed to activate a motor simulation which allows the subject to understand this person's intention.
According to this theory, a subject's knowledge of objects and space is *pragmatic* knowledge (Rizzolatti and Sinigaglia 2006):

- objects are conceptualized through a process of simulation, like "points of virtual action" defined by the intentions directed toward them.
- space is defined by the "system of relationships which such virtual actions utilize and which are limited by various parts of the body".

We will endeavor to explore these two concepts further.

2.2 From Intention to Action

Rizzolatti's studies on bimodal neurons (Gallese and Lakoff 2005; Rizzolatti et al. 1997; 1996; 2000; Rizzolatti et al. 1998) have shown that their activation is influenced by intention. For example, *"canonical" neurons* are distinguishable by the correspondence between motor characteristics (for example a way of picking

something up) and vision (the shape and size of the codified object). This allows the visual information about an object to be transformed into the motor functions required to interact with it.

In practice, "canonical" neurons permit an immediate and intuitive (prereflexive) understanding of opportunities for interaction which various objects may offer (in the case of the handle of a coffee cup, there is the possibility of being taken hold of if the subject wants to drink).

One of the crucial elements of this definition is the concept of intuition. We shall now elaborate on this point. The work of the Nobel prize winner Daniel Kahneman (2002) has emphasized how our cognitive system is based on two systems, *intuition* and *reasoning*:

- *System 1* (Intuition): this generates *impressions* of a perceived and considered object's characteristics. These impressions, rapid and simple from a computational point-of-view, are involuntary and are often unconscious.
- *System 2* (Reasoning): general *judgments* are slow, ordinal, costly from a computational point-of-view, and always explicit and intentional.

The existence of two separate cognitive systems is made evident by the distinction between *being able to do* something, and *knowing* something. On the one hand, we are able to control complex dynamic systems without being capable of explaining the rules which enable us to do so (intuition): for example, we are able to ski or ride a bike without knowing how to explain how we do it. On the other hand, however, we can describe the rules which permit a system to function (reasoning) without being able to put them into practice: for example, reading the highway code and knowing all the necessary information to drive a car does not mean that you will not fail your driving test.

In this sense, the ability to understand a subject's intentions is an intuitive process of which the subject is unaware (Riva and Mantovani 2012a, b). But how can the subject know whether his or her intention has really been transformed into an effective action? We shall try to answer this question in the following paragraphs.

2.2.1 The Structure of Intention

According to Searle, every action is made up of two components (Searle 2001): *movement* and *intention*. The intention component "represents" the conditions which must be met by the action in order for the subject to be satisfied. Movement is the means which is analyzed to verify the success of the intention.

In Searle's words, the representation of the conditions of satisfaction refer to a "previous intention", which defines the conditions of satisfaction, and to a "background" in which they are situated (Searle 1998). Specifically, the *background* includes the set of abilities, capacities, tendencies, and dispositions that humans have and use intuitively, and that are not themselves intentional states.

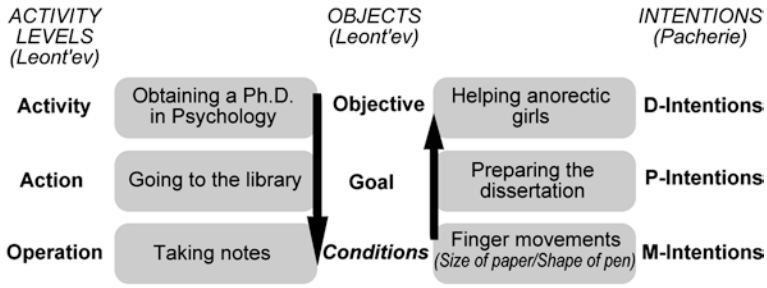

Fig. 2.1 The structure of intentions

For example, my intention to draw a house is satisfied if (a) I manage to produce a drawing and (b) what I have drawn looks like a house (in this case, the background is the implicit knowledge that a house has four walls); my intention to paint my house green is satisfied if (a) I manage to paint or have the house painted and (b) the color of the walls is green. In both cases, the background of the *previous intention* is the knowledge of what a house is and which house is mine.

However, Searle notes that there is an object, the body, which does not respect these conditions of satisfaction. It is in fact, *intention in action* which determines the body's movements (Searle 1983, 1992), an intention which meets its conditions of satisfaction in movement itself *(auto-referential causality)*: my intention to move my arm is satisfied by moving my arm.

In other words, if intentions regarding external objects are satisfied by the accord between a previous intention and the result of the action, in the case of the body, the action is in itself the condition of satisfaction.

But how is it possible to analyze the complex network of intentions necessary to perform difficult actions such as "obtaining a degree in psychology"? Two very similar answers come from two different theories developed in different contexts: *activity theory* and *the dynamic theory of intentions* (see Fig. 2.1).

2.2.1.1 Activity Theory

Activity theory originated in the psychological culture of the former Soviet Union, thanks to the work of scholars such as Vygotskij (1965, 1978), Leontjev (1978, 1981), and Anokhin (1976). The ideas initially formulated by Russian authors were then adapted to the world of media by a number of Scandinavian writers, including Engeström (1990) and Kuuti (1996). A detailed study of this theory in Italian was recently presented by Elvis Mazzoni (2006).

The basic principle of this theory is the fact that it places human activity at the center of psychological studies, and divides it into three levels of analysis*activity, action*, and *operation* (Kaptelinin and Nardi 2006; Leontjev 1978):

- *Activities, composed of the sum of the actions*: Activities are social practices directed toward "objects" (also known as "motives"). Every object is created to

meet man's needs, and determines the limits of possible actions. Activities have a duration of varying length, the beginning and end of which are not always easily recognizable. *One example of an activity is the process necessary to obtain a degree in psychology;*

- *Actions, composed of the sum of the operations*: actions are complex acts, consciously directed toward a precise objective which move the subject closer to the object of the activity. Unlike activities, actions are characterized by a known duration, with a precise beginning and end. *One example of an action is going to a seminar.* An action can simultaneously be part of several activities. For example, attending a seminar can be part of the "degree in psychology" activity, but may also be part of the "finding someone to go out with this evening" activity;
- *Operations*: Operations are the chains of specific motor actions which constitute the structure of an action and are often carried out without the subject's awareness. To be more precise, the operations which make up an action are carried out unconsciously. However, learning about the organization of the operations which constitute an action requires the conscious participation of the subject. *One example of an operation is writing the word "subject", while taking notes during a seminar.* These operations are guided by an "orienting base", composed of unconscious expectations relating to the execution of the operation. The orienting base develops through the process of trial and error.

These three levels are neither fixed, nor structurally separate. In general, for a specific object directing an activity, objectives, actions and operations may change according to the situation in which the subject finds himself (Hasan et al. 1998). For example, an operation may become an action when the expectations which guide it are not fulfilled. If my pen stops working while I am writing the word "subject", a new action will begin, with the aim of finding a new pen.

The three levels of human activity are linked by *expectation, the anticipation of the action*. In relation to the activity, expectation takes the form of *motivation*: I want to graduate so that I can become a psychologist. It is the *objective* which changes according to the level of action: I go to lectures in order to pass the exams as quickly as possible: to write a letter "M" I first move my hand upwards and then downwards at an angle of approximately 45 degrees, and then upwards again at the same angle before moving my hand straight down.

2.2.1.2 A Dynamic Theory of Intentions

The second attempt to explain the structure of intentions was made by the French researcher Elisabeth Pacherie (2008). The main assumptions of this model, known as the *"dynamic theory of intentions"* which was recently published in the journal "Cognition" (Pacherie 2006, 2008), are the following:

- It does not make sense to consider an action as an individual mental act. Intentions are a dynamic structure arranged on a number of levels.

- This organization is hierarchically structured on three mutually inclusive levels:
    1. *Motor intentions (M-intentions);*
    2. *Proximal intentions, situated in the present (P-intentions);*
    3. *Distal intentions, directed toward the future (D-intentions).*
- The relationship between these levels is one of inclusion and organization. Specifically, a distal intention (to build a house) is composed of a series of proximal intentions (to lay the foundations, build the walls), which are themselves made up of a series of motor intentions.
- The connection of inclusion and organization between an upper level and that beneath it is clear to the subject as long as he is not required to intervene in the management of the situation. This means that a conscious distal or proximal intention is carried out through the organization and integration of a series of intentions at the lowest possible level.

If we compare the three levels of the structure of intentions proposed by Pacherie with those of the Activity Theory, the similarities are very clear. In both cases, the subject's activity is a dynamic system of intentions/objects built on three levels, each including and organizing the levels beneath. The overlap of the concept of "intention-in-action" proposed by Searle and that of "operation" and "motor intention" is equally evident.

2.2.1.3 Private Intentions, Social Intentions, and Collective Intentions

The Centre for Cognitive Sciences in Turin has recently become involved in the debate on the structure of intentions (Bara 2007; Ciaramidaro et al. 2007; Walter et al. 2009), suggesting a further distinction: that between "*private intentions*" and "*social intentions*".

- *Private intentions* are all intentions which require nothing more than the intervention of the subject in order to be satisfied. Examples of this type of intentions are "removing a bulb" or "picking up an apple";
- *Social intentions* are all intentions which (a) involve at least one other person, and (b) the other person is essential in order for the intention to be satisfied.

Furthermore, these intentions make a distinction within the category social intentions, between *present intentions* and *future intentions*:

- *Present social intentions* are all social intentions shared in real time by two or more subjects. The prototype of this type of social intention are communicative intentions;
- *Future social intentions* are all social intentions in which the subjects are not interacting in that moment but they will have to do so in order to satisfy their intentions. Examples of this type of social intentions are "passing a psychology exam" or "going to buy a loaf of bread".

In order to verify their hypothesis, Ciaramidaro, Walter, and their colleagues conducted a series of studies using magnetic resonance functional imaging. Thanks to these studies, carried out both on healthy subjects (Ciaramidaro et al. 2007), and subjects suffering from schizophrenia (Walter et al. 2009), it has become possible to monitor the activation of different cerebral areas according to the type of intention that the subject had to identify. While private intentions only activated the precuneus and the right temporal parietal junction, social intentions also activate the left temporal–parietal junction and the front paracingulate cortex. In addition to the research of the Centre for Cognitive Sciences in Turin, we can consider Searle's views on *"collective intentions"* (Searle 1995). Unlike other social intentions, collective intentions are characterized by a 'sense of the other', which moves from being an intentional subject to a collaborative subject and is then able to share the collective intention and collaborate in its realization.

As well as entailing the role of another in order to be satisfied, collective intentions call for a form of cooperation which is not the result of individual intentions. These intentions (We-intentions) which can be expressed as "We intend to do action A", include one or more private or social intentions which represent a subject's personal contribution to the collective action: "I intend to do action B as part of the group's action A".

An example of a collective intention is a husband and wife who intend to assemble the bed they have just bought at Ikea: it is their shared intention which directs and organized the individual activities of the two subjects.

2.2.2 *Verifying the Efficacy of an Action: From the Body to Possible Worlds*

After having carried out this analysis it is possible to propose a structure of intentions (Morganti et al. 2010) which has seven levels (Table 2.1):

- *Motor Intentions*: motor intentions are at the basis of our most simple motor actions (not directed toward an object) such as making a fist or closing my mouth. They are innate as they are part of our genetic makeup.
- *Private, social, and collective proximal intentions*: proximal intentions are at the basis of actions directed toward states, objects or subjects in our present world. They may be *private*—"pick up the pen" or "get up from the chair"—*social*—"climb on daddy's shoulders" or "suckle at mummy's breast"—or *collective*—"communicate". These intentions come about in the relationships between our needs and our surrounding physical and social environment.
- *Private, social and collective distal intentions*: distal intentions are at the basis of our actions toward possible states, objects and subjects in possible worlds. These intentions may be *private*—such as "study more" or "do more physical exercise"—*social* such as "get a degree" or "start a family"—or *collective*—"win the university football tournament" or "prepare the communications project for

Table 2.1 The intentional structure

Intention	Definition	Example	Verification of the action's efficacy
Motor intentions	Simple motor acts not directed toward an object	Making a fist or closing your mouth	Managing to perform the act
Private proximal intentions	Motor acts directed toward objects or states in the present world	Picking up a pen or getting up from your chair	Concordance between representation (previous intention) and perception (resulting action)
Social proximal intentions	Motor acts directed toward subjects, objects or states in the present world	Climbing on daddy's shoulders or suckling at mother's breast	The wishes of the subject/s involved and the concordance between representation (previous intention) and perception (resulting action)
Collective proximal intentions	Motor acts collectively directed toward subjects, objects or states in the present world	Communicating or completing a puzzle together	The wishes of the subject/s involved, sharing a common representation (intention) and the concordance between representation and perception (resulting action)
Private distal intentions	Acts directed toward objects/states in a possible world	Studying more or eating less	Concordance between representation (previous intention) and perception (resulting action)
Social distal intentions	Acts directed toward objects/states in a possible world	Getting a degree or starting a family	The wishes of the subject/s involved, agreement between the subjects of their intentions, and concordance between representation (previous intention) and perception (resulting action)
Collective distal intentions	Acts organized collectively and directed toward objects/states in the present world	Winning the university football tournament or preparing a communications project together	Wishes of the subjects involved, sharing a common representation (intention) and the concordance between representation and perception (resulting action)

the X company". These intentions come about in the relationships between our needs and the various possibilities open to us in our culture of reference.

The first noteworthy element which emerges from the analysis of the proposed intentional structure is that understanding another's actions becomes increasingly difficult as we move from motor to distal to private and social intentions.

Nevertheless, if we compare this intentional structure with the intentions present in other previous studies on mirror neurons, it is evident that the majority of observations made relate specifically to private proximal and motor intentions. There are, however, no studies measuring the response of mirror neurons to social or distal intentions.

The second element which comes to light, is that the greater complexity required by intentions of a higher level, is not only reflected in the comprehension of the other's intentions, but also in the judgment of the efficacy of one's own actions. More exactly, how can a subject verify whether his or her intentions have really been transformed into an effective action?

It may seem a banal question, but to ask oneself whether one's actions have been effective or not is a crucial element for the survival of the individual. Without the ability to verify whether one's actions have been correctly performed—have I managed to get the food that I need? Have I escaped from the predator who was chasing me?—the subject would not be able to survive the dangers of his environment.

Let us answer this question beginning with motor intentions. As we have just seen, these intentions are innate and, as suggested by Searle, they are satisfied by the action itself: I have managed to make a fist if my fingers are closed in my palm; I have managed to close my mouth if I have reduced the distance between my lips.

More complex however, is the case of proximal intentions. We shall begin with the analysis of private proximal intentions, composed of a chain of motor intentions directed toward a state or an object in my surroundings in the present world. In this case, the satisfaction of my proximal intention is linked to the relationship between intentional content (a previous intention) and the real-world object toward which my intention is directed: if I want an apple I will satisfy my intention by picking up the apple, and not the orange next to it.

The subject learns to connect representation to object, stimulus to response by means of imitation, the classic active conditioning. In all cases, the key to learning correct association—this is an apple and not an orange, is *covariation*: the properties of the stimulus and the response change at the same time.

The situation is more complicated in the case of social proximal intentions: even if the learning mechanism is the same—covariation—in order to verify whether my intention has been fulfilled, not only do I have to consider the link between stimulus and response, but also the wishes of another. If I want to take the red apple that Martina has in her hand, it is not enough to verify whether I have taken the apple from her hand instead of the orange on the table. I also have to check whether Martina has allowed me to take the apple or not.

In the case of collective proximal intentions, there is another element to take into account: a universal representation which guides the intentions of various subjects toward a shared objective. If this universal representation is not present, the collective intention is destined to remain unfulfilled.

It is, however, even more complex to ensure the efficacy of distal intentions. Once again, we shall begin with private distal intentions, composed of a chain of motor and proximal intentions directed toward a possible state or object (a possible world).

But what is a possible world? The concept of "possible worlds" was introduced by Leibniz and taken from philosophical logic to denote "alternative worlds", or worlds which could exist but are only possible and not real (Lycan 2002). An example of a possible world is the world in which instead of writing this chapter I am lying on a beach listening to music. It is not my present world, but it could happen.

Using the language of the philosophy of the mind (Crane 2003), every possible world is characterized by an "*intension*"—the sum of the elements which enable to me to describe this world—and by an "*extension*"—the number of situations and contexts in which my theoretical world is in fact real. When a possible world has an extension, that is, it *does* exist somewhere, I am able to verify the efficacy of my intention by comparing its intentional content with the real-world context to which my intention corresponds: if I want to go to the beach and listen to music, I succeed in fulfilling my intention if I really do find myself on a beach and am at the same time listening to music on my iPod.

If, however, the possible world has no extension—for example, I want to become like Albert Einstein, but at the moment there is no one in the real world who corresponds to the description of Albert Einstein, how can I verify whether I have fulfilled my intention? A similar problem exists if the possible world has several extensions. If I want to become a psychologist, but there are various types of psychologist—clinical, industrial, social, etc.—how can I tell whether I have managed to carry out my intention?

In both cases, the answer can be found in the culture of reference—it is my culture which provides me with the knowledge and standards which enable me to say whether I have succeeded in becoming Albert Einstein or not. In practice, when a possible world is not currently real or it is not certain, the only reference that the subject can use to check whether an action has created this possible world as the description that he or she has used to represent it (intension), the result of social conversational practices: I am able to recognize Albert Einstein's main characteristics from what I have learned about him.

The limit of this approach is clear: it is possible to define Albert Einstein in different ways. For example, I can describe him as "a German physicist who won the Nobel Prize in 1921" or as "a member, supporter or affiliate of 34 communist movements between 1937 and 1954" (this is the opening description of the FBI's file on Albert Einstein, available online at: http://vault.fbi.gov/Albert%20Einstein).

In addition to what has thus far been mentioned, in the case of social distal intentions, it is also necessary that the other subjects involved in my intention are willing to accede to it. If I want to start a family with Fabrizia, and Fabrizia does not want a family, my intention cannot be satisfied despite my culture having taught me what having a family means.

There is, however, another problem: the intensions (meanings) which different subjects attach to the possible world may not be the same. For example, if my view of starting a family with Fabrizia means marrying her, but for Fabrizia having a family entails nothing more than living together, my social distal intention will not be satisfied.

This problem is particularly relevant to collective distal intentions which, as well as what we have just seen, also require a shared universal intension which guides the intentions of various subjects toward a common goal. If there is no universal intension, or if the intension is not the same for each of the subjects, the collective intention is destined to remain unfulfilled.

This lengthy analysis makes it clear that very different skills and knowledge are required in order to ensure that an intention is carried out. We can use the language of contemporary cognitive science to affirm that the satisfaction of motor and proximal intentions is always "embodied", that is, it concerns the relationship between the subject as a body, the surroundings and the objects/subjects present therein. The satisfaction of motor and proximal intentions is *objective*—in the sense that is the same for all subjects: I have taken the apple from Martina if the apple is now in my hand.

On the other hand, the satisfaction of distal intentions is always "situated", that is, it concerns the relationship between the subject as a social being, the culture of reference and its possible worlds. The satisfaction of distal intentions is *subjective,* as it is only the same for members of the same culture: to become a "*velina*" is an intention directed toward a possible world which does not make sense for an American (in fact the word "velina" can only be roughly translated as 'showgirl' in English), while it is one of the most common distal intentions for young Italian girls.

This analysis has also demonstrated that mirror neurons alone are not able to recognize distal intentions: the recognition of these intentions requires a reference to a possible world, subjective and semantically definable, which cannot be reduced to the sum of motor acts toward an object. On the other hand, an accurate simulation mechanism is able to work without problems for the identification of motor and proximal intentions.

The difference between "embodied" and "situated" intentions reflects the distinction which currently exists between the two most relevant areas of cognitive psychology: the theory of embodied cognition and that of situated cognition. Despite the differences highlighted in this analysis, the two theories share a common vision of knowledge: *knowing means being able to do*.

In this view, knowledge can be defined as a "capacity for interactive action", the result of interaction in real time directed toward reaching an objective between an organism which has a body and its environment. In such a view, knowledge can be described as the capacity to behave in an *adaptive way* in one's environment: through the analysis and continuous coordination of perception and action within an environment, the subject learns how to fulfill his or her intentions.

2.3 From Action to Perception

The existence of bimodal neurons has led cognitive scientists to reflect on the characteristics of spatial perception, and in particular on the link between action and perception. This reflection has led to the belief—as previously suggested by Piaget *(assimilation)* and Gibson *(affordance)*—that we *view space in relation to the actions which we can perform in that space*.

This hypothesis, recently confirmed by various studies in the field of neuropsychology (Di Nocera et al. 2006; Matelli and Luppino 2001; Postma 2005) has two significant implications:

- The knowledge of the position of an object cannot be separated from the *affordance* that this object offers and from the actions required to reach it;
- There is not one representation of space. The space surrounding an individual is divided and represented in different partial portions of information.

For example, Previc (1998) distinguishes between the "peri-personal" (near) and "extra-personal" (far) representations of space, depending on the type of actions that the subject is able to perform in a given space. More precisely, "peri-personal space" is the result of the multi-sensorial (visual-tactile) integration of the representations required to extend one's arm (*reaching*) and manual manipulation (*grasping*).

The distinction between "peri-personal" and "extra-personal" space is already widely accepted in the scientific literature (Di Nocera et al. 2006; Knoblich et al. 2006). The boundary between these two types of spatial representation is set by the subject's direct actions: *"peri-personal space" comprises the space which is directly accessible by human action, without the necessity to move one's body; "extra-personal space" is the space which is not directly accessible.*

A recent study by Gamberini and colleagues (Gamberini et al. 2008) has demonstrated how crossing the boundary between "peri-personal space" and "extra-personal space"—both physical and virtual space—entails the activation and deactivation of two very different spatial representations. This study also confirmed the flexibility of such boundary, highlighting the effect of the artifacts on the perception of space.

