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4 Positive Change and Networked Flow: From Creative Individuals to Creative Networks

Abstract: The history of creativity in the arts, science and technology suggests that most great innovators do not work in isolation, but are part of an intellectual community in which they can share their thoughts and discoveries. In this chapter, we describe a model – "Networked Flow" – of how these creative networks are born and evolve. We first review main theoretical models of «collective» creativity. Next, we present and discuss the six stages model of the Networked Flow process: meeting (persistence); reducing the distance; liminality-parallel action; networked flow; creation of the artifact; application of the artifact in a social network. Finally, we describe social network analysis as an appropriate methodology to investigate Networked Flow in creative collaboration settings.

Keywords: Group creativity, flow experience, social presence, social network analysis

4.1 Introduction

Traditionally, creativity has been mostly investigated from an individual perspective, focusing on the psychological features that distinguish creatively-gifted individuals from «normal» people. These features include, for example, personality traits, intellectual abilities and the type of education received (Sternberg e Lubart, 1999). More recently, however, there has been a shift in interest from individual to social and cultural factors that shape creativity (Amabile, 1983; Amabile et al., 1996; Csikszentmihalyi, 1999; John-Steiner, 2000; Sawyer, 2003, 2007). This change of perspective has been driven by the increasing acknowledgement that creativity is a complex phenomenon, which results from multiple psychological, socio-economic and cultural factors (Hennessey & Amabile, 2010). Csikszentmihalyi (1996, 1999) has been among the first researchers to introduce a systemic perspective on creativity, emphasizing the importance of the interaction between the individual and the surrounding domain. According to Csikszentmihalyi, the creative process results from three interacting forces: «a culture that contains symbolic rules, a person who brings novelty into the domain and a field of experts who recognize and validate the innovation» (1996, p. 29). Csikszentmihalyi defined this model as «systemic» because all its components – the person, the field and the domain – are necessary to achieve creativity: although the new ideas produced by the individual are important, a critical role is also played by the cultural domain (including the conventions, the techniques, the system of symbolic codes and norms) and by the experts (the hierarchy of groups and

individuals who can influence the knowledge system and can eventually recognize the value of the innovation). Essentially, Csikszentmihalyi considers creativity as the result of an evolutionary process: the individual produces variations in the pool of ideas/artifacts (or «memes»). Then, the field operates a selection among the memes (allowing the replication of the ideas that are more worth to the field itself), which are eventually retained (or not) by a specific domain. This systemic model of creativity is particularly useful to understand how creative products are originated by groups or communities of individuals. When one looks at the history of creativity in the arts, science and technology, it is easy to recognize that most great innovators do not work in isolation, but in collaboration with like-minded peers, friends and colleagues, with whom they share insights, knowledge and aspirations (Sawyer, 2007). But why collaboration is so determinant in creativity? At first glance, the answer to this question may seem obvious. First, collaboration allows complex problems to be broken down into smaller issues or tasks, which can be distributed according to the expertise of co-workers. For example, the discovery of the so-called Higg's boson within the Large Hadron Collider (LHC) project at CERN would have been virtually impossible without the contributions of thousands of physicists, informaticians and engineers from over the world. Second, collaboration can foster divergent thinking and promote the sharing of methods, competences and techniques. Third, successful collaboration empowers individuals to engage and can make them feel like they are part of something greater than themselves, by sharing a same objective or ideal.

The increasing acknowledgment of the critical role played by collaboration in creativity has resulted in several conceptual models and a number of empirical studies to validate them. In an attempt to systematize this field, Glăveanu (2011) identified two main perspectives on «collective» creativity, namely the *sociocognitive* approach and the *sociocultural* approach. The first paradigm has mainly focused on the cognitive dimensions of group creativity and on the possible strategies to enhance its effectiveness. The sociocultural approach, in contrast, has put more emphasis on the process of creative collaboration, focusing in particular on its intersubjective and cultural dimensions. In the following sections, we draw on Glăveanu's review of this field to summarize the main models of collective creativity. Next, we introduce the Networked Flow model, which attempts to identify a possible link between these two different views of social creativity. Finally, we describe social network analysis as an appropriate methodology to investigate Networked Flow in creative collaboration settings.

