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Rethinking inter- and transdisciplinarity: Undisciplined knowledge and the emergence of a new thought style



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ABSTRACT

There has been a visible increase in academic productivity in the field of inter- and transdisciplinarity (ITD) over the past decade. Does this greater visibility mean that ITD has entered a 'golden age' crowned with universal success, or does this new approach still face difficulties of an institutional, individual, epistemological or methodological nature? Does the researcher who situates himself between or beyond disciplines represent a new scientific profile that is transforming traditional disciplinary identities? Finally, is ITD a simple recombination of existing disciplines with varying degrees of originality, or does it embody a new thought style that calls for the dedisciplinarization of academic structures and the full recognition of its transgressive status? In this paper I shall attempt to answer these programmatic questions and shed light upon the following elements: the inter- and transdisciplinary approach is underway and still – beyond its potentialities and success – faces some obstacles; interdisciplinary research is often promoted or claimed, but it is sometimes not recognized as a form of research in its own right; and taking seriously the issues of ITD involves rethinking disciplinary identities. It represents a new thought style and a promising future for education and research.

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1. Introduction

Inter- and trans-disciplinarity (ITD)¹ does not come down to a mere pious hope based on the simple rhetoric of the promotional appeal for the crossing of disciplinary boundaries. While inter- and trans-disciplinarity are being practised more concretely between and beyond the disciplines within the humanities and social sciences and the so-called 'hard' sciences, it is now also the subject of specific research studies that may be roughly grouped under the heading of Interdisciplinary Studies (Repko, Szostak, & Buchberger, 2013). This polymorphous field of study involves national and international actors and their complementary and interconnected networks, for example the Association for

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¹ The concepts of inter-disciplinarity and trans-disciplinarity (ITD) can certainly be defined independently (see Section 2.1). Nevertheless, in this paper they are linked insofar as they share the common idea of an opening – even of a transgression – of the boundaries between disciplines. The Td-net Network for Transdisciplinary Research for instance also uses this common understanding. Sometimes, I write "inter- and trans-disciplinarity" with a double hyphen, when the focus is reflexively placed on these concepts, recognized as different but coupled for the purpose of the analysis.

Interdisciplinary Studies,² the Network for Transdisciplinary and Interdisciplinary Research (INIT),³ the Science of Team Science (SciTS),⁴ the Td-net Network for Transdisciplinary Research⁵ and Integration and Implementation Sciences (I2S).⁶ Apart from the important activity of academic networks, which gives rise to the organization of numerous conferences, it is also important to highlight the increasing work being done since the 1970s in the area of scientific publications, which specifically relates to the issue of inter- and trans-disciplinarity.⁷ Hence the publication of monographs and handbooks demonstrates today the progress being made in this field of reflection, and in the area of teaching and research practice (see, for example, Darbellay & Paulsen, 2008; Frodeman, Thompson Klein, & Mitcham, 2010; Hirsch Hadorn et al., 2008). These unifying publications act as an important indicator of the establishment of a field of study that is both legitimate and legitimized by an active scientific community. This community is diverse and not paradigmatically disciplined on a theoretical and methodological level, however, it shares epistemological values and a common interest in the analysis and understanding of teaching and research practices beyond disciplinary limits. In effect, this practice involving the presentation of the field in the form of handbooks is based on the more or less consensual sharing of theoretical frameworks, methodological tools and case studies, and leads to the presentation of inter- and trans-disciplinary practices of varying quality. Thus, for several decades now, the studies on inter- and trans-disciplinarity have been endeavouring to understand the epistemological issues, production and evaluation mechanisms, and methodological, practical and institutional implementation of the approach.

It should also be noted that the call for the decompartmentalization of disciplines features increasingly on the agendas of universities and organizations for the promotion and financing of scientific research, at both national and international levels. This development may be seen in Switzerland, for example, in the encouragement and support that the Swiss National Science Foundation (SNSF) provides for interdisciplinary projects, which are evaluated by a ‘Specialised Committee Interdisciplinary Research’. In the same vein, one can also mention the interdisciplinary programmes of the National Centre for Scientific Research (CNRS) in France and those of the Research Councils UK (RCUK). The publicized promotion of interdisciplinarity by the European Research Council (ERC), which explicitly refers to the latter in its mission statement is noteworthy. Also worthy of mention is the support provided to interdisciplinary research by the US National Science Foundation, which opts for a relatively consensual working definition of interdisciplinarity, which it borrows from the Committee on Facilitating Interdisciplinary Research (National Academies, 2005):

“Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.” (National Academies, 2005, p. 2)