As various researchers in this field (Farné et al. 2007; Holmes et al. 2004, 2007) have underlined, *during an effective action—in which the subject is able to fulfill an intention—the artifact is "incorporated" into the subject's perception*.

In practice, neuropsychological studies have confirmed the ideas of Andy Clark (2003): man is a "*natural born cyborg*" capable of incorporating the technology which he creates and uses into his existence, in order to extend his boundaries.

This process of incorporation takes place on two levels (Riva and Mantovani, 2012a): *on a static level,* modifying the boundaries of the body (Knoblich et al. 2006; Whiteley et al. 2008), and *on a dynamic level,* incorporating the artifact into the *operations,* the motor actions involved (Jacobs et al. 2008). If the use of an artifact immediately alters the subject's boundaries (Holmes et al. 2007), it is only a matter of training for the artifact to become incorporated at the level of motor function (Imamizu et al. 2007).

2.4 From Perception to Presence

In the previous paragraph, we saw how neuropsychological research has confirmed the dialectic dimension among actor, body, and artifact proposed by cognitive psychology's new ideas; by using an artifact, the subject is able to clearly and

intuitively extend his or her boundaries, *becoming "present" in the artifact which is being used.* In practice, *carrying out one's actions through the use of an artifact enables the subject to become present in the artifact*.

But what does it mean to be "present"? We shall find out in the following paragraphs.

2.4.1 Presence as a Specific Cognitive Process

The concept of "presence" originated from and was diffused by the scientific community at the same time as the introduction of a unique piece of communication technology*, teleoperators*: robots controlled from a distance by a human operator. In this case, the term *telepresence* refers to the human operator's sensation of being present in the remote location in which the teleoperator is situated.

In fact, thanks the contribution of cognitive science, it is today possible to directly connect intention to action and the subject's position, using this concept (Riva 2007, 2008a, b; Riva et al. 2011). Presence is the sensation of "being" in an environment, whether it be real or virtual, which results from the ability to carry out one's intentions within one's surroundings through the affordance which that environment offers.

According to Gamberini, Spagnolli and Mantovani, the sense of presence is linked to a subject's capacity for action and his ability to position himself within his physical and social space (Spagnolli and Gamberini 2002, 2005; Spagnolli et al. 2003). More precisely, for Spagnolli and Gamberini (2005): "Presence is the feature of the agent which is manifested through the creation of a space during action" (p. 8).

A similar, but broader view, was recently outlined by Riva and Waterworth (Riva et al. 2006, 2011; Riva and Waterworth 2003; Waterworth et al. 2010). The idea proposed by the two authors is the following: presence can be described as a *selective and adaptive mechanism which allows itself to define the boundaries of action by means of the distinction between "internal" and "external" within the sensory flow.*

In other words, from an evolutionary point-of-view, presence has three functions:

- To permit the subject to position himself in a space—real, virtual, or social—through the distinction between "internal" and "external" and the definition of a boundary;
- To check the efficacy of the subject's actions through the comparison of intention and the result of the action. From a computational viewpoint, the experience of presence is achieved through a forward–inverse model (Fig. 2.2):
  - First, the agent produces the motor command for achieving a desired state given the current state of the system and the current state of the environment;
  - Second, an efference copy of the motor command is fed to a forward dynamic model that generates a prediction of the consequences of performing this motor command;

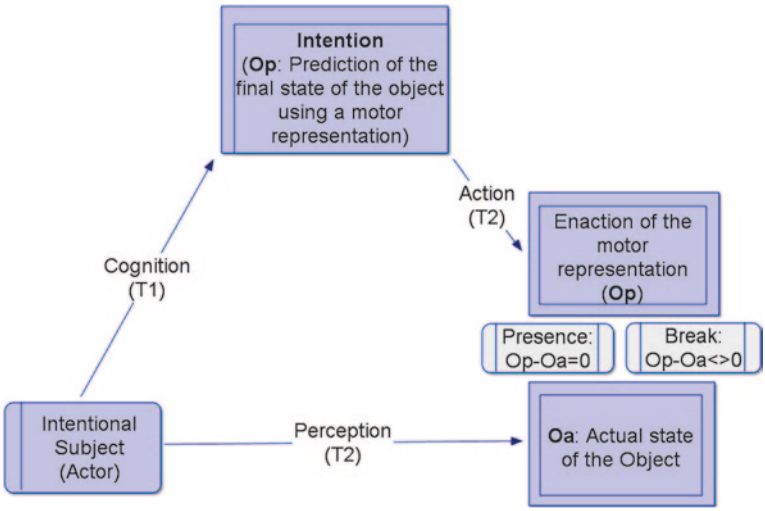

Fig. 2.2 The experience of presence

– Third, the predicted state is compared with the actual sensory feedback. Errors derived from the difference between the desired state and the actual state can be used to update the model and improve performance.

- To allow its own evolution through the identification of *"optimal experiences" (Flow)* and the incorporation of the artifacts—physical and social—linked to it.

To sum up, we can define presence as *the intuitive sensation of "being" in an environment, real or virtual, which results from the capacity to carry out one's intentions within that environment.* In other words, *because of presence, an individual is able to situate himself in a physical and social space by defining his own boundaries*.

This definition emphasizes the close link between consciousness and presence. However, consciousness and presence are dissociable mechanisms:

- *There are types of behavior and stimuli which can be consciously independent from the intentions and actions of the subject:* presence is connected to the link between intention and action. Without an intentional structure there can be no presence, even if the subject is aware of his or her own behavior. An example of this is the *"alien hand syndrome"* (Della Sala 2006): the hand of a patient suffering from alien hand syndrome moves without the patient telling it to. *Despite knowing the hand is theirs, these patients are not "present" in their hand.* The astonishment with which they view the unwanted actions carried out by their own hands comes from the fact that they did not intend to do them.
- *It is possible to unconsciously carry out one's intentions, such as in the case of operations:* a subject can carry out his or her actions without being conscious of doing so. The subject is present, but unaware of carrying out an intention. I am

present while I am pressing the keys on my keyboard to write this sentence, but I am unaware of what I am doing: I am just writing.

2.4.2 Social Presence as a Specific Cognitive Process

The concept of presence concerns the subject and his or her ability to act in the world: I am present in a real or virtual space if I manage to put my intentions into action. But how does one connect to the Other? How does the Other become present for the subject? To answer this question, we will analyze the implications of the "mirror" neurons which we mentioned at the beginning of the chapter.

These neurons, discovered in the ventral pre-motor cortex of apes (area F5), have, among other qualities, that of activating not only when the animal performs a given action, but also when the animal sees another animal—man or ape—performing the same action (Rizzolatti et al. 1996; Rizzolatti and Sinigaglia 2006). Therefore, the individual who observes is able to put himself in the shoes of the actor: I am able to understand what another is doing because when I watch him I gain experience, completely intuitively, the same neuron activity as when I perform that action.
The result is the creation of neural representations which are shared on two levels (Gallagher and Jeannerod 2002):

- On the one hand, execution and observation share the same neural substratum in one individual subject;
- On the other, when a subject observes another subject's action, the same representations are simultaneously active in the brains of both subjects.

This means that at neural level, the action performed and the action observed are codified in a multisubjective format, which does not recognize actor or observer. This process is, however, effective if the subject is capable of distinguishing between an action performed and an action perceived. As Becchio and Bertone point out (2005): *By codifying an agent-free representation of action, mirror neurons support the visual and motor comprehension of the action, but are not in themselves enough to attribute an action to an agent. This level of comprehension, defined as "agentive" by the authors, requires that the agent parameter is specified as a separate parameter: only in this way does the action become the action of a particular agent (p. 859).*

In order to be able to distinguish between myself and another subject, *I have to make use of a specific cognitive process—presence—which is able to position me "in" or "out" by analyzing my actions and their effects.*

At the moment in which the subject is able, through presence, to distinguish between him or herself and another, "an I and an Other are created". The "other similar to the Self" thus becomes, together with the self, one of the two relevant elements which the organism is able to identify within its perceptive flow.

This suggests the existence of a second selective and adaptive mechanism, social presence, *which enables the Self to identify and interact with the Other by understanding his intentions*. In other words, from an evolutionary point-of-view, social presence has *three functions*:

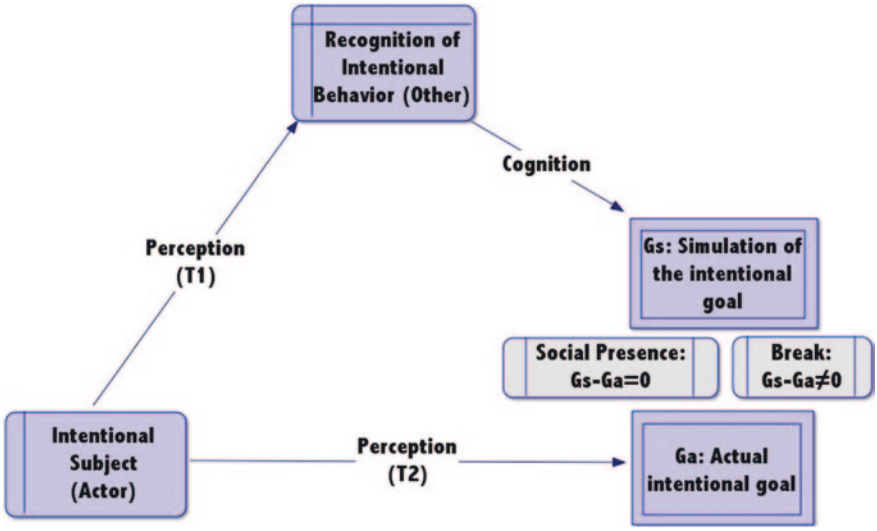

Fig. 2.3 The experience of social presence

- To enable the subject to identify the Other and to attribute to him an ontological status—"the other similar to the self"—different from the other objects perceived,
- To allow interaction and communication through the understanding of the Other's intentions; From the computational viewpoint, it happens using the same approach used by Presence (Fig. 2.3):
  - First, the agent recognizes a motor intention, and identify the actor as another intentional self (other);
  - Second, an efference copy of the motor command is fed to a forward dynamic model that generates a prediction of the consequences of performing this motor command (goal);
  - Third, the predicted state is compared with the actual sensory feedback. Errors derived from the difference between the predicted state and the actual state (break) can be used to update the model and improve performance.
- To permit the evolution of the Self through the identification of *"optimal shared experiences" (Networked Flow)* and the incorporation of artifacts—physical and social—linked to them.

In summary, we can define social presence (Biocca et al. 2003; Riva 2008a; Riva et al. 2003) as *the sensation of "being with other Selves" in a real or virtual environment, resulting from the ability to intuitively recognize the intentions of Others in our surroundings*.

From the combined analysis of presence and social presence, it emerges that the point of contact between these two processes clearly lies in the *intentions*

and their codification by means of *motor representations of action* (Knoblich and Flach 2003; Prinz 1997):

1. On the one hand, presence verifies the effective fulfillment (enaction) of the intention in action;
2. On the other hand social presence permits the identification of the Other's intentions through the analysis of his actions.

2.5 The Evolutionary Role of Presence and Social Presence

In the previous paragraph, we saw that the point of contact between presence and social presence is found in *intentions* and in their codification by means of *motor representations of actions.* We have also seen how the *dynamic theory of intentions* describes an intention as a dynamic structure organized on three levels. In the following section, we will see how this triadic structure can be attributed to the evolutionary process of the Self and is also existent in presence and social presence.

2.5.1 Presence and the Evolution of the Self

In his book, "*Descartes' Error: Emotion, Reason, and the Human Brain*", the neuropsychologist Antonio Damasio identifies the sense of the self as the essential nucleus of the conscious, *the result of interaction and the relationships between the organism and the object* (Damasio 1994). In this view, the conscious consists of the construction of knowledge concerning two elements:

1. the organism which enters into a relationship with an object;
2. the object involved in the relationship which brings about a change in the organism.

In Damasio's view, this ability is not immediately natural for the organism, but it evolves through time leading to a level of conscious (Fig. 2.4).

The origin of the sense of the self lies in the *"proto-self"* (Damasio 1994), "a coherent collection of neural patterns which map second by second the state of the physical structure of the organism in its various dimensions" (p. 189). The proto-self's main task, of which the subject is not aware, is 'positionality', that is, to identify organism's physical boundaries by verifying somatic functions.

Through the evolution of the proto-self, two other types of self successively emerge—the "*core self*" and the "*autobiographical self*"—which are at the basis of conscious experience. The core self can be described as a conscious representation of the present in which there are three elements: the object of which the

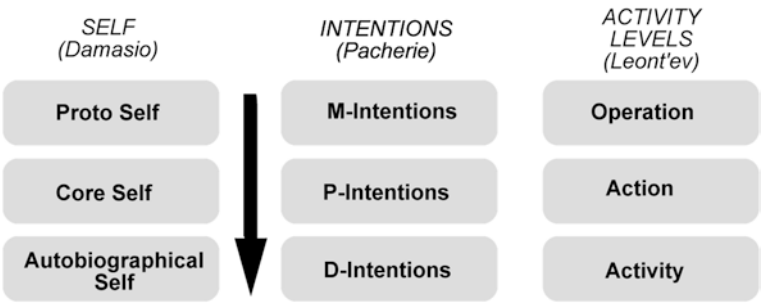

Fig. 2.4 From self to agency

subject is aware, the position of the subject's own body in relation to that object, and the relationship which is established between the two.

The transition from the core self to the autobiographic self is made possible through the use of language. By using language we can create a story, our story, in which we position and structure the different experiences which we have had. It is through the development and awareness of this story that the self becomes self-conscious, aware of itself.

Beginning with this theory, the hypothesis formulated by Riva and Waterworth (Riva et al. 2004; 2006) is that each level of the Self is associated to *a specific ability to differentiate between internal and external* which increases the control that the organism has over its own activities, thus increasing its chances of survival. Furthermore, the close link between the levels of the Self and the dynamic theory of intentions (Riva 2008a) enables us to *associate each level to a specific intentional capacity and a level of presence*.

1. *Proto-self*: Motor Intentions (the Self toward the body);
2. *Core self*: Proximal Intentions, directed toward the Present (the Self toward the World/Nature);
3. *Autobiographic self*: Distal Intentions, directed toward the Future (the Self toward Possible Worlds/Culture).

In practice, the Self evolves by extending the boundaries of its actions through the acquisition higher levels of intentional ability. This allows the limits of the subject's actions to be extended (Fig. 2.5).

In fact, the three levels of intention are differentiated by the limits to the actions which the subject is able to perform. The boundaries of the actions resulting from motor intentions are defined by the relationship between body and mind: I can only move my body. The boundaries of the actions resulting from proximal intentions depend upon the relationship between the mind and the physical world: I can only interact with the objects which are present around me. The boundaries of the actions resulting from distal intentions are given by the relationship between the mind and the possible world: I can try to do everything that I can imagine doing.

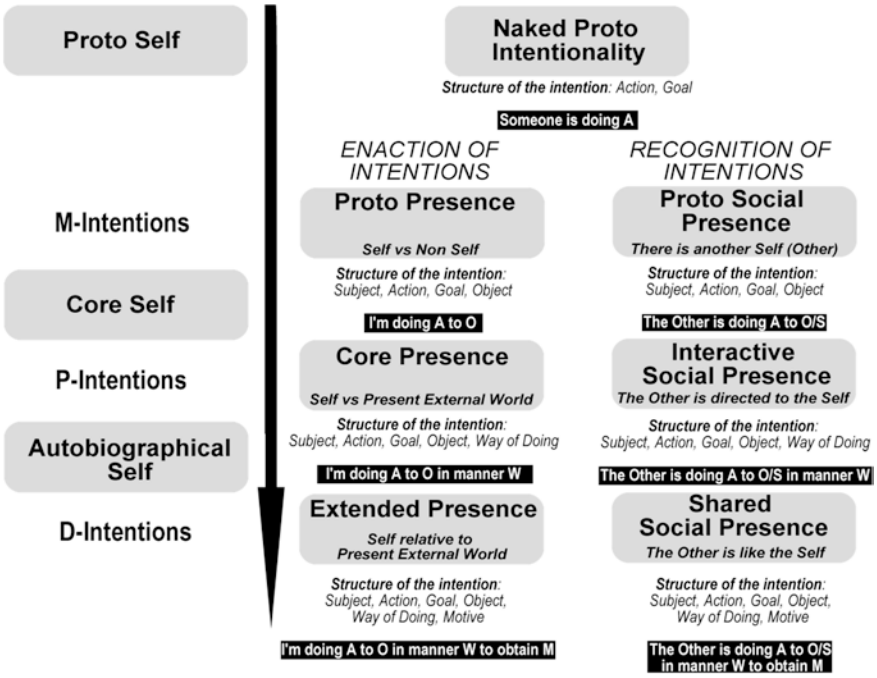

Fig. 2.5 The evolution of self

2.5.2 The Three Levels of Presence

As we have just seen, the development of an intentional ability and the positioning of the Self enable presence to evolve through three successive stages or levels. We shall now analyze these in greater detail.

The first level of the self, the *proto-self,* corresponds to "*proto presence",* the ability to enact motor intentions by moving the body (given that the boundaries of the self's actions are determined by the body). This is made possible by the Self's ability to distinguish between internal and external states. This happens through *perception–action coupling:* the more the organism is able to *correctly associate stimuli to movement in sensorial flow,* the better it is able to differentiate itself from its external surroundings and thus increase its chances of survival (the Self as opposed to the not-Self). According to evolutionary psychology, a newborn learns these skills during the first three stages of the sensorimotor phase (Piaget 1945).

The second level of the self—the *core self*—corresponds to *"core presence",* the ability to enact proximal intentions through the identification of direct *affordances* (the limits of the Self's actions are determined by the present world). This is made possible by the Self's ability to separate and couple representations and perceptions,

picking out those which are relevant. Within the experiential flow, the Self separates intentional information from the real object. The better the organism is able to distinguish between imagination and perception, planning, and action, the greater its chances of survival will be.

However, the organism must also be able to analyze and identify the perceptions which correspond to the intentional information (*relevance*). The more the organism is able to successfully connect intentional information to real-world objects, the greater the likelihood of fulfilling its proximal intentions and thus the greater its chances of survival (the Self in relation to the present world). In general, there are two elements which allow this distinction to be made: *vividity* and *multisensoriality.* In fact, mental images are much less vivid than perceptions, and are also characterized by the predominant visual component.

Coupling, on the other hand, takes place thanks to *recognizability:* the capacity to associate a real object to a given intention. According to evolutionary psychology, a newborn learns this skill during the final three stages of the sensorimotor phase (Piaget 1945).

The third level of the self—the *autobiographic self*—corresponds to *"extended presence",* the ability to enact distal intentions (the co-networked flow in the Self's actions is the possible/conceivable world) through the identification of indirect *affordances.* This is made possible thanks to the Self's ability to analyze representations and identify those which are relevant. The better the organism is able to separate itself from the present and *identify within its own representations those most relevant,* the greater are its chances of survival (the Self in relation to possible/conceivable worlds). According to developmental psychology, the newborn learns this skill in the preoperational phase (the acquisition of semiotic functions) before then moving on to the concrete operational and formal operational stages (Piaget 1945, 1947).

Extended presence is also the element which allows for the subject's "*absence",* that is, *its presence in an exclusively mental activity*. During an experience of absence, such as thinking, daydreaming or meditating, the subject tries to separate itself as much as possible from the outside world and to concentrate exclusively on its own mental processes (the self outside of its external surroundings). In general, the more the subject believes that mental activity is important for its "internality", the greater its attempts will be to isolate itself from the outside world.

What is the link between the three levels of presence? They are evolutionarily organized—from the lowest to the highest—but functionally separate. This means that, in the case of injuries which may impair the subject's ability to activate one of the three levels, the others will still be functional. For example, in the case of a neurologic disorder called *autotopagnosia*—the inability to localize parts of the body—the subject loses its *proto presence*. This does not prevent the subject from continuing to experience core presence and extended presence.

The three levels of presence are linked by their *simultaneous influence on the actions of the subject*: The experience of the action changes according to the presence of the subject on each of the three levels. It is important to note that the subject is usually unaware of the role of the three levels of presence in determining

the characteristics of his or her actions. *However, the subject is evolutionarily programed to consciously understand the variations between the three levels and if necessary, to modify an action in order to return to its initial state.* If, during a virtual reality experience, my arm moves and suddenly comes into contact with a cable, I immediately become aware of the change at the level of proto presence and I shift my attention from my virtual reality experience to the cable which is impeding my movement (Spagnolli and Gamberini 2002).

The same is true for the other levels. If the reality TV show the subject is watching becomes boring or upsetting, the subject becomes immediately aware of the variation in the level of extended presence, and can decide whether or not to pick up the remote control and change channel.

As will we see in greater detail, there are particular situations defined as "flow experiences" or "optimal experiences", in which the subject's actions are so fluent and effective that they produce a feeling of maximum presence within the subject. On the other hand, every glitch in the action makes the medium visible, and thus increases the perception of opacity.

2.5.3 The Three Levels of Social Presence

The importance of imitation in developmental psychology and in particular its link to empathy and intentionality has driven several researchers to explore this area of study. One of the researchers who has studied the development of imitative processes and their link to cognitive processes in depth is the American psychologist, Andrew Meltzoff. Meltzoff's research is well known in developmental psychology for having demonstrated that, unlike Piaget theorized, a child is capable of imitating various gestures made by an adult—sticking out their tongue, opening their mouth, or moving a finger—as early as only 2 or 3 weeks old (Meltzoff and Moore 1977).

Meltzoff and Decety have recently summed up 25 years of research on imitation in a review for the Royal Society (Meltzoff and Decety 2003). The article identifies three phases in the development of imitative skills:

- *The capacity to imitate a human being*: as we have noted, the child begins to develop this capacity when it is 2 weeks old. During this phase, the child learns first which parts of the body to move and how to move them.
- *The capacity to identify a human being who is imitating the child*: the child begins to develop this ability at around 14 months. The child understands that, although he is not controlling the adult's actions, the adult is imitating him.
- *The capacity to recognize intentions and emotions in a human being*: from 18 months the child is able to understand that a subject's activities are structured in terms of objectives and intentions.

