

Collaborative Research, Knowledge and Emergence

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Published online: 5 September 2007
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Abstract We use the notion of emergence to consider the sorts of knowledge that can be produced in a collaborative research project. The notion invites us to see collaborative work as a developmental dynamic system in which various changes constantly occur. Among these we examine two sorts of knowledge that can be produced: scientific knowledge, and collaborative knowledge. We argue that collaborative knowledge can enable researchers to reflectively monitor their collaborative project, so as to encourage its most productive changes. On the basis of examples taken from this special issue, we highlight four modes of producing collaborative knowledge and discuss the possible uses of such knowledge.

Keywords Collaboration · Emergence · Knowledge production · Reflexivity

Socio-cultural psychology as a paradigm examines systemic, interactive, and mediated phenomena. Within this frame, all the papers gathered in this special issue examine how new forms of knowledge can emerge when people work together. In this final discussion, we draw on developmental systems theories of emergence and socio-cultural psychology to examine what is emerging in collaborative research, and how it emerges. We argue that two sorts of knowledge can emerge

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through collaborative work: the *scientific knowledge* for which the collaboration has been set up; and *collaborative knowledge*, a reflective knowledge about collaboration, acquired through experiences of collaborative research.

The Notion of Emergence

The notion of emergence in the social sciences usually designates the fact that something qualitatively new grows out of something existing, and is elaborated in *systemic* approaches to theorising change (Boulding 1956). Systems theory and developmental system theory attempt to understand how change can be produced within a complex dynamic system made out of elements which have their own dynamics. In such a system, causality is not linear. Any change in the parts of the system affects the whole and its parts; consequently, change is due to the specific configuration of the system rather than single factors, and is largely unpredictable. Emergence, here, is the appearance of a new form or entity due to the organisation of the whole.

Emergence is the idea that a whole can have properties (or powers) that are not possessed by its parts—or, to put it more rigorously, properties that would not be possessed by its parts if they were not organised as a group into the form of this particular kind of whole (Elder-Vass 2007, p. 28).

Complex systems are dynamic systems. To analyse them into isolated bits is to lose their dynamic quality. For example, the whirlpool of water formed by pulling the plug from a sink of water cannot be explained by any number of molecules analysed in isolation. The whirlpool emerges from the dynamics of the molecules interacting. Mathematicians of such complex and dynamic systems speak of ‘attractors’. An attractor is a stable state for a complex system which is usually impervious to minor disruptions. One can thus try to disrupt the whirlpool, but it is likely to return to a similar state. However, whirlpools have two basic attractors, namely, spinning clockwise and spinning anticlockwise, and with the right intervention it is possible to ‘knock’ the system from one relatively stable direction of spin, to the reverse relatively stable direction of spin.

Classical fields where the notion of emergence is used are physics, biology and philosophy (Kim 2006). In psychology, emergent properties have been examined by developmental psychologists: new stages of thinking through individual reconstruction of one’s thinking (Piaget 1936/1953), or allomorphic development, that is, qualitatively new forms of behaviour resulting from the joint internalised reconstruction of cultural tools and meanings (Ivić 1994; Vygotsky 1934). Recently the notion has more generally become an object of discussion in certain streams of social sciences (Cilliers 1998; Elder-Vass 2007; Epstein and Axtell 1996; Fogel 2006; Nelson 2007; Valsiner 2000). In most cases, the emergent property is at a higher level of organization in a given system, that is, in a different state of matter (e.g., social structures emerge from practices; properties of the mind emerge from biological properties of the brain).

We use the notion of emergence as a heuristic tool to identify the processes whereby new forms of knowledge are produced in a collaborative research project

that can be seen as system. For this, we have asked the authors in this special issue to examine the processes through which new knowledge emerges in their practices as collaborative researchers. We believe that this process has itself led to the emergence of new knowledge about the potential and pitfalls of collaboration.

Collaborative Research as a Developmental System

What does it mean to see collaborative research as a developmental system? It leads us to identify its components, their relationships, the changes that can occur, and conditions that may inhibit such change.

Collaborative Research as a System in Development

A collaborative research project in the social sciences can be seen as a system composed of researchers; interactions between them (face-to-face, mediated through the internet, etc.); all the objects that mediate them (papers, computers, data, existing knowledge); the participants, if any; each of the actors' perspectives; and goals. It is also shaped by the symbolic and material powers of the institutional environment of research, which assigns roles and hierarchies to researchers, allocates access to means, and can control goals or available time.