4.1.1 The Sociocognitive Approach

According to Glăveanu (2011), the sociocognitive paradigm considers group creativity as an input-elaboration-output process, in which group dynamics (such as level of participation, leadership and conflict management) act as mediating variables between input and output factors. The epistemological position of this approach is

that creativity is essentially embedded «in the mind» of individuals, while the social dimension is «external» to this process. Models of sociocognitive creativity are thus oriented towards understanding the subcomponents of team creativity and their interrelations. Typical questions with which the sociocognitive approach is concerned include, for example, what difference exists between individual and group creative performance; how creative performance can be optimized, both in quantitative (i.e. production of more ideas) and in qualitative (i.e. generation of better ideas) terms; how experimental manipulation of specific variables (i.e. the nature of the task, competence level, cognitive load, group size and others) affect creative performance. To address these issues, sociocognitive approaches have mostly relied on quantitative methods typically used in social and experimental psychology (Paulus, 2000; Paulus et al., 2006). Within this paradigm, brainstorming has been one of the most investigated technique to assess (and enhance) group creative ideation. Essentially, brainstorming consists of a group of people collaborating in a noncritical environment to generate a high number of ideas. This technique typically involves gathering a group of 5–6 participants (including both novices and experts, from a wide variety of background). The increasing popularity achieved by brainstorming over the years has led sociocognitive researchers to investigate the effectiveness of this technique in enhancing group creative performance. Surprisingly, the bulk of empirical evidence indicates that group brainstorming is not more effective than individual brainstorming (Paulus and Nijstad, 2003). In a typical experiment of this kind, creative performance of a group of participants ("real groups") is compared to that of the same number of participants working individually ("nominal groups"). In most cases, it has been observed that real groups tend to generate fewer ideas than nominal groups. This reduced productivity has been explained by both social and cognitive influence processes. Janis (1972) highlighted the «groupthink» effect, in which members of a group tend to avoid producing too many personal thoughts and conform with peers, adapting their proposals to be similar to others. Other known social effects include comparison among members, such as evaluation apprehension (i.e., fear negative evaluations from others) and social loafing (individuals give less effort in a group because responsibility is diffused). Cognitive influence processes include the so-called «production-blocking effect» (in the course of idea generation, one person speaks while the others listen, and this results in a cognitive interference that hinders the generation of ideas), excessive demands on cognitive resources and working memory (due to the dual tasks of paying attention to others' ideas and generating one's own ideas), distractions and fixation (being exposed to others' ideas, members tend to focus on those and block other types of ideas from taking hold). Paulus and Brown (2007) have proposed a cognitive-social-motivational perspective of group ideation, which provides a basis for understanding group creative processes for ideational tasks. They argued 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 posits 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 accessed, and more elaborated combinations 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. Another influential sociocognitive model is the «Search for Ideas in Associative Memory» introduced by Nijstad and colleagues (Nijstad et al., 2003). According to this theory, creative ideation is characterized by a continuous search within associative memory. The ideas provided by group participants provide cues that trigger the activation of a specific «image» in the long-term memory, from a pool of images associated to it and structured in a complex network. When the image is triggered, this can be used to generate new ideas (resulting from the combination of previously-existing knowledge), new associations or new applications of pre-existing knowledge in a new domain. According to Nijstad and colleagues, the production block within real groups is can be explained by the delay between generation and expression of an idea, since ideas cannot be communicated while another group member is speaking. On the other hand, the model suggests that the ideas generated by participants can effectively stimulate processes of knowledge activation and production, by reducing the time needed to combine cues and thereby optimizing search within long-term memory. An interesting practical implication of this model is that diversity of competences in a group is directly reflected in the variety of knowledge that can be accessed. Thus, internal diversity plays an essential role in creative performance of a team: as the overlap between accessible knowledge increases, so it increases the tendency to activate knowledge from a restricted number of domains, which in turn can undermine both the variety and complexity of ideas generated by the group. As Glăveanu (2011) points out, sociocognitive models are based on a vision of individuals and groups as systems for the elaboration of information. The main advantage of sociocognitive approach is that it is based on highly-operationalizable constructs and testable hypotheses, which can be assessed in rigorously-controlled experimental settings using quantitative methods. However, for Glăveanu, the price for this strength is a risk of methodological reductionism, which can lead to the exclusion of other levels of the phenomenon. A further limit of this approach is the individualization of the group creative process, which tends to overlook the role of interactions between participants.