On the basis of these points, Meltzoff has developed the "*like me"* model, which explains the structure of the process in three successive phases through which a child is able to develop a theory of the mind (Meltzoff 2007):

- *The presence of an innate predisposition for action representation*: thanks to *mirror neurons* the child is able to experience a perceived action almost as if he had performed it;
- *First person experience*: through his daily experiences the child learns to connect his motor acts with mental states. For example, the child learns to connect the feeling of having a wish being denied with the facial expressions and movements which indicate this.
- *Understanding other minds*: when the child sees other people behaving like him, he is able to understand that, by analogy, they are experiencing the same mental state as he does when he behaves that way.

Our view links the different phases classified by Meltzoff to the capacity to identify the specific intentional levels which permit the subject to perform a given social activity: if the recognition of motor intentions enables the subject to *imitate,* the capacity to recognize motor and proximal intentions allows him to *interact*, while the ability to recognize motor, proximal and distal intentions offers the subject the possibility to *communicate* and *empathize.* It is important to highlight the direct link between presence and social presence: the subject is only capable of recognizing intentions which he is able to perform (see Fig. 2.5).

The first level of imitative skills—the ability to imitate a human being—corresponds to *"proto social presence",* the ability to recognize motor intentions, which allows the Self to recognize an intentional Other: the better the subject is able to *recognize within the sensorial flow the stimuli which relate to "another similar to the self",* the better he is able to carry out an intention, and thus increases his chances of survival (the Other in opposition to the Self).

The second level of imitative skills—the ability to identify a human being who is imitating me—corresponds to *"interactive social presence",* the ability to recognize motor and proximal intentions which allows the Self to identify the Other whose intention is directed toward him: the better the subject is able to *recognize within the sensorial flow the intention direct toward him by "an Other similar to the self"*, the greater the chances of successfully carrying out an action, and therefore the greater the chances of survival (the Other toward the Self).

The third level of imitative skills—the ability to recognize the intentions and emotions of a human being—corresponds to *"shared social presence",* the ability to recognize motor, proximal and distal intentions, which enables the Self to identify Another whose intentions correspond to his own: the better the subject is able to *recognize within the sensorial flow an "Other similar to the self" with intentionsthe same as his own,* the better he will be able to successfully initiate collaborative interaction or communication, increasing his chances of survival (the Other like the Self).

Shared social presence permits the subject to feel empathy, *the capacity to see oneself in another person, to get inside another's thoughts and state of mind.* During the experience of empathy, the subject separates himself from his own intentional and emotional state, and identifies with that of another person (the Other merges with the Self).

What is the link between the three levels of social presence? As with presence, the three levels are evolutionarily organized: from the lowest to the highest. However, unlike presence, the levels of social presence are not functionally separate but mutually inclusive. This leads to two consequences. The superior levels also include the inferior levels: if the subject is able to understand distal intentions (shared social presence), he is also capable of understanding motor intentions (proto social presence). At the same time, it is impossible to activate the higher levels of social presence if the lower levels are not activated first: if I am unable to understand a subject's proximal intentions (interactive social presence) then I will not be able to understand his distal intentions (shared social presence).

The three levels of social presence are linked by *simultaneous influences on the subject's capacity for social interaction*: the way in which the interaction is experienced changes depending on the level of social presence experienced by the subject. It is important to note that, as with presence, the subject is unaware of the role of social presence in determining the characteristics of his actions. He is, however, evolutionarily programed to perceive the shift from one level of social presence to another in social interactions. Furthermore, if this shift offers him a valuable opportunity, the subject can act in order to increase his level of social presence. If a girl starts staring at me at a party, I immediately become aware of the shift from proto social presence (the girl is at the same party as me) to interactive presence (the girl is looking at me). If the girl is interesting, I can approach her and talk to her in order to understand her intentions: is she looking at me because she likes me or because I have a stain on my jacket?

2.6 The Social Process: The Point of Contact Between Presence and Social Presence

So far, we have analyzed presence and social presence separately. In fact, there is a very strong link between these two concepts, and their point of contact is the social process: it is thanks to the correct levels of presence and social presence that it is possible to communicate. To be able to communicate the subjects, as well as sharing a series of common concepts, must be able to recognize the presence of another in the same situation (proto social presence), understand the other's wish to begin communication (interactive social presence), and they must be able to identify the intention which the other expresses through communication (core presence and extended presence) and express their own actions through motor acts (proto presence).

The relationship between social process and presence is, however bidirectional. On the one hand, presence and social presence are necessary in order to

interact and communicate. On the other hand, it is through the social process that the subject and the group evolve. When this happens, the subjects and the group progressively increase both the characteristics of their own intentions (from motor to distal) and the sense of presence that they experience, creating the basis for new creative acts, both individual and group. To understand how this occurs, however, it is necessary to introduce three new concepts: *optimal experiences, memes, and narration*.

2.6.1 Presence, Activity, and Optimal Experiences

One of the deductions which can be made from what has thus far been discussed, is the existence of a link between presence and the effectiveness of an action: the greater level of presence a subject experiences in an activity, the greater the organism's involvement in the activity will be, and this increases the probability of the activity ending well (the transformation of the intention into action).

This concept is particularly important when the subject carries out the activity by using a tool, including media. The use of a tool compels the subject to modify his action, forcing him to adapt himself to the tool. In this case, given equal conditions and skills, the greater efficacy of the activity when carried out using a tool is linked to the tool's ability to facilitate the subject in increasing his level of presence. We shall give an example to explain this concept.

Imagine that we have a computer and have to copy a file from a disk onto a USB stick. We have seen that proto presence constitutes the first level of presence, which concerns the level of coupling between movement and perception. This means that an activity in which it is easy to immediately identify the result of one's own movements is preferable to an activity in which this is not possible. For this reason, the subject, all things being equal, will tend to choose a program which facilitates the direct perception of movement—*I move the file by dragging it with the mouse*—as opposed to one which does not—*the instruction "copy name-of-file a: b:"*. Likewise, using the arrow key on the keyboard to copy the file is preferable to using an instruction, but worse than using the mouse.

During an activity, we are obviously not influenced by only one level of presence, but by all three levels together. For example, when we are doing a distance-learning training course, interaction with the mouse is preferred to interaction with the keyboard (proto presence); the use of multimedia equipment is better than making use of a simple text (nuclear presence); undertaking tasks linked to experience and to the interests of the project is preferable to carrying out abstract tasks (extended presence). But what happens when we have to choose between activities or artifacts which differ within the different levels of presence? For example, how do users choose between a distance-learning training course with interesting modules but which uses only texts, and another which makes extensive use of multimedia but which addresses less interesting topics? In these situations, the level of presence which is evolutionarily superior prevails: first extended presence,

followed by nuclear and then proto presence. Users will, therefore, choose the course featuring interesting topics but which only uses text.

The second consequence of the considerations made in the preceding chapter, is the existence of certain *"optimal experiences", in which the individual experiences the maximum feeling of presence at each of the three levels.* This experience, when it is associated with a positive emotional state (it is also possible to experience the maximum feeling of presence in emotionally negative situations, such as during an escape) is defined as *"flow experience"* (Csikszentmihalyi 1990, 1994). This state is characterized by a high level of concentration and participation in the activity, by the balance of the perception of the difficulties of the situation and the *challenge*, and personal *skills,* by the distortion of the sense of time (the internal clock slows down, while the external one speeds up), and by a natural interest in the process which produces a sense of pleasure and satisfaction.

Similar considerations can also be made concerning the concept of social presence. First, there is a link between presence and efficacy of interaction: *the more often that the organism experiences a high level of social presence during interaction, the greater his ability to understand the other, and therefore the chances of the interaction being successful increase.*

Second, there is also a specific optimal experience for social presence—*"networked flow"*—the result of the association between:

- *The maximum level of social presence*: the feeling of sharing objectives and emotions with others;
- *The group members' perception of being in a phase of liminality*: a state of transition, of being "about to…", in which the earlier *positive* condition is no longer present, and the future *positive* condition has not yet come into being.
- *The shared recognition of a possible common strategy for exiting from liminality*: everybody working toward a shared objective, which the group can change.
- *The maximum level of presence*: the feeling of being able, through the personal involvement in the group, of successfully transforming intentions—both individual and collective—in actions.

Let us now explore these concepts further.

The term *liminality* denotes a state of transition, of being "about to…", in which the earlier *positive* condition is no longer present, and the future *positive* condition has not yet come into being (Turner 1982). A typical situation of liminality is when a recent graduate is looking for work: he is no longer a student, but he is not yet employed. Another example is when a person has been left by their partner: they are no longer part of that couple, but they are not yet part of a new one. When this happens the subject is naturally pushed toward change.

His situation is linked to the psychological concept of the "inner conflict", described by Festinger (1957) and by Miller and Rollnik (1991): the perception of the discrepancy between reality on one side, and aspirations and expectations on the other. The inner conflict pushes the subject to change, but the effectiveness of the change is linked to the *self-efficacy* of the subject: the subject's belief in his

ability to change his own behavior (Bandura 1997). If the subject thinks that he is able to change, he will try to do so. If not, he will wait until he is forced to do so by a feeling uneasiness or by his surrounding environment.

In this case, the maximum level of social presence permits the subject to increase their self-efficacy and to find the motor for change within the shared group activity. As we will see in Chap. 3, there are several cognitive and social factors which influence this process. For the moment, we shall limit ourselves to underlining how the sensation of sharing objectives and ideals, associated to the push for change brought about by the feeling of liminality, can lead the group to the experience of *networked flow*.

This concept shares a number of similarities with the concept of the "nascent state" proposed by Alberoni. Subjects who go through this have a strange experience which causes them to develop an alternative interpretation of existence (Alberoni 1977). *Nascent state is an exploration of the boundaries of the possible, given a certain type of social system, with the goal of maximizing what is realizable within that experience and solidarity for oneself and others in that moment in time. The group of men among whom a nascent state is created will always attempt to construct a way of living which is completely different from the everyday institutional norm (p. 31).* Alberoni's ideas highlight how the experience of *networked flow* is important for the subject and is therefore characterized by a high level of presence. The simultaneous union between high levels of presence and social presence make it a *state of transition* which constitutes the specific conditions for social transformation. It is at this moment that the subjective intention becomes collective (*we-intention).* As noted by Searle (1995), collective action is characterized by the use of an individual action to reach a shared goal: *I intend to perform this action as part of our common action*.

2.6.2 The Result of Optimal Experiences: Memes

What happens during an optimal experience? The hypothesis presented in this book and explored further in the following chapter, is that during an optimal experience the subject is able to produce creative works more easily. Notably, optimal experiences are fundamental for the creation and diffusion of "*memes*". But what is a meme?

The concept of memes was first introduced by the zoologist Richard Dawkins, in opposition to the concept of the gene: an element of culture which can be transmitted from one individual to another by non-genetic means, and in particular through imitation (Blakemore 1999; Dawkins 1989). Dawkins presents the concept of memes as part of the theory of "universal Darwinism", according to which life evolves through the differential survival of entities, which replicate themselves, "replicators".

If a gene is a replicator of a particular genotype, the meme is the replicator of a phenotype (Dawkins 1989): a unit of cultural information which is copied with variations or errors, and whose nature influences its chances of replication. In practice, it is via memes that that skills, habits or manners are transmitted from

one person to another through imitation. For this reason, memes do not overlap with the cultural units, but are selected by them (Dawkins 1989).
There are three elements in Dawkins' definition which are not sufficiently explained by the author (Blakemore 1999; Distin 2005):

- The content of the meme, or, more specifically, what type of cultural information it contains;
- The different ways that memes can be transmitted;
- Whether memes only exist inside the brain or also outside.

This book presents two hypotheses:

1. That the memes' content is intentional: *each meme contains within it a specific intention.*
2. *The creation and diffusion of memes depends on the* level of presence and social presence experienced during action and communication.

More precisely:

- Memes are more likely to be created during an activity characterized by high levels of presence: The condition required for the creation of a meme is *a high level of extended presence*, that is, the intention must contain elements of particular significance for the subject's representations. For example, if I am sitting in my armchair listening to a song on the radio which brings to mind memories from my past—I remember my first holiday abroad—the words and notes will tend to become fixed in my memory. Moreover, high levels of proto and nuclear presence linked to extended presence further increase the chances of creating memes. The more vivid the music is, the greater the possibility that a meme will become activated. The concept of presence allows us to predict the development of memes, even in situations where there is a high level of extended presence but a negative emotional element. For example, the screams of a hunter engaged in combat with a wild beast may become a meme and be used by other hunters to indicate the moment of battle.
- Memes are more easily replicated during an activity characterized by high levels of presence and social presence. More precisely, the replication of memes requires:
  - *High levels of extended presence*: the interaction must contain notable significant elements for the subject's representations;
  - *High levels of shared social presence*: During the intentional interaction I must be able to understand the meaning that the "other similar to myself" attaches to it.

When the meme is produced by a "friend"—a person who I consider like myself, or by a person who I respect—during an activity directed toward an objective which is important to me, the probability of the meme being transmitted (the internalization of the intention) increases significantly. This explains why the behavior of singers and actors is so often imitated by their fans.

2.6.3 From the Group to Society: The Role of Narration

The creation of a new meme—a new product, a new concept, a new idea—does not necessarily imply its diffusion. As we have just seen, the transmission of memes is strongly linked to the level of social presence experienced during the interaction between the subject who passes on the meme, and the subject who receives it. There is, however, a tool which is able to facilitate this process: *narration*. As noted by Bruner (1991): *Just as our experience of the natural world tends to imitate the categories of familiar science, so our experience of human affairs comes to take the form of the narratives we use in talking about them* (p. 5).

It is in fact narration which connects one meme to another, giving them a sense and allowing people outside the group to recognize them as possible intentions (internalization). The link between narrative, memes, individuals, society and activities, exists on four levels:

- *Individual:* narrative thought is the cognitive tool which enables us to interpret situations and to construct a vision of the world which is not only related to the present, and which guides our individual activities;
- *Social:* narratives allow memes to connect with each other, so that the community of customs to be defined. This allows social activities to be structured and artifacts to be constructed;
- *From social to individual*: through the processes of *positioning and internalization,* narratives influence the characteristics of our social identity and our vision of the world;
- *From individual to social:* through narration, made possible by narrative thought and the process of *externalization,* we are able to share our vision, expressed in a series of memes, which allows common activities in the community of customs to be structured.

Narrative psychology maintains that a significant part of knowledge of the self is organized in narrative schemes which the individual uses to interpret reality and to give it meaning (Crossley 2000; Rollo 2007). Hutto, exponent of the *Narrative Practice Hypothesis* (2008), is one of the foremost advocates of this view and he defines the narrative structures which facilitate social interpretation as "*folk psychology narratives*": narratives which allow the listener or reader to understand the thoughts, actions and feelings of the characters. These narratives are not structured as rules, but as descriptions of subjects who act according to precise objectives and whose actions change their emotional state and their relationship with the world.

As Hutto notes (2008), the most effective conversations are those in which the subject is forced to present and negotiate his personal point-of-view: *The most prominent feature of such interchanges is that of participants being unavoidably forced to come to terms with others' peculiar takes. (p. 136).*

Using the same terminology that we have employed thus far, it can be said that only narratives in which the subject is present are able to position the subject: the greater the subject's presence, the greater the positioning effects of the narrative.

2.7 Conclusions: The Process of Networked Flow

In the previous paragraph, we concluded our extensive description of the cognitive processes which allow for the emergence of *networked flow*, and we are thus able to answer the questions that were posed at the beginning of the chapter.

What makes a subject "present" within a group? It can be said that a subject is present within a group if he is able to put his own intentions (presence) into practice and to understand the intentions of the other group members (social presence). This implies that not all groups are the same: it is not enough to put together a group of people in order for them all to be "present". It is necessary to give the group the possibility of expressing itself and of understanding what each individual member is doing. This becomes a fundamental requirement when the group is broken up and the members can only communicate through the use of modern technology.

However, if this should happen, that group may transform itself and become a creative group characterized by an optimal group experience—*networked flow*.

Csikszentmihalyi, in his book on creativity (1996) identified it as the result of three elements: a culture that contains meanings and symbols, a person who uses optimal experiences to bring novelty into the symbolic domain, and an external group who recognize and validate the innovation. At this point we are able to shed some light to the relationships between three elements.

To have a creative group four conditions must be met: (i) *The maximum level of social presence*: the feeling of sharing objectives and emotions with others; (ii) *The group members' perception of being in a phase of liminality*: a state of transition, of being "about to…", in which the earlier *positive* condition is no longer present, and the future *positive* condition has not yet come into being; (iii) *The shared recognition of a possible common strategy for exiting from liminality*: everybody working toward a shared objective (collective intention), through which the group can change; (iv) *The maximum level of presence*: the feeling of being able, through the personal involvement in the group, of successfully transforming intentions—both individual and collective—in actions.

When this happens the team experience an "optimal" experience (Riva et al. 2009) *at individual level, each subject experiences a state of conscience characterized by high levels of concentration, involvement, control of the situation, clarity of objectives, natural motivation and a positive emotional state; at group level, all the members of the team share the same intention (collective intention) that is experienced as critical to produce a long-term change relevant both for the team and for themselves.*

The result of the optimal experience is the creation of new artifacts, memes: new products, new concepts, new ideas. However, the group is not necessarily able to promote and share these new concepts outside its boundaries. In order for this to happen, two things are required: (i) the existence of interactions between group members and people outside the group—characterized by high levels of social presence—which make use of the new concept; (ii) the creation of narratives

which link the new concept to old ones allowing people outside the group to make sense of it (internalization).

In sum, an optimal personal experience produces memes that are used by the group to define its own culture (subculture). When these memes are internalized by most individuals, through imitation and communication, they modify and shape the culture and the behavior of the individuals.

Into this view, *networked flow* is a process of *transformation and creation,* which constitutes the specific means for social change (Gaggioli et al. 2011). We use the term 'process' because the final outcome of *networked flow*—social change—can only take place after a succession of phases. The following chapter will explore these different phases and explain their particular characteristics.

Chapter 3
The Emergence of Networked Flow

Abstract This chapter proposes a structural model for the emergence of Networked Flow in real life groups. We consider Networked Flow as a process and its emergence takes on the characteristics of a dynamic process in which it is possible to identify a number of sub-phases, each of them characterized by internal coherence and by distinctive properties. The six phases are:"Meeting—Persistence": an initial mutual recognition between people with certain characteristics in common who share the same conceptual context, or frame. "Reducing the distance": the subjects who recognize their similarities tend to reduce the distance between them and form a sub-group, though they are still in the pre-existing *frame*. "Liminality-parallel action": the subjects orient themselves and the newly formed sub-group in a specific direction which causes them to cross the boundaries of the original *frame*. In this case, the subject or the sub-group's leader perceives a common intentionality within the group (*we-intention)* and thus begins the process of redefining the pre-existing *frame* which again creates a new context. "Networked Flow": the group shares the new context in every respect, and experiences a permeating state of optimum experience which enables them to work creatively. "Networked Flow: Creation of the artifact": the group in Networked Flow expresses its creative power by generating an artifact (an object, thought, practice, idea, etc.) which embodies a new intention (*meme*) which was not present in the previous *frame*. "Networked Flow: Application of the artifact in a social reality": the artifact created by the group in Networked Flow is applied to the social reality of the previous *frame* in one of two ways: imposition "from above" (when the group in Networked Flow is also a group in power) or "from below", which entails a sort of absorption on the part of the social network or the individual.

As we have seen, the creative-transformative act cannot prescind from the interactive process which concerns both the social and cognitive spheres. We will now define the characteristics of this *creative process* more specifically, proposing a possible dynamic for the creation of Networked Flow in social groups.

The theoretical hypothesis of the phases in the emergence of Networked Flow in a social group—in contexts both of mediated communication (and therefore at different levels of presence) and of physical connection—originates from

A. Gaggioli et al., *Networked Flow*, SpringerBriefs in Education,
DOI: 10.1007/978-94-007-5552-9_3, © The Author(s) 2013

reflections by the authors of this book, and draws on theoretical matrices from a variety of sources: the psychology of communication, social psychology, cognitive psychology, cultural psychology, but also the history of science and the study of new technology. Our six-stage model bears some resemblance with the model outlined by Farrell (2001) regarding the life of collaborative circles, but it differentiates from Farrell's scheme mainly in terms of scope (psychological vs. sociological) and focus (process-based vs. activity-based). Moreover, while Farrell' scheme is clearly sociological in nature—i.e. speaks mainly of relationships between individuals and groups—our scheme tries to expand the focus on the intra-subjective dimensions of creative experience. These dimensions are mainly cognitive (intention) and affective (emotional state), and cover very basic processes, while Farrell's work is focused upon higher grade processes and relational consequences (e.g. who is friend of whom, who is angry with whom, etc.…). Finally, since our proposal is based upon lower grade processes, it is relatively culturally-independent. While Farrell's Collaborative Circles could require somewhat of a mixture or a clash of cultures in order to fuel the process (e.g. post-WWII New York became a center of art and literature development due to the enriching presence of many intellectual refugees), our scheme develops upon the micro co-occurrence of individual cognitive and affective dispositions and, as such, it does not require a specific cultural milieu in order to be engaged. Our proposal has many overlappings with Glăveanu (2012) "five-A" framework of creativity (Actor, Action, Artifact, Audience, Affordances), and we will briefly highlight stage-by-stage these similarities.

A slight difference between the present idea of creative process and the one from Glăveanu is that we opted to focus on the structural (i.e. phase) dimension, while Glăveanu focuses more upon a general, broader redefinition of the theoretical framework about creativity.

The proposal in stages which will now be outlined stems from an initial operation of *selection* and of the critical analysis of the main theoretical contributions from social science, with the aim of creating a *platform* which enables us to use a language which permits a multi-disciplinary discussion.

