Activités

17-2 | 2020

Le programme de recherche cours d'action

Distributed cognition and “Course of action”

Cognition distribuée et Cours d'action

Jacques Theureau

Electronic version

URL: <https://journals.openedition.org/activites/5368>

DOI: 10.4000/activites.5368

ISSN: 1765-2723

Publisher

ARPACT - Association Recherches et Pratiques sur les ACTivités

Electronic reference

Jacques Theureau, “Distributed cognition and “Course of action””, *Activités* [Online], 17-2 | 2020, Online since 15 October 2020, connection on 25 August 2021. URL: <http://journals.openedition.org/activites/5368> ; DOI: <https://doi.org/10.4000/activites.5368>

This text was automatically generated on 25 August 2021.

Activités est mis à disposition selon les termes de la licence Creative Commons Attribution - Pas d'Utilisation Commerciale - Pas de Modification 4.0 International.

Distributed cognition and “Course of action”

Cognition distribuée et Cours d'action

Jacques Theureau

I would like to thank Edwin Hutchins for giving me the opportunity to begin this reflection and for encouraging it. Thanks also to Guillaume Azéma, Gilles Dieumegard, Nicolas Donin, Jérôme Guérin, Serge Leblanc, Germain Poizat, Pascal Salembier and Jacques Saury, who have broadened my knowledge of Edwin Hutchins' publications and, even more importantly, of their international reception, and to all those who in January 2019 discussed an initial and incomplete version of this article. Especial thanks to Guillaume Azéma who provided me with a detailed critical re-reading and Germain Poizat who did exactly the same thing for the second and third full versions, and to all of the final proofreaders of this article.

Introduction

- 1 On the occasion of a lecture I gave on his “legacy” (imposed title!) (Theureau, 2018), Edwin Hutchins wrote to me: “From time to time I felt that I should pull together the ideas I have had over the past 15 years into a coherent statement of the new distributed cognition” (personal correspondence). Indeed, since his book *Cognition in the Wild* (Hutchins, 1995), which led to his “distributed cognition” hypothesis becoming widely known, he and his colleagues had been carrying out a range of research projects that, approximately twelve years ago, caused a major shift in theoretical and methodological perspective. In (Hutchins, 2006), Edwin Hutchins revisited this work and wrote the following: “In the years since its publication, *Cognition in the Wild* has been criticized for saying so little about the people in the navigation setting. It describes the tools of the trade, and the historical development of the tools. It describes social processes and the cognitive properties of those social processes, but it says almost nothing about the embodied practices of the navigators as flesh-and-blood people. For the most part, the cognitive processes described in *Cognition in the Wild*, and in other treatments of distributed cognition, are presented without reference to the role of the body in

thinking. In spite of the fact that distributed cognition claims that the interaction of people with things is a central phenomenon of cognition, the approach has remained oddly disembodied.” From there, it was only a short step for Edwin Hutchins to see a family resemblance between his own research, the “enaction perspective”, and the various works of research on “embodied cognition” that had begun to flourish at that time (Hutchins, 2010a, 2010b).

- 2 Without waiting for the “new distributed cognition” that Edwin Hutchins promised, and without prejudging its content, in this paper I will draw on more than 30 years of periodic discussions with Edwin Hutchins, mutual advice on interpretation from other authors¹ and my own reading of his individual and collective publications and of those of some of his collaborators, to present the essential elements of what might be, in my opinion, a research program that benefits from the progress made over all these years from my point of view by two research programs, partly similar, partly complementary and partly alternative to one another: the “distributed cognition” and “course of action”² programs. Such a research program might be called an “augmented “course of action” research program” or, in a more precise but still very succinct manner, a “research program on human activity as enaction and cultural dynamics”. We will see that, while the gains in terms of heuristic resources (tools and methods of data construction and analysis) from such an “increase” in the ‘course of action’ research program will be secondary, those relating to theoretical resources (hypotheses, objects and theoretical notions) and to the coherency between these theoretical resources will be significant and might open up new empirical and technological research, new connections between one another and new dialogues with other research programs.
- 3 Moreover, as in this respect I will need to retrace the parallel dynamics of the two research programs (“distributed cognition” and “course of action”) from 1987 to the present day, a collateral objective of this article will be to make this real-life case of the relationships between two research programs partly similar, partly complementary and partly alternative, a test bed for a general epistemological reflection on what the relationship between two such research programs should ideally be.
- 4 While I may recall in passing the hypotheses, notions and methods of the empirical ‘course of action’ research program, along with elements of its epistemology and ethics, I will assume that readers are familiar with the essentials, including the notions of the epistemology of research programs that the ‘course of action’ program integrated from the start, at least through the other papers in this collection, in particular the one by Germain Poizat and Julia San Martin, and I will not explain them. The reader who discovers this research program or some of its parts and wishes to deepen his/her reading of this article may therefore have to consult certain previously published books, book chapters and articles. When I refer to publications of specific research carried out within the framework of the “course of action” research program, I will not aim to be exhaustive, whereas concerning publications of specific research carried out within the framework of the “distributed cognition” research program, I will aim to do so, although I cannot promise to succeed. While Edwin Hutchins does not mention any technological research program in “distributed cognition”, though from the very outset L. Pinsky and I (Pinsky, & Theureau, 1987) saw the “course of action” research program as articulating two strands, one empirical, the other technological, he and his colleagues have devoted a whole section of their publications to the technological consequences of the distributed cognition hypothesis. So I will not hesitate to

formulate the overspill of the technological aspects of these two research programs in terms of a technological research program³.

- 5 I will follow this plan: in sections 1 and 2, I will successively follow the respective developments of the “distributed cognition” and “course of action” programs between 1987 and today, emphasizing the relations between them so as to introduce the question that now arises of an “augmented course of action research program”, thanks to the in-depth study and systematization of past contributions and the introduction of new contributions from the “distributed cognition” research program; in sections 3 to 6, I will present the small number of components of this “augmented course of action research program” which come from a possibly unequal pooling of the contributions made by the two research programs; finally, in section 7, I will consider two components of this “augmented course of action research program” which concern its relations with other research programs⁴ and which are inspired by the “distributed cognition” research program alone. So in total, the components of this “augmented course of action research program” which I will specify will be as follows: the empirical data and engineering of observation, recording, transcription and statistical calculation tools (section 3); the systematic study of the relationships between individual and collective activities giving and not giving rise to experience for the actors (section 4); situation engineering and cognitive tool engineering (section 5); the analysis of scientific and technological research activities, artistic creation activities and, more generally, creative activities (section 6); the articulation with research on animal activity as an enaction and cultural dynamic and the pursuance of the debate with the neurosciences (section 7).

1. A short history of distributed cognition

- 6 Let us first recall the notions of paradigm and research program. A proposition can constitute a paradigm under two conditions: (1) it must be non-trivial and provide solutions to important problems that previous science was unable to solve; (2) it must be sufficiently open to leave a large number of questions for specialists to address (Thomas Kuhn). We might say that in a given scientific, technological and philosophical context, a paradigm is a particularly productive idea. According to Imre Lakatos⁵ definition, a research program articulates: (1) theoretical means, possibly including a paradigm; (2) heuristic resources founded both theoretically and epistemologically; (3) the challenging of these theoretical and heuristic resources at any given time through empirical facts and other research programs; (4) the evaluation at any moment of the heuristic power and capacity for growth of these theoretical and heuristic resources.

1.1. The paradigm and the “distributed cognition” research program

- 7 Edwin Hutchins' suggestion that cognition is distributed among actors and material supports that together constitute a “distributed cognition system” (or “cognitive ecology unit”) is clearly a paradigm. At least since 1987 (when I became aware of it), the “distributed cognition” research program has articulated: (1) this paradigm along with other theoretical resources, in particular the “information flow model” which has undergone several successive formulations; (2) the “cognitive ethnography” method

and the renewal by digital technologies of the tools for observing and recording behavior and the environment; (3) the reference to the mathematics of dynamical systems defined by their initial state as potential tools for synthetic modelling; (4) submission to the empirical debate on detailed descriptions of distributed cognitive processes based on explicit data; (5) the evaluation of the heuristic power and growth capacity of the theoretical and heuristic resources specified above, from both the empirical standpoint (scientific knowledge of human and animal cognition) and the technological standpoint (the design of cognitive tools and, in a less developed manner, of the training of actors in systems of distributed cognition).

1.2. The development stages of the “distributed cognition” research program

- 8 This “distributed cognition” research program appears to have developed in three main stages: **Stage 1**: development of the cognitive ethnography method in the Trobriand Islands (New Guinea); **Stage 2**: the research series based on the book “*Cognition in the Wild*”; **Stage 3**: the development of research in terms of embodied cognition and “marriage” (i.e. an official, possibly fruitful and long-term, alliance between “protagonists”, partly similar but also partly unfamiliar!) between the paradigms of distributed cognition and enaction.
- 9 **Stage 1** led to the publication of a book (Hutchins, 1980) on the negotiations surrounding land exchanges in the Trobriand Islands and a book chapter (Hutchins, 1983) on navigation in the same islands, later taken up in “*Cognition in the Wild*”. The former aims “to document the kind of natural activities in which the natives demonstrate their inferential abilities (...). This whole effort was based on the conviction that a careful analysis of the skilled behavior in the real world can bring scientific data on the cognitive processes involved in the production of this behavior” (Hutchins, 1980, p. VII). Although when I read it (in 1987) it was this methodological aspect and the implementation of George Polya's “logic of the plausible” in the modelling that interested me, today it is the way in which this analysis shows the descriptive and explanatory limits of gift theory, which is supposed to account for the economic system of these lands, and therefore also the need to relay this gift theory by analyzing the activities involved, which seem to me to be just as interesting (see Theureau, 2019). But what characterizes **Stage 1** from the standpoint of the construction of the “distributed cognition” research program is first and foremost the development of the “**cognitive ethnography method**”. As defined by Edwin Hutchins, this is made up of the following elements: ethnographic field analysis focusing on the cultural dynamic and augmented by the researcher's cultural training in the relevant line of work; a selection of activity episodes; a detailed description of the distributed cognitive processes in these activity episodes in terms of “information flow models”, hence in scientifically defined terms, in order to account for cultural dynamics. We must not forget that classical ethnographic analysis (since Bronisław Malinowski) has on the contrary been based on a static conception of culture.
- 10 **Stage 2** led to the publication of “*Cognition in the Wild*” (Hutchins, 1995), to the leading empirical research works (simulators for navigation training, warships, aircraft cockpits, air traffic control, driving, etc.) organically related to engineering in these fields, to speculative research on language development (lexicon and grammar) (see

sections 4 and 5) and to an initial series of empirical studies of animal cognition emphasizing its collective and environmentally situated character (see section 7). What characterizes **Stage 2** is the proposition and implementation of both the **notion of the “distributed cognition system” (or “cognitive ecology unit”)**, which links cognition, community and environment, and of the **analytical notion of the “information flow model”**.