4.1.2 The Sociocultural Approach

The sociocultural perspective considers creativity as an inherently social phenomenon, which results from the interaction between different subjects. In contrast with the sociocognitive paradigm, which embeds creativity in the individual minds, the sociocultural view places creativity «in the space 'in between' the self and the others.» (Glăveanu, 2011, p. 9). The focus of sociocultural models is on notions such as shared meanings, negotiation, intersubjectivity. Besides cognitive dimensions, socio-affective, motivational, cultural and identity dynamics become central issues in the understanding of creative collaboration. Glăveanu observes how sociocultural models have extended the investigation from the laboratory to the real contexts in which creative collaborations are situated. Further, the sociocultural approach encompasses both the macro-genetic (following the evolution of creative collaborations over long periods of time) and micro-genetic (considering the micro-interactions within creative groups) levels of analysis: this is reflected in the empirical procedures used, which rely mostly on field observations and qualitative methods such as biographic analysis, videotaped observations, interviews and case studies. In educational contexts, particular attention is dedicated to the study of collaboration among students; examples include creative writing (Vass et al., 2008), solution of mathematics problems (Armstrong, 2008) and the development of Web pages (Fernández-Cárdenas, 2008). In all these cases, the methodology used is based on the analysis of interactions between students, the content of discourses and strategies of collaboration. A model of collaborative creativity, which has gained significant attention, is the one proposed by John-Steiner (2000). Building on Vygotsky's theory, John-Steiner holds that every collaboration context defines a "mutual zone of proximal development", which allows participants increasing "their repertory of cognitive and emotional expression" (p. 187). This is associated with a personal re-elaboration of what has been learnt, which is able in turn to modify both the field and participants, determining a circular process of knowledge co-construction. Another influential sociocultural model of creative collaboration has been introduced by Sawyer (2003; 2007). This author argues that a team performs at its best when it is able to achieve a state of "group flow", an optimal collective experience defined as a "collective state of mind" (p. 43). The concept of flow was originally introduced by Csikszentmihalyi (1975; 2000) who described it as an optimal experience characterized by global positive affect, high concentration and involvement, feeling of control, clear goals, and intrinsic motivation: in particular, a key feature of this experience is the perception of high skills matched by equally high personal resources (i.e. knowledge, abilities, proactive coping, positive engagement modes) to face them. Whereas Csikszentmihalyi studied the link between flow and creativity at an individual level, Sawyer (a former student of Csikszentmihalyi) extended the analysis to group collaboration by considering two specific domains: jazz and theater improvisation (Sawyer, 2003). He used a technique called "interaction analysis", which consists of an in-depth observation and classifi-

cation of participants' conversations, gestures, and body language. By examining the data collected over ten years of observations of several performing groups, Sawyer concluded that group flow requires members to develop a feeling of mutual trust and empathy, which culminates in a collective mental state in which individual intentions harmonize with those of the group. Jazz music players often refer to this state as to achieving a "group mind" characterized by a profound emotional resonance, which allows artists to be fully coordinated within the improvisational flow. According to Sawyer, group flow "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; rather, this phenomenon emerges from the interactions occurring within a group and is able to positively influence overall performance. Furthermore, Sawyer suggested 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 software); therefore, it requires the achievement of more shared structures. In contrast, an intrinsic goal is largely unknown and undefined (i.e., the task faced by an improvisation group in theatre); therefore, it requires the achievement of structures that are less shared (2003, p. 167).

More recently, Glăveanu (2011) introduced the «Model of Shared Representational Resources». This theory is based on the assumption that creativity, and specifically creative collaboration, unfolds within a «representational space». Glăveanu draws on Winnicot's third or potential space (1971), a place of experiential mediation within which individuals can creatively interact with artifacts; a space which is shaped by collective thinking systems and continuously restructured by experiences and communicative processes. Such intersubjective space is at the same time an interface between the Self and the other and between the Self and the community/culture an individual belongs to. Within this space, there is a wide repertoire of symbolic representational resources used in all our interactions, which includes not only our judgments and dialectic strategies, but also the various artifacts that we use. According to the Shared Representational Resources model, in the context of a creative collaboration individuals use the symbolic resources that are embedded in their specific knowledge system and, by means of communication, they generate new and useful artifacts (the creative products) within the representational space of the group (p. 12). By exploring the representational spaces and their externalization, participants can identify new means of understanding and action. This «merging» of individual spaces lead to the development of a shared representational space, which Glăveanu considers as the very forge of creative collaboration. However, as acknowledged by the author himself, the current version of the model does not provide a theorization of how creative ideas take shape within such intersubjective space. According to Glăveanu, this issue can be addressed by focusing on participants' ability to identify the implicit potential of