We shall consider Networked Flow as a *process* rather than a specific event (cf. Chap. 2): in this sense the emergence of this phenomenon takes on the characteristics of a dynamic process in which it is possible to identify a number of sub-phases, each of them characterized by internal coherence and by properties distinctive from those of the other phases.

It is our opinion that the process of the emergence of Networked Flow occurs in six stages:

- "Meeting—Persistence": an initial mutual recognition between people with certain characteristics in common who share the same conceptual context, or frame.
- "Reducing the distance": this mutual recognition lays the foundations for the second phase, in which the subjects who recognize their similarities (a high level of social presence) tend to reduce the distance between them and form a sub-group, though they are still in the pre-existing *frame*.

- "Liminality-parallel action": the subjects orient themselves and the newly formed sub-group in a specific direction which causes them to cross the boundaries of the original *frame*. In this case, the subject or the sub-group's leader perceives a common intentionality within the group (*we-intention)* and thus begins the process of redefining the pre-existing *frame* which again creates a new context.
- "Networked Flow": the group shares the new context in every respect, and experiences a permeating state of optimum experience which enables to work creatively.
- "Networked Flow: Creation of the artifact": the group in Networked Flow expresses its creative power by generating an artifact (an object, thought, practice, idea, etc.) which embodies a new intention (*meme*) which was not present in the previous *frame*.
- "Networked Flow: Application of the artifact in a social reality": the artifact created by the group in Networked Flow is applied to the social reality of the previous *frame* in one of two ways: imposition "from above" (when the group in Networked Flow is also a group in power) or emergence "from below", which entails a sort of absorption on the part of the social network or the individual. There are two possible outcomes: the artifact is able to modify the pre-existing *frame* and the social network; or, in the other case, the artifact is not able to modify the social network and it therefore breaks down. In this phase the capacity of the group to effectively "narrate" the history and the objectives of the artifact plays an important role.

Each of the stages will be described in the following sections, and each stage description will be preceded by a short example drawn from the outstanding work on Impressionist painters done by Farrell (2001).

3.1 "Meeting—Persistence"

In the 1850s, the art world of France was a centralized network dominated by the Académie of Beaux-Arts. This was a state agency whose task was to keep Art in the mainstream aesthetic boundaries. When young impressionists arrived in Paris in the early 1860s, they were confronted with classicism: a major current in the art world, favored by the Academy members. Classicism emphasized idealized, bucolic landscapes with references to mythology. Classicists also dominated the jury of the Académie contests, and considered Manet's "Dejuner sur l'herbes" as not on par with the aesthetic norms of the time. The painting from Manet was quite distant from the parameters of the Académie: it consisted of sharp color contrasts and showed two dressed men having a picnic with two naked women.

The first phase in the emergence of Networked Flow, "Meeting—Persistence", can take place in any social environment in which there are a certain number of individuals who share an interactive context. Referring to Goffman (1974), we can

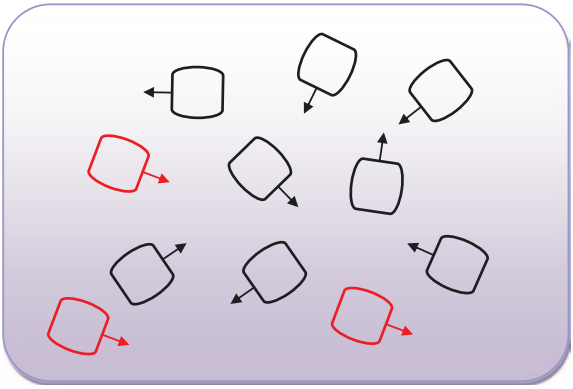

Fig. 3.1 The first phase in the emergence of networked flow: "Meeting—Persistence"

define this interactive context as a *frame*, that is, an area of inter-subjective expression which is in some way shared by the participants. The concept of *frame* is not so much an addition to reality, as a device which supports reality; a pre-existing reality which is organized, selected, and structured by the frame itself. In Goffman's view (*ibid.)* an individual tends to make use of a variety of structures to interpret a given event. The central structures are denoted by the author as primary structures, that is, those which are key to the interpretation of reality and which do not need to refer to previous structures and which, for a given social group—when considered all together—combine to define culture, the shared system of beliefs.

Referring to Fig. 3.1, we are able to represent the *frame* that we have hypothesized as a shell which contains our participants (represented by the circles). Each person—or Actor in Glăveanu (2012) terms—possesses their own individual intentional structure (cf. Chap. 2) which can be represented as a vector. As we can clearly see in the diagram the directions of the intentionality-vectors vary in similarity to each other: in many cases they are completely different, in other more sporadic cases they are going in a similar direction, and in rare cases their directions overlap.

When the intentionality-vectors overlap a potential sub-group of people begins to form. In order for this sub-group to be formed effectively, a number of requirements must be met (cf. Rubin 1984; McGrath 1984): for example, the frequency of interaction, the sharing of rules, the existence of a system which assigns roles, the pursuit of a common objective. Therefore, in this first phase there is identification between the individuals according to their intention directed toward the present (cf. Chap. 2): the people placed within the same *frame* "meet" based on the level of similarity in their intentions at that time. At that moment their intentions directed toward the future are not yet being taken into consideration, but the subjects must be able to "read" at least a part of the others' intentions.

In this phase we can certainly say that our participants are sharing a *frame*, and that some of them share the same intention-vector. In other words, what we can see is an *extended group,* within which some members have the potential to create a *close knit group* (cf. De Grada et al. 1999).

In this social context, processes of influence—always a popular area of study in psychology—become of primary importance. We may remember the renowned work of Asch (1952, 1956) concerning the influence of the majority: the group has a consistent power of persuasion in determining the conformism of the individual in the dominant position, even when this turns out to be plainly mistaken. Equally well-known are the studies carried out by Milgram (1974), who demonstrated how people, in order to obey a person in authority, do things which are against their beliefs and clearly harmful.

As for the influence of the minority, Moscovici (1976) hypothesized that the process of the majority influencing the minority may be balanced out by the influence that the minority can exert over the majority, given that the process of influence does not only work in one direction. While the majority induces a feeling of contrast (the minority is called on to support their position as opposed to that held by the majority), the minority causes a process of ratification within the group: it is the majority who must confront a potentially innovative and revolutionary position, and they must pass judgment on it. From a cognitive point of view, Nemeth (1986) theorized that the influence of the majority activates a process of cognitive convergence (the individuals consider a problem putting themselves in the place of the majority), whereas the influence of the minority encourages cognitive divergence and thus causes the individuals to consider the problem from multiple points of view.

In this phase we can therefore clearly pick out processes of social influence primarily favoring the majority: in this extended group the opinion of the majority directs the collective action. It is, however, probable that—should the participants who share the same intention-vector not wholly approve the direction of the collective action—a nascent minority influence will begin to grow which may, at least in part, represent an alternative for the collective action. Nonetheless, the participants not yet possess mutual *awareness* of the overlapping of their influence-vectors, and for this reason the creation of an out-and-out sub-group cannot be truly formalized.

The *frame*—in this phase—is not called into question, nor can we foresee any elements for a possible transformation of the shared context into something else: we must wait for the second phase in the emergence of Networked Flow for this to happen. This is where the term "Persistence" in this phase originates from: the *frame* "supports" and persists (we could also say "*pre-exists"*), it is never questioned, nor "challenged" by the presence of a potential core of minority influence represented by the members who have the same intention-vector direction.

In order to pass from this "Meeting—Persistence" phase, to the successive phase of "Reducing the Distance", this *temporal persistence*, the fact that the individuals have enough time to consolidate their intentions at a minimal level of awareness and begin to "read" the intentions of others, is indispensable. This temporal criterion can be met in two ways: first, through coercion (the individuals are *forced* to remain with their current frame), or through voluntary participation due to the quality of the experience for the individual (the subject experiences the activity positively).

3.2 Reducing the Distance

In the first period, the core impressionist group consisted of four young painters: Monet, Bazille, Renoir, Sisley. They were students in the studio of Gleyre—a teacher renowned for his willingness to favor some independency in his students—in 1862. The innermost group expanded in the 1960s; by 1865 it comprised also Pissarro, Manet, Degas, Cèzanne. The group also included extended members from other disciplines, such as novelists, poets, sculptors, who participated at the discussions and supported the groups with their knowledge (e.g. Émile Zola). In 1862, the four men began to close together and to know each other moving from the common ambition of becoming painters. None of them had a unique style, or a clear definition of their preferred techniques.

In this second phase something new happens: the *perception* of similarities between the people who share the same direction of the intention-vector. The perception of similarities triggers an important dynamic which we have defined—in coherence with the phase of emergence which it is characterized by—"reducing the distance". Individuals, having perceived these similarities, tend to prefer to interact with each other and to become aware of more and more similarities between them and in their motivations.

In this phase, however, the individual still senses a certain dissatisfaction regarding his personal *present intention,* caused by the perception of non-compliance regarding intentions directed toward the future. The subject recognizes that the other subjects he comes across in Phase 1 are experiencing the same sense of dissatisfaction, and this mutual dissatisfaction leads—on a structural level—to the creation of a sub-group which finds itself in a situation of *liminality* (cf. Chap. 2).

In our diagram (cf. Fig. 3.2) the person-circles get close to one another and begin to form a sub-group: self-definition causes the identity-making identification to grow, and it is probable that the feeling of fulfillment when participating in the sub-group will increase in parallel. As noted by Searle (1995), social groups are able to express their so-called "collective intention": they are not only guided by *cooperation*, but also by the genuine sharing of mental states, such as beliefs, wishes, intentions. According to Searle (*ibid.*) collective intentionality cannot be reduced to an individual intention "plus something extra"; it is instead something more and something different: the creation of individual intentionality originates from the wish to act as part of a group. In other words, it is my individual intentionality which comes from a collective intentionality, and not vice versa.

It is therefore probable that among the members of the new sub-group there is a growing perception of a common finality, although this may not be directly expressed or transformed into a *goal.* These individuals will now tend to act toward the *frame* of reference as a *unit*.

However, the sub-group does not yet put itself in direct contrast with the group (or better, with the *frame*) of reference: instead, it acts in terms of minority

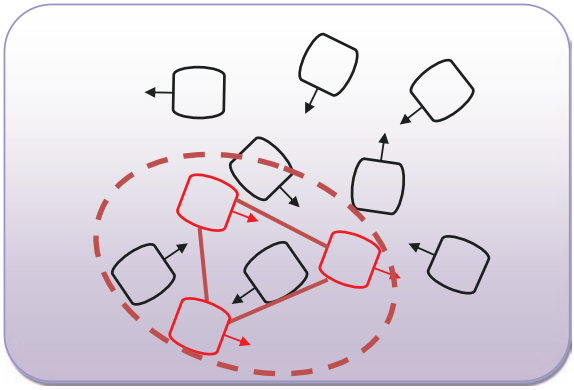

Fig. 3.2 The second phase in the emergence of networked flow: reducing the distance

influence and draws on its persuasive skills (cf. O'Keefe 2002 for a summary) in order to affect, in some way, the general direction of the *frame*. If we refer back to the classic theories of persuasion, we can find various possible attitudes of the subjects toward their relationships with the pre-existing rules and with the new information. If we adopt Ajzen and Fishbein's view of reasoned action (1980) for example, behavior becomes the result of a pre-existing attitude and subjective norms (in this case of a "small group"). If, however, we adopt the view of the Elaboration Likelihood Model (Petty and Cacioppo 1986), we can hypothesize that the members of the sub-group—unlike the other members of the *frame*—may reserve the "central" processing channel for the hypothetical new interpretative frame which constitutes an alternative to that provided by the completion of the group-work, leaving the "periphery" processing channel free for information considered to be secondary. Personal significance and the need for knowledge thus favor access to a processing channel for the most accurate information, therefore also favoring a process of group identification and mutual commitment between the members.

A similar consideration can be made if Chaiken's heuristic-systematic model (1980) is used: systematic evaluation is reserved for the most important information, that which is creatively processed by the small group, whereas a heuristic evaluation can be used for the remaining information, considered to be "acquired"—that is to, the reserve of information of the previous *frame*.

The sub-group which is forming begins to take on certain characteristics of what, in social psychology, is known as "the small group" (cf. Levine and Moreland 1994): regular interaction, the presence of emotional bonds, a common frame of reference and, finally, behavioral interdependence. In this dynamic, the process of reducing the distance can be likened to the process of introducing a new member into the group: if the mutual feelings (of the individual and of the group) lead to the conclusion that there is an equal advantage, the new member will become a part of the new group and the group will therefore have access to new resources.

3.3 The Liminality-Parallel Action

Bazille had strong opinions in terms of Art: he wanted to paint everyday scenes of people attending their activities in their habitual surroundings. Soon after forming a friendship with Renoir, Bazille brought in the group Sisley. Monet was the last to join the group: he was more colorful and rebellious than the others. He resisted his fathers' attempts to steer him toward teachers who would have given him a solid foundation in arts, preferring to practice in open studios, and paying models. Gleyre labeled Monet the class rebel, which made him even more interesting for Bazille, Renoir, and Sisley. In these early days of the group, the members were held together by their shared commitment to the role of student and one to another. They shared the same negative reactions to the established styles of the Academy, but none had yet developed a personal style. They also shared a sense of alienation from their teacher's preference for classical style. They knew what they did not like, but they did not know where they were going. Their reciprocal commitment strengthened, their interactions intensified and finally Monet take the lead.

In this third phase we can theorize that the newly created sub-group, after reducing the distance, begins to consolidate its "boundaries" with respect to the pre-existing *frame*, and to position its common "intention-vectors" in a direction which enables the sub-group to close in on the limits of the pre-existing *frame* (cf. Fig. 3.3).

The members of the original frame diminish in importance in the eyes of the new group's members, and they therefore begin to lose importance for the frame's boundaries.

Returning to Goffman's theory, we can say that the members of the new sub-group—supported by satisfying interactions, by a now-clear sense of a common finality, by the sharing of intentions—begin to transform their group (or better, the *potential structure* of their group) into something resembling a new *frame*. The participants structure their experiences according to a common interpretative pattern, they establish conventions to indicate the boundaries of their transformation and finally through this process they are able to radically transform the meaning of the previous experience.

On the one hand, it is necessary that the group members experience a high level of social presence: the sensation of sharing objectives and emotions with others. On the other, it is also necessary that the group members experience the situation of *liminality* (a state of transit, of being "about to …") and identify within the group the means to overcome it.

This allows for the emergence of a *collective intention,* which, moreover, becomes the group's *first creative act* in potential Networked Flow at the moment when they break definitively with the pre-existing frame and advance toward the new one. Coherently with Glăveanu (2012), this action can be defined as "Coordinated psychological and behavioral manifestation" (ibid., p. 3).

If we go back to the well-established theories relating to the creation and evolution of social groups (cf. Worchel et al. 1992), we are able to identify six phases in this sub-process:

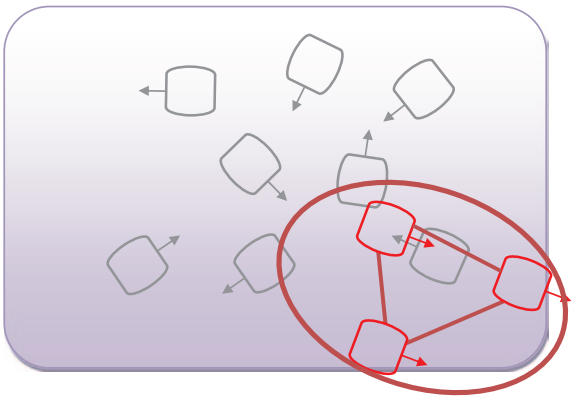

Fig. 3.3 The third phase in the emergence of networked flow: the liminality-action parallel

1. A Period of Discontent: this is the preliminary step for the formation of a new group deriving from one which already exists and which has disappointed its members.
2. Precipitant Event: an occurrence which clearly and recognizably signals the creation of a new group. The new group's potential members are markedly different from the "central" or "prototype" members of the original group.
3. Group Identification: the new group looks for and assumes a new identity, it distinguishes itself from other groups, and it has an internal structure based on rules and leadership. It is in this phase that the feeling of belonging is maximized, and the in-group/out-group differences are amplified: the group is quite rigid and requires notable conformism on the part of its members.
4. Productivity: once the group's identity has been consolidated, the productive phase can begin. The group has objectives to be fulfilled and formalizes the way in which it will do this; members are evaluated based on the contribution that they make to meeting the group's goals. The group "relaxes" its boundaries and considers the integration of new members from outside.
5. Specification: the group's main focus moves from the collectivity to the individuals, who begin to ask themselves whether is still beneficial for them to stay in the group from the point of view of the balance between the effort spent on the common goal and the rewards of their investment. The new members are received positively as new resources, and the "older" members start to evaluate whether other groups may be better suited to their needs.
6. Decline: the value of the group is called into question, members, and subgroups enter into competition with one another and culprits are sought for any mistakes made. It therefore becomes possible that the group may return to the Phase 1, Discontent.

Between returning and the theory of Networked Flow, we can hypothesize that our sub-group has now transformed itself into an out-and-out new social group, and is therefore in the phase between "precipitant event" and "group identification". In doing so the new group physically "moves" toward (and passes) the

limits of the frame, a threshold (nascent state) similar to that proposed by Alberoni (1977). The previous balance is upset, and the sub-group completely redefines its state, thus creating the basis for a new and completely innovative frame with respect to the previous. The group is therefore freed from the control of the pre-existing social reality and is balanced internally.

In this phase a leader figure has not yet emerged, the parameters for a common goal have not yet been defined and the group is still working toward *finality* as opposed to *goal.*

3.4 Networked Flow

Gleyre closed his studio due to his impending blindness and Monet suggested they had to paint in the open air. The group then started to paint in the woods of Fontainebleau. At the time, Academics thought open air painting as a sort of forbidden activity, as the artist could not achieve the concentration and focus needed to portrait the classical neat lines of the Classicism.

In the following years, the entire group painted in the woods of Fontainebleau: members shared their ideas and style, fostering the creation of a shared vision of what Art should be. The process was not linear: many achievements looked like failures or uncertainties at best. Some subgroups emerged, pairs of painters that shared some breakthroughs and new ideas. Some of these ideas—e.g. new brushing techniques, ideas about the colors in the nature, etc.*…—were then reframed by the group discussions that followed. In the process, however, the group as a whole consolidated a strong identity and a coherent style and they mutually enjoyed their company. They thought that Nature was the best teacher, and their outdoor painting could benefit by their immediate perception of the surroundings, rather than copying works in the Louvre as was usual for painters at the time.*

In this phase we enter into what we have defined as Networked Flow: an "optimum" experience which defines members of a group and guides their actions.

The new group identifies one or more leaders, who we can define, in this context, as the individual or individuals who are better able than the others to transform what was previously only *finality,* into *goal.* The leaders exercises his influence over the group and thus helps in clarifying the group's objectives and facilitating its cohesion.

The pre-existing *frame* is abandoned, and a new *frame*, which provides a more valid background in which to support the group's creative activity, is established.

It may be worthwhile noting that in this phase (cf. Fig. 3.4) the certain "je ne sais quoi" which defines Networked Flow may be the quality of the experience perceived by the participants: *a state of consciousness defined by a high level of concentration, involvement, control of the situation, clarity of objectives, intrinsic motivation, and a positive emotional state.*

In this phase there are several critical events which bring about the onset of Networked Flow:

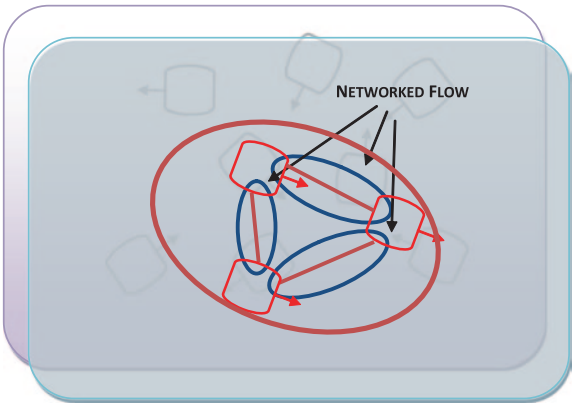

Fig. 3.4 The fourth phase in the emergence of networked flow: networked flow

- *The transformation of the collective intention into a collective action*. The group uses the resources at its disposition to act in concrete terms within its environment. The action can clearly be either physically instrumental or purely conceptual in nature. This task involves the group considerably, given that it needs to reserve a notable amount of resources in order to be able to pass from an intentional to an operational level.
- *The internalization of the collective intention directed toward the future.* The participants are engaged in their task—which is very taxing from a cognitive and emotive point of view, but this time individually—to introduce the collective intention into the array of "private" individual intentions, and to transform it into an individual intention itself. Furthermore, this internalized collective intention must hold a position of particular significance in terms of personal objectives.
- *The balance between the resources available to the group and those required by the common action*: this requirement recalls to mind, in a potentially very useful way, the notion of *flow* as the balance between challenge and skills. In this sense, Networked Flow ends up having the same conceptual requirements as an optimum individual experience.
- *The identification of one or more leaders.* In this phase, as we have already mentioned, the leader emerges as a catalyzing element who answers two possible individual needs of the group members:
  - He first provides a model of the "standard" which other group members can conform to, above all concerning the introjection of the future collective intention. The leader presents himself as a "prototypic element" who is the first to synchronize his own individual intentions with the collective intention of the group.
  - We can hypothesize that the disparity between the leaders original intentions and the collective group intention is minimized, and this explanation would fit well with the theories of social psychology which views the leader as the "most prototypic" individual compared to the ideal of the group to which he belongs.

  - Second, the leader provides a model which is seen as "achievable" by the other group members. In this sense he works as a unifying element for the group.

- *The new frame must be made explicit.* This means that the group must pass from an "implied" way of operating to an explicit way of operating, clearly declaring their future collective intention and, as a result, the operative steps which will enable them to transform this intention into action.