- 11 **Stage 3**, which began around 2005 and which has not yet been completed, saw the development of the “distributed cognition” research program in terms of “embodied cognition” and the “marriage”, which has not yet borne all its fruits, between the paradigms of distributed cognition and enaction. What these paradigms of distributed cognition and enaction had in common, as did, therefore, the “distributed cognition” and “course of action” research programs, was already in place beforehand: the environment as internal to cognition; cognition as collective; the absence of the “self” of any actor that might be constituted outside the immediate environment of said actor, including the other actors at that moment in time. What was explicitly missing from enaction as a paradigm but not from the “course of action” and “distributed cognition” research programs was: the consideration of technology and culture as being dynamic; in the environment internal to cognition, the emphasis on the technical environment; the establishment of an organic relationship (to varying degrees) between empirical research and technological research. The introduction of the notion of embodied cognition and the “marriage” between the two paradigms of distributed cognition and enaction led to Edwin Hutchins' clarification of the notion of “cultural practice” and opened up empirical research on embodied and distributed cognition and a new series of empirical research on animal cognition, focusing not only on its collective and environmentally situated nature, as in **Stage 2**, but also on its embodied nature (see section 7). The active participation of the “distributed cognition” research program in scientific debates (as part of the heuristic power of this research program) shifted from the debate around cognitivism (also entered into by the “course of action” research program and the set of research programs using enaction as a paradigm) to the debate around the monopolistic claims of the neurosciences and, incidentally, with the so-called “extended mind” current (to which I shall return in section 7). What essentially characterizes **Stage 3** is thus the **synthetic notion of “cultural practice”**, which links body and culture. Indeed, according to (Hutchins, 2008a) a “cultural practice” is “a practice [that] exists in a cognitive ecology such that it is constrained by or coordinated with the practices of other persons. (...) Particular practices include particular ways of seeing (or hearing, or feeling or smelling) the world (...). To this definition, and without betraying Edwin Hutchins, one might add the particular ways of moving around, sitting down, talking to others, etc., which are not necessarily the same as those of other people. Such a “cultural practice” does not necessarily include symbolic communication and does not necessarily give rise to a form of consciousness among the actors concerned.”
- 12 Throughout all this development, there has been a broad acceptance in the international literature of the “distributed cognition” paradigm, albeit with navigation and the cockpit reduced to illustrations of the latter, and without acceptance (or with reduced acceptance) of the various other components of the “distributed cognition” research program and of the cognitive ethnography method⁶ in particular. As we will now see, and as I perceive it today, the ‘course of action’ research program’s acceptance of the work by Edwin Hutchins and his collaborators has been gradual, examining the

different kinds of situation studied for themselves and considering in a sometimes critical manner every aspect of the ‘distributed cognition’ research program, and not just its paradigm.

2. And meanwhile, the ‘course of action’ research program...

- 13 Concerning the “course of action” research program, I wish to emphasize three points: (1) the relationships it has maintained with the “distributed cognition” research program, essentially between 1987 and 1996, and occasionally thereafter; (2) the main inflections⁷ – independent of these relationships – that it underwent between 1987 and the present day; (3) the levels of analysis of human activities that are common to the two research programs and those which are not (emphasizing the methodological consequences of the latter). I will conclude this section by discussing the way in which the question of an “augmented “course of action” research program” and its response are presented today.

2.1. The contributions that the ‘distributed cognition’ research program has made to the ‘course of action’ research program since its initial formulation (1987)

- 14 More than 30 years ago, in 1987, at that first meeting with Edwin Hutchins in San Diego, Leonardo Pinsky and I, in (Pinsky, & Theureau, 1987)⁸, had in fact just observed same family resemblance between the “enaction perspective” and our own previous research as Edwin Hutchins had more recently seen between this “enaction perspective” and his research. The discussions that took place between 1986 and 1990 in San Diego between Leonardo Pinsky and myself and Donald Norman, Edwin Hutchins, Aaron Cicourel and Michael Cole, in New York with Sylvia Scribner and in Palo Alto with Jon Barwise, John Perry, Jean Lave and Lucy Suchman, led us to abandon the reference to the French academic psychology of that time in favor of the reference to cognitive anthropology, i.e. to the development of cultural anthropology oriented towards the theme of cognition – more precisely the study of culturally and situationally specific cognitive activities, of the need for modelling and articulation with engineering, and thus to leave behind the unproductive passionate reactions that our work provoked, in favor of stimulating debates that led to institutional complications.
- 15 On the other hand, the integration, through transformation, of the entire method of cognitive ethnography took longer. Although Leonardo Pinsky and I immediately integrated the selective focus on episodes of activity – but activity conceived of as individual-collective and collective-individual rather than just collective, as in Edwin Hutchins – and the analysis of these episodes in scientifically defined terms – but not in terms of “information flows”, as with Hutchins – that we were already using, as well as the dynamic definition of culture that was part of this cognitive ethnography, it was only in my lectures at the Université de Technologie de Compiègne in 1997⁹, and then in (Theureau, 2006), that I proposed to give full place to classical ethnographic analysis, updated by emphasizing cultural dynamics. Given the efficiency of our data construction methods (which, enriched and rethought, participated in what I later

called “the observatory of the ‘course of action’ research program”), we initially and very pragmatically thought that a rapid economic, social, cultural and political survey, combined with the construction, with the actors, of concrete methods of data collection and analysis to be implemented with their collaboration, would suffice to obtain significant empirical and technological results¹⁰. However, it should be noted that when this was done, the integration of the cognitive ethnography method into the “course of action” research program was accompanied by an initial enhancement: instead of isolated selective focalizations subjected to local analyses, in relation to the value of this research program for the different temporal horizons of human activities, it was a case of linking these local analyses of selective focalizations in “histories”, via various synthetic notions. Finally, it should be noted that, overall, this integration of the cognitive ethnography method did not systematically translate into the specific research carried out afterwards: as far as I am aware, the only study to systematically use the classical tools developed by Bronisław Malinowski (field notes and journal) over a significant period of time in the field and to have exploited the data thus collected is that of (Dufresne, 2001) on rail traffic control in Canada¹¹, which has only resulted in practical ergonomic publications; in the other specific works of research, for example those on musical composition activities that I carried out in collaboration with Nicolas Donin, the researchers essentially paid increased attention to the prior cultural appropriation of the musical milieu under consideration.

- 16 Finally, if, as I wrote above, the “course of action” research program did not give a monopoly to the analysis of collective activity, the definition that was given of the theoretical objects of the study of collective activity was largely inspired by the hypothesis of distributed cognition. While we have talked about the “collective articulation of individual-social, or individual-collective courses of action¹²”, and not of “system of distributed cognition” or “unit of cognitive ecology” as Edwin Hutchins did, we have indeed specified through various formulae that this collective articulation involved “actors furnished with their interstitial environment and immersed in a broader environment”, thus attributing, following Edwin Hutchins, a fundamental role in collective activity to the combination of this interstitial environment and this broader environment.
- 17 We might add that the discussions in San Diego and Paris, during all those years, and Edwin Hutchins' criticisms of our methods of collecting verbal data from actors¹³ and of some of my provisional theoretical essays inspired by Peircean¹⁴ speculative semiotics contributed to the progress of the “course of action” research program. Most recently, while preparing for the above-mentioned conference on the “Edwin Hutchins legacy”, a closer reading of (Hutchins, & Johnson, 2010), which I will discuss further below (section 7), and of (Hutchins, 2012) led me to discover the relevance of the notion of “cultural practice” that was developed therein. We will see (section 4) that this notion of “cultural practice”, when introduced into the ‘course of action’ research program, can be augmented by notions developed independently within the framework of the latter and thus contribute to a reflection on the genesis of a “system of distributed cognition” (or “cognitive ecology unit”).

2.2. The main inflections of the development of the 'course of action' research program, independent of the contributions made by the 'distributed cognition' research program

- 18 After its initial formulation (in 1987, see above), the 'course of action' research program underwent several theoretical and methodological inflections independent of the abovementioned contributions made by the "distributed cognition" research program. The latter emerged either from difficulties encountered in specific empirical research, or from comparisons with empirical research carried out by other authors, or from problems of theoretical coherency between notions borrowed from other authors and having undergone insufficient transformation. It should nevertheless be noted that as soon as they include a development connected to cognitive ethnography or to collective activity, these independent changes in direction relate to some extent to this "distributed cognition" research program.
- 19 We can distinguish between the following independent inflections:
- **Independent inflection 1:** systematization in (Pinsky, 1992 ; Theureau, 1992 ; Theureau, & Jeffroy, 1994) of the progress made since 1987, which constituted what I later called the "elementary method" (Theureau, 2004): the limited empirical analysis of human activities when working and using products and the associated ergonomic engineering (artefacts, organization, training);
 - **Independent inflection 2:** between 1995-1996 and 2000: development of research on sporting activities and then on educational activities (trainers, trainees, collective articulation of their activities) which essentially led to: (1) a more developed exploration of collective activities, including agonistic activities, and of the construction of knowledge through human activity; (2) a more refined expression by the actors of their sensations and emotions over the course of their activity; (3) an overflow from ergonomic engineering towards the engineering of training, education and practice situations and an opening onto the engineering of situations in general.
 - **Independent inflection 3:** 1997-2006: the initial formulation, followed by the systematic construction of what I called the "developed method" (Theureau, 2006), which explicitly integrated the cognitive ethnography method and proposed a notion of hexadic signs, with six components, modeling the enaction at a given point in time, and more specifically, translating it into an organized set of six categories of documentable phenomena, which allowed a systematic analysis of the construction of knowledge in the activity and not just of its implementation;
 - **Independent inflection 4:** since 2003, the development of sports research in terms of "information courses" and of the collective articulation of "in-forma-tion courses" within the limits of available data on behaviors, physiological parameters and material processes;
 - **Independent inflection 5:** also since 2003, research on musical activities (some of which have been linked to research in cultural engineering) which has led, more generally, to research on long-term creative activities in all kinds of socio-technical fields;
 - **Independent inflection 6:** more recently, the development of the first works of research in terms of multi-level activity analyses in pair* (pair-star) relationships¹⁵;
 - **A series of independent inflections associated with the development of the notion of appropriation** that interfere with some of the previous independent inflections, which affect the three stages of a construction: (1) appropriation as a displacement of the actor-situation boundary that is at the heart of the notion of enaction; (2) the three sorts of

appropriation (in-situation, in-incorporation, in-culturation) in relation to the individual-collective activity of an actor; (3) mutual appropriation¹⁶ and its variations (institutional or conventional appropriation, appropriation-mutual action, appropriation-mutual transformation¹⁷) in relation to the collective articulation of the individual-collective activities of several actors with their interstitial environment, immersed in a broader environment.