the ideas expressed by others, highlighting aspects which are even not perceived by the person who generated the idea. This aspect underlines the importance of taking the perspective of the other, cultivating empathy and developing the capacity to locate «the Self in the context of the Other». Resuming the systematization proposed by Glăveanu, sociocultural models are not only focused on the creative process but also on its content (the creative product and the resources used to generate it) and the context in which it unfolds, mainly relying on qualitative methods. For Glăveanu, the main advantage of this paradigm is that it offers a more comprehensive view of collective creativity, by extending the analysis from cognitive to contextual and cultural dimensions. On the other hand, some sociocognitivists consider collaboration studies not appropriate to draw rigorous inferences about creativity, because they are mostly based on interpretive qualitative research methods (Paulus and Nijstad, 2003; Glăveanu, 2011).

4.2 From Group Creativity to Creative Networks: the Networked Flow Model

The Networked Flow model argues that the key to group creativity is the development of "collaborative zone of proximal development" in which actions of the individuals and those of the collective are in balance and a sense of social presence is established. Furthermore, the model suggests that if this condition is achieved, the group has the opportunity to experience group flow, an optimal experience that fosters the generation of new knowledge and ideas. The creative products of the group, however, are not automatically recognized by the social context. Two further conditions can facilitate this process: (i) the existence of interactions between group members and individuals outside the group, who can eventually recognize and adopt the innovation (ii) the creation of narratives which link the new concept/product to existing ones, allowing nonmembers to attach meaning to it (internalization).

4.2.1 The Emergence of Networked Flow: the Role of Social Presence

A common feature among sociocultural models of creativity is the importance given to the development of a shared intersubjective space, which has been differently conceptualized as «mutual zone of proximal development» (John-Steiner, 2000), «group mind» (Sawyer, 2007) or «shared representational space» (Glăveanu, 2011). However, little is known about the cognitive processes, which underlie such intersubjective space. Understanding the neuropsychological mechanisms that mediate and support the emergence of such shared intersubjective space could help in linking sociocognitive and sociocultural models of group creativity. We contend that the theory of social presence can offer a useful framework to address this issue. In the context of

Networked Flow model (for more details see Gaggioli et al., 2013; Riva et al., 2011), social presence is defined as the non-mediated perception of an enacting Other (I can recognize his/her intentions) within an external world (for a broader discussion see Riva & Mantovani, 2014). But how does one connect to the Other? How does the Other become present for the subject? The analysis of the "mirror" neuron system provides a possible answer to these questions. Mirror neurons, discovered in the ventral premotor 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, through the same neuronal 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:

– 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 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, 2008) as the feeling 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. This process is characterized by three levels:

– *proto social presence*, which is essentially based on the recognition of the motor intentions of the Other (Other vs. the Self);
– *interactive social presence*, which allows for the recognition of the intentions of the Other that are oriented towards the Self (Other toward the Self);
– *shared social presence*, which allows the Self to enter in resonance (like a diapason) with the intentions of the Other (Other like the Self).

Since these levels are hierarchically organized, the activation of the maximum level of social presence (empathy) requires the activation of the lower levels (namely, interactive and imitative social presence). In other words, shared social presence is associated with the highest level of empathy between the Self and the Other, allowing progression to a state of «we-intentionality» where the objective of the Self and the objective of the Other are at one: this is well exemplified by the notion of «group mind» often described by Jazz musicians (Sawyer, 2007). Empathic social presence allows for the emergence of an intersubjective state, the evolution of which is unpredictable but nevertheless coherent with the objective of each participant. In this perspective, group flow (Sawyer, 2007) can be regarded as the experiential correlate of such we-intentionality, associated with the highest level of social presence (Gaggioli et al., 2011), and can be achieved also using mediated communication (e.g Facebook use, see Mauri et al., 2011).

4.3 Networked Flow: a Six-Stage Model of Group Creativity

In the previous section, we have argued that achieving the highest level of social presence allows the group to experience group flow, maximizing its creative potential. The result of this optimal experience is the creation of new products, concepts or artifacts. In the following, we argue that this process is achieved through different stages, each characterized by specific processes (for a more detailed description of each phase see Gaggioli et al., 2013).

4.3.1 Phase 1: Meeting (Persistence)

The first phase in the emergence of networked flow, *Persistence*, can take place in any social environment where there are a certain number of individuals who share an interactive context. Referring to Goffman (1974), we can define such an interactive context as a *frame*, that is, an area of intersubjective 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, 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, nor is it 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.