The increasing interest in ITD reflects a growing awareness of the multidimensional complexity of research contexts and objects and, hence also, of societal issues that require the greater synergization of institutionalized disciplinary skills. Today, the implementation of this type of approach responds to a need within the community of researchers, who must provide answers on a daily basis to theoretical and practical questions that are highly complex and not reducible to a single disciplinary point of view. This need is also prominent in society and among citizens, who expect science to provide concrete answers to the problems currently affecting many areas of activity (economy, society, politics, environment, health, urbanism, violence, etc. See, for example, Lawrence, 2004; Ramadier, 2004). It would even appear that it has also become a necessity for the universities and research institutes and also for the organizations that manage third-level teaching and research. Hence, this institutional preoccupation with the knowledge dialogue reverberates with the approaches of numerous researchers, who are questioning the limits of their own disciplines and the ways in which new connections can be made with other disciplinary fields. The activities of researchers are rooted in the disciplinary knowledge necessary for increasing knowledge (in sociology, law, psychology, history, geography, physics, biology, mathematics, etc.) while also connecting with other disciplinary languages. In this regard it is interesting to note that the paths taken by researchers follow certain academic trajectories within ‘disciplined’ career paths but, at the same time, they also tend to hybridize, evolve and develop through the contact with other disciplines.

This paper aims to shed light on these individual, institutional and epistemological issues of ITD through two major stages. In the first stage (Section 2), it is to show that the importance of ITD is certainly recognized, but often taken for granted and treated as obvious which actually prevents questioning its transformative potential in universities (Section 2.1). This is also true for inter- and transdisciplinary research whose specificity is sometimes not recognized as such and is always caught in a tension between conformism and innovation (Section 2.2). This constitutive ambivalence of ITD, both full of potential but subject to obstacles, is also found in the identities of researchers who are between and beyond disciplinary

² www.units.muohio.edu/aisorg/index.shtml.

³ www.inidtd.org.

⁴ www.scienceofteams.org.

⁵ www.transdisciplinarity.ch.

⁶ <http://i2s.anu.edu.au/>.

⁷ See, for example, the analysis of the number of publications containing the terms “interdisciplinary/interdisciplinarity” and “transdisciplinary/transdisciplinarity” carried out by Td-net based on data from the Web of Science. Available from: www.transdisciplinarity.ch/e/Bibliography/Publikationstrend_itd.php.

boundaries. This discussion is conducted in the second stage through the idea of hybrid and more or less undisciplined identity (Section 3.1), presiding over the emergence of the ITD as a new thought style, both individually and collectively (Section 3.2). To carry out and illustrate these reflections, we will notably build on some meaningful results of our research on interdisciplinary practices in the Swiss universities.⁸ Based on the growing number of studies dealing with the institutional, epistemological, conceptual and methodological challenges of ITD, the priority aim of this research project is to make a theoretical and empirical contribution by examining different research practices in a variety of academic contexts. The Swiss university context has been chosen as the field of enquiry: from among the French- and German-speaking Swiss universities and the two Swiss Federal Institutes of Technology, we have selected ten centres or representative institutions as case studies, which we use to analyze different ways of implementing interdisciplinarity, highlighting their distinctive features but also what they have in common, epistemologically, methodologically and practically.⁹ A total of 66 researchers from these ten university structures were surveyed through the filter of a mixed methodological device with a dominance of qualitative methods, including a questionnaire (65 respondents), semi-structured interviews (30, 3 interviews per case) and focus groups (1 per case, 10 focus groups of 4–7 researchers). The participants were selected on the basis of the diverse criteria of academic status, disciplinary affiliations, gender and age. The research questions bring together the *who* (the researchers practising inter- and trans-disciplinarity), the *what* (the academic context), the *why* (their reasons for practising it) and the *how* (their method of implementing it).

2. Concepts, potentialities and obstacles

2.1. Concepts and evidence

Although the examination of the knowledge dialogue has its roots far back in the history of science (Gusdorf, 1983), it may nonetheless be agreed that the issue of ITD itself emerged in the 1960s and 1970s (Thompson Klein, 1990). As far back as 1972, the OECD's seminal contribution on the place of interdisciplinarity in the universities (Apostel, Berger, Briggs, & Michaud, 1972) broached the challenges and forms of collaboration between disciplines in both teaching and research. In that contribution, Berger (1972) viewed interdisciplinary work as a form of interaction between two or more disciplines:

“This interaction may range from simple communication of ideas to the mutual integration of organising *concepts, methodology, procedures, epistemology, terminology, data*, and organisation of research and education in a fairly large field. An interdisciplinary group consists of persons trained in different fields of knowledge (disciplines) with different concepts, methods, and data and terms organised into a common effort on a common problem with continuous intercommunication among the participants from the different disciplines”. (Berger, 1972, p. 25)

With a certain sense of anticipation and with a strong emphasis on the place of interdisciplinarity in epistemology and the philosophy of science, the multiple implications of interdisciplinarity were identified on the institutional level of the organization of universities – which were extensively structured on a disciplinary basis – on the conceptual and theoretical level of the definitions of interdisciplinarity, and on the level of the methodological implementation and modalities of cooperation between researchers (Jantsch, 1972; Piaget, 1972). With respect to the concepts relating to the dynamics of the opening up between disciplines, in particular, a relative consensus currently prevails on the definitions of pluri- or multi-disciplinarity, interdisciplinarity and transdisciplinarity (see for example Darbellay, 2005; Huutoniemi, Thompson Klein, Bruunc, & Hukkinena, 2010; Rosenfield, 1992; Stokols, Hall, Taylor, & Moser, 2008). These definitions henceforth constitute a relatively constant topic of academic discourse on the issues surrounding ITD. There follows a brief account of these complementary concepts (see Darbellay & Paulsen, 2008; Darbellay, Moody, Sedooka, & Steffen, 2014):

- *Multi-(pluri-)disciplinarity*: in a multi- or pluri-disciplinary perspective, a given object of study or a theoretical and/or practical problem that requires resolution is approached from two or more unconnected disciplinary viewpoints, in succession and in isolation without any real interaction between them. This procedure gives us some idea of the institutionalized and standardized nature of teaching and research practices, both socially and historically, which are governed by compartmentalized scientific paradigms. It reflects the traditional institutional juxtaposition of a number of communities of specialists, organized in the same number of relatively autonomous faculties, departments and laboratories.
- *Interdisciplinarity*: this brings into play two or more established disciplines so that they interact dynamically to allow the complexity of a given object of study to be described, analyzed and understood. Interdisciplinarity, which goes further than

⁸ This Project (“Analyzing Interdisciplinary Research: From Theory to Practice. Case studies in the Swiss University Context”) is funded by the Swiss National Science Foundation (SNSF/ committee specialised in interdisciplinary research, request: CR1111_143816) [2013, 2014]. The Project Leaders: Frédéric Darbellay (Main applicant), Pasqualina Perrig-Chiello, Anne-Claude Berthoud and François Höpflinger (Co-applicants). The Members of the Research Staff: Ayuko Sedooka, Theres Paulsen, Gabriela Steffen. Within the limits of this paper, we do not present all details of this project and all the results that will be released in a book in preparation. In the same way, we intentionally did not opt for the standard format for the presentation of research results IMRaD (Introduction, Methods, Results, and Discussions).

⁹ We respect the anonymity of the participants and their institutions. The confidentiality of the collected data applies to all of the quotes from the researchers presented in this paper.

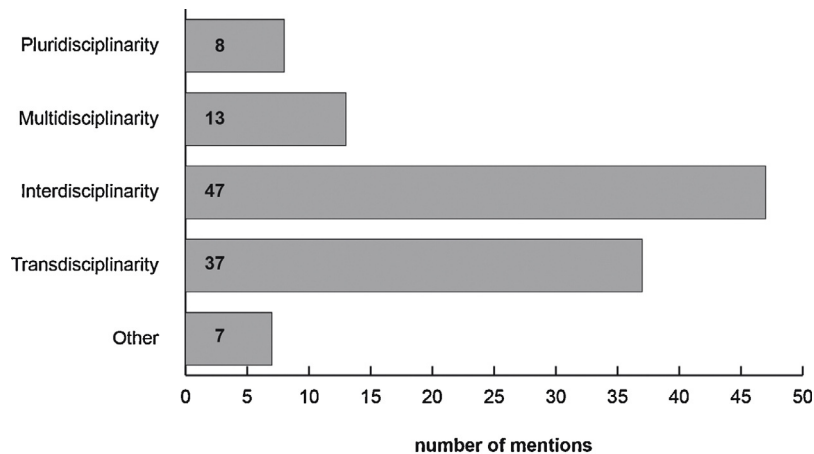


Fig. 1. Terms used to describe the decompartmentalization of disciplines ($N = 65$).

simply juxtaposing different disciplinary viewpoints, involves a collaborative and integrative approach by disciplines to a common object, in the joint production of knowledge. Collaboration and integration of disciplinary competencies and knowledge can occur at different levels of interaction: it can be a matter of transferring or borrowing concepts or methods from another scientific field, of hybridization or crossing mechanisms between disciplines, or even of creating new fields of research by combining two or more disciplines. In all these scenarios, the organization of knowledge along interdisciplinary lines is based on the interaction between several points of view, with the issues and problems treated falling 'between' (inter) existing disciplines, being recalcitrant to treatment by a single discipline.

- *Transdisciplinarity*: the concept of transdisciplinarity covers two major and complementary orientations. According to the first of these, which has an epistemological and theoretical accent, *trans*-disciplinarity is a process of knowing that *trans*-cends disciplinary boundaries, and entails a major reconfiguring of disciplinary divisions within a systemic, global and integrated perspective. According to the second orientation, which is