As the *raison d'être* of a research team is research, the overt goal is in principle the production of new scientific knowledge.¹ Scientific knowledge is a specific form of semiotic discourse, obeying the rules of a culturally regulated domain of science, which has to be communicable, and validated by an appropriate and legitimising community:

Knowledge is not something which exists and grows in the abstract. It is a function of human organisms and of social organisation. Knowledge, that is to say, is always what somebody knows: the most perfect transcript of knowledge in writing is not knowledge if nobody knows it. Knowledge however grows by the receipt of meaningful information—that is, by the intake of messages by a knower which are capable of reorganising his knowledge. We will quietly duck the question as to what reorganisation constitute “growth” of knowledge by defining “semantic” growth of knowledge as those reorganisations which can be profitably be talked about, in writing or speech, by the Right People. Science, that is to say, is what can be talked about profitably by scientists in their role as scientists. (Boulding 1956, p. 198)

Once the collaborative research is described in terms of a system, any production of knowledge implies some change within the system—some pre-existing knowledge, or some facts, have been analysed, reorganised, reflected upon, etc.

¹Of course it can be accompanied by other goals, such as to increase international cooperation; constitute a database for further studies; offer training sites for young researchers; develop marketable objects or procedures; legitimate an institution, etc.

Now when some part of a system located in time is changing, it is quite likely that other aspects of the system are also being changed: not only is new knowledge externalised, but the researcher's understandings are changed, interpersonal relationships may be modified, financial and material resources may be exhausted, etc. In other words, it also follows that no piece of research can be produced without changing the system itself.

Change in a Developmental System

What kinds of changes to the research system may come about? Stability in developmental systems is provided by 'attractors', which are relatively stable configurations of the system's elements and relationships. One possible attractor for a research project, for instance, could be a hierarchical organisation of a research team with a one-way flow of instructions. Describing developmental systems of various sizes, Fogel (2006) distinguishes three levels of change. A level 1 change is a change within an attractor that does not change the attractor itself: for example, two people greet each other every morning following the same pattern. A level 2 change is a form of innovation: an attractor is replaced by a new one; these two persons now start to go for lunch together. A level 3 change is development: it requires a real reorganisation of the system of attractors or part of the system: "development is the destabilization, re-organization and re-stabilization of the collective system of historical attractors" (Fogel 2006, p. 15).

So what sort of changes can we expect in the case of collaborative research? The authors in this special issue have answered this question by adopting a retrospective, reconstructive outlook on the research process. We can for example identify changes of all three levels in Pontecorvo's description (2007): normal activities in research collaboration routinely involve senior researchers to train young researchers (and the circulation of young researchers can be seen as level 1 change). At some point, it is required from senior researchers to learn from junior researchers who have an additional competency, which would be a level 2 change. Eventually, this process has brought the research team to the realisation of the necessary intergenerational exchange of skills and competencies, which transforms the very organisation of the collaborative team (a level 3 change).

More generally, change in collaborative research can imply the normal adjustment of regular routines and interactions (level 1). It can also imply the evolution of patterns of interactions and practices (level 2), for example when collaborators redefine their communicative style (Tartas and Muller Mirza 2007). Finally, it can imply the reorganisation of the collaborative research (level 3), such as when the research questions or the goals of the research are transformed (Marková and Plichtová 2007).

What changes can be qualified as emergent? If we accept our definition of emergence as some property which cannot be reduced to the cause of any prior elements, emergence can occur at any level of change. It might designate that one person in a research team comes to a totally new understanding (Toomela, this issue), that the team as a whole produces new software (Tartas and Muller Mirza 2007), or that the collaborative project defines a new general research question (Marková and Plichtová 2007). In the case described by Pontecorvo (2007), junior

to senior transmission of knowledge is an emergent dynamic. Additionally, the lead researcher realised the potential of this form of symmetric collaboration. It led her to change perspective and examine past dynamics, bringing about a new situation (Mead 1932). She thus developed a new understanding about the dynamics of collaboration, thanks to which she could organise further collaborative research in a more reciprocal manner. This reflective perspective is another emergent product of collaborative research.

In other words, new practices, new relationships, new goals, new perspectives and new discourses can be qualified as emergent in a collaborative research. Knowledge is only one of the many emergent properties of a changing collaborative research.

Threats to Change, Canalising Change

A systemic collaborative research project is constantly changing, but not all changes lead to the emergence of knowledge. Some changes can threaten the attempt to research together and the goal of producing new scientific knowledge. Yet against these threats, researchers can develop techniques and use resources for canalising change so as to achieve their goals.