During this phase we can also imagine that the members of the sub-group may decide to further formalize their belonging (and consequently also the *frame*), creating artifacts which serve as collaborative support for their common experience. The continuity of interactions, and their quality, the creation of a new and qualitatively relevant product function as reinforcing agents within the group, and at the same time constitute extra criteria for the *in-group/out-group* definition.

3.5 Networked Flow: Creation of the Artifact

The group met some of the older painters in Fontainebleau and started to spread some of their ideas of Art. The group was inspired by Monet's attempt to surpass Manet's controversial painting ("Dejuner sur l'herbes"), and all the participants bolstered a sense of audacity and experimentation. Throughout the 1860s the members of the core group continued to live and work together. During the 1860 and the 1870 s the group passed through many hardships: impoverishment, mounting needs in terms of family expansion, little means to earn incomes. Their paintings were constantly rejected by the Salon juries.

In the late 1860s the group began to expand their scope and started to apply those techniques learned in the woods of Fontainebleau to paintings of Paris urban life and also to portraits. Manet, Degas, and Cézanne were not part of the original group, but eventually they became more and more interconnected with the emerging group culture. In group discussions, the artists decided to discard historical, religious, and mythological themes from their works, and decided to focus exclusively on depictions of modern life.

It is our opinion that the group, once it has reached a state of Networked Flow and remains there at length, must in some way "substantiate" its common activity in the form of a product (meme) originating from that collective activity. This product may be an object, a thought, a theory, a custom which is taken up by the group (a parallel could be drawn with the concept of "community of practice"; cf. Wenger 1998); a concrete or abstract *artifact* which did not exist before. (see also Glăveanu, 2012).

The group in Networked Flow is therefore characterized by the adoption (or use) of the new artifact—and this aspect represents a further element of differentiation from the previous *frame* (Fig. 3.5).

Furthermore, the participants clearly perceive a *continuous empathetic social presence*. Individual intentions directed toward the future are therefore *fully recognized* in the collective action of the group in Networked Flow.

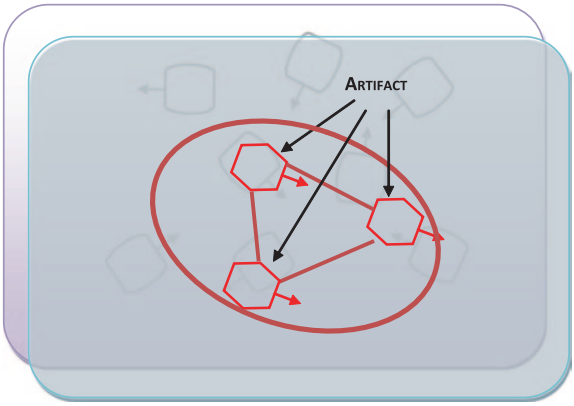

Fig. 3.5 The fifth phase in the emergence of networked flow: creation of the artifact

The collective action is now measured in terms of *effectiveness*: Networked Flow must result in the production of a new and relevant artifact which represents the *embodiment of the collective intention (and subordinate to the collective action).* At this stage, however, the artifact is solely and exclusively *relevant* to the group itself: this is not *network* sharing since the artifact has not yet been applied outside the frame.

3.6 Networked Flow: The Application of the Artifact in a Social Network

At the end of the 1860s decade, the crucial innovations of the impressionists began to emerge in the larger community of artists. Monet and Renoir, in particular, were the two that bolstered the most innovative techniques of painting (e.g. the rendering of water reflections). These techniques soon became the distinctive mark of impressionists. The group had the habit of meeting every week in the Café Guerbois, and these meetings were notices by some leading intellectuals who started to record the interactions and the discussions of the group in letters and journals.

Having consolidated a common view that guides the individual action, the group becomes more organized and starts planning negotiate and decide about collective action (e.g. exhibitions, getting the paintings to the public and selling them, etc.*…). In the early 1870s the group was even more marginalized by the juries—due probably to a conservative mood in France following the wars. In this stage Pissarro emerged as a leader, due to his skills in negotiating conflicts and clarity in conveying the intentions of the group. He proposed a set of norms for the exhibition (e.g. each member would have gathered 60 francs for the initiative) and for the organization of the group (e.g. election of a governing board, equality of rights between the members,* etc.*…). The implicit norms shifted from being*

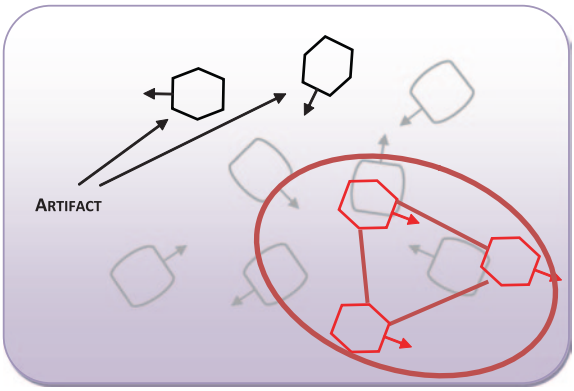

Fig. 3.6 The sixth phase in the emergence of networked flow: the application of the artifact in social reality

personality-centered to favor the commitment to the group. The response to their first exhibition was almost derision: critics flocked to harshly judge the paintings, and one of them coined the term "impressionist" by referring to the fact that the paintings looked raw and unfinished but "the impression was there". The reception to the first exhibition rallied the painters instead of discouraging them.

Once the artifact has been created the group enters into the sixth and last phase, in which the artifact is taken into the pre-existing social network. At this point, the group in Networked Flow must make itself known to the world (which means it must take up a position in the network); and consequently the artifact also needs to be recognizable (Fig. 3.6). If we recall the work of Glăveanu (2012), this is the stage where the Artifact meets the Audience, in terms of interdependence between the creative act and the world.

We can therefore surmise that contact with other groups and/or individuals is crucial, otherwise the effect of Networked Flow will remain unsuccessful. Although stages 4 and 5 can be defined as Networked Flow, it is only in this phase that we are able to speak specifically in terms of *network*, since:

- The artifact *embodies the collective intention directed toward the future,* and is able to inform *other groups,* leading them to adopt the *same* collective intention as the original group in Networked Flow. This process can be understood in the light of the stigmergy mechanism theorized by Pierre-Paul Grasse in 1959 to explain how insects manage to coordinate themselves in order to produce highly complex structures.
- At this point, logical progression *takes us back to phase 1 of this model*, with the difference that the focus of analysis is now directed toward the *group* and no longer toward the individual: the "circles" with the vector are no longer individuals but groups, and the surrounding "frame" is no longer the boundary of the social group, but of the extended network of reference.

In this process the artifact therefore has to confront the "outside world", which may react in a variety of ways.

The artifact may be endowed with a more or less significant number of *affordances,* that is, with opportunities for potentiality, which may or may not be exploited by the context of reference (cf. Glăveanu, 2012). The artifact's opportunities may in fact be *inferior* in number than those required by the context (so the artifact would only be useful in the context in which it was created); or they may be *equal* in number to those required (and so the artifact could be "extended" to other users in the network); or, finally, they may be *superior* in number to those present in the context (and the artifact could therefore be "exported" into other contexts). As we have already seen in Chap. 2, the group's ability to "explain" the artifact through the creation of narratives which link it to other existing memes and to allow those outside the group to recognize it as a potential intention (internalization), plays a key role in this analysis.

Logically speaking, we can consider the situation in these terms: considering (A) the sum of the artifact's potentiality and (C) the sum of the context's potentiality, we have three conditions:

1. (A) < (C)
2. (A) = (C)
3. (A) > (C)

As previously noted, in case 1 the artifact does not enter into competition with other artifacts *unless they originate from the same context*, and this is therefore not a genuine sharing of the network. In case 2 (sometimes) and in case 3 (always) a process is triggered, through which the artifact enters into competition with other artifacts deriving from other contexts. The process through which the artifact enters into competition with other artifacts in the following:

- Phase 1: KNOWLEDGE: The existence and the potentiality of the artifact must be in some way communicated by the group in Networked Flow which designed and created it.
- Phase 2: USE: The artifact's potentiality must be usable and applicable to a variety contexts to which it can be "exported".
- Phase 3: COMPETITION: If the artifact has become well-known, and its affordances or potentiality are compatible with the context of its possible "exportation", then it can enter into competition with other artifacts (B, C, etc.). In this case the group's insistence in promoting the artifact is crucial.

In some cases, the group which created the artifact may not have the strength and/or the interest in promoting it, and it may therefore be that this whole process of knowledge/use/competition requires a third party which does this (e.g. consulting services, or the situation in which an idea has been taken on and used by a group other than that which created it).

The *outcome* of the process of Networked Flow can be synthesized in Table 3.1:

As we can see, the number of *affordances* available to the artifact changes considerably according to the level of coercion of the context. When the context has a low or non-existent level of coercive power, the number of *affordances* should be notably higher to make the artifact attractive in some way.

Table 3.1 The outcome of the process networked flow

	Context working from the top–down	Context working from the bottom–up	
		Emergence from beneath	Stigmergy
Number of affordances of the artifact	Unimportant	Medium/high	Very high
Level of coercive power	High	Low	None

When the level of coercion is high, the number of *affordances* is unimportant, since the group in power has the resources to impose the adoption of the artifact. In this process the aspects of persuasive communication linked above all to the perceived characteristics of the source (cf. Horai et al. 1974; Maddux and Rogers 1980; McGinnies and Ward 1980; Milgram 1974) and of the recipient (cf. Rhodes and Wood 1992; McGuire 1964; Easley et al. 1995), play an important role, especially in the case of a top–down imposition, in which the roles of source and recipient can be attributed to the high status group and the social context respectively.

On the whole, Impressionism had a major impact on the Art movement. From a technical point of view, the movement brought critical innovations in terms of use of the color (considered more important than lines and contours), of subject of paintings (realistic scenes and outdoor settings), of brushing techniques (short, thick strokes), of image composition (paintings resemble photographs, without a clear distinction between subject and background).

In sum, the relevance of the Impressionist movement can hardly be overestimated in the field of visual Arts.

Chapter 4
Analyzing the Experience of Networked Flow Through Social Network Analysis

Examples of Application

Abstract Focusing its attention on Social Network Analysis, this chapter describes a methodological proposal pertaining to the monitoring and analysis of the dynamics which characterize the collective experience of Networked Flow. Since the Networked Flow is a social process that evolves thanks to the relationships of a set of persons, its study needs techniques of inquiry that consider adequately the structural dynamics of the interactions between the involved actors. So this chapter is intended to show how the SNA could be applied to the typical interactional dynamics of the Networked Flow process. It presents three different ways of using SNA which can help the understanding and analysis of some of the typical dynamics described in the other chapters of this book. The first is the use of SNA to analyze a network's communicative structure such as an online group. The first example of the application of SNA relates SNA indices to two variables which can be particularly relevant for the experience of networked flow, or rather, in what depth a group discusses/analyzes given subjects and the performance which originates from the group's collective action. The second way in which SNA can be used is directed toward a longitudinal analysis of the interactions which characterize a given network of people. In this case, the chapters present the longitudinal use of SNA to monitor and analyze the evolution through time of the relations between participants in an online social network in the field of education. The need to go beyond quantitative data and to take account of the content of the exchanges within a network may however turn out to be crucial to fully understand its dynamics, above all if we consider semantic networks. The final way in which SNA is used therefore concerns the links between concepts as opposed to the links between people.

4.1 A Brief Introduction to the Analysis of Social Interactions

In the previous chapters we have often referred to social interaction as one of the essential aspects which characterize human cognition, both in the context of generic groups and communities which collaborate for a variety of reasons and endeavors, and more specifically in the context of the experience of *networked flow* to which this book is dedicated. The current opportunities for interaction

A. Gaggioli et al., *Networked Flow*, SpringerBriefs in Education,
DOI: 10.1007/978-94-007-5552-9_4, © The Author(s) 2013

determined thanks to the birth of the web and the creation of virtual collaborative spaces, facilitate the analysis of interaction between members of groups and communities to a considerable degree, due to the possibility of automatically tracking the exchanges between individuals (Mazzoni and Gaffuri 2009a). As well as facilitating the application of quantitative analysis, this aspect also makes the application of an alternative method of analysis much easier; a method which is applicable not only in real life environments but also in virtual ones: *Social Network Analysis*—SNA (Daradoumis et al. 2004; Carrington et al. 2005; Zhu 2006; Martinez et al. 2003; De Laat et al. 2007; Mazzoni et al. 2010).

Focusing its attention on SNA and on the potential of this investigative technique in the context of Networked Flow, this chapter describes a methodological proposal pertaining to the monitoring and analysis of the dynamics which characterize this collective experience. Since the Networked Flow is a social process that evolves thanks to the relationships of a set of persons, its study needs techniques of inquiry that consider adequately the structural dynamics of the interactions between the involved actors. So this chapter is intended to show how the SNA could be applied to the typical interactional dynamics of the Networked Flow process. We will present three different ways of using SNA which can help us in understanding and analyzing some of the dynamics outlined in the previous chapters. The first is the use of SNA to analyze a network's communicative structure: from this point of view the focus turns toward understanding the web of relationships and the exchanges which, at a particular moment, characterize a given network of people. In the third chapter, however, it was noted that mapping carried out in one specific moment of the process is not sufficient to enable us to understand the dynamics of the developments which have lead to such a structure of relationships and exchanges. The second way in which SNA can be used is therefore directed toward a longitudinal analysis of the interactions which characterize a given network of people. In both of these two cases, SNA only considers the quantity of exchanges/links which characterize the individuals involved, while it tells us nothing about the semantics of the network, that is to say, about the innate meaning of the established exchanges/links. The need to go beyond quantitative data and to take account of the content of the exchanges within a network may therefore turn out to be crucial to fully understanding its dynamics, above all if we consider semantic networks. The final way in which SNA is used therefore concerns the links between concepts as opposed to the links between people.

4.2 SNA and Networked Flow: A Methodological Proposal

To best understand the characteristics of Social Network Analysis, we shall provide a concise description of how it distinguishes itself from other types of analysis. To be brief, unlike other types of analysis often used in social sciences, SNA does not focus its attention solely on individuals' characteristics (their attributes); instead, the focal point of the analysis becomes the relations (ties) which exist

between them (Wasserman and Faust 1994). For this reason, data in SNA analysis is defined as *relational data* and it represents the connections, contacts, or ties which link one entity to another, both people and organized groups of varying complexity (groups, families, societies, organizations, nations, populations). These relationships can be represented by various types of "exchanges" (for example, friendship, money, the exchange of material or information, judgments that one individual makes on another, etc.) and they are constituted by the qualities of the different couples concerned (x–y; y–z; etc.) and not by the single entities.

In addition to this fundamental aspect of SNA, Wasserman and Faust (1994) point out further four important aspects which can help us to understand how this tool is both interesting and effective in analyzing the experience of networked flow:

- The actors and their actions are studied in view of their interdependence rather than as autonomous and independent units;
- The relational links between the actors represent channels for the transmission of "flow" or resources, both material and non-material;
- Considering network models which focus on individuals, each network represents an environment which offers opportunities but also places certain limits on an individual's actions;
- According to models of social networks, structure (social, economic, political, etc.) represents a fixed configuration of relations between the actors who make up the network. It is fixed in the sense that the relationships are created through time and have a beginning, a development, a maturation, and perhaps also an end.

SNA makes use of matrix algebra which:

1. Enables us to trace and profile a network of relations using various indices which we can define as structural indices (they measure and profile specific aspects of the structure of the network of relations);
2. By using Graph Theory[1] it enables us to graphically represent relational data in both two and three dimensions.

[1] In graph theory, the graph, also known as *sociogram*, depicts a number of different lines (relations, exchanges, ties) which connect various points (actors) and represents the relational structure of the network in question. If we consider, for example, a social network (such as Facebook, MySpace, LinkedIn, among others), we are able to plot a graph in order to reproduce, in a two-dimensional space (or three-dimensional, thanks to current SNA softwares) the network of exchanges (sending messages or files) between the individuals belonging to the SN. If a group uses multiple web tools for interacting, by using an SNA incidence matrix we could also differentiate members on the base of the type of web tool used to communicate. If, however, we consider a basketball or football team, the sociogram is able to reproduce the passes of the ball from one player to another. This graphic representation can be obtained from a data matrix known as the *adjacency matrix* (Fig. 4.1). Referring to the example shown above, the sociogram derived from the adjacency matrix represents the network of exchanges which characterizes a basketball team. The arrows therefore represent the direction of the passes of the ball, while the numbers represent the number of such passes. It can be noted that player number 2 made five passes to player 5, whereas player 5 only passed the ball once to player 2. The tight network of exchanges between players 1–4 is quite evident, as well as the particularly central position of player 2, who,

	Actor1	*Actor2*	*Actor3*	*Actor4*	*Actor5*
Actor1	0.0	3.0	3.0	4.0	0.0
Actor2	0.0	0.0	2.0	0.0	5.0
Actor3	1.0	4.0	0.0	0.0	0.0
Actor4	2.0	3.0	3.0	0.0	0.0
Actor5	0.0	1.0	0.0	0.0	0.0

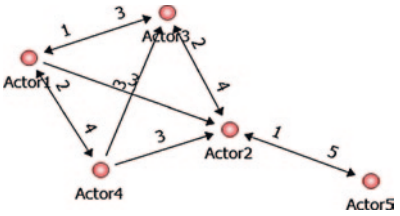

Fig. 4.1 Relational data in an adjacency matrix with relative sociogram

SNA can be carried out at two different levels, on the basis of different focuses on the object of analysis: the *Ego-centered Analysis* focuses particularly on the networks of links which define the individual actors; *Whole Network* or *Full Network Analysis,* on the other hand, concentrates on the group or community as a whole and on its structural characteristics (Garton et al. 1997; Hanneman and Riddle 2005). The first level of analysis allows us to obtain a representation of a "local" network, or "neighborhood" which positions each individual actor in a network and this provides information useful to understanding how the network may influence the individual's behavior. Whole Network Analysis, however, examines the structure of a given social network as well as its components and connections with the outside environment. Whole Network Analysis implies the collection of comprehensive information concerning the relationships which connect the actors in a given social network; something which is not always easy, particularly in real-life contexts.[2]

(Footnote 1 continued)
in fact, could be the playmaker as he/she is the only one who has any exchanges with player 5. Player 5, despite being more isolated, appears to be the game's 'finalizer': he receives five passes from player 2 without returning the ball to him or passing it to any other members of the team; it is therefore highly likely that once he receives the ball he tries to shoot (which does not necessarily mean that he manages to score). Figure 4.1 shows that the graph is made up of a number of lines which connect the points (or nodes) and that its construction is based on a *matrix* of relational data. The lines (relations or links) constitute the main unit of measurement in Graph Theory and it is from them that the structural indices which we shall later present, can be measured.

[2] As with any type of research, however, the collection of data in SNA constitutes a fundamental phase for as truthful an interpretation as possible of the phenomena under analysis. There are several techniques which are customarily used, and these range from observation, questionnaires, and relational interviews, to archival records, without forgetting experiments and diaries (Wasserman and Faust 1994; Garton et al. 1997). More recently, the expansion of SNA's fields of investigation to include the internet and virtual interaction contexts has led to new types of tracking which can be added to those 'classic' techniques of data collection. These include log-tracking, an example of which will be described in this chapter, and, more simply, the observation of exchanges which take place within given virtual environments (such as email, web-forums, and also more complex settings like Social Networks and Virtual Worlds, e.g. *Active World*, *Second Life* or Google's newly created *Lively*.

Even after only having briefly set forth these first essential elements of SNA, it is easy to grasp its potential for the analysis of the processes fundamental to the experience of Networked Flow. First, Arrow (Arrow et al. 2000) characterizes collaborative groups on the basis of three dynamics: local, global, and contextual.[3] These dynamics, the first two in particular, are further strengthened in SNA which, as we saw previously, enable us to carry out an analysis on two levels: on the individual (at a local level) or on the entire network (at a more global level). Furthermore, as we shall see more clearly later in this chapter, certain specific SNA indices are directed toward the analysis of the sub-components of a main network, and there are, therefore, several levels of investigation: the individual, the various components of a network, the formally defined sub-groups, and the network as a whole.

4.3 Groups, Social Networks, and Social Network Analysis

After the brief presentation of Social Network Analysis and the description of some of its more interesting aspects for the study of networks of exchanges/relations which characterize networks of people, this chapter proposes four examples of the application of SNA (two empirical and two explorative study) with the primary intention of further clarifying the reasons for which we prefer SNA for the description and analysis of the dynamics behind the experience of Networked Flow outlined in the previous chapter (cfr. Chaps. 2 and 3). The first example presents a cross-sectional study in which the effectiveness of SNA in highlighting certain important factors for creativity in small groups collaborating online is underlined. The second example proposes a longitudinal study carried out over 10 months on a social network in the field of training, and it shows the importance of SNA in representing and explaining the evolution of the interactive/communicative dynamics of a network, which is a particularly important aspect in identifying the emergence of Networked Flow. The third example proposes a description of the evolutionary structural dynamics of online creative learning teams of students. This exploratory study shows also the correlations between some selected SNA indices and the network creativity.

The fourth example, unlike the previous three, is an explorative study which shows a possible integration of content analysis of conversational exchanges and SNA, and it demonstrates the possibility of using SNA to throw light on "networked knowledge".

[3] In the authors' view, a collaborative group includes three types of elements, the members, the tasks and the tools, and the model of overall functioning is determined by the integrated member-task-tool network which conditions individuals' and groups' actions and the ways in which they act. From this point of view, the incidence and adjacency matrices in SNA allow us to study the sum of these variables and to analyze the relational dynamics of a network considering the individuals, their affiliations (and individual characteristics) as well the technology used by the individuals, and in particular that which promotes interaction and contact between them, as a whole.