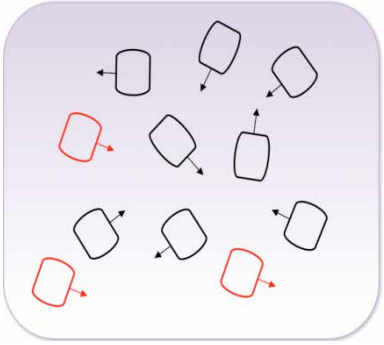

Figure 4.1: Phase 1: Meeting (or Persistence).

4.3.2 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 intentionvector. 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 noncompliance 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 subgroup which finds itself in a situation of liminality. People start to get close to one another and to form a subgroup: self-definition enhances the identity making process and it is likely that the feeling of involvement in the subgroup increases as well. 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 subgroup 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 in order to influence and to affect the general direction of the frame.

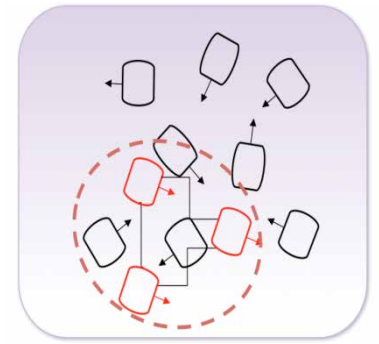

Figure 4.2: Phase 2: Reducing the distance.

4.3.3 Phase 3: The Liminality-Parallel Action

In this phase, the new subgroup starts consolidating its boundaries with respect to the preexisting frame and to position its "intentionvector" towards a common direction that enables the subgroup to close in on the limits of the preexisting frame. Group members experience high level of social presence and identify the group itself as the means to overcome this situation of *liminality*. In this sense, it might be said that the emergence of a co-intentionality is the very first creative act of the subgroup.

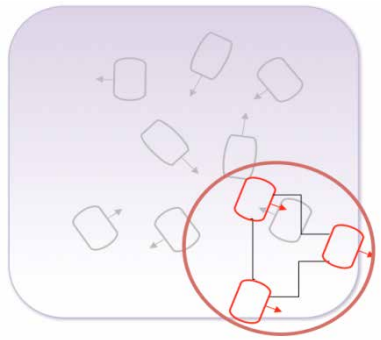

Figure 4.3: Phase 3: Liminality-Parallel Action

4.3.4 Phase 4: Networked Flow

At this stage, the group shares a new frame and experience an optimal state (group flow), which allows participants to express their maximum creative potential. 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 a goal. The leader/s help clarify the group's objectives and enhancing its internal cohesion. The preexisting frame is abandoned, and a new frame, which provides a more suitable background to support the group's creative activity, is established. Several key features can indicate the emergence of networked flow:

- the collective *intention* is transformed into a collective *action*;
- the internalization of the collective intention is directed toward the future;
- there is a balance between the resources available to the group and those required by the common action;
- one or more leaders are identified;
- the new frame is made explicit.

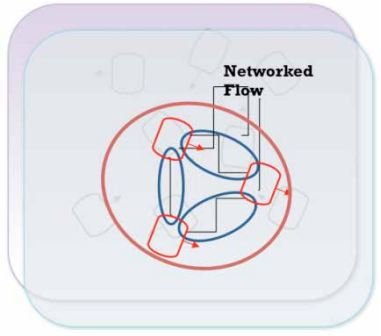

Figure 4.4: Phase 4: Networked Flow

4.3.5 Phase 5: 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 shared since the artifact has not yet been applied outside the frame.

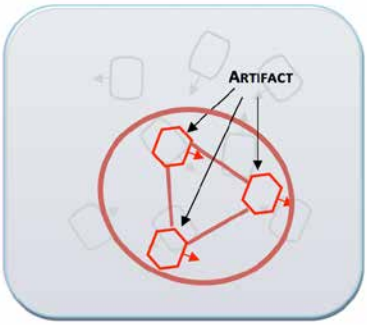

Figure 4.5: Phase 5: Creation of the artifact

4.3.6 Phase 6: Application of the Artifact

Once the artifact has been created the group enters into the sixth and final phase, in which the new artifact (an artistic product, technology, idea, theory, etc...) is taken into the preexisting social network. At this point, the new product must be recognized by the social reality. Therefore, in this stage, the creation of links with other individuals/groups/communities is crucial. The process can lead to either two possible outcomes: (a) the new artifact is recognized and is able to modify the pre-existing social reality: this allows the group to extend its boundaries and originating a creative network, which is able to attract new members who share the same intentionality of the original group; (b) the artifact is not able to affect the existing framework and therefore is not able to propagate itself in the social reality, which either ignores or rejects it.