The papers presented here reveal elements that have threatened or destroyed projects' research orientation. In Tartas and Muller Mirza (2007), the change of communicative style of one participant led the researchers to feel directly attacked; as a key relationship was undermined, the effort of working towards a joint goal was compromised. Psaltis (this issue) shows the strong constraining role of the funding agency in the Sloan project, which set the goal and the agenda of the project. This strong constraint restrains the zone of free movement of the researchers, and prevents their spending time exploring opportunities for change raised by the collaboration itself. Toomela (this issue) reminds us of the conservative effects of social influence which may emerge in a collaborative processes, rendering impossible the emergence of true novelty. Even the semantics used to describe the project can restrain its dynamics: Pontecorvo (2007) and Marková and Plichtová (2007) remind us how the words "collaborator" or "cooperation" used in research can undermine the participants' commitment to the project, and thus threaten the whole system.

More generally, given the fact that emergence is an unpredictable process, no authentic collaborative research can strictly guarantee that knowledge corresponding to the goal of the research will actually emerge. Consequently, in order to achieve scientific goals, the research collective has to monitor the changes involved, so as to canalise and orient them towards some expected but still unknown outcome ("the discovery").

Researchers can use resources to canalise change in a way that is productive for the research. One shared technique for containing the degree of change is through agreed-upon methodologies. Methodologies are explicit semiotic procedures that guide research practices and facilitate the processes of change in the direction of producing knowledge. However, there are other resources for canalising and monitoring research. Our argument is that one unexpected outcome for the research enterprise is collaborative knowledge, and that this knowledge can precisely be used for monitoring collaborative research.

Emergence of Scientific and Collaborative Knowledge

What sorts of knowledge can be produced through collaborative research? One sort of knowledge produced is obviously—and hopefully—scientific knowledge. Yet the research practices can engender other sorts of knowledge. Especially, we suggest, the emergence of unexpected events can be seen as an invitation for researchers to reconstruct the events that led to the new perspective obtained. Through this reflective stance, non negligible, yet not sufficiently validated knowledge is produced: knowledge about collaborative research. This knowledge, in turn, offers a reflective distance enabling us to monitor collaborative research. These two forms of knowledge are not “naturally” occurring in self-organising systems; they are the result of active, agentic and reflective human perspectives.

Scientific Knowledge

As indicated, a given research collaboration has among its goals the production of scientific, valid knowledge. Scientific knowledge can be thematic, theoretical or methodological, or combine these components.

The research programs undertaken by Pontecorvo (2007) and Arcidiacono (2007) have greatly contributed to the understanding of dynamics of learning and socialisation in families. Yet doing so, they have developed a methodological knowledge regarding the collection and analysis of real-life data. The research led by Marková and Plichtová (2007) has contributed to a more theoretical knowledge about the articulation between cultural–historical constraints and people’s representations.

Theoretical, thematic and methodological observations and understandings are produced by a collaborative team, but soon come to circulate and become shared with further researchers, funding agencies or end-users. They thus enter into the dialogical exchanges taking place in a scientific community. Research practices and results are usually answers to previous questions and practices, and need to be acknowledged by further research. It is through such social practices that the outcomes of a collaborative practice can be acknowledged as valid and possibly new scientific knowledge.

Collaborative Knowledge

Through their work in a collaborative research project, researchers develop experience and informal expertise about their practices. But they may also develop a more explicit collaborative knowledge—that is, reflective knowledge about the process of collaboration itself.

While most of the reflective knowledge on collaboration has been produced by researchers from outside the discipline being analysed, such as sociologists of science analysing the practices of scientists (e.g., Latour 1987; Mondada 2000), we have been producing an internal analysis of collaboration. That is, we have proposed an analysis of the practice of sociocultural research by sociocultural researchers. In this section, we propose four way of producing such collaborative knowledge, and thus suggest possible forms of that collaborative knowledge.

Firstly, we can use existing notions and concepts from sociocultural psychology to reflect upon collaborative research practices. For example, sociocultural psychology has highlighted the potentially constructive role of divergence and conflict in collaboration (Engeström 2005; Perret-Clermont 1979/2000). In collaborative research, conflicts can be, in some cases, the points from which knowledge will emerge (e.g. conflicts in Tartas and Muller Mirza 2007; misunderstanding in Baucal 2007; language issues in Marková and Plichtová 2007). Reflecting on the resolution of these conflicts contributes to collaborative knowledge. Baucal (2007), who retrospectively sees incidents in Tartas and Muller Mirza (2007) as occasions for change, considers a misunderstanding about the term ‘deliverable’ as a pseudo-concept: although people do not share a representation of its meaning, they engage in productive practices. The question raised is then: How can this potential for change be preserved? For instance, a guarantee of enough space and time for exploration seems to be important. In the Sloan project presented by Pontecorvo (2007) and Arcidiacono (2007), the guidelines produced by the teams—which create some boundaries to each team’s work—can be seen as a direct actualisation of the researchers’ experience of the importance of preserving such zones of free movements in research teams.