To describe and analyze the structure of the relations which characterize a network (both those made up of people and those made up of other types of entities), SNA uses various types of analysis which, in turn, make use of specific structural indices (the four examples below presented are completed by a depth description of the related SNA indices used for the analysis). In this book on the experience of Networked Flow we will naturally turn our attention to the SNA indices which result as being more suited and effective for analyzing this experience. Therefore, as we are interested in the collective dynamics which characterize the functioning of a group of individuals we shall give precedence to the level of analysis which concerns the network as a whole (*full* or *whole network analysis*) rather than concentrating on networks of individual people (*ego-centered analysis*). Furthermore, we will not enter into a detailed explanation of the mathematical algorithms in which these indices are based on, but refer the reader to Wasserman and Faust's manual (1994) for further information on this point.

4.4 The Analysis of Small Groups Collaborating Online

The first example of the application of SNA relates SNA indices to two variables which can be particularly relevant for the experience of networked flow, or rather, in what depth a group discusses/analyzes given subjects and the performance which originates from the group's collective action. The studies presented derive from the field of training courses which, rather than using only the lessons and face-to-face activities which normally take place in university courses, made use of the web-platform Synergeia in order to allow the participants, sub-divided into small groups, to collaborate with one another.

The groups and communities which work together in order to acquire and improve their knowledge and skills are certainly among the most important and interesting examples of current online training. Let us turn our attention for a moment to the activity carried out by a group which worked together online and we shall attempt to define the extent to which their output can be analyzed. Returning to what has previously been explained about the experience of networked flow, we can begin with the assumption, already mentioned in the description of complex systems (cfr. Chaps. 1 and 2), that the final result of a group-task does not come from the simple sum of each individual's work, but from the collective actions carried out by the various participants. A deeper analysis of a group's output, whether it be physically tangible or whether it exists in a virtual environment of interactions, cannot base itself solely on individual indicators (such as those usually 'measured' using web-tracking[4]), but it requires indices which permit the identification of the group's collective activity.

[4] Web-tracking is a quantitative technique for gathering information on what a user 'does' on the net (Maimon and Rokach 2005; Mazzoni and Gaffuri 2009a). Through web-tracking it is possible to "record (…) a certain number of parameters relating to the presence and time spent on web pages when connected to the server (…). It is therefore not a method of evaluation, but a method of data collection on visits made to a site" (Bastien et al. 1998).

Beginning from these points and referring to the Activity Theory perspective presented in the second chapter, the studies which will be briefly described have the primary objective of evaluating whether and how the indices of individual actions (Ego-centered Analysis) and collective activity (Whole Network Analysis) obtained from SNA can not only be useful indicators in the analysis and description of activities carried out collectively by a groups which collaborate online, but also predictors of their performance in terms of creativity. This is the case, e.g., of the Cliques Participation Index (Sect. 4.4.7) that represents a sort of structure of the social presence previously described in the second and third chapter.

4.4.1 Originality in Small Groups Collaborating Online

This first study is based on the post-university Specialization Course "Environments and Communities for Online Learning", organized by the Faculty of Education at the University of Florence (Calvani et al. 2005). The participants were sub-divided into small groups (mostly made up of 5 or 6 participants) and they co-operated on the web using the Synergeia platform[5] to carry out activities relating to projects, product design, repository construction, problem solving, and case studies. The group work was carried out through the Synergeia's web forum and essentially consisted of three phases:

1. The choice of topic and organization of activities to be performed
2. Creation and production of the product defined in phase 1
3. Concluding reflections on the knowledge/skills acquired and on the application of this 'know-how' in other contexts.

The final output of each group was evaluated by two judges who, independently from one another, judged the originality and transferability of the final product:

- Originality value of the final product;
- Transferability value of the final product.

The research focused on the interactions which took place on the web-forum and which characterized phase (1) (in which the virtual group was created and the members began to socialize) and phase (2) (in which the members cooperated to achieve the agreed final goal). In Networked Flow, these phases correspond to stages (1) (meeting), (2) (reducing the distance), and (3) (liminality-parallel action). Therefore, the interactions which took place on the generative and constructive web-forum were considered for each group. The data relating to the interactions was tracked and elaborated using Synergeia Log Miner (SLM), a purpose-built piece of software (Calvani et al. 2005) with which it was possible to obtain:

1. *SLM Indicators*: primarily concerning the group's productivity, these are automatically extrapolated by SLM from the data being tracked;

[5] http://bscl.fit.fraunhofer.de/, 28 giugno 2005.

2. *SNA Adjacency Matrices of the exchanges*: from the discussions which takes place on the web-forum, SLM reconstructs the adjacency matrix of the exchanges made for each group.

Beginning with the data tracked on Synergeia's log file, SLM reconstructs five types of indicator (Participation, Productivity, Reactivity, Reciprocal Reading, Depth of Discussions) which are essential for monitoring certain group dynamics as they have possible implications on the collective output. Among these SLM indicators, the following are of particular significance for this study:

- Maximum depth reached in a given discussion or thread[6];
- Average depth of discussions in the group (Wiley index[7]).

In addition to these indicators, by using the data tracked on Synergeia's log file, SLM allows us to construct the relative adjacency matrices of exchanges made between the participants for each group. It is therefore possible to apply Social Network Analysis to the exchanges made between members of the specific groups and to compare these groups on the basis of the structural characteristics discovered. Of the various SNA indices considered in this study, we will focus our attention above all on the density (Sect. 4.4.2), cohesion (Sect. 4.4.3), and flow betweenness centrality indices (Sect. 4.4.4).

4.4.2 Neighborhood Analysis: The Density of a Network

Neighborhood analysis focuses on the concentration of the relations which distinguish a given network, as well as the direct ties which characterize individuals *(nodal degree)* and the community as a whole *(density).* The main indicators for this type of analysis are the *density index* and the *inclusiveness index.* The density of a network can briefly describe as the percentage (from 0 to 1 or also to 100 %) of aggregation of its members, calculated on the base of the totality of direct contacts that each member has activated or received by others (Matteucci et al. 2008; Mazzoni et al. 2010). As it is based on the interactions activated and received by each members of a group, the density index is clearly a measure of the neighbor interactions between a networked set of people. The latter (inclusiveness) shows the percentage of individuals who have ties/relations with other participants relative to the network's total number of members. To give an example, a network composed of ten participants, of which 2 are isolated (they do not have ties to other members), will have an inclusivity of 0.8, or 80 %, while a network composed of 15 members of which 6 are isolated, will have 0.6, or 60 %, inclusivity.

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[6] A chain of messages characterized quence "message→reply→reply to the reply→…".

[7] To analyze the structure of a web-forum, SLM uses the Mean Replay Depth proposed by David Wiley (2002) which, in the author's view, allows us to rapidly obtain an indicator of the level of activity of the discussions on a web-forum.

Neighborhood analysis has various potential advantages. First, it allows us to use just one index to quantify a network's compactness. In this sense, the density index represents an interesting indicator of the emergence of a "small group" within a pre-existing network, in particular considering the similarities which can be noted between this emerging structure and the concept of a complete group or graph.[8] Second, it offers the possibility of continually monitoring the interactive dynamics of the group, which is a particularly important aspect for the experience of Networked Flow. In the previous chapters we underlined the importance of feedback for creative networks, and particularly for monitoring and modulating their performance and maintaining their identity in both time and space. Neighborhood analysis is therefore particularly interesting in that it enables us to analyze the evolution of ties and exchanges which characterize the participants in a network and, in particular, to quickly pick out two crucial situations: one which could be defined as the network's "responsiveness", and the other, as the isolation of some of its members. As far as responsiveness is concerned, the possibility of representing the direction of contacts and of the exchanges which characterize a network allows us to evaluate whether it offers sufficient feedback to the requests made by its members. A member who sends messages to four other individuals without receiving a single reply could represent a problem to be promptly addressed and overcome. The isolation which may define certain members of the network could be determined by various factors such as, for example, a choice on the part of the individual (who may choose not to interact with other members of the network) or the insufficient circulation of information within the network (for example if the communicative channel chosen does not let the individual reach all the other members). In both cases, as far as the experience of networked flow is concerned, isolation represents a significant limit to participation and the circulation of information within the network, hindering the sharing of information and productivity. Finally, beginning with the assumption that the social processes of persuasion and influence are essentially based on interaction and communicative flow, neighborhood analysis can be viewed as a first step in analyzing the aggregation of a network and, therefore, the uniformity of ideas and positions which may define it.

4.4.3 Analysis of Cohesion: Zones of Confrontation and Exchange in a Network

Approaches like Social Network Theory (cfr. Chap. 1) and Swarm Creativity (Gloor 2006) underline the importance of a selection for the process of collective creativity. A highly-aggregated network (high density) which is strongly connected (high connectivity) does not necessarily imply the 'homogeneity' of exchanges within the network. Each participant, for example, often does not interact with all

[8] The network in which all the other participants have ties with one another.

the other participants, but follows certain discussions and themes, therefore forming sub-aggregations of individuals who prefer to interact with each other and less with other members of the community. In other words, despite interacting with many or all the members of a network, participants demonstrate a certain preference for some 'neighbors' as opposed to others; we can define such aggregations as the 'preferential neighborhoods' of the individuals who constitute them, and they normally represent the most interactive zones of a network, or better, the zones in which there is a more active exchange of information. This element defines the second phase in the emergence of networked flow, 'reducing the distance' (cfr. Chap. 3).

Cohesion analysis investigates specifically these particularly dense sub-structures which characterize the main network and which are identified using a variety of definitions: clique, n-clique, clan, n-clan, etc. (Scott 2000; Wasserman and Faust 1994). *Cliques*, to which we will make specific reference in this and the following paragraphs, represent complete sub-graphs characterized by three or more nodes which are fully connected; in other words, each node is linked to all the other nodes (a clique will therefore have maximum internal density). Cohesion analysis allows us to verify the presence and the structure of these components of preferential aggregation and to analyze the participation of particular individuals in these sub-groups particularly dense from the point of view of connections. If we return to the previous example of a virtual community whose aim is collaborative knowledge building, but which is also a group which is collaborating in a brainstorming phase in order to create a project, these types of aggregations are especially important as they represent the areas in which the exchange and confrontation of ideas are more likely to take place. For example, research carried out by Aviv and colleagues (2003) on two groups of students who interact on the internet through a web-forum, has shown that the presence of multiple cliques indicates the existence of various areas of exchange and confrontation of ideas, in which the diverse points of view may lead to a process of constructing 'better' knowledge, characterized by the relevant phases of critical thinking.

4.4.4 Centralization and the Communicative Structure of a Network

Before going into the details of certain important centralization indices which are of notable interest when analyzing the experience of Networked Flow, it is necessary to make a distinction between *centrality indices* and *centralization indices*[9] (Wasserman and Faust 1994; Scott 2000).

[9] Following Scott's suggestion (2000), for the rest of this discussion we will use the term *centrality* when referring to individual nodes, while the term *centralization* will be used to denote the centrality of the whole graph.

The *centrality index* of an individual expresses its importance or relevance for the web of contacts which define the network. The centrality index is therefore a specific measure of individual actors which allows us to analyze their level of centrality/peripherality in relation to given dimensions, thus also enabling us to compare them in relation to the importance that they have for the reticular structure of the network. The value of this index normally falls somewhere between a minimum of 0 (typical of a peripheral individual) and a maximum of 1 (a very central individual).

Unlike centrality indices, *centralization indices* are values which concern the entire structure of a network and describe how much it may or may not be centralized around its most important (central) points. Like centrality indices, most of centralization indices also tend to vary between a minimum of 0 and a maximum of 1[10], although they are usually expressed as a percentage from 0 to 100 %.

One of the simplest ways of defining the centralization of a network consists in considering the various participants' neighborhoods, in other words, how many individuals each participant has direct links with. From this point of view, the participants who have a greater number of links with other actors in the network result as being more central (Wasserman and Faust 1994) and the *degree centralization index* simply indicates the extent to which single individuals are different from each other in terms of the quantity of links activated/received.

In respect to the degree centralization index, the *closeness centralization index* is not based on the rank of the nodes, but rather on their closeness or distance. In this case, the actor who is the quickest to interact with all the other participants will become the most central (Wasserman and Faust 1994), considering the various paths which directly and indirectly connect the participants in a network. In a network in which information is exchanged (for example, a group of people who work together to carry out a project), the closeness centrality index represents a measure of the actors' proximity, that is to say, of the rapidity with which the information sent by a given participant reaches all the other members of the network. Therefore, the participant characterized by a high level of centrality will have a greater "informative effectiveness", as their information will reach other group members more quickly.

Other two centrality indices, which are undoubtedly of particular interest in the experience of networked flow, are the *betweenness centrality index* and the eigenvector centrality *index*.

The concept of *betweenness centrality* is based on the role which certain nodes may have in the connection of non-adjacent nodes, or rather, the strategic importance of the nodes which lie on the path running from node X to the non-adjacent node Y: the exchange of information between these two nodes can only occur thanks to the nodes which lie along the path which connects them (Fig. 4.2).

In the example above, interaction between point X and point Y occurs thanks to the mediation from points A, B, C, and D, and they therefore take on particular

[10] Since, as will become clear in the following paragraph, there are many centrality and centralization indices, not all of them are calculated using a range of values from 0 to 1.

Fig. 4.2 Line graph

significance for the graph. Using Scott's definition (2000, p. 86), the betweenness centrality expresses *the extent to which an agent can play the part of a 'broker' or 'gatekeeper' with a potential for control over others*. From this point of view, the betweenness centrality index is higher for those nodes which find themselves on the paths which connect several other nodes (Wasserman and Faust 1994). The betweenness centralization index *allows a researcher to compare different networks with respect to the heterogeneity of the betweenness (centrality) of the member of the networks* (Wasserman and Faust 1994, p. 191) and determines the centralization of the communicative structure on the basis of the individual participants mediating potential. In this sense, this index measures the degree to which the group depends on the participants who function as mediators of interaction.

As it is based on the absolute points of degree and distance, the analysis of measurements of centrality have always been more or less influenced by the 'local' substructures which characterize the individual nodes (Scott 2000). In Bonacich's view (1972), the centrality of a single point is not independent from the centrality of the all the other points to which it is connected; in other words, the centrality index of a given point will be higher, the higher the centrality of the points to which it is connected. The centrality of these points will, in turn, be influenced by the centrality index of the first point considered. Bonacich's alternative approach (1972, 1987) therefore uses weighted scores and represents an attempt to identify the central actors, principally taking account of the graph's global structure and attaching less importance to the local substructures. The *eigenvector centrality* does in fact represent an alternative to closeness centrality, and it uses the potential of factorial analysis *in order to identify "dimensions" of the distances among actors. The location of each actor with respect to each dimension is called an "eigenvalue," and the collection of such values is called the "eigenvector"* (Hanneman and Riddle 2005). Returning to what we have said on the subject of Networked Flow, in particular regarding the structural characteristics and dynamics of creative networks, the eigenvector centrality index appears particularly interesting in the study and measuring of dynamics similar to those analyzed by Grandadam (2008) in his study on networks of collaboration in jazz (cfr. Chap. 3). Grandadam highlighted the fact that collaborations between emerging artists and established stars are profitable for both: the emerging artists gains prestige from the collaboration with already well-known artists who see the influential position in the context of jazz music strengthened further (an aspect which naturally also helps them to profit in terms of record sales).

Finally, another index which is of notable interest in discovering the dynamics of the circulation of information within a network is the flow betweenness

centrality index. This index analyzes the flow of information managed by the individual participants, or rather, the quantity of information which is filtered through them; the greater the participant's index, the more central this individual will be, having dealt with a greater information flow. For the flow betweenness centrality there is no real centralization index, but it is necessary to consider the relative coefficient of variation; this enables us to identify the dispersion of the flow betweenness centrality indices of each participant compared to the average. The coefficient of variation of the flow betweenness centrality index therefore calculates the centralization of the communicative structure on the basis of the networked influence (cfr. Chap. 2) 'managed' by the various participants, and it thus determines the extent to which the group is centralized around the participants who deal with a greater flow of information compared to others.

Since centrality in the field of Social Network Analysis is, as described at the beginning of this paragraph, synonymous with "importance", "relevance", but also of "prestige" (Knoke and Burt 1983) and "power" (Bonacich 1987), it is easy to see how useful these centralization indices can be in monitoring and analyzing the processes of leadership previously discussed, in particular regarding the fourth phase in the emergence of Networked Flow (cfr. Chap. 3).

4.4.5 An Interpretation of Density, Cohesion and Centralization

The density of the relationships is a measurement of the group's compactness based on the relations which exist between its members. In the case here proposed we shall consider each 'contact' established between two members as a relation, whether it be reciprocal (each sends the other messages) or unilateral. This definition does not consider the quantity of contacts (messages exchanged).

As far as cohesion analysis is concerned, the study considered *cliques* as a measurement of the group's cohesion. Cliques indicate the number of sub-groups with maximum density of at least three individuals, which characterize the main group. The groups characterized by more than three participants and by maximum density are composed by only one clique which coincides with the entire group, independently of the number of individuals of which the latter is composed. Given that each individual is connected to all the other group participants, the group results as being uniformly compact and it is impossible to identify subgroups which are more cohesive than the main group. From the point of view of the dynamics of a group which works together online, cliques represent especially active areas of discussion characterized by "preferential neighborhoods": the individuals who are part of a clique prefer to interact with other members of the clique and to interact less with other members of the group (this explains the maximum density of the sub-group). Considering collaboration online, the presence of multiple cliques is undoubtedly a positive factor in that the participants have a greater

chance of having contact with different points of view and this helps in discussions and in the identification of original and creative solutions.

Finally, regarding the centrality and centralization analyses, we will examine the coefficient of variation of the Flow Betweenness Centrality. This index, as described earlier, calculates the communicative structure's centralization on the basis of the flow of information 'managed' by the various participants, and it thus determines the extent to which the group is centralized around the participants who deal with a greater flow of information relative to the others.

Among the interesting aspects which were investigated and analyzed in the proposed study, we shall focus on two specific relations:

1. The groups' communicative structures (in terms of density and flow betweenness centrality) and the depth of discussions between participants;
2. Structural SNA indices (especially cohesion index) and the quality of the results collectively reached (in terms of originality and transferability).

4.4.6 Communicative Structures and Depth of Group Discussions

As far as the first type of relation mentioned above, we must make the premise that, given that we are dealing with groups which work together online to achieve a specific objective in a training course, the depth of discussion[11] does, in certain ways, represent the exhaustiveness with which the group confronts certain subjects. From this point of view, the group's compactness, measured by the density of their links, can certainly be a particularly important factor in as much as it points of the existence, or absence, of a good network of communication and of the 'ease of conversation' within the group. However, it is also necessary to consider another element which enables us to throw light on certain aspects of Swarm Creativity and Collaborative Innovation Networks (Gloor 2006): two groups which are equally compact may have a communicative structure which is centralized to a greater or lesser degree, and this may have an influence on the way in which various subjects are addressed/analyzed. Some research on the topic of the productivity of working groups with different communicative structures, shows that a highly centralized structure results as being more effective for groups of a substantial number of participants who deal with simple tasks (Mulder and Stemerding 1963). The progressive increase of the task's complexity, however, favors decentralized groups as they do not run the risk of one central individual being overwhelmed by the amount of information passed his way and the

[11] The depth of a discussion is normally determined by the sequence "message→reply→reply to the reply→reply to the reply of the reply…" and so on.

responsibility of his position (Hummon et al. 1990; Morrisette et al. 1965; Shaw 1981; Sparrowe et al. 2001).

In view of these premises, we can ask ourselves whether, in small virtual groups with a complex objective to be reached (such as the groups in this study), the high level of compactness (which implies a good level of communication) and the decentralized structure (which represents the distribution of information) might favor in-depth discussions. As we can see, compactness, and a more or less centralized group are characteristics quite closely linked to those highlighted by Gloor (2006) relative to typical examples of Collaborative Innovation Network such as the Linux and Wikipedia communities.

In order to answer this question, the groups in the study were re-codified on the basis of their compactness (density of links) and the coefficient of variation of the Flow Betweenness Centrality. Particular attention was given to the groups with a communicative structure characterized by High Density and Low Centrality (HD–LC) and those with the exact opposite characteristics, Low Density and High Centrality (LD–HC). The comparison between the two types of group, considering the two indicators of the depth of discussion, highlighted the fact that the HD–LC groups, those which are very compact and decentralized, reach average and maximum levels of depth of discussion which are significantly higher relative to those reached by LD-HC groups, not so compact and more centralized.

This result is undoubtedly important in understanding and evaluating certain dynamics of Networked Flow linked to the elaboration of "group thinking" which, as we saw in the previous chapters, is supported by networks with not too many participants. It is more difficult to understand if these dynamics can also be observed in wider networks such as the COINs introduced by Gloor (2006). It is indeed necessary to consider how networks such as Linux and Wikipedia are based around millions of users (actively involved or merely supporters/visitors) who base the sharing of aims not so much on interactions, but on the reciprocal and tacit sharing of norms and rules which concern not only their goals, but also the content and ways of relating to one another. If social presence in the small groups in the study proposed here evolves thanks to interaction, in COINs, social presence is something which relies much more on reciprocal trust between participants and considerably less on real or virtual interactions between them. The focus becomes the shared undertaking and, above all, the conviction that in the end, the individual's action will have a result for the collective activity which:

1. Would have been difficult if carried out individually (for example the contents of Wikipedia);
2. Is much more than the mere sum of each individual contribution (for example the entire Lynux operating system).

Therefore, further in-depth studies of COINs, in line with what Gloor has previously noted (Gloor 2006) and using the SNA proposed in this book, could be used to investigate in greater detail the phenomenon of Swarm Creativity in environments in which trust is the process of aggregation rather than interaction in itself.