2.3. The “course of action” and “distributed cognition” research programs: a community of levels of analysis of human activities up to the recent project of multi-level analysis of human activities

- 20 The theoretical objects (or objects of knowledge) that are usually studied as part of the “course of action” research program come from what we might call the **average levels of analysis of human activity**, if we consider: (1) that the lower levels of human activity link a description of the neuronal dynamics of an actor to elements of that actor's environment, as in the neuro-phenomenology research program initiated by F. Varela; (2) that the average levels of analysis of human activity concern the individual-collective activities of individual actors or the collective-individual activities of small groups of actors (unless we reduce sets of actors to collective actors) within narrow temporal, spatial and organizational limits (for example, until now, the maximum duration of activity that I have personally taken into consideration in research on individual-collective activity has been five years); (3) that higher levels of analysis of human activity extend to varying degrees said temporal, spatial and organizational boundaries of collectives and their interstitial environments and thus open up the study of organizational, social, historical, political and cultural dynamics.
- 21 As for the “distributed cognition” research program, while it does not talk about levels of human activity analysis, it does examine levels of study of human cognition, and the specific research carried out up to now, covers in part – since it excludes the study of individual-collective activities – the average levels of analysis of human activities that I have just described, but extends these average levels of analysis to animal activities.
- 22 However, within the framework of the “course of action” research program, the recent project to analyze human activity on several levels in pair* relationships (independent inflection 6 mentioned above) removes this research program from this community of levels of human activity analysis. In this multi-level analysis: the **relatively lower levels** are the abovementioned average levels; the **relatively higher levels** concern all activities at different temporal, spatial, organizational and cultural scales, e.g. company, region, etc. This project was presented on a speculative basis in (Theureau, 2015) and (Theureau, 2019). In part independently and in relation to possibly more specific conceptions of cultural ethnography, it has also been more or less empirically implemented in various ways by other researchers, for example in (San Martin, 2015), (Perrin, & Vanini De Carlo, 2016) and (Watteau, 2017). This project involves taking more or less standard cultural ethnography fieldwork as the basis for a phenomenology of human activity at higher levels, after having oriented it towards an understanding of cultural dynamics and having overcome the barriers between cultural ethnography, sociology, history and even political economics. This multi-level analysis of human activity in pair* relationships had not been envisaged by Edwin Hutchins, but his colleague and friend Aaron Cicourel had laid down the premises for it.

- 23 We have seen above that the integration of the cognitive ethnography method into the "course of action" research program went hand in hand with an initial transformation, that of linking together the joint analysis of several selected successive but spaced periods of activity. This multi-level analysis of human activity in pair* relationships requires a further transformation of the cognitive ethnography method which, unlike the original method and its initial transformation in the 'course of action' research program, modifies classic fieldwork-based cultural ethnography. Instead of the static cultural notions of the classic fieldwork-based cultural ethnography, we have: an empirical phenomenology based on cultural ethnography data the descriptive categories of which are what we might call the "synthetic patterns of activity" of various sets of actors¹⁸; and a pair* relationship between the latter and the empirical phenomenology of activities leading to pre-reflective consciousness (or experience) based on data on selected periods of activity, i.e. the descriptive categories of the average levels of these activities giving rise to pre-reflective consciousness (or experience).

2.4. The question posed today of the shift from a series of contributions from the "distributed cognition" research program to the "course of action" research program and on to the formulation of an augmented "course of action" program

- 24 Overall, while in my publications, as in those of Leonardo Pinsky or of other authors developing this "course of action" research program, one finds positive references to publications in terms of "distributed cognition", they are generally accompanied by criticisms and limitations – for example, regarding the hypothesis of "distributed cognition", I spoke of the "limited [critical aspect] truth [positive aspect] of methodological collectivism" (Theureau, 2006, p. 87) and of "inspiration from "socially distributed cognition" and its limitations" (ibid., p. 116).
- 25 In fact, the stumbling block between the two research programs lay just as much in the divergence between the paradigm of distributed cognition and that of enaction, as in the translation of this divergence into the data collected and the theory guiding the analysis of the latter: the "information flow model" describing the "distributed cognition system" (or "cognitive ecology unit") on the one hand and the "activity-sign theory" describing the "course of action" (or concatenation of instants of enaction leading to pre-reflective consciousness or experience) on the other. More precisely, in the "distributed cognition" research program, the organized set of descriptive categories of phenomena relates to distributed cognition phenomena as they appear to the scientific observer alone – whether or not this is the result of a more or less fruitful interaction with the actors and an appeal for their point of view, the question is set aside from the epistemological standpoint – and it boils down to the "information flow model". Justification for its implementation is based on data on actor behavior and material processes. In the "course of action" research program, the organized set of descriptive categories of phenomena is formed by the "activity-sign theory" and concerns activity phenomena as the enaction of a given actor which appear to this actor through his pre-reflective consciousness, and which the scientific observer-interlocutor can document by virtue of the different methods of accessing this pre-reflective consciousness. The justification of its implementation is based on such pre-

reflective consciousness data and on additional data both on the actors' behaviors and on the material processes at stake.

- 26 If this theoretical divergence does not prevent (and has not prevented) scientific discussion based on the data collected by either of these two research programs, it is because for both heuristic objectives (of wider submission to empirical data and debate with other research programs) and contribution to situation engineering (for example, the comparison between alternative options for the conception of situations), studies and research on courses of action and their collective articulation generally lead, in a second phase (so after the first phase has been completed) to synthetic theses such as: “in this human activity, everything happens more or less as if... under such and such conditions”. This “as if...” can be expressed in objectivist terms of the same type as those of the “information flow model” (or “as if distributed cognition consisted of shifts and transformations of the specifications of an entity called ‘information’”). While due to such common research not having been conducted it is impossible, here, to explain and compare analyses in terms of “information flow” and “activity-sign” which would have been carried out on the basis of identical or similar activities in an identical or similar situation, in section 4 I will provide an outline of what such an explanation and such a comparison might be, based on specific empirical research carried out in terms of courses-of-action.
- 27 Once the paradigm of enaction has been brought into the “distributed cognition” research program, even if Edwin Hutchins has not yet drawn all the consequences from it, and once the various areas of progress of the “course of action” and “distributed cognition” research programs (which I have summarized above) have been completed, there is now the issue of the systematic integration of new contributions from the “distributed cognition” research program into the “course of action” research program, which would make the latter, as I pointed out in the introduction, an “augmented “course of action” research program”, or, more precisely, “a program of research on human activity as cultural enaction and dynamics”, which would be “organically related to technological research program(s) and to philosophical research program(s)”.
- 28 In the following sections, I will specify certain essential components of this “augmented ‘course of action’ research program” or “research program on human activity as an enaction and cultural dynamic”. But it should once again be noted beforehand that the integration of the achievements of the “distributed cognition” research program into this research program can only be complete, in some cases, by means of an original conceptualization. This is demonstrated, for example, in recent research (Dieumegard, & Nogry, 2018) which both contributes to the “course of action” research program and which, from the perspective of designing cognitive tools for training and education, in part takes inspiration from research by (Hutchins, 2005)¹⁹.

3. The observatory and the workshop: empirical data and the engineering of observation, recording transcription and statistical calculation tools

- 29 Having declared earlier on that this augmented “course of action” research program’s gains in heuristic resources are secondary, I will start by presenting the latter. It should

however be noted that the illusion of the total independence of the methods (whether they belong to the “observatory” or to the “workshop”, to borrow the notions developed within the framework of general enactive epistemology and which obviously apply to research programs on human activities²⁰) in relation to the theories, is likely to be reinforced as soon as one relies on technical development to renew these methods. As is the case in the “distributed cognition” and “course of action” research programs, the enhancement of the latter’s observatory and workshop by those of the former must be accomplished while at the same time remaining attentive to its coherency with the theories: (1) the coherency of the resulting observatory with the theoretical objects; (2) the coherency of the resulting workshop with both the theoretical objects and the theories²¹.

- 30 Among the conditions of possibility of an “augmented course of action research program” which have already been met and which endure, there is the compatibility between the data collected within the framework of the two research programs. The tools and methods of the observatory of courses of experience, courses of action and courses of in-formation and their collective articulations developed within the framework of the “course of action” research program, and the tools and methods of data collection developed within the framework of the “distributed cognition” research program can therefore be cumulated. We can thus rework the DEW (Digital Ethnographer’s Workbench) Manifesto launched by Edwin Hutchins by broadening its content so as to take into account the pre-reflective consciousness or experience of the actors. In a plenary speech at the Cognitive Science Society (Hutchins, 2008b), Hutchins described this digital ethnography as: (1) extending the horizons of cognitive science by focusing on the phenomena likely to be the most interesting: cognitive activities in the real world; (2) understanding what these phenomena are and what we must do to improve this understanding; (3) developing theories that explain what happens in these activities between the brain, the body and the world and what allows us to predict it; (4) adapting and developing tools and methods suited to the challenges of empirically testing theoretical conjectures about cognition in the real world, this being DEW’s mission; (5) disseminating the new conception of cognitive science to cognitive ethnographers and to the wider scientific community (“and remaining patient”, he added!).
- 31 DEW combines an observatory and a workshop. Associated publications include: (Fouse, & Hollan, 2010); (Fouse, Weibel, Hutchins, & Hollan, 2011); (Weibel, Fouse, Hutchins, & Hollan, 2011); (Weibel, Fouse, Emmenegger, Friedmann, Hutchins, & Hollan, 2012). This renewal applies not only to the cockpit (see Hutchins, Weibel, Emmenegger, Fouse, & Holder, 2013) but also to animals in their environment (see, for example, research on the vocalizations of dolphins in captivity: (Johnson, 2015) and (Karnowski, Hutchins, & Johnson, 2015)).
- 32 Regarding the workshop itself, efforts by the ‘course of action’ research program have been more modest, but not non-existent. Although in terms of observation and recording, it has mainly been a case of adapting the uses of tools developed elsewhere (for example, different kinds of video cameras), we also find, for example, in the field of pre-analysis, statistical calculation and analysis: (Perrin, Theureau, Menu, & Durand, 2011) and (Goldszmidt, Donin, & Theureau, 2007). Obviously, as these data are not limited to observation and recording data on bodies and the environment, but add data on the pre-reflective consciousness (or experience) of the actors, which are foreign to

the “distributed cognition” research program, the contributions of the renewal of observation and recording tools on bodies and the environment and of transcription and statistical analysis carried out within the framework of this “distributed cognition” research program are themselves to be enhanced.

4. The opening of a systematic study of relations between individual and collective activities that lead, or not, to experience for the actors

- 33 Concerning “collective-individual activities”, as considered by the “course of action” research program, *versus* a “system of distributed cognition”, as considered by the “distributed cognition” research program, in this section I will consider three series of phenomena.
- 34 The first series is that of the phenomena relating to the de-collectivization of collective activities that the “course of action” research program has emphasized from the very start, based on the notions of individual-collective activity and collective-individual activity. The second series is that of the phenomena engendering a “distributed cognition system” (or “unit of cognitive ecology”) from the collective articulation of the individual-collective activities of the actors who ultimately form it.
- 35 These first two series of phenomena enhance the phenomena that have been considered by the “distributed cognition” research program to date. While the first phenomenon was formulated from the outset and tested in empirical research, the second had to wait, in order to be explained in a manner that remains purely speculative, as I will do below while waiting for its empirical testing: for the “distributed cognition” research program, the integration of the paradigm of enaction and the clarification of the synthetic notion of “cultural practice”: and, for the “course of action” research program, the recent formulation of the different notions of “mutual appropriation” between actors and the integration of this notion of “cultural practice”.
- 36 In relation to this first series of phenomena, I will refer to a chapter of a book (Theureau, 2000) which I will summarize in a drastic fashion. Incidentally, as I announced (in the final sub-section of section 2), this will give me the opportunity, in passing, to offer a very partial insight into what might be an explanation and comparison of the analyses in terms of “information flow model” and “activity-sign”. Regarding this second set of phenomena, I will refer to publications of empirical research by Edwin Hutchins and his collaborators and to a book of my own (Theureau, 2019), dealing with the critique of political economics from the point of view of human activity, in which I had to develop in terms of “mutual appropriation” the notions of appropriation already proposed in the past.
- 37 The third series of phenomena enhances the phenomena taken into consideration in the past in the “course of action” research program. This involves going beyond the descriptive and explanatory limits of the consideration, in the “course of action” research program, of the only human activities that give rise to pre-reflective consciousness (or experience), and that Edwin Hutchins has criticized from the outset. A similar branching-out has recently begun to take place in some sports research in terms of “in-formation courses” and “collective articulation of in-formation courses”. Regarding this third series of phenomena, which is currently the subject of many and

varied empirical research studies, I will refer to a certain number of recent publications.