Secondly, we can collaboratively reflect on our practices as sociocultural psychologists. This was the main object of our exploratory workshop and this special issue. Through reflective collaboration, some collaborative knowledge has emerged. We have identified some of the main dimensions along which collaborative research could vary (Cornish et al. 2007; Gillespie et al. 2006). We have seen that researcher could share basic assumptions (as in the Sloan project, Arcidiacono 2007), or work with very different basic assumptions (as in the DUNES project, Tartas and Muller 2007). There can be a strong division of labour, as in the DUNES project, or a strong overlap of tasks, as described by Pontecorvo (2007). In some projects, there is strong familiarity between collaborators, in others not (for example in international collaboration). Collaborative research can be managed through centralised or distributed control. And finally, participants can share goals, or have divergent goals to be accommodated.

These dimensions offer us a vocabulary to describe and comprehend collaborative research. They are descriptive rather than prescriptive. They enable a systemic understanding of research collaboration. There is no “right” location on one dimension; rather, it appears that for a collaborative research to be generative, each location on these dimensions requires adjustments on other dimensions. For example, if we follow the “Similar basic assumptions vs. different basic assumptions” dimension, we can see that collaborating with a colleague who shares one’s theoretical and methodological presuppositions is a very different experience from collaborating with somebody with contrasting assumptions (such as interdisciplinary collaboration). Where the parties share assumptions, their work together is likely to be made easy by much implicit self-regulation in line with those assumptions. Where the parties have very different assumptions, they may need to work harder on making their assumptions and expectations explicit so that each understands why the other contributes as they do. In this case, the collaboration may need additional time and flexibility to develop a shared basis for working together, in

order to be able to learn from each others' different perspectives. Collaborative knowledge might thus take the form of identifying configurations along these dimensions that help the emergence of new knowledge.

Thirdly, collaborative knowledge can be used to design research so as to stimulate further collaborative knowledge. For example, we can use the potential generativity of divergence, as well as our knowledge of the dimensions identified above, to choose collaborators who differ on the dimensions that we might want to reflect upon. Thus, if one chooses to collaborate across disciplines, reflection upon one's research assumptions is likely to be stimulated. Or if one chooses to collaborate with educationalists or health workers, then one will be forced to question the practical contributions of one's paradigm (Gillespie et al. 2006).

Fourthly, collaborative knowledge developed from a sociocultural perspective can be enriched with the expertise of specialists in management, organisational behavior, or collaborative work. This would highlight other important aspects of the research system, such as people's interpersonal skills enabling them to maintain relationships despite misunderstandings (as in Tartas and Muller Mirza 2007); the structure of the team (Pontecorvo 2007); the planning and coordination of the work (as in Arcidiacono 2007); negotiation skills with fund raisers and with participants (in Arcidiacono 2007; Tartas and Muller Mirza 2007).

Uses of Collaborative Knowledge

In collaborative research as in many other developmental areas, change and development can take many directions and are partly unpredictable (Vygotsky 1934). Yet they can be described, and reflected upon. Collaborative knowledge enables a reflective distance on the daily routines of research, on the distances between practices and goals, or on the interactions between researchers. It helps researchers to guide collaborative research activities, monitor their overall direction, while maintaining a free enough space for genuine exploration of changes which might lead to new understandings. Yet applied in a too strongly constraining or prescriptive manner, such collaborative knowledge might destroy the possible emergence of new changes.

Seen in all its dynamics, a research project oriented towards the goal of producing knowledge is in constant evolution. Reflecting about collaborative research, about our advances and failures, social science researchers can participate in the creation of an emerging, shared knowledge about the conditions of creating new knowledge. Knowledge about collaborative research is not disconnected from the actual knowledge developed about the objects of the social sciences (Marková and Plichtová 2007). It is even deeply constitutive of the sort of scientific knowledge we produce, its potential, its flexibility, its quality, and its ability to develop new and more complex perspectives on the world.

Our modest attempt here is thus part of this more general reflective attitude which might help us to become better practitioners of the art of research. Expertise in collaborative research might be, like in many other fields, an ability to identify tensions and conflict in the research procedure, to identify dimensions along which

some reorientation could be done, and to evaluate the risks of different routes and the margin of freedom they require. This might enable us to turn practical challenges in the research process into occasions for knowledge to emerge.

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