4.4.7 Cohesion and Group Creativity

We shall now move on to the second type of relation, which is based on the results of a study carried out by Aviv and colleagues (2003) which underlines how a highly structured web-forum determines a greater number of strongly cohesive sub-groups (cliques) and lesser centralization leads the group toward a process of knowledge building which is qualitatively better and characterized by relevant phases of critical thinking. So, beginning with these results, this study is looking into whether a high number of cliques implies a greater chance of having contact with multiple and varied points of view on given subjects, giving the group wider and richer argumentations of topics proposed and, therefore a better-quality final product. This point is particularly important in the study of Networked Flow as it directly connects to concepts like divergent thinking (Guilford 1959; Torrance 1969) and *small-world* structures (Watts 1999; Watts and Strogatz 1998). Many studies (Nemeth et al. 2001; De Dreu and West 2001; Van Dyne and Saavedra 1996) highlighted how divergent thinking promotes creative cognition as it influences the extent to which a group, before taking a decision or favoring a course of action, considers multiple alternatives. This turns out to be a particularly crucial aspect at the moment in which the collective *performance* has a direct link with the decision made or the course of action undertaken.

In order to answer this question, the groups could be sub-divided according to the number of cliques present and then this index could be used to verify the effect on the quality of the final product of each group (transferability and originality indicators). Despite the statistical accuracy of this procedure, the SNA index used, or rather the number of sub-groups (cliques) which structure the main group, is not wholly convincing. In fact, two groups could be characterized by the same number of cliques but be of different dimensions. Furthermore, the same groups could be composed by different numbers of participants which could, clearly, lead to different levels of involvement within the cliques which make up the two groups. If we merely calculate the number of cliques then the two groups will be considered equal, but this would not correspond to the reality of the situation.

For this reason, a new index (the Cliques Participation Index—CPI) has been created, which considers not only the number of cliques which make up the group, but also their dimensions and the dimensions of the main group. This index illustrates the average involvement of individuals in the cliques present, or, in other words, the average number of cliques each participant is involved in. Given that participation in cliques determines perforce the coming together of diverging points of view and the variegation of the main network, it is, in our view, a gauge which is directly connected to the concept of social presence, particularly considering the function it performs from a developmental point of view (cfr. Chap. 2). At the same time, this measure of social presence may be an indicator for the differentiation of the groups in relation to the emergence of the optimal experience of Networked Flow, or rather, the level to which the group is able to involve its members in the new context and work in a creative way (cfr. Chap. 3).

On the basis of the CPI, the groups were sub-divided into two categories, groups with a high CPI and groups with a low CPI, and a comparison was made using the value obtained regarding the transferability and originality of the final product. On the basis of the analogies proposed earlier between CPI and social presence, despite remaining within the limits of this study, we can nevertheless conclude that the results obtained tend toward the conclusion that the optimal experience of Networked Flow acts as an impulse toward originality and creativity in group performance.

4.5 Evolutionary Dynamics of a Web Social Network

As highlighted in the previous chapters, the web and, in particular, web 2.0, is bringing about notable changes to the way in which we interact, communicate and, more in general, perform work tasks and also personal activities. The current possibilities offered by means of transport (which allow us to cover 1000 km in 1 h) and means of communication (which allow us to reach anyone connected to the internet without going anywhere), put man in a global situation which was unthinkable only 50 years ago and, above all, with even now unknown future socio-cultural repercussions. The current success of online social networks and web environments which have the specific goal of creating networks of relations (professional, support, friendship among others) highlights the fact that people are more often adopting different alternatives and, perhaps, more effective alternatives for 'contacting', 'getting to know', and 'making themselves known'. Limiting our attention to the world of work and education, as far as Lifelong Learning is concerned, the phenomenon of online social networking comes about through the use of web artifacts which constitute the so-called Personal Learning Environment (Attwell 2007), or rather, environments which, relative to the classic Virtual or Online Learning Environments, i.e. Learning Management Systems, also support more informal aspects of learning and constitute the space in which participants learn by using their own thoughts, reflections, and connections (Mazzoni and Gaffuri 2009b). One of the essential elements in the 2.0 artifacts is the rediscovery of the personal sphere which, mainly due to web tools like the web forums of the classic e-learning platforms, was practically non-existent in the Virtual Learning Communities and Knowledge Building Communities. In these areas the sharing of resources, information, and contents emphasized the user in relation to the collective, and put awareness, choices and planning typical of individual action in second position, if not eliminating it from the action altogether.

In this paragraph we shall present the longitudinal use of SNA to monitor and analyze the evolution through time of the relations between participants in an online social network in the field of education. Going back to the process of Networked Flow, the longitudinal application of SNA is interesting when trying to understand the evolution of these relations through the various phases of emergence which characterize this process and, therefore, also in the monitoring

or verification of whether we are dealing with a network which could potentially evolve toward a process of collective Flow, or if the network is not able to bring about the emergence of this dynamic. As regards the SNA indices involved in this longitudinal analysis, the attention has been focused on the Neighborhood indices previously described (Sect. 4.4.2), on the analysis of the connectivity within the network (Sect. 4.5.1) and on the analysis of the segregation (Sect. 4.5.2).

4.5.1 Connectivity Analysis; Strength, and Vulnerability in the Relations in a Network

Connectivity Analysis quantifies the vulnerability of a network and shows the extent to which the network can remain aggregated should some of its members be absent and/or some contacts are blocked. Before examining this type of analysis further, it is necessary to briefly explain some important properties of a network, that is to say, the degree to which it is connected and whether it is made up of components. A network can be described as "connected" if all of its members are accessible, that is, if all the individuals which make up the network are connected to each other by paths.[12] In networks it is common to find members in a 'pendent' position, who have only one link with one other member. If this link is broken, these individuals become isolated and the network is disconnected. There may be one or more *isolated (non-accessible) members* in a disconnected network, and/or one or more components. The components represent the sum of the points linked to each other through continuous chains of connections. In principle, the members of a component can communicate with each other either directly or through a chain of intermediaries. Isolated members, however, do not have the same opportunities. The model of components in the form of a graph showing their number and size, can, therefore, provide an indication of the opportunities for and obstacles to communication or the transfer of resources within the network. Regarding this point, Scott (2000) believes that these components incorporate the ideas at the base of topological areas from early academics in the field of *field theory* (e.g. Kurt Lewin).

In the example above (Fig. 4.3), the network is initially characterized by only one component (made up of 7 nodes connected to each other); after the elimination of node 1, we can see how the network becomes disconnected as it now has two separate components, each consisting of three persons. A sociogram's connectivity index can be measured from the nodes (*point-connectivity)* or from the lines (*line-connectivity).* Point-connectivity and line-connectivity indicate, respectively, the minimum number of nodes or lines which would need to be removed in order to disconnect a graph. Connectivity index therefore also provides a measure of the vulnerability of a network of relations determined by how easy it is to disconnect the graph. The connectivity and vulnerability of a network of relations are therefore inversely proportional, and represent the two faces of the same coin: a

[12] Sequences of lines which connect the nodes on a graph.

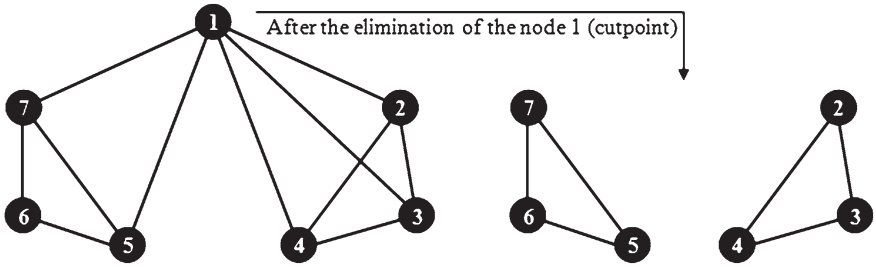

Fig. 4.3 Connected graph and disconnected graph after the elimination of node 1 (cutpoint)

highly-connected network will also be characterized by a low level of vulnerability, while a weakly-connected network will have a higher level of vulnerability.

The analysis of connectivity results as being particularly important when considering the experience of Networked Flow in as much as it enables us to analyze the areas or points weakly connected in the relations which characterize a network. Consider, for example, an online social network which has the aim of collaboratively building knowledge. This index offers information about the solidity of the network of relations in order that the participants may transmit and share information and knowledge with each other. A very vulnerable network of relations, when confronting various problems, cannot guarantee the efficient flow of information between its members, due to, for example, the momentary absence of certain members (*point-connectivity)* or the temporary impossibility of using given channels of communication (*line-connectivity)*, such as a technical problem with the computer or internet connection. This weakens the base of the essential reason for creating a network dedicated to collaborative knowledge building—the transmission and sharing of knowledge between various participants.

Before concluding this paragraph, it is necessary to say one more thing regarding connectivity and density indices. Connectivity and density are two dimensions of a network which are linked to one another: a network which guarantees maximum connectivity (and therefore minimum vulnerability) is also, as we saw in the previous paragraph, a complete network characterized by maximum density. The elimination of one of the links or nodes in a complete network does not mean that the network is divided, and the flow of information is still guaranteed by the remaining nodes. However, networks which have an intermediate level of density have varying levels of connectivity.

4.5.2 Being Part or Sub-Part of a Network: Segregation Analysis

A type of analysis which can result as being particularly interesting for analyzing the dynamics behind the experience of Networked Flow is *segregation analysis.* This analysis looks into certain fundamental aspects of inter-group and intra-group

dynamics as it allows us to identify the preference for relationships with members from inside the group as opposed to people outside the group. Segregation analysis does, in fact, enable us to verify whether communications, exchanges and links which characterize the possible sub-groups of a given network are prevalently between members of the same sub-group (*ingroup*) or whether they are also directed toward people outside the group (*outgroup*). This index therefore allows us to discover whether a network is acting as a whole or if it acts in a divisive way. Segregation analysis is based on two distinct indices: the *External-Internal Index (E-I Index) and Segregation Matrix Index (SMI).* The *E-I Index* simply considers the presence of a relationship between group members while the SMI does not only consider the presence of relationships, but also their direction (for example, the fact that A has sent a message to B and that B has, in turn, sent a message to A).

The interest in this type of analysis stems specifically from the possibility to study and analyze the phenomenon of "group thinking" (cfr. Chaps. 1 and 2), through which highly developed systems of knowledge (such as the Community of Practices and open-source communities) tend to 'confine' their knowledge, limiting the possible exposition to outside ideas and the willingness to accept them.

4.5.3 Being Part or Sub-Part of a Network: Segregation Analysis

As our intention is purely demonstrative, the following description does not aim to linger too much on the aspects of data analysis, but more on the potential of this investigative technique in the description and analysis of the evolution of the network of exchanges which characterize an online social network developing and expanding on the web.

The online social network which we refer to is LTEver, implemented to create a network favoring the convergence of interested people, collaborators, students, ex-students, and teachers of courses at the Technology of Education Laboratory at the University of Florence, and based on the open source social platform Ellg.[13] Normally, in traditional educational courses, once the course has finished the areas and the activities available during the phase of learning are progressively dissolved. In Lifelong Learning, however, the emphasis is placed on the necessity to think about, plan, and build new educational possibilities which are innovative in character and which are able to accompany the individual throughout his life in such a way as to support him in the construction of new knowledge and new skills which may not appear without the continuity or contact with the professional context. It is in this scenario that the initiative of creating LTEver arose. The staff, collaborators, teachers, and the students of Masters or Specialization courses supported by LTE, represent the sum of a community made up of people who, in spite of their different levels of involvement, share materials, exchange knowledge

[13] http://elgg.org/

and stay in contact with people with whom they have common interests, problems, and points of view in related professional areas.

Of the various analyses which characterized the LTEver experience, here we shall present the evolution of the exchanges (comments) between the participants in the social network in the first 10 months following its creation, considering that in the first 3 months the network was only made up of people enrolled in the course (OldLTEver), while in the following months these members could invite new 'outside' members (NewLTEver) according to the affinity of interest in the subjects concerned. In this case, we define 'comments' as the thoughts, ideas, and discussions that the actors post on the other members' blogs. The comments represent the highest level of activation and participation on the part of each individual user relative to the entire network. Below are the sociograms of the analysis of the neighborhood in the first 3 months (January–February–March) considered as a whole and corresponding to the OldLTEver (Fig. 4.4a), in the month of July (Fig. 4.4b) and in the month of October (Fig. 4.4c).

Analyzing the sociograms and data gathered in the three periods, we can see that the network is initially characterized by a relatively dense network of relations (links), with the presence of individuals directly involved in the Masters and Specialization courses at the Laboratory for the Science of Education (in Fig. 4.4a the OldLTEvers, represented by circles). In the month of July, more than 3 months after the opening of the network to 'outside' individuals (NewLTEvers, represented by triangles) invited by the OldLTEver, we can see the progressive breaking-up of the network, highlighted by a decline in the number of links and comments (Fig. 4.4b). The NewLTEver begin to progressively substitute the OldLTEver in the creation of a central network of contacts and of nascent peripheral networks (represented by the two pairs of individuals with a link between them but not connected to the main network). In the final period (October), the central network returns to a relatively dense state, although the network as a whole (also including the isolated members who make up its frame) is still very segregated (Fig. 4.4c). If, however, we focus our attention on the quantity of relations between the members and on the quantity of comments, we can note that, in respect to the previous periods, the average number of exchanges characterizing the relations increases. What is not immediately visible from these sociograms, is that the network demonstrates a progressive selection of the individuals who 'actively' participate in the interactions, and 'stronger' links are created between them, shown by the increase in the number of exchanges.

This brief description of the study underlines the potential of SNA to analyze, from a longitudinal point of view, the evolution of the processes highlighted in the previous chapters (cfr. Chap. 1), where we spoke about creative networks and, in particular, of the model proposed by Guimerà et al. (2005). In this view, the emergence of leadership, the selection of those with whom one has previously made connections, the progressive participation of newly-arrived individuals, etc., are dynamics about which SNA can make a substantial contribution regarding both the phase of monitoring/describing and a more in-depth analysis of the mechanism behind these processes.

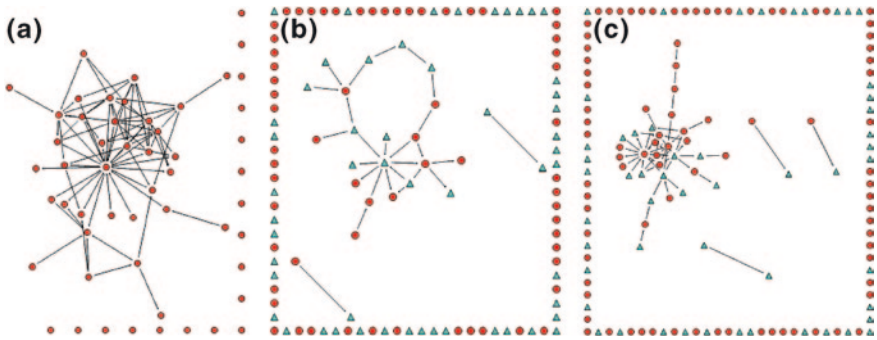

Fig. 4.4 **a** LTEver in the first 3 months: 53 members, 77 links (relations), 185 comments. **b** LTEver in July: 117 members, 25 links (relations), 36 comments. **c** LTEver In October: 143 members, 45 links (relations), 160 comments. Images elaborated using Netminer 3. Cyram (2009). Netminer 3 3.4.0.d.090924 Seoul: Cyram Co., Ltd.

4.6 Modeling the Structural Dynamics of Interaction in Creative Learning Teams

Based on some SNA indices (density, centralization, and CPI) previously used also in the first example (Sect. 4.5) and on their longitudinal use (such as described on the previous example, Sect. 4.6), in this third example we illustrate how these indices

- allow us to describe the networked flow process in its evolutionary structural dynamics
- are directly correlated with the network creativity.

By describing an exploratory study carried out with five networked groups of students, this empirical example would also show the applicability and effectiveness of our approach based on SNA. Students have been associated to one of five groups, having the task of designing and developing a service (or an application), during about 11 weeks, integrating the ICTs. The collaboration within each group occurred both in presence (during the two ours of the weekly workshop) and online by means of a web platform. The final relation of each group has been evaluated by four judges using the creative product semantic scale (Besemer 1998; O'Quin and Besemer 2006) by which it is possible to assess four dimensions of the product realized: three specific dimensions (novelty; resolution; elaboration, and synthesis) and an overall evaluation i.e. a mean of the first three dimensions. Data for the analysis are based on messages sent by means of the web platform, coded by using the procedure proposed by Manca, Delfino and Mazzoni (2007) and elaborated for obtaining the SNA adjacency matrices necessary for carrying on the analysis.

The elaboration of the final results of this study is still being processed, so we present some example of analysis and some preliminary observations on the relation between SNA indices evolution and network (group) creativity.

First of all, thanks to the SNA graphs, we can take a look of the evolution of the interactivity of each group (Fig. 4.5) and having a first impression, albeit brief,

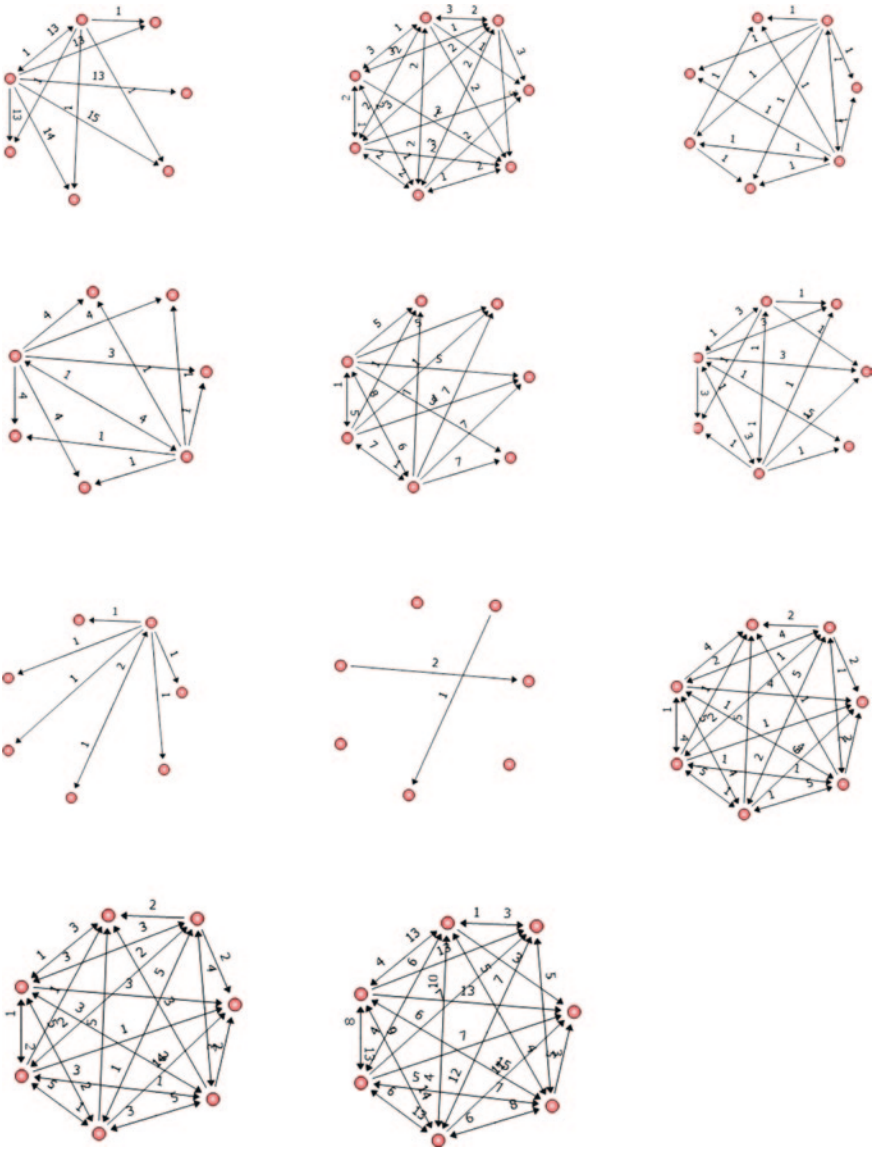

Fig. 4.5 The evolution of interactions of one group during the 11 weeks. Images elaborated using Netminer 3

about whether a group during the networked task has an increase in relations and interactions between his members or not.

The graphs above show that group has increased the interactions between his members, but not progressively: the most interactions took place during the second and the last 3 weeks, probably in coincidence with the initial phase of defining and structuring the idea and the last phase of writing the final relation.

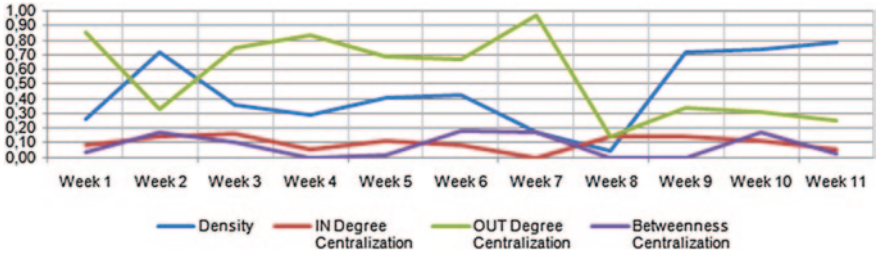

Fig. 4.6 The evolution of SNA indices of one group during the 11 weeks

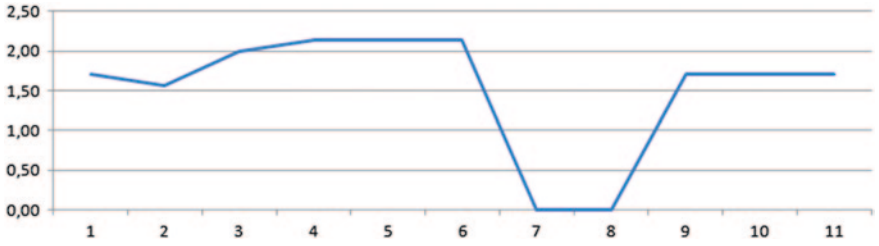

Fig. 4.7 The evolution of the CPI of one group during the 11 weeks

The same evolution can be analyzed by considering the SNA indices and observing the structural dynamics characterizing each group (Fig. 4.6).