- 38 The accumulation of analyses of these three series of phenomena constitutes one component of an "augmented research program" which might be formulated as the opening of a **systematic study of relations between individual-collective and collective-individual activities that lead, or not, to experience for the actors.**
- 39 I will discuss below these three series of phenomena, accumulated in this order, and will briefly conclude this section by opening up a reflection on how their findings, and more broadly the progress made within the framework of these two research programs, related to the characteristics of the situations under study that gave rise to them.

4.1. Analysis of de-collectivization phenomena

- 40 If the collectivization of human activities, as the collective articulation of human activities, should be analyzed, then its de-collectivization should also be analyzed if we wish to understand what takes place in a collective of actors. This is why, in (Theureau, 2000), I subjected the same incidental-accidental nuclear reactor driving activity data on a full-scale simulator of a provisional version of a control room, to a double analysis, in terms of "activity-sign" and in terms of "information flow models", in order to highlight the descriptive and explanatory gain of the former relative to the latter. These data were insufficient in many respects from the point of view of the "course of action" research program [video recording of the behavior of the three actors involved and standard debriefing at the end of the simulation, limited prior ethnographic study by the researchers, see (Jeffroy, Theureau, & Vermersch, 1998) for details] but sufficient from the standpoint of the "distributed cognition" research program by means of a sufficient ethnographic study.
- 41 I showed that, in the full-scale simulator of the nuclear control room during the incidental-accidental situation, the activities of the three main actors [Operator-Reactor (OPR), Operator-Water-Steam (OEV), and Supervisor (SUP)], which were supposed to be collective, were instead more like those of the characters in Alain Resnais' film, *Last Year at Marienbad*: some of these actors were from different cultures, crossing paths but rarely meeting one another even though the procedures more than provided for such encounters; and so to speak they did not see the same film, did not have or did not often take the time to come to an agreement when disagreement occurred, hence did not select the same information available during their actions, thus constructing knowledge that was far from fully shared²².

4.2. The development of notions of mutual appropriation, the integration of the notion of "cultural practice" and the phenomena engendering a "distributed cognition system" (or "cognitive ecology unit")

- 42 The integration of the enaction paradigm and the development of the synthetic notion of "cultural practice" into the "distributed cognition" research program, and their association with the notions of mutual appropriation recently introduced into the "course of action" research program, make it possible to account for the genesis of a

“system of distributed cognition” (or “cognitive ecology unit”). Thus: (a) a “system of distributed cognition” (or “unit of cognitive ecology”) constitutes both a constraint and an individual and mutual appropriation process effect that are themselves a consequence of the individual-collective activities of the actors giving rise, or not, to pre-reflective consciousness (or experience) for these actors, therefore as “cultural practices” that go beyond the limits of the theoretical ‘course of action’ object, and the description of its dynamics can only be explanatory within the limits of the realization of this individual and mutual appropriation; (b) when the result of this individual and mutual appropriation is insufficient to ensure that the interaction between the actors does not lead to misunderstandings, whether observed by them or not, it is necessary and possible to analyse the emergence of these misunderstandings and the processes of mutual appropriation that the actors may have implemented in order to overcome them.

- 43 Regarding the definition of “cultural practice”, recalled (in section 1) by (Hutchins, 2008a), I noted that such a “cultural practice” does not necessarily include symbolic communication and does not inevitably give rise to any particular form of awareness among the actors concerned. So it must of course be added here that as a consequence, it does not necessarily lead to pre-reflective consciousness (or experience), even if only partially, among these same actors. In (Theureau, 2019), as an illustration of the notion of mutual appropriation I proposed that of a pair of tango dancers, which led to a study by Serge Leblanc (personal communication). This illustration is also valid for the notion of “cultural practice”.
- 44 Without such notions (cultural practice, mutual appropriation), neither the individual-collective activity as enaction and the dynamics of the “distributed cognition system” (or “cognitive ecology unit”), nor the descriptions in terms of “information flow models” and those in terms of “activity-sign”, could be linked to one another; they could only be compared with one another, and the observed divergences could only be related to the divergence between paradigms (distributed cognition *versus* enaction) and to that between theoretical objects (“system of distributed cognition”) (or “cognitive ecology unit”) *versus* “collective articulation of individual-collective activities”) which is the consequence of the former.

4.3. Research on ‘courses of in-formation’ and their collective articulation as a way of taking both the ‘course of action’ research program and the ‘distributed cognition’ research program even further

- 45 On the one hand, we saw in the introduction that the distributed cognition research program had encountered the enaction hypothesis based on the research on embodied cognition conducted from 2005 onwards. On the other hand, in section 2 we saw that during the same period the “course of action” research program was seeing the development of sports research on in-formation courses and of the collective articulation of “in-formation courses” within the limits of the available data on behaviors, physiological parameters and material processes (**Independent inflection 4**). A new preferred meeting point has thus emerged between the two research programs: that between research on embodied cognition (relating to the “distributed cognition” research program) and research on “courses of in-formation” and their

collective articulation, in which the description of activities and their collective articulation goes beyond that of activities leading to pre-reflective consciousness (concerning the “courses of action” research program).

- 46 The difference between the “courses of experience” (and therefore the activities giving rise to pre-reflective consciousness or experience at each moment in time) of the actors and the set of activities, whether or not that difference leads to the pre-reflective consciousness (or experience) of these same actors – a distinguishing feature between the two research programs – is replicated within the “course of action” research program itself, in this case in the section examining the “courses of in-formation” and their collective articulation. Sports research on “courses of in-formation” and their collective articulation takes into consideration both the pre-reflective consciousness (or experience) of the actors (along with the details of their embodied cognition) and the material processes in the environment which are foreign to this pre-reflective consciousness (or experience). In this regard, I will refer, for example, to the following publications: (Gal-Petitfaux, Adé, Poizat, & Seifert, 2013 ; R’Kiouak, 2017 ; R’Kiouak, Saury, & Bourbousson, 2018 ; Seifert, Lardy, Bourbousson, Adé, Nordez, Thouwareq, *et al.*, 2017 ; Terrien, Huet, Iachkine, & Saury, 2020).

4.4. Preferred situations for any given scientific development

- 47 To conclude this section, let us return to how earlier on I demonstrated the need to go beyond the limitation of the “distributed cognition” research program, namely that it ignored the phenomena of the de-collectivization of human activities, by drawing on research on the activities of operators in a full-scale nuclear reactor control room simulator. The de-collectivization phenomena and the various operator activity phenomena described by the concatenation of hexadic signs pointed out on this occasion effectively escape the theoretical “distributed cognition” object and its description in terms of “information flow”. But, if we consider the published research conducted by Edwin Hutchins and his collaborators on distributed cognition in the cockpit (Hutchins, 1994, 2000, Hutchins & Klausen, 1998)²³, setting aside the hypotheses, analytical notions and empirical data of the “course of action” research program, we cannot help but be convinced by the descriptions of distributed cognition in terms of the “information flows” that are created therein and which serve both as an illustration and as an empirical test of the “distributed cognition” research program. It might even be said that descriptions of distributed cognition in terms of “information flow model” provided by the “distributed cognition” research program then appear, from the standpoint of the “course of action” research program, as limited local operational reductions, which can be used to highlight the phenomena of distributed cognition and/or which are sufficient to contribute to possible engineering projects on the situations under consideration.
- 48 In my opinion, this observation illustrates once again the relevance of the notion of “privileged situation for the resolution of this or that scientific problem”, which was suggested from the outset as part of the epistemology of the “course of action” research program in order to play the role that experimental situations play during the development of experimental research programs. From this observation we can safely infer that de-collectivization phenomena appear more easily in a nuclear reactor control room or a railway traffic control room or a hospital care unit, i.e. in situations

studied at the beginnings of the course of action²⁴, than in a cockpit where the actors are confined inside a restricted space.

- 49 If we consider one by one the other situations discussed in this section, we might similarly say that: the situation of swimmers training with a device for evaluating their performance (Gal-Petitfaux *et al.*, 2013) is an advantageous situation for the study of individual courses of in-formation; the situation of a pair of tango dancers on a dance floor is an advantageous situation for studying cultural practices and mutual appropriation; rowing situations for two-rower teams (R’Kiouak, 2017 ; R’Kiouak *et al.*, 2018 ; Seifert *et al.*, 2017) and situations of the collective sailing of “flying” sailing boats (Terrien *et al.*, 2020) are advantageous situations for studying the collective articulation of courses of in-formation.
- 50 Whence the relevance of accumulating situations preferred by the two research programs in the past and of generalizing this consideration of “advantageous situations for the resolution of this or that scientific problem” in the future.

5. Situational engineering and the engineering of cognitive tools

- 51 Much of the research carried out as part of the “distributed cognition” and “course of action” research programs has had a technological component and has resulted in contracts with companies. This is a common feature of the two research programs which is far from being shared by human and social science research as a whole, including psychological and cognitive research. Regarding “distributed cognition”, let us first mention publications on the technological component of research on the navigation of warships, which have the particularity of focusing on simulator training: (Halff, Hollan, & Hutchins, 1986 ; Hollan, Hutchins, & Weitzman, 1984). The same is true of later research on the cockpit, air traffic control, driving, etc. In (Hollan, & Hutchins, 2009 ; Hollan, Hutchins, & Kirsh, 2000 ; Hutchins, & Hollan, 1986), the authors present an entire range of such cognitive tools that constitute an inventory of what might be referred to as “*cognitive ergonomics in organic relation to the “distributed cognition” research program*”.
- 52 While Edwin Hutchins and his collaborators conceive these cognitive tools as having to be inserted in “systems of distributed cognition”, “course of action” research conceives them as having to be inserted in “systems of distributed cognition” that are conceived in terms of “collective (or rather collective-individual) situations”, but also in individual-collective situations, including those of training and education. Although “course of action” research has focused on the global conception of situations, be they individual-collective or collective-individual, and has not, unlike that of Jim Hollan and Edwin Hutchins, presented cognitive tools conceived as generic, it has also allowed the conception of cognitive tools that are supposed to be valid in various situations or families of situations (one recent example being the case of active listening aids and active listening situations: Goldszmidt *et al.*, 2007 ; Goldszmidt, & Theureau, 2010).
- 53 One can, in keeping with the paradigm of enaction, reformulate the technological counterpart of the “distributed cognition” research program and, at the same time, renew the technological counterpart of the collective part of the “course of action” research program as a “technological research program on the engineering of

collective situations, i.e. collective-individual situations, as including the actors and their interstitial environment”. Of course one might also clarify the “technological research program on the engineering of individual-collective situations” by underlining the fact that each actor considered is located in an environment composed of other actors, of the interstitial environment between this actor and these other actors and of the wider environment encompassing all of these actors. Until now, aside from the engineering of training, education and practice situations, the technological research aspect of the “course of action” research program has only been the subject of an already old work of synthesis centered on ergonomics (Theureau, Jeffroy, 1994, partly taken up in Theureau, 2015b). The developments which have taken place since then and which go well beyond ergonomics, along with those I have just mentioned and which are in progress or awaiting completion should provide the material for a new synthesis.

- 54 Although “cockpit knowledge” was examined in the “distributed cognition” research program, it was only to a small extent, and the engineering consequences of training, education and practice situations, while they have been drawn, have not been published. Most of the engineering of training, education and practice situations developed in the “course of action” research program, the specificities of which Marc Durand has underlined in relation to the engineering of situations in general (Durand, 2008), is therefore to be continued. Several works on the state of the art (Bourgeois, & Durand, 2012 ; Poizat, Durand, & Theureau, 2016 ; Yvon, & Durand, 2012) and works of synthesis (Saury, Adé, Gal-Petitfaux, Huet, Sève, & Trohel, 2013) on the engineering aspects have already been published. It would nevertheless be useful to bolster this work in terms of “cockpit knowledge” or “distributed cognition system” (or “cognitive ecology unit”) and therefore in terms of training and educational for the cockpit or “distributed cognition system” (or “cognitive ecology unit”).

6. The analysis of scientific and technological research activities, artistic creation activities and, more broadly, creative activities

- 55 Although the “distributed cognition” research program has addressed scientific research activities, it has only done so with regard to very short terms. The “course of action” research program has addressed artistic activities and as far as musical composition activities were concerned, has done so in relation to longer terms. While there are many differences between scientific research activities and musical composition activities, the study of one can be used as a basis for the study of the other. The achievements of the two research programs can thus complement each other in an approach to creative activities in all their generality (see Theureau, 2017).²⁵

6.1. Scientific research on the instantaneous over the long term, without forgetting the medium term

- 56 According to (Alac, & Hutchins, 2004): “The conduct of scientific research involves many kinds of cognitive processes: internal processes; processes that take place when representations are propagated across representational media; widely distributed

processes that play out in the traffic of inscriptions and the spread of ideas across scientific communities (Fleck, [1935], 1979, 2005) (...). We will address a different kind of cognitive processes that (...) occurs in the interactions of scientists with one another and with material representations. They are not internal processes that accompany observed behavior; rather we will see interactions as cognitive processes” (op. cit., pp. 629-630)²⁶. However, the various “distributed cognition” publications relating to research activities (Alac, & Hutchins, 2004, Becvar, Hollan, & Hutchins, 2008 and Hutchins, 2012) within the limits thus specified, consider these interactions only in the very short term. The processes exemplified by (Fleck, [1935], 1979, 2005), as well as by (Holton, 1973), can only be studied within the framework of a development of the “course of action” research program concerning the multi-level analysis of human activity in pair* relationships (see section 2) or their equivalent. But the study of the collective articulation of the individual-collective activities of a set of scientific actors (researchers and others) equipped with their interstitial environment can *a priori* go beyond this very short term by looking at a medium term, of a few days, a few months or a few years, if one extends to all research activities – and, more generally still, to all creative activities – something that has already been done in various works of research on musical composition activities.

6.2. From musical composition activities to creative activities in general

- ⁵⁷ Although the “course of action” research program did not address this empirical analysis of scientific research activities, the analyses that have been developed concerning the activities of musical composition do open up their study on such medium terms. These analyses focused on the musical composition activity, over a five-year period, of two associated works by Philippe Leroux, *Voi(r)ex* and *Apocalypse* (Donin, & Theureau, 2007, 2008, 2015, Theureau, & Donin, 2006), as well as the joint activity over a two-year period of composing a work for quartet by Florence Baschet, *Streicherkreis*, and of the designing of a computer device by a team researching musical gesture (Donin, 2017, Donin *et al.* 2009). These analyses, prolonged by those of other musical composition activities (Donin, & Ferron, 2012) and those of other authors, have given rise to a synthesis (Donin, 2018) that emphasizes the complementarity between these medium and long-term historical analyses. The latter are illustrated by (Fleck, [1935], 1979, 2005) and (Holton, 1973, 1981) already cited above with regard to scientific research activities.

7. The augmented ‘course of action’ research program, its articulation with research on animal activity as enaction and cultural dynamic and the continuing debate with neurosciences

- ⁵⁸ In conclusion, by benefiting from the “distributed cognition” research program’s integration of the enaction paradigm, it is a question of (1) benefiting from the “distributed cognition” research program extending research to include animal

activities; (2) continuing the debate with neurosciences that was initiated by Edwin Hutchins. Let us address these two points in turn in this final section.

7.1. Analysis of animal activities and the question of the emergence of language

- 59 The observatory of distributed cognition, which unlike ‘course of action’ does not use a strict protocol for eliciting actors’ verbalizations, opened up research to include animal activity just as much as human activity. The integration of the paradigm of enaction, which is supposed to concern all living creatures, from ticks to human beings, was bound to reinforce this opening in **Stage 3** of the development of this research programme (see section 1). In retrospect, the research on animal cognition carried out during **Stage 2** demonstrates both the relevance and the inadequacy of taking the collective and the environment into consideration if the embodied character of cognition is not also considered. I am thinking here of Deborah Forster's PhD thesis under the supervision of Edwin Hutchins on the cognition of troops of baboons (see, for example, Sturm, Forster, & Hutchins, 1997).
- 60 The consideration of embodied cognition and the integration of the enaction paradigm effectively renewed this research in **Stage 3** (Hutchins, 2008a ; Hutchins, & Johnson, 2009). It is the notion of “cultural practice” (for its definition, see also section 1) that is at the center of such research. While there are symbolic cultural practices, at least among humans, this notion of “cultural practice” is broader, as we have seen. In (Hutchins, 2008), it allows for criticism of interpretations in terms of the access to symbolism of captive chimpanzees with no language training – Edwin Hutchins (personal communication) was initially enthusiastic until he noticed that the notion of cultural practice that was constructed between the chimpanzees and their guardians and experimenters was sufficient to interpret the observed phenomena and that it was therefore not necessary to postulate such access to symbolism by these chimpanzees, while, in Hutchins & Johnson (2009), it makes it possible to show in chimpanzees the *“complementarity of action in addition to imitation, iconic in addition to indexical gesture, coordination among multiple sensory and perceptual modalities, and the orchestration of intra- and inter-individual motor coordination”*. It should be noted that this second text advocates a phenomenology of animal activity that is also semiotics, in this case semiotics of activity, as is the theory of activity-sign (in which the non-symbolic part can be extended from human to animal).
- 61 As is the case with research activities, these animal activities need to broaden the temporal horizon of research. We also need to examine the relationship between cultural practices, culture and different types of mutual appropriation (see section 4). Research on the collective articulation of animal and/or animal-human activities would benefit from being developed in organic relation to the engineering of animal situations and/or shared between humans and animals. Finally, even within their current limits, the research carried out as part of the “distributed cognition” research program on animal cognition shows the theoretical and heuristic relevance of a relationship between this research and that on human cognition, which is embodied, situated and cultivated in the same way as animal cognition, albeit with some significant differences.

62 Yet an “augmented course of action research program” can only include in its theoretical core the hypothesis of pre-reflective consciousness (or experience) and in its methodological core methods of access to this pre-reflective consciousness (or experience); and an extension of the activity-sign theory to animal activity would require clarification of a notion of consciousness in animals that could be empirically documented – which poses many unsolved problems²⁷. So it might be said that now it is less a question of including the study of animal activities in this “increased “course of action” research program” than it is of developing its relationships, or even its articulations, in the preferred situations which, from this standpoint, are situations of human-animal interaction, with research on animal activity conducted within the framework of other research programs, and, more especially, the “distributed cognition” research program revamped following integration of the enaction hypothesis, i.e. the “new distributed cognition” promised by Edwin Hutchins (see introduction).

7.2. Human and animal activities and the debate with neuroscience

- 63 In the context of the academic struggle for funding, the current creativity and hopes of neuroscience have led to neuroscientists claiming the monopoly in research on cognition (both human and animal, as both humans and animals are the subject of laboratory experiments). Yet Hutchins (2011) talks about “cultivated cognition” and points out that “the brain has causal powers, but when it comes to human cognition, most of the causal powers of the human brain derive from the previous experience in cultural practices”. It is also this omission of cultural practices that Edwin Hutchins criticizes in the so-called “extended mind” movement (Clark, & Chalmers, 2010).
- 64 Once this oversight had been repaired, anthropology and the neurosciences could enjoy a fruitful dialogue. The debate that Edwin Hutchins initiated with neuroscience seems to me to be vital in France, particularly in the sciences of training, education and practice, where the monopoly of neuroscience, and even the near-monopoly within neuroscience of research programs in terms of predefined mental models of a predefined environment, which directly oppose the hypothesis of enaction, readily inspire the discourse of the current French Ministry of National Education. Indeed, in the same way and in a dominant if not monopolistic manner, psycho-physiological laboratory experimentation inspires contemporary neoclassical political economics, itself largely dominant if not monopolistic, and therefore also the secondary and higher education of political economics in France (see Theureau, 2019, already cited). It seems to me that the continuation of this debate with neuroscience on the basis of the results of research on human activities should be part of this “augmented ‘course of action’ research program”. I will close on this point.

BIBLIOGRAPHY

- Alac, M., & Hutchins, E. (2004). I see what you are saying: action as cognition in fMRI brain mapping practice. *Journal of Cognition & Culture*, 4(3-4), 629-661. <https://doi.org/10.1163/1568537042484977>
- Ball, L., & Ormerod, T. (2000). Putting ethnography to work: the case for a cognitive ethnography of design. *International Journal of Human-Computer Studies*, 53(1), 147-168. <https://doi.org/10.1006/ijhc.2000.0372>
- Becvar, A., Hollan, H., & Hutchins, E. (2008). Representational gestures as cognitive artifacts for developing theories in a scientific laboratory. In M. Ackerman, C. Halverson, T. Erickson, & W. Kellogg (Eds.), *Resources, co-evolution and artifacts: theory in CSCW* (pp. 117-143). London: Springer.
- Bourbousson, J., & Sève, C. (2010). Analyse de la performance collective, nouveau terrain d'expression de la théorie des systèmes dynamiques. *STAPS*, 90(4), 59-74. <https://doi.org/10.3917/sta.090.0059>
- Bourbousson, J., Sève, C., & McGarry, T. (2010a). Space-time coordination dynamics in basketball: Part 1. Intra- and inter-couplings among player dyads. *Journal of Sports Sciences*, 28(3), 339-347. <https://doi.org/10.1080/02640410903503632>
- Bourbousson, J., Sève, C., & McGarry, T. (2010b). Space-time coordination dynamics in basketball: Part 2. The interaction between the two teams. *Journal of Sports Sciences*, 28(3), 349-358. <https://doi.org/10.1080/02640410903503640>
- Bourgeois, E., & Durand, M. (Eds.). (2012). *Apprendre au travail*. Paris: PUF.
- Button, G. (2008). Against “distributed cognition”. *Theory, Culture & Society*, 25(2), 87-104. <https://doi.org/10.1177/0263276407086792>
- Clarke, E., Doffman, M., & Lim, L. (2013). Distributed creativity and ecological dynamics: a case study of Liza Lim's “Tongue of the invisible”. *Music and Letters*, 94(4), 628-663. <https://doi.org/10.1093/ml/gct118>
- Clark, A., & Chalmers, D. (2010). The extended mind. In R. Menary (Ed.), *The extended mind* (pp. 27-42). Cambridge: MIT Press.
- Dieumegard, G., & Nogry, S. (2018). Experienced relations and structured inscriptions. *EARLI SIG 17 Méthodes in learning & SIG 25 Educational theories*, August 26th-28th, Cambridge, United Kingdom.
- Dillenbourg, P., Baker A., Blaye, A., & O'Malley, C. (1996). The evolution of research on collaborative learning. In E. Spade, & P. Reiman (Eds.), *Learning in humans and machines: Towards an interdisciplinary learning science* (pp. 189-211). Oxford: Elsevier.
- Donin, N. (2017) Domesticating gesture: the collaborative creative process of Florence Baschet's Streicherkreis for 'augmented' string quartet (2006-2008). In E. Clarke, & M. Doffman (Eds.), *Distributed creativity: collaboration and improvisation in contemporary music* (pp. 70-87). New York: Oxford University Press.
- Donin, N. (2018). La musicologie des processus de composition : Entre histoire et cognition. *Transposition*, H-51. <https://doi.org/10.4000/transposition.1689>
- Donin, N., & Feron, F.-X. (2012). Tracking the composer's cognition in the course of a creative process: Stefano Gervasoni and the beginning of *Gramigna*. *Musicae Scientiae*, 16(3), 262-285. <https://doi.org/10.1177/1029864912448328>

- Donin, N., Goldszmidt, S., & Theureau, J. (2009). Organiser l'invention technologique et artistique ? L'activité collective de conception conjointe d'une œuvre et d'un dispositif informatique pour quatuor à cordes. *Activités*, 6(2), 24-43. <https://doi.org/10.4000/activites.2253>
- Donin, N., & Theureau, J. (2007). Theoretical and methodological issues related to long term creative cognition: the case of musical composition. *Cognition, Technology & Work*, 9(4), 233-251. <https://doi.org/10.1007/s10111-007-0082-z>
- Donin, N., & Theureau, J. (2008). L'activité de composition musicale comme exploitation/construction de situations : Anthropologie cognitive de la composition d'une œuvre musicale par Philippe Leroux. *Intellectica*, 48-49, 175-205. <https://intellectica.org/fr/l-activite-de-composition-comme-exploitationconstruction-de-situations>
- Donin, N., & Theureau, J. (2008). La coproduction des œuvres et de l'atelier par le compositeur (à partir d'une étude de l'activité créatrice de Philippe Leroux entre 2001 et 2006). *Circuit : Musiques contemporaines*, 18(1), 59-71. <https://doi.org/10.7202/017909ar>
- Donin, N., & Theureau, J. (2015). Le sentiment de la forme : analyse génétique et cognitive de la composition d'un mouvement d'Apocalypsis par Philippe Leroux. In N. Donin, A. Grésillon, & J.-L. Lebrave (Eds.), *Genèses musicales* (pp. 101-128). Paris: Presses Universitaires de Paris-Sorbonne.
- Dubbels, B. (2011). Cognitive ethnography: A methodology for measure and analysis of learning for game studies. *International Journal of Gaming and Computer-Mediated Simulations*, 3(1), 68-78. <https://doi.org/10.4018/jgcms.2011010105>
- Dufresne, R. (2001). *Le contrôle des environnements dynamiques : étude ergonomique dans une perspective d'automatisation d'un système de contrôle de la circulation ferroviaire*. Thèse de doctorat, École Pratique des Hautes Études, Paris, France.
- Durand, M. (2008). Un programme de recherche technologique en formation des adultes : Une approche enactive de l'activité humaine et de l'accompagnement de son apprentissage/développement. *Éducation et Didactique*, 2(3), 97-121. <https://doi.org/10.4000/educationdidactique.373>
- Fauconnier, G., & Turner, M. (2002). *The way we think - Conceptual blending and the mind's hidden complexity*. New York: Basic books.
- Fleck, L. ([1935], 1979) *Genesis and development of a scientific fact*. Chicago: Univ. of Chicago Press. [Traduction française: (2005) *Genèse et développement d'un fait scientifique*. Paris: Les Belles Lettres]
- Fouse, A., Hollan J. (2010). Dataprism: a tool for visualizing multimodal data. MB'10: *Proceedings of the 7th International Conference on Methods and Techniques in Behavioral Research* (pp. 1-4). <https://doi.org/10.1145/1931344.1931345>
- Fouse A., Weibel, N., Hutchins, E., & Hollan, J. (2011). ChronoViz: a system for supporting navigation of time-coded data. *CHI '11 Extended Abstracts on Human Factors in Computing Systems* (pp. 299-304). <https://doi.org/10.1145/1979742.1979706>
- Gal-Petitfaux, N., Adé, D., Poizat, G., & Seifert, L. (2013). L'intégration de données biomécaniques et d'expérience pour comprendre l'activité et concevoir un dispositif technologique : étude d'une situation d'évaluation avec des nageurs de haut niveau. *Le Travail Humain*, 76(3), 257-282. <https://doi.org/10.3917/th.763.0257>
- Goldszmidt, S., Donin, N., & Theureau, J. (2007). Navigation génétique dans une œuvre musicale. *IHM'07 : Actes de la 19ème Conférence Interaction Homme-Machine* (pp. 159-166). <https://doi.org/10.1145/1541436.1541467>

- Goldszmidt, S., & Theureau, J. (2010). Conception de situations d'assistance à l'écoute musicale et analyse de l'activité de composition musicale. In G. Valléry, M.-C. Le Port, & M. Zouinar (Eds.), *Ergonomie, conception de produits et services médiatisés* (pp. 157-182). Paris: PUF.
- Gorman, J., Dunbar, T., Grimm, D., & Gipson, C. (2017). Understanding and modeling teams as dynamical systems. *Frontiers in Psychology*, 8, 1053 <https://doi.org/10.3389/fpsyg.2017.01053>
- Grisson, B. (1998). *Structures de raisonnement dans un laboratoire de neurobiologie du développement : étude dans une perspective d'écologie cognitive*. Thèse de doctorat, EHESS, Paris, France.
- Halbwachs, M. (1925). *Les cadres sociaux de la mémoire*. Paris: Librairie Alcan.
- Halff, H., Hollan, J., & Hutchins, E. (1986). Cognitive science and military training. *American Psychologist*, 41(10), 1131-1139. <https://doi.org/10.1037/0003-066X.41.10.1131>
- Haradji, Y., Guibourdenche, J., Reynaud, Q., Poizat, G., Sabouret N., Sempé, F., Huraux, Th., & Galbat, M. (2018). De la modélisation de l'activité humaine à la modélisation pour la simulation sociale : entre réalisme et fécondité technologique. *Activités*, 15(1). <https://doi.org/10.4000/activites.3106>
- Haué, J.-B. (2005) Comparing distributed cognition and course of action: an application to car driving. *EACE'2005: Proceedings of the Annual Conference of the European Association of Cognitive Ergonomics* (pp.139-146). <https://doi.org/10.5555/1124666.1124685>
- Haviland, J. (2011). Musical spaces. In J. Streeck, C. Goodwin, & C. Le Baron (Eds.), *Embodied interaction, language and body in the material world* (pp. 289-304). New York: Cambridge University Press.
- Hollan, J., Hutchins, E., & Weitzman, L. (1984). STEAMER: an interactive inspectable simulation-based training system. *AI Magazine*, 5(2), 15-27. <https://doi.org/10.1609/aimag.v5i2.434>
- Hollan, J., & Hutchins, E. (2009). Opportunities and challenges for augmented environments: a distributed cognition perspective. In S. Lahlou (Ed.), *Designing user friendly augmented work environments: From Meeting Rooms to Digital Collaborative Spaces* (pp. 237-259). London: Springer.
- Hollan, J., Hutchins, E., & Kirsch, D. (2000). Distributed cognition: toward a new foundation for human-computer interaction research. *ACM Transactions on Computer-Human Interaction*, 7(2), 174-196. <https://doi.org/10.1145/353485.353487>
- Holton, G. (1973). *Thematic origins of scientific thought - Kepler to Einstein*. Cambridge: Harvard University Press.
- Holton, G. (1981). *L'imagination scientifique*. Paris: Gallimard.
- Hutchins, E. (1980). *Culture and inference: a Trobriand case study*. Cambridge: Harvard University Press.
- Hutchins, E. (1983). Understanding micronesia navigation. In D. Gentner, & A. Stevens (Eds.), *Mental models* (pp. 191-225). Hillsdale: Lawrence Erlbaum.
- Hutchins, E. (1994). Comment le cockpit se souvient de ses vitesses. *Sociologie du Travail*, 46(4), 451-473.
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge: MIT Press.
- Hutchins, E. (2000). Les conséquences cognitives des configurations du flux d'information. *Intellectica*, 30, 53-74.
- Hutchins, E. (2005). Material anchors for conceptual blends. *Journal of Pragmatics*, 37(10), 1555-1577. <https://doi.org/10.1016/j.pragma.2004.06.008>

- Hutchins, E. (2006). Imagining the cognitive life of things. In L. Malafouris, & C. Renfrew (Eds.), *The cognitive life of things: recasting the boundaries of the mind* (pp. 91-101). Cambridge: McDonald Institute for Archaeological Research.
- Hutchins, E. (2008a). The role of cultural practices in the emergence of modern human intelligence. *Philosophical Transactions of the Royal Society B*, 363(1499), 2011-2019. <https://doi.org/10.1098/rstb.2008.0003>
- Hutchins, E. (2008b). Dew (Digital Ethnographer Workbench) Manifesto, Distributed Cognition and Human-Computer Interaction Laboratory (Dcog-HCI Lab), Department of Cognitive Science, University of California, San Diego (UCSD). Retrieved February 22, 2020, from <http://hci.ucsd.edu/research/dew/manifesto/>
- Hutchins, E. (2010a). Cognitive ecology. *Topics in Cognitive Science*, 2(4), 705-715. <https://doi.org/10.1111/j.1756-8765.2010.01089.x>
- Hutchins, E. (2010b). Enaction, imagination, and insight. In J. Stewart, O. Gapenne, & E. Di Paolo (Eds.), *Enaction: towards a new paradigm in cognitive science* (pp. 425-450). Cambridge: MIT Press.
- Hutchins, E. (2011). Enculturating the supersized mind. *Philosophical Studies*, 152(3), 437-446. <https://doi.org/10.1007/s11098-010-9599-8>
- Hutchins, E. (2012). Concepts in practice as sources of order. *Mind, Culture and Activity*, 19(3), 314-323. <https://doi.org/10.1080/10749039.2012.694006>
- Hutchins, E., & Hazlehurst B. (1991). Learning in the cultural process. In C. Langton, C. Taylor, D. Farmer, & S. Rasmussen (Eds.), *Artificial life I I: Santa Fe Institute studies in the sciences of complexity* (pp. 689-706). Redwood City: Addison Wesley.
- Hutchins, E., & Hazlehurst, B. (1995). How to invent a lexicon: the development of shared symbols in interaction. In N. Gilbert, & R. Conte (Eds.), *Artificial societies: the computer simulation of social life* (pp. 157-189). London: UCL Press.
- Hutchins, E., & Holland, J. (1986). Direct manipulation interfaces. In D. Norman, & S. Draper (Eds.) *User centered design* (pp. 87-124). London: Lawrence Erlbaum.
- Hutchins, E., & Johnson, C. (2009). Modeling the emergence of language as an embodied collective cognitive activity. *Topics in Cognitive Science*, 1(3), 523-546. <https://doi.org/10.1111/j.1756-8765.2009.01033.x>
- Hutchins, E., & Klausen, T. (1998). Distributed cognition in an airline cockpit. In Y. Engeström, & D. Middleton (Eds.), *Communication & cognition at work* (pp. 15-34). Cambridge: Cambridge University Press.
- Hutchins, E., Weibel, E., Emmenegger, C., Fouse, A., & Holder, B. (2013). An integrative approach to understanding flight crew activity. *Journal of Cognitive Engineering and Decision making*, 7(4), 353-376. <https://doi.org/10.1177/1555343413495547>
- Hutto, D., Kirchhoff, M., & Myin, E. (2014). Extensive enactivism: why keep it all in? *Frontiers in Human Neuroscience*, 8, 706. <https://doi.org/10.3389/fnhum.2014.00706>
- Jeffroy, F., Theureau, J., & Vermersch, P. (1998). *Quel guidage des opérateurs en situation incidentelle-accidentelle ? Analyse ergonomique de l'activité de conduite avec procédures*. Rapport DES SEFH n°2, Fontenay aux Roses: IRSN.
- Johnson, C. (2015). The cognitive ecology of dolphin social engagement. In D. Herzing, & C. Johnson (Eds.), *Dolphin Communication & Cognition* (pp. 229-256). Cambridge: MIT Press.

- Kaastra, L. (2011). Annotation and the coordination of cognitive processes in western art music performance. In A. Williamon, D. Edwards, & L. Bartel (Eds.), *Proceedings of the International Symposium on Performance Science* (pp. 675-680). Utrecht: European Association of Conservatoires (AEC).
- Karnowski, J., Hutchins, E., & Johnson, C. (2015) Dolphin detection and tracking. *Proceedings of 2015 IEEE Winter Applications and Computer Vision Workshops* (pp. 51-56). <https://doi.org/10.1109/WACVW.2015.10>
- Latour, B. (1995). "Cogito ergo sumus!" A review of Ed Hutchins Cognition in the wild, *Mind, Culture and Activity*, 3(1), 54-63. https://doi.org/10.1207/s15327884mca0301_5
- Perrin, N., Theureau, J., Menu, J., & Durand, M. (2011). SIDE-CAR : Un outil numérique d'aide à l'analyse de l'activité par rétrodiction. Exploitation selon le cadre théorique du « cours d'action ». *Recherches qualitatives*, 30(2), 148-174. [http://www.recherche-qualitative.qc.ca/documents/files/revue/edition_reguliere/numero30\(2\)/RQ_30\(2\)_Perrin-al.pdf](http://www.recherche-qualitative.qc.ca/documents/files/revue/edition_reguliere/numero30(2)/RQ_30(2)_Perrin-al.pdf)
- Perrin, N., & Vanini De Carlo, K. (2016). L'événementialisation comme co-construction des connaissances : esquisse d'une multi-méthode issue de l'analyse de l'activité et de l'analyse narrative. In F. Ligozat, M. Charmillot, & A. Muller (Eds.), *Le partage des savoirs dans les processus de recherche en éducation* (pp. 251-271). Louvain-la-Neuve: De Boeck.
- Pinsky, L. (1992). *Concevoir pour l'action et la communication : essais d'ergonomie cognitive*. Berne: Peter Lang.
- Pinsky, L., & Theureau, J. (1987). *L'étude du Cours d'Action : Analyse du travail et conception ergonomique*. Rapport du Laboratoire de Physiologie du travail et d'Ergonomie, Paris: CNAM.
- Poizat, G., Durand, M., & Theureau, J. (2016). The challenges of activity analysis for training objectives. *Le Travail Humain*. 79(3), 233-258. <https://doi.org/10.3917/th.793.0233>
- R'Kiouak, M. (2017). « Ramer ensemble » en aviron : Entre régulation inter- et extra-personnelle : Contribution à une approche enactive des couplages sociaux. Thèse de doctorat, Université de Nantes, Nantes, France.
- R'Kiouak, M., Saury, J., & Bourbousson, J. (2018). Joint action in an elite rowing pair crew after intensive team training: the reinforcement of extra-personal processes. *Human Movement Science*, 58, 303-313. <https://doi.org/10.1016/j.humov.2017.09.008>
- San Martin, J. (2015). *La culture d'action des enseignants de l'école primaire au Chili : Contribution au développement d'une anthropologie enactive*. Thèse de doctorat, Université Toulouse II-Jean Jaurès, Toulouse, France.
- Saury, J., Adé, D., Gal-Petitfaux, N., Huet, B., Sève, C., & Trohel, J. (2013). *Actions, significations et apprentissages en EPS : une approche centrée sur le cours d'expérience des élèves et des enseignants*. Paris: Éditions EPS.
- Seifert, L., Lardy, J., Bourbousson, J., Adé, D., Nordez, A. et al. (2017). Interpersonal coordination and individual organization combined with shared phenomenological experience in rowing performance: two case studies. *Frontiers in Psychology*, 8(75), <https://doi.org/10.3389/fpsyg.2017.00075>
- Smith, E. (2008). Social relationships and groups: new insights on embodied and distributed cognition. *Cognitive systems research*, 9(1-2) 24-32. <https://doi.org/10.1016/j.cogsys.2007.06.011>
- Sturm, S., Forster, D., & Hutchins, E. (1997). Why Machiavelian intelligence may not be machiavelian. In A. Whiten, & R. Byrne (Eds.), *Machiavelian Intelligence II: extensions & evaluations* (pp. 50-85). New York: Cambridge University Press.

- Sutton, J., Harris, C., Keil, P., & Barnier, A. (2010). The psychology of memory, extended cognition, and socially distributed remembering. *Phenomenology and the Cognitive Sciences*, 9, 521-560. <https://doi.org/10.1007/s11097-010-9182-y>
- Terrien E., Huet B., Iachkine, P., & Saury, J. (2020) Coordination between crew members on flying multihulls: a case study on a Nacra 17, *Journal of Sport Science and Medicine*, 19, 298-308. <https://jssm.org>
- Theureau, J. (2000). L'analyse sémio-logique des cours d'action et de leur articulation collective en situation de travail. In A. Weill-Fassina, & T. Benckroun (Eds.), *Le travail collectif: Perspectives actuelles en ergonomie* (pp. 97-118). Toulouse: Octarès.
- Theureau, J. (1992/2004). *Le cours d'action : Méthode élémentaire (2nd remaniée)*. Toulouse: Octarès.
- Theureau, J. (2006). *Le cours d'action : Méthode développée*. Toulouse: Octarès.
- Theureau, J. (2009). *Le cours d'action : Méthode réfléchie*. Toulouse: Octarès.
- Theureau, J. (2015a). *Le cours d'action : L'énaction & l'expérience*. Toulouse: Octarès.
- Theureau, J. (2015b). *O curso da ação método elementar*. Belo Horizonte: Fabrefactum.
- Theureau, J. (2017, Outubro). *Processus créatifs : analyse de la créativité en acte*. Comunicação apresentada ao Instituto de Estudos Avançados Transdisciplinares, Universidade Federal de Minas Gerais, Brasil.
- Theureau, J. (2018, October). *The Hutchins's heritage*. Communication presented at the conference "Is Cognition Still in the Wild: A tribute to Ed Hutchins", EHESS, Paris, France.
- Theureau, J. (2019). *Le cours d'action : Économie & Activités - Suivi de Note sur l'éthique*. Toulouse: Octarès.
- Theureau J., & Donin, N. (2006). Comprendre une activité de composition musicale : essai méthodologique sur les relations entre sujet, activité créatrice, environnement et conscience préreflexive dans le cadre du programme de recherche « cours d'action ». In J.-M. Barbier, & M. Durand (Eds.), *Les rapports sujets-activités-environnements* (pp. 221-251). Paris: PUF.
- Theureau, J., & Jeffroy, F. (Eds.) (1994). *Ergonomie des situations informatisées : La conception centrée sur le cours d'action des utilisateurs*. Toulouse: Octarès.
- Vaughan, D. (1996). *The Challenger launch decision: risky technology, culture and deviance at NASA*. Chicago: Chicago University Press.
- Walmsley, J. (2007). Methodological situatedness: or, DEEDS worth doing and pursuing. *Cognitive Systems Research*, 9(1-2), 150-159. <https://doi.org/10.1016/j.cogsys.2007.07.006>
- Watteau, B. (2017). *Approche écologique de l'activité de création en formation : le cas de l'atelier de projet en architecture*. Thèse de doctorat, Université Rennes, Rennes, France.
- Weibel, N., Fouse, A., Emmenegger, C., Friedman, W., Hutchins, E., & Hollan, J. (2012). Digital pen and paper practices in observational research. *CHI'12: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1331-1340). <https://doi.org/10.1145/2207676.2208590>
- Weibel, N., Fouse, A., Hutchins, E., & Hollan, J. (2011). Supporting an integrated paper-digital workflow for observational research. *IUI'11: Proceedings of the 16th international conference on Intelligent User Interfaces* (pp. 257-266). <https://doi.org/10.1145/1943403.1943443>
- Williams, R. (2006). Using cognitive ethnography to study instruction. *ICLS'06: Proceedings of the 7th international conference on Learning sciences* (pp. 838-844). <https://doi.org/10.5555/1150034.1150156>

Yvon, F., & Durand, M. (Eds.) (2012). *Réconcilier recherche et formation par l'analyse de l'activité*. Bruxelles: De Boeck.

NOTES

1. I am thinking, for example, of Ludwig Fleck's work, which he showed me and, conversely, that of Maurice Halbwachs (the speculative predecessor of the distributed cognition paradigm) which I shared with him.

2. Because it engages the entire 'course of action' research program, this reflection would have benefited from being collective from the outset, thus leading to a collective article. Yet although, until 1990, direct contact between Edwin Hutchins and his collaborators involved, in addition to Leonardo Pinsky and myself, students doing ergonomics theses, along with Maurice de Montmollin and Michèle Lacoste, who were collaborating with us at that time, with a few exceptions, they then only involved me, while at the same time, through me, influencing the whole 'course of action' research program. Whence this personal article intended to provoke collective reflection.

3. Let me add that if Edwin Hutchins accompanied the justification of his theoretical object, which he calls "system of distributed cognition" or "cognitive ecology", with a free translation ("carve nature at its joints") of a passage from a dialogue by Plato (Phaedra, 265d-266a), and if he has occasionally published articles in philosophical journals, since 2007 I have personally and systematically sought in several books to define a philosophical research program in organic relationship with my empirical and technological research (Theureau, 2009, 2015 and 2019). Yet because arguing for the necessity, and presenting the content, of such a philosophical research program take up too much space and are not "augmented" by the reading of Edwin Hutchins, I will leave the latter aside.

4. This description of section 7 might baffle the reader who is unfamiliar with the epistemology of research programs and its developments. As we will immediately see below, the epistemological notion of research programs, as defined by Imre Lakatos, includes "the contestation at any moment, by empirical facts and by other research programs, of the theoretical and heuristic resources of the research program under consideration". A more developed notion of epistemological research programs includes among its elements not only contestation by other research programs, but also more broadly the set of relationships it has with other research programs.

5. I.e. without the most recent improvements to this definition in (Theureau, 2015) – in passing, we have just seen one of these in relation to the content of section 7 – in order to draw the epistemological consequences of the enaction hypothesis. In particular, they justify the extension of the notion of research program from scientific research to technological and philosophical research.

6. Without claiming to be exhaustive, in the international literature and leaving aside that which is also part of the 'course of action' research program or which is in part inspired by it, such as (Grisson, 1998), we find: Bruno Latour "tipping his hat" to '*Cognition in the Wild*' as a justification of his own actor-network theory (Latour, 1995); various works of research (or rather 'studies', with no theoretical pretensions) on the piloting of aircraft in relation to aviation safety, on the steering of submarines, etc. directly inspired by the publications of Edwin Hutchins and his colleagues; research on collaborative learning (for example, Dillenbourg, Baker, Blaye & O'Malley, 1996); research in music on distributed creativity (Clarke, Doffman & Lim, 2013; Kaastra, 2011); research on memorization and recall (Sutton, Harris, Keil & Barnier, 2010) which refers directly to Maurice Halbwachs' early speculations on Social Frameworks of Memory (Halbwachs, 1925); research on communities as dynamical systems (Gorman, Dunbar, Grimm &

Gipson, 2017). Similarly, challenges and attempts by other researchers to go beyond the model have focused solely on the paradigm (Button, 2008 ; Hutto, Kirchoff, & Myin, 2014 ; Smith, 2008 ; Walmsley, 2007). When reference is made to the cognitive ethnography method, as in Ball & Ormerod (2000), Dubbels (2011) and Williams (2006), said method is reduced to data collection and a common sense description of the phenomena (i.e. without phenomenological notions, or any organized system of descriptive categories referring to theoretical hypotheses).

7. While I spoke earlier of "stages" in relation to the "distributed cognition" research program, I will speak here of "inflections" in order to distinguish the two points of view that govern the descriptions made: from the outside, but benefiting from fruitful interactions with Edwin Hutchins and a number of his collaborators, regarding the 'distributed cognition' research program; from the inside, first following a research activity or discussions with others about research they had carried out, and then followed by a reflective activity on my part.

8. This was the first expression of the 'course of action' research program (containing a significant part of its hypotheses, objects and theoretical notions and of its data collection and analysis methods) following a period that was highly eclectic both from a theoretical and methodological standpoint.

9. These may be downloaded from the www.coursdaction.fr website.

10. I still consider this pragmatic reasoning to be valid, at least as long as our research was carried out in France, thus guaranteeing a minimal level of common culture between researchers (ourselves and, more broadly, students working on their ergonomics theses) and the actors.

11. It is interesting to note that this research was carried out by a French-speaking Canadian, for the most part in a center where the supervisors were English-speaking Canadians.

12. As I have already so begun, here I will systematically refer to "individual-collective and collective-individual activities", and "individual-collective and collective-individual courses of action". Indeed, experience shows that in reference to certain conceptions of 'social', the adjective 'social' can be interpreted as pointing to entities ontologically different from individual-collective activities, which is not the case here.

13. He believed that at best these methods produced what he described as "culturally sound discourse" (see Theureau, 2006, pp. 194-196).

14. These theoretical essays, stemming from dissatisfaction with the initial notion of "tetradic sign", led to the notion of "hexadic sign" and to notions of sub-categories of its components (see the following sub-section).

15. By definition, a 'pair*' relationship links different levels of activity analysis, such as: (1) the lower-level activity belongs to the higher-level activity and helps it to emerge; (2) the higher-level activity constrains the lower-level activity.

16. As a reminder, I had to introduce this notion to account for economic phenomena in terms of human activities.

17. In what follows I will essentially set the latter aside as it generally relates to actors other than those which are usually found in the activity situation under consideration, in particular scientific researchers and/or engineers and technicians belonging to other sectors of the company to which these actors belong or outside said company.

18. As a basic example of such "synthetic patterns of activity", I tend to mention the "trickle-down effect" (Vaughan, 1996): in a bureaucratic organization such as NASA, it appears that an objective proposed at the top (for example, so that the space shuttle is no longer considered as a research object but as a commercial object) is increasingly seen as a reality the further one moves down the hierarchical ladder. While the bureaucratic nature of the organization is a constraint, the "trickle-down effect" synthesizes a description of the activities of the managers concerned at the various hierarchical levels.

19. The latter is based on two general notions. The first, empirical, is that of "conceptual blending", defined as "a general and ancient human cognitive phenomenon, the association of

conceptual structure with material structure" and borrowed from (Fauconnier, & Turner, 2002). The "conceptual blending" theory is supposed to provide "a useful framework for considering the joint contributions and mutual constraints of mental and material structures". The second notion, both empirical and technological, is that of "material anchor for conceptual blend", that translates "projecting material structure into a blended space". "Projecting material structure into a blended space can stabilize the conceptual blend". Anyone familiar with the 'course of action' research program can already perceive many problems of conceptual translation to be solved if one thinks – rightly so it seems to me – that it is interesting to draw inspiration from it. When Edwin Hutchins then emphasises the difference between what he calls "material anchorage" and "sign", one might feel one is on familiar ground. But, for him, "a sign is a pattern in a material medium that captures a minimal aspect of the conceptual domain, a sign is a very weak form of material anchor". In the course of action research program, the notion of "sign" is conceived in a completely different way and that which is associated with what is called "anchoring" is what is referred to as "Representamen" and not what is called "sign". In such a case we therefore find ourselves achieving not a simple conceptual integration, but a conceptualization that is both different from the initial version and that enhances or modifies the final version.

20. The "observatory" is the set of data construction methods and related theoretical hypotheses, whereas "the workshop" is the set of methods for pre-analysis, statistical calculation, analysis and analytical and synthetic modelling, along with the theoretical hypotheses that accompany them.

21. Here I will leave aside the part of the workshop that relates to synthetic modelling tool, both scientific and technological. It has given rise to various publications that include, for example: regarding 'distributed cognition', (Hutchins, & Hazlehurst, 1991, 1995); regarding 'course of action', (Bourbousson, & Sève, 2010, Bourbousson, Sève, & McGarry, 2010a, 2010b, Haradji, Guibourdenche, Reynaud, Poizat, Sabouret, Sempé, *et al.*, 2018).

22. In the same chapter of the book I also showed that the description of distributed cognition in terms of "information flow models" ignored phenomena taken into account by the description in terms of the concatenation of hexadic signs: the fields of possibilities of the actors and their transformations through their activities; the selection at each moment in time by each actor of the information relevant to him/her, as well as the biases of his/her interpretations in relation to his/her field of possibilities at that instant; the knowledge implemented and the knowledge constituted in the activity by each actor and their more or less effective collective sharing; and finally, the emotions of these actors. Haué (2005) made similar type of comparison in relation to the driving of cars.

23. The cockpit also served as a test bench for DEW (Digital Ethnography Workshop) and led to a new set of publications (see section 3).

24. One might be tempted to add "or in a warship, a situation which was studied as part of the 'distributed cognition' research program", but then it is the military ideology of collective monopoly that might prevent one from benefiting from such a facility.

25. Activities of musical composition are even closer to those of technological research than they are to scientific research activities, as demonstrated by the case examined in (Donin, Goldszmidt, & Theureau, 2009) which I will discuss in a little more detail later on in this section; I will restrict myself here to the extension of scientific work.

26. "The conduct of scientific research involves many kinds of cognitive processes: Internal processes; processes that take place when representations are propagated across representational media; Widely distributed processes that play out in the traffic of inscriptions and the spread of ideas across scientific communities (Fleck, [1935], 1979, 2005) (...). We will address a different kind of cognitive processes that (...) occur in the interactions of scientists

with one another and with material representations. They are not internal processes that accompany observed behavior ; rather we will see interactions as cognitive processes".

27. In the same way, this extension of the activity-signal theory to the portion of human activities that do not give rise to pre-reflective consciousness (or experience), so that it can be considered within the framework of the study of in-formation courses and their collective articulation (see 4. 3), would mean replacing this notion of pre-reflective consciousness (or experience) with a notion that takes into account the actuality for the actor, with the emergence and virtuality that accompanies it, that would encompass this pre-reflective consciousness (or experience) and that, moreover, would be just as empirically documentable, which raises problems that are not solved either.

ABSTRACTS

The 'distributed cognition' research program, initiated by Edwin Hutchins, has contributed to the development of the 'course of action' research program from 1987 to the present day. Edwin Hutchins having recently recognized the close relationship between his latest research, developed in terms of embodied and distributed cognition, and that on the enaction paradigm, of which this 'course of action' research program is a part, the question now arises of the definition of an "augmented 'course of action' research program". In relation to this enaction paradigm, such a program should go into greater depth and provide a new synthesis of the 'distributed cognition' research program's past contributions to the 'course of action' research program and integrate its new contributions. This in-depth analysis, synthesis and renewal of the contributions to the 'course of action' research program are facilitated by the mutual contribution and addition of different theoretical and methodological results obtained by the two research programs over recent decades. In this paper we will present our personal view of the answer to this question.

Le programme de recherche « cognition distribuée », initié par Edwin Hutchins, a contribué au développement du programme de recherche « cours d'action » de 1987 à nos jours. Edwin Hutchins ayant reconnu récemment la proximité de ses dernières recherches, menées en termes de cognition incarnée et distribuée, avec celles qui sont commandées par le paradigme de l'énaction, dont font partie les recherches menées dans le cadre de ce programme de recherche « cours d'action », la question se pose aujourd'hui de la définition d'un « programme de recherche "cours d'action" augmenté », qui, en relation avec ce paradigme de l'énaction, d'une part, approfondisse et systématise les apports antérieurs de ce programme de recherche « cognition distribuée » au programme de recherche « cours d'action », d'autre part, intègre de nouveaux apports de celui-ci. Une telle systématisation, un tel dépassement et un tel renouvellement des apports au programme de recherche « cours d'action » peuvent s'appuyer sur la mutualisation et le cumul de divers progrès théoriques et méthodologiques obtenus par les deux programmes de recherche. Nous allons voir ici quelle réponse nous pouvons apporter personnellement à cette question.

INDEX

Keywords: distributed cognition, course of action, enaction, pre-reflective consciousness, research program, cognitive ethnography, mutual appropriation, augmented course of action research program

Mots-clés: cognition distribuée, cours d'action, éaction, conscience préreflexive, programme de recherche, ethnographie cognitive, pratique culturelle, appropriation mutuelle, programme de recherche « cours d'action » augmenté