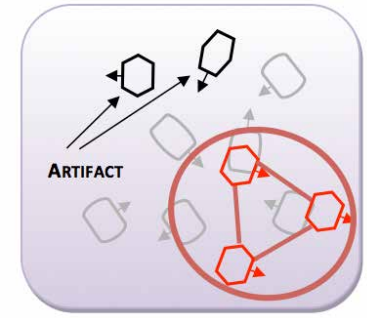

Figure 4.6: Phase 6: Application of the artifact to social reality

4.4 Understanding Networked Flow: Social Network Analysis

The six-stage model of Networked Flow described in the previous section is based on the attempt to define a possible connection between *structural* and *processual* dimensions of collective creativity. The use of the adjective «networked» to define the model reflects our emphasis on the inherent social dynamics that characterize collective creativity. We contend that only by looking at these complex interactions it is possible to understand how a we-intentionality can emerge and stabilize (Gaggioli et al., 2013). The next step is to identify an appropriate methodology for analysing Networked Flow, which is able to take into account both structural and processual aspects of creative collaboration. To this end we introduced Social Network Analysis (SNA) as a suitable procedure to address this issue. By considering individuals as interdependent units as opposed to autonomous elements, SNA offers a promising methodology to study group dynamics as well as to investigate the role of the individuals within these dynamics (Scott; 2000; Wasserman & Faust, 1994). Furthermore, SNA has previously proven useful for gaining insight into social network characteristics associated with creativity (Cattani & Ferriani, 2008; Guimerà, Uzzi, Spiro, & Amaral, 2005). SNA focuses on various aspects of the relational structures and the flow of information, which characterize a network of people, through two types of interpretation, graphs and structural indices (Mazzoni & Gaffuri, 2009; Wasserman & Faust, 1994). Graphs (or sociograms) plot the dots (individuals) and their social relationships (edges). Structural indices depict quantitatively the network of social relations analyzed based on several characteristics (e.g., neighborhood, density, centrality, centralization, cohesion, and others). SNA is based on the flow of messages that individuals of a dyad, which are conceived and mutually dependent entities (i.e., each message sent by X to Y is also a message received by Y from X), send and receive within the network. This aspect is critical in online environments in which posting a message on

a web forumdoes not guarantee that all participants will read it. To address this issue, some authors (Manca, Delfino, & Mazzoni, 2009) have proposed a coding procedure to identify the receivers (or readers) in relational data collected within online environments. 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). To study the Networked Flow, different structural SNA indices have been proposed, such as Density, Group Centralization and Cliques Participation index.

4.4.1 Density

Density of a network (in this case a group) is defined as the percentage (ranging from 0 to 1, or from 0% to 100%) of aggregation of its members calculated based on the totality of direct contacts that each member has activated or received from others (Scott, 2000; Wasserman & Faust, 1994).

4.4.2 Group Centralization

Group Centralization (ranging from 0 to 1, or from 0% to 100%) represents "the dependence of a network on its 'most important' actors" (Mazzoni & Gaffuri, 2009, p. 122). According to Wasserman and Faust (1994) it measures the centrality of a variable or heterogeneity of the actor. It can also be viewed as a measure of inequality between the individual actor values, as it (roughly) indicates the variability, dispersion, or spread. Regarding Degree and Betweenness Centralization indices, the first simply indicates the extent to which single individuals are different from each other in terms of the quantity of links activated (Out-Degree Centralization index) and received (In-Degree Centralization index). The second determines the centralization of the communicative structure based on the individual participants' mediating potential, since it measures the degree to which the group depends on the participants who act as mediators of interaction (Freeman, 1979; Mazzoni & Gaffuri, 2009; Wasserman & Faust, 1994).

4.4.3 Cliques Participation Index (CPI)

This index measures the mean involvement of group members in its cliques. The higher its value, the more opportunities its members have to participate in different discussions (Gaggioli et al., 2013; Mazzoni, 2014). Cliques are defined as sub-graphs composed of at least three adjacent completely connected nodes, i.e., each clique

node is connected to all other nodes of the same clique (Wasserman & Faust, 1994). Within any network, community, or group, although an individual may interact with a number of other participants, he or she will preferentially interact with some individuals rather than others. The clique index (the number of cliques characterizing a group) can therefore indicate the preferential interaction zones within which it is more likely that individuals will interact at a certain time (Gaggioli et al., 2013). As a study by Aviv, Erlich, Ravid, and Geva (2003) showed, the availability of a larger number of cliques may provide group's participants with more opportunities to access different and varied opinions about the subjects discussed. The negotiation process that follows this step could in turn enrich the number of arguments, eventually enhancing group's productivity both quantitatively and qualitatively. However, an issue with the clique index is that it is affected by the number of participants in the group and also by the number of participants in the cliques. To address this issue Mazzoni (2014) introduced the Cliques Participation Index (CPI), which is calculated by adding the participants who make up the various cliques in a certain network, community, or group, and then dividing this number by the total number of members of the main structure. This calculation considers the main group dimensions and the participation of group participants in cliques. Defined in this way, the CPI can also be regarded as a structural indicator of the social presence that characterizes a group. In fact, the CPI is an indicator of the extent to which a group enables its member to be involved in different cliques and benefit from the diverse discussions going on within the group. The higher the CPI, the more group members participate in cliques, increasing the group's internal cohesion, which is a key dimension of social presence, as identified in previous related research (Garrison & Vaughan, 2008; Swan & Shih, 2005; Shea, Hayes, Vickers, Uzuner, Gozza-Cohen, Mehta, & Valtcheva, 2010).

4.4.4 The SNA Procedure: Examples of Analysis

The first step of the SNA procedure consists in collecting relational data to generate sociograms and to calculate structural indexes, such the ones previously described. Data collection can be based on observations (e.g. the quantity of exchanges occurring in a group), trackable communications (i.e. sms or emails) or questionnaires/interviews. In the following example, we list three questions requiring each group member to indicate who are the participants that they perceive «closer» to themselves in terms of shared ideas, values and objectives.

a) Which member of the team do you think most shares your vision?
b) Which member of the team do you think most matches your objectives?
c) Which member of the team do you think is most supportive to your goals?
d) (...)

These type of questions can also be repeated over time to obtain a set of longitudinal data, which allows investigating different aspects of creative collaboration dynamics. Once participants' data are collected, it is possible to generate an *adjacency matrix*, in which each row represents a respondent and each column represents the members of the group who have been selected by the respondent.

	A	B	C	D	E	F	G	H	I	J	K
A						1,0		1,0			1,0
B											1,0
C								1,0			1,0
D								1,0			1,0
E											
F	1,0										1,0
G										1,0	1,0
H	1,0	1,0	1,0	1,0	1,0	1,0	1,0			1,0	1,0
I											1,0
J											
K	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0		

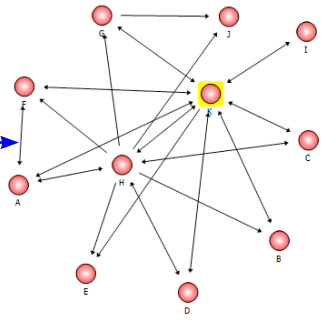

Figure 4.7: An example of adjacency matrix, which provides the possible choices of respondents to the question: *«Which member of the team do you think most shares your vision?»*. It is interesting to note a remarkable centralization of the two most internal members, who probably are the carrier of a vision which is shared by most of the members of this group.

SNA data can also be collected from the observation of the participants' behaviors, e.g. by videotaping their interactions. Clearly, this procedure is facilitated by online collaboration contexts, thanks to the possibility of tracking and analyzing the exchanges of information and contents between participants (i.e. e-mail, web forum, social networking sites). To exemplify this method, we describe two studies in which we used SNA to analyze the Networked Flow process in online collaborative groups.

The first study (for more details see Mazzoni, 2014), involved 26 small groups of adults with a university degree in Education who followed a training course to become designers of online courses. Participants were tasked with designing an innovative online training course. To this end they collaborated using the web platform *Synergeia* (http://bscl.fit.fraunhofer.de/). Two experienced team trainers evaluated the teams' projects along the dimensions of quality and originality. Groups' interaction logs in Synergeia web forum were collected to generate the adjacency matrix of each group. Next we calculated the Cliques Participation Index (CPI) for each team. Results showed that projects created by groups with higher mean involvement in cliques (high CPI) obtained significantly higher evaluations on the originality dimension compared to the groups with low CPI. This result might suggest that participation in cliques allows group members to access different views and opinions, supporting divergent thinking and variety of ideas. Since (as previously mentioned) in our terms

CPI can also be regarded as a structural indicator of the social presence that characterizes a group, these findings could also support a possible role of social presence in promoting group creativity.

In a further study (Gaggioli et al., in press) we investigated the relationship among the indices of social network structure, flow, and creative performance in students collaborating in a blended setting. Thirty undergraduate students enrolled in a Media Psychology course were assigned to five groups tasked with designing a new technology-based psychological application. Team members collaborated over a twelve-week period using two main modalities: face-to-face meeting sessions in the classroom (once a week) and virtual meetings using a groupware tool. Social network indicators of group interaction and presence indices were extracted from communication logs, whereas flow and product creativity were assessed through survey measures. The findings showed that the social network indices of density and degree of centralization (which, in our terms, are two key indicators of collaborative zone of proximal development) were positively correlated with several flow dimensions, supporting the hypothesis that the establishment of a "zone of joint action" can be associated with group flow (Armstrong, 2008; Gaggioli et al., 2013). Furthermore, it was found that the projects of the groups characterized by higher values on density and lower values on centralization received higher scores on several dimensions of creativity.

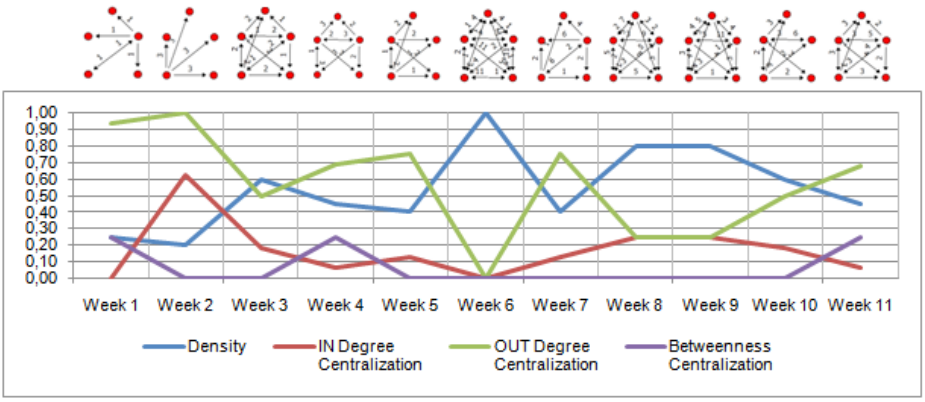

Figure 4.8: Density and Centralization indices of a group over 11 weeks of collaboration (adapted from Gaggioli et al., in press)

In sum, the findings of these preliminary studies suggest that the combination of qualitative evaluation of participants' experience and SNA is a potentially useful approach for investigating Networked Flow and the evolution of creative collaborations over time. SNA provides a mixed-method approach, which can mitigate the disadvantages of using a single method (quantitative/deductive or qualitative/inductive) by combining the advantages of both approaches. In fact, although SNA is primarily

considered a quantitative technique, it also allows for an in-depth examination of ties and the content that is communicated between actors (Jack, 2005).

4.5 Conclusions

In this chapter, we have described a model of collective creativity aimed at analyzing how a creative network is born and develops. Central to this model is the definition of a shared intersubjective space, which we identify with (highest level of) social presence. When shared social presence is achieved, participants can experience networked flow, an optimal state that maximizes the creative potential of the group. Following Glăveanu's distinction between sociocognitive and sociocultural paradigms of collective creativity, we contend that our model is closer to the sociocultural perspective, since (i) it places at the center of the analysis the creative collaboration process and the intersubjective dynamics which characterize it; (ii) it emphasizes the role of interaction between participants and symbolic/physical artifacts involved in the collaboration process; (iii) it aims at casting light on the evolution of the creative collaboration process, by taking into account both the micro and macro-genetic levels; (iv) it looks at how collaboration is embedded within wider social and cultural networks. On the other hand, the Networked Flow model does not propose a rigid dichotomy between creativity «embedded in interaction» (as in the sociocultural view) and creativity «embedded in the mind» (as in the sociocognitive view). Rather, we argue for an approach where cognitive and intersubjective dimensions of collective creativity are taken equally into account. Furthermore, at the methodological level, the Networked Flow model supports both qualitative and quantitative procedures, and introduces social network analysis as a possible *trade union* between them. A future goal is to empirically evaluate the validity of the theoretical phases of Networked Flow, as well as to improve our understanding of the neuropsychological underpinnings of shared social presence.

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