The density in Fig. 4.6 is specular to what has been observed in Fig. 4.5, i.e. a higher interactivity during the second and the last 3 weeks. But, thanks to the evolution of the out-degree centralization index, is now more clear that during the other weeks (except the eigth), there's no a real lack of collaboration but an organization of activities more centralized on one member. In other terms, during the phase of construction (2nd week) and of completion (last 3 weeks), all members play a similar role and the group is almost completely decentralized, while during the other phases, the group shows a leadership that guides the activities and it is centralized, particularly as regards the sending of informations (out-degree centralization).

Now, based on these data and on the evolution of the CPI level during the 11 weeks (Fig. 4.7), and by considering the evaluation of the four judges coming from the creative product semantic scale, we can propose some first general observations coming from the ongoing analysis.

First of all, it is interesting to observe that even though the density of the group analyzed (Fig. 4.6) is not so high during weeks from 3rd to 6th, however, in this period the group shows the highest level of CPI (a measure of the social presence and of the ideas diversity).

In general, at first glance, groups that show the best results in term of novelty and overall evaluation of the project are also those characterized by the best trends as regards social presence (represented by the CPI), decentralized control (measured by the centralization indices), and neighbor interactions (represented by the

density index). At the same time, groups characterized by a low CPI and many variations of density index or high levels of centralization have also low results in terms of novelty and overall evaluation of their project.

4.7 Future Perspectives of Analysis: Text Mining and SNA

In an earlier paragraph (cfr. Sect. 4.2.7), we highlighted the fact that one of the criticized aspects of SNA is that analysis is based solely on quantitative data, and we pointed out the opportunity to integrate SNA with types of analysis which also take the content of messages into account and thus allow us to go beyond simple numerical data relating to the exchanges. Therefore, at the conclusion of this chapter we shall present a possible analysis which proposes an interesting possibility for the integration of a textual analysis of content (text mining) and SNA. In other words, we are not talking about applying SNA to the relations and exchanges within a network of individuals, as much as using it to analyze the similarities which characterize the subjects (terms) discussed in the conversations in the network.

The idea behind this perspective originates from the possibility of using SNA not only for the analysis of quantitative data, but also for studying qualitative data (Mangione, Mazzoni, Orciuoli, and Pierri, 2011). The starting base is naturally still the adjacency matrix previously described (Fig. 4.1), but rather than tracing the relations, contacts, and exchanges between the participants in a specific network, in this case the matrix reads the similarities which mark the subjects (terms) in the network concerned. As we have shown, not all SNA indices are equally effective in every situation; in this case, for example, the SNA indices to which we will make specific reference are the cohesion index and, above all, the eigenvector centrality index. Thanks to the latter, it is possible to analyze which subjects are more central in the discussions in a network, and which are more peripheral; in other words, it represents a sort of indicator of the more and less important aspects which characterize an object at the center of conversations in a given network of individuals. For example, if we return to the previous case concerning small groups which collaborate online, the eigenvector centrality applied to the various messages exchanged can give us an idea of their views of the objects in discussion. The cohesion analysis enables us to verify how the central and peripheral aspects are linked to one another, and which are more cohesive, allowing us to have a sort of description of the 'network thinking' relating to a specific topic.

Readjusted in this way, SNA may turn out to be particularly interesting and effective for analyzing that which, in a study of social representations,[14] Abric

[14] Social representations originate from a collective elaboration carried out by a group of individuals (of varying dimensions) which confronts a problem which is of some relevance to them. Social representations distinguish themselves as being the sum of the knowledge shared by each member of the group, and they assume the appearance of "common sense theories". They are included in the concepts which take meaning from the world and order that world, and they are also among the images which offer a meaningful and comprehensible reproduction of the world.

(1989) defines as the *central* (or *structuring) core* around which the representations concerning a given object or topic are organized. This is the fundamental element of representation, since it defines both its meaning and its structure. This hypothesis, initially formulated by Abric in 1976, has been taken up again and elaborated, particularly in France, by various authors (including Abric himself) who maintain that the structure of social representations is based on a double system:

- The *central system,* which corresponds to the core of the representation and is fixed socially, as it is linked to historic, sociological, and ideological conditions. This system, the sum of various norms and values, specifies the fundamental elements around which representations are generated, and constitutes the social and collective basis of the representations which defines the degree of consensus and homogeneity of a group, independently of each individual. The central core is fundamental for the stability and coherence of each representation, guaranteeing that it will endure in time.
- The *peripheral system,* which depends strictly on characteristics of the individuals and the context in which they are positioned. Such a system therefore makes a differentiation within the group of individuals and is able to adapt itself to specific situations and to explore certain everyday experiences. It is much more versatile than the central system, and it enables the integration of information and practices of varying types, thus showing the heterogeneity of behavior and contents. The peripheral system is essential in the identification of the changes and transformations underway in the representations which indicate their evolution and likely future modifications.

Therefore, stability and rigidity of representation depend on the core, strongly linked to the value systems shared by members of the group, while the richness and variety of individual experiences and the evolution of everyday practices determine a representation's mutability and flexibility. This dynamic is very similar to that described in stage three in the emergence of Networked Flow (cfr. Chap. 3), the "liminality-parallel action phase", in which a common intentionality among certain group members, who in fact constitute a new context and distinguish themselves from the original group, is recognized.
The core, which Abric (1989) calls the structural core of a representation, essentially performs two functions:

- Thanks to its *creative (*or *meaning-generating) function,* the other elements which constitute the representation acquire or change meaning and value;
- Through the *organizing function*, the core determines the nature of the links which connect the various elements of the representation. In this sense, the core can be considered a unifying and stabilizing element of representation.

Since the core creates and organizes representation, Abric maintains that it is also its most *stable* element, that which more than any other resists change. This means that a representation's evolution will begin from the modification of its peripheral and less central elements. A transformation of the central nucleus would indeed

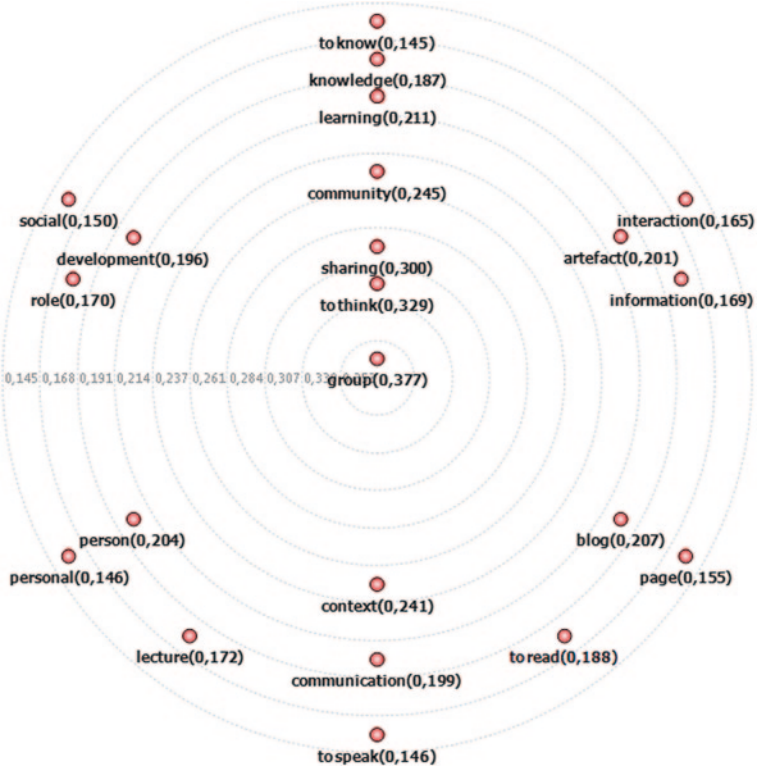

Fig. 4.8 The eigenvector centrality index applied to the matrix of the similarity between the terms. The *square* in the bottom right-hand corner is a zoomed image of the most central themes with which the students qualify their social network

bring about a modification in the structure and the totality of the representation. Therefore, we can presume that the change and evolution of a representation will only be superficial if it comes about through the modification of the meaning, or the nature, of the peripheral elements, while the involvement of the core would radically alter the representation itself.
There are therefore two interesting aspects which relate to the use of SNA in the analysis of the representations which characterize a network of individuals:

- The possibility to differentiate between elements of the central core and peripheral elements in a social representation;
- The possibility to carry out a longitudinal analysis of the representation's evolution, paying particular attention to the transition of certain aspects from peripheral to central, and vice versa.

At the conclusion of this chapter we shall thus propose a purely demonstrative example of an analysis of the conversations held on an online social network by a group of students about the usefulness of a web artifact in their university course.

The conversational exchanges were gathered, elaborated, and analyzed through the text-mining software T-Lab. In this case, the T-Lab software was not used for the analysis of the text of the conversations, but to construct the *similarity matrix* of the terms which characterize the conversations on the network of students. This matrix demonstrates the probability that two terms will co-occur within the analyzed text. The similarity matrices are, to all intents and purposes, square matrices similar to typical SNA adjacency matrices and show, at the crossing of two terms, the strength of the link (the amount of similarity) which characterizes them. It is therefore possible to transpose the data of this matrix onto an adjacency matrix and then analyze its centrality.

Figure 4.8 shows the centrality analysis (carried out using the eigenvector centrality index), performed on the similarities which characterize the terms used in the conversations in a network of students who discuss the use of internet technology (especially online social networks) in their education.

As we can see, the most central positions is occupied by the subjects which, relative to the topic of discussion, are the most central for the network of students. Having considered the eigenvector centrality index, the terms in the most central positions do not only hold that positions on the basis of the degree of co-occurrence which they have with the other terms, but also in relation to the centrality of these terms. From this point of view, they represent the subjects which most strongly characterize the conversation in virtue of their co-occurrence with the subjects which are, in turn, particularly relevant to the topics discussed.

This brief and succinct example of the application of SNA to the contents of the conversations in a group shows the potential of this investigative technique for entering into collective thinking and providing a representation of the originality, richness, and creativity with which a group confronts and discusses given topics.

4.8 When and Why Do We Use SNA Indices?

What has thus far been said about using SNA indices to describe, monitor, and above all, analyze the experience of Networked Flow, highlights their potential in all situations in which relationships, links, communicative exchanges, or flows of information become important aspects for the dynamic being observed (as in the case of Networked Flow). This is particularly evident considering what has been examined in the previous chapters regarding cognitive stimulation and the emergence of culture in creative networks. It is, however, necessary to take into consideration not only the positive aspects of this technique, but also to carefully evaluate the elements of criticism in order to avoid misleading interpretations of the observations made and the data collected. The researcher should take care to interpret graphs and SNA indices appropriately, and, obviously, the interpretation will be more accurate the more detailed knowledge the

researcher has of the context which he or she analyzing. Both ways of representing relational data (graphs and SNA indices) are important for an appropriate interpretation of the dynamics observed, keeping in mind certain crucial points which we will now see.

First of all, as we mentioned previously, the adequacy of SNA indices for describing and understanding the analyzed phenomena is not independent of the context: not every SNA index is necessarily appropriate to every situation. It is up to the researcher to evaluate each occasion based on the type of relationships that characterize the network, in order to decide which indices may be more appropriate to investigate the relational dynamics observed (for example, using the flow betweenness centrality index where there is no flow of information but simple family relationships would not make much sense).

Furthermore, the application of SNA may have varying degrees of effectiveness according to whether one is working with small groups or large communities. It is mainly in the latter case that SNA is most effective, as:

- The SNA indices have high reductive power, enabling them to express relatively complex relational dynamics with just one value;
- Other types of analysis (such as conversation analysis) may turn out to be quite wasteful when exchanges are characterized by a large and complex amount of data. With small groups, however, the effectiveness of SNA is considerably less evident in as much as certain structural indices always, or almost always, reach critical values which are difficult to compare. The compactness of the group (density and inclusivity), for example, in small groups almost always reaches its maximum level, while connectivity and cohesion indices are not particularly indicative due to the low number of participants, and so there are often no separate components and no sub-groups. For these reasons, with groups of small dimensions, the longitudinal application of SNA may be more effective, as it highlights the way in which the relational dynamics evolve through time, as opposed to giving a single static representation of them.

Finally, the reductive power of SNA indices itself represents a critical element. This type of analysis considers the quantity of relations, exchanges, and flows which characterize a network, while it tells us nothing about the quality of relationships activated or the content which is produced and exchanged within the network. From this point of view, it would be appropriate to use SNA alongside other types of qualitative analysis which focus on the content of interactions and which therefore allow us to go beyond simple numerical data relating to exchanges. Although the density index of a given network of people who work together to carry out a project may be high, this could in fact be illusory if, when we read the text in the messages sent and received, we discover that the close network of exchanges is characterized by comments about football matches or the members' musical preferences: this would of course point to the presence of good relational dynamics, but they do not have much to do with the reason for which the network was created.

Chapter 5
Conclusion
Networked Flow: A Future Vision

We have started this book by presenting creativity as a complex sociocultural phenomenon that cannot be analyzed by considering separately individuals and the sociocultural context; the latter acts as a "cognitive breeding ground" for the development of the individuals' ideas (Di Maggio 1997). We have then described the passage from the idea of "creative genius" to that of "creative networks", as the history of great creations in different fields—science, art, politics, literature—shows, most great innovators (charismatic and visionary leaders who are able to tune themselves into the times and culture in which they live) are part of an intellectual community in which they can share their thoughts and discoveries.

We have then turned our attention to the mediated communication environments, trying to answer to some critical questions arising from the group flow theory that sees the synchronization of action and thoughts (i.e., physical closeness, echoing of gestures, and phrases) as an important dimension of the group flow experience. However, how is this synchronization achieved within virtual collaborative environments? Is physical co-presence a pre-requisite for optimal team experience?

Our perspective considers the existence of two selective and adaptive basic mechanisms: the presence and the social presence. We have described the first concept as a mechanism which allows to define the boundaries of action by means of the distinction between "internal" and "external" within the sensory flow (Riva and Waterworth 2003). Thanks to this mechanism, an individual is able to situate himself and act in a physical and social space by defining his own boundaries. The second selective and adaptive mechanism, the social presence, enables the Self to identify and interact with the others by understanding their intentions. From an evolutionary point of view, we have suggested three main functions of the social presence. First, it enables the subject to identify the others and to attribute them an ontological status different from that of the other objects perceived in the context. Second, it allows interaction and communication through the understanding of the others' intentions. Third, it permits the evolution of the intentionality of the Self through the identification of group-based "optimal experiences" (Networked Flow) and the incorporation of artifacts—physical and social—linked to them.

Based on these premises, we have theorized and argued that group flow is the result of the association between a situation of "liminality" (definable as a state of

A. Gaggioli et al., *Networked Flow*, SpringerBriefs in Education,
DOI: 10.1007/978-94-007-5552-9_5, © The Author(s) 2013

transit, of "being about to") and maximum levels of presence and social presence. Thus, in order to reach this optimum collective status it is necessary, on the one hand, that group members experience a high level of social presence and, on the other hand that they experience a situation of liminality and also that, within the group, they find the means to overcome it. Thanks to this experience, the group creates and shares new meanings and new intentions. Specifically, we suggested that the main creative outcome of optimal experiences is the creation and diffusion of "*memes*". But what is a meme?

The concept of memes was first introduced by the zoologist Richard Dawkins, in opposition to the concept of the gene: an element of culture which can be transmitted from one individual to another by non-genetic means, and in particular through imitation (Blakemore 1999; Dawkins 1989). In this book we extended this vision presenting two hypotheses:

1. The memes' content is intentional: *each meme contains within it a specific intention.*
2. *The creation and diffusion of memes depends on the* level of presence and social presence experienced during action and communication.

The creation of a new meme—a new product, a new concept, a new idea—does not necessarily imply its diffusion. As we have seen in the book, the transmission of memes is strongly linked to the level of social presence experienced during the interaction between the subject who passes on the meme, and the subject who receives it. There is, however, a tool which is able to facilitate this process: *narration*. It is in fact narration which connects one meme to another, giving them a sense and allowing people outside the group to recognize them as possible intentions (internalization).

By considering the activity theoretical approach (that we have presented in second chapter), Engeström (2001) will speak of expansive learning since 'people and organizations are all the time learning something that is not stable, not even defined or understood ahead of time. In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not yet there. They are literally learned as they are being created. There is no competent teacher' (p. 137–138).

The link between creativity and optimal experience is not a new concept and was introduced and discussed widely by the positive psychology movement. The seminal work by Mihaly Csikszentmihalyi in the mid-1970s identified in the optimal experience, or "Flow", a specific consciousness state experienced during challenging activities characterized by deep absorption and enjoyment (Csikszentmihalyi 1990). Later, in his book "Creativity: Flow and the psychology of discovery and invention" (1997), Csikszentmihaly, analyzed a series of interviews to 91 internationally recognized creative people. In his analysis he clearly described creativity as the result of three elements: a culture that contains meanings and symbols, a person who uses optimal experiences to bring novelty into the symbolic domain, and an external group who recognize and validate the innovation.

The main criticisms to this vision are three. First, the lack of attention to the interpersonal context; we experience optimal experiences, such as the "networked flow", that are the outcome of a social interaction. Second, linking the optimal experience to the balance between perceived high challenges/opportunities for action and high personal skills is too vague to be useful within a scientific research program: What is high and low for me and you?

Third, if creativity is a process linking the individual with a culture and a reference group, how does it work? No specific cues are offered by the author.

To address these issues started from the concept of experience. According to the Merriam Webster Dictionary, it is possible to define experience both as "(a) the fact or state of having been affected by or gained knowledge through direct observation or participation" (personal experience), and "(b) direct observation of or participation in events as a basis of knowledge" (subjective experience). These definitions underline the two connected faces of our experience; on one side, we can intentionally control the contents of our experience (subjective experience); on the other side, its contents define our future emotions and intentions (personal experience). In other words, we both shape and are shaped by it.

However, there is a critical difference between subjective experience and personal experience. If subjective experience is the experience of being a subject (experience as subject, the "I" described by William James), personal experience is the experience affecting a particular subject (experience as object, the "Me" described by William James). This simple shift suggests that, independently from the subjectivity of any individual, it is possible to alter the features of our experience from outside. In other words, personal experience becomes the dependent variable that may be manipulated and studied by external researchers. Specifically, we suggest that it is possible to manipulate the features of our experience in three separate but related ways (Riva et al. 2012):

- By structuring it using a goal/meaning, rules, and a feedback system.
- By augmenting it to achieve multimodal and mixed experiences.
- By replacing it with a synthetic/fictional one.

For example, as suggested by "Positive Technology", it is possible to use technology to manipulate the quality of experience, with the goal of increasing creativity and well-being both in individuals and in groups (Botella et al. 2012).

The other advantage offered by the concept of personal experience is that it allows the connection between the three levels originally identified by Csikszentmihalyi: the individual, the culture,, and the group. Specifically, an optimal personal experience produces memes that are used by the group to define its own culture (subculture). When these memes are internalized by most individuals, through imitation and communication, they modify and shape the culture and the behavior of the individuals.

Based on the this theoretical background, we have then presented the six stages model of the Networked Flow process, i.e., the dynamics of the emergence of a creative network: meeting (persistence); reducing the distance; liminality-parallel action; networked flow (NF1); NF2—creation of the artifact; NF3—application of

the artifact in a social network. Looking at the sequence of these stages, it is clear the result of the optimal collective experience is the creation of new artifacts such as new products, new concepts, and new ideas. However, we have highlighted that a network is not necessarily able to promote and share these new artifacts outside its boundaries. For this, two things are required: (i) the existence of interactions between group members and people outside the group—characterized by high levels of social presence—which make use of the new concept; (ii) the creation of narratives which link the new concept to old ones allowing people outside the group to make sense of it (internalization).

These elements justify a method of inquiry that takes into consideration the structure and the flow of information and knowledge exchanges between the network's members: the social network analysis (SNA). So we have described some useful indices of the SNA (such as density, cohesion, and centrality) for describing, monitoring, and analyzing the networked flow process. We have also presented some application of the SNA in creative contexts and, also, the possibility to apply this type of analysis not only to interactions and exchanges, but also to contents of discussions/communications within a network of people. This innovative application of the SNA to data coming from content analysis allow us not simply to understand the structure of the network of relations within a group of person, but also which types of contents are more relevant in their exchanges.

After this brief summary of the book, we would suggest its main elements and the new idea it involves for the future in this field of study.

One of the main elements we introduce is a vision of creativity distant from an individual conception and also different from the creative group. The Networked Flow is a stadial process based on three elements: a network of person, their perception of presence and social presence, and an artifact (meme) that, on the one hand, represents their objectives and, on the other hand, their interactions. Thanks to the perception of being present and also of being socially present, in a network it is not important to "see" or "meet" the others, but it is most important being aware of their existence/presence. This is guaranteed by the artifact on which the network is reflected and that delimits the context on which and by which the interactions between the network's members take place. From this point of view, the Networked Flow model has the merit to consider all those dynamics that take place in Web 2.0 contexts (such as Wikis and Social Network Sites) in which the interactions and the exchanges between persons are somewhat different from those we experiment in everyday offline world. However, although this model fits perfectly for the online environments, it is also able to sketch and systematize the dynamics involved in creative offline social contexts.

From classic concepts such as the Lewin's field theory or the Vygotskij's zone of proximal development, up to more recent and innovative concepts such as the Leont'ev's functional organ, the activity theoretical perspective of Engeström, the discover of the mirror neurons and the perspective of presence and social presence, our model takes into consideration and integrates many important elements of social psychology, of developmental and educational psychology, and of cognitive psychology.

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A. Gaggioli et al., *Networked Flow*, SpringerBriefs in Education,
DOI: 10.1007/978-94-007-5552-9, © The Author(s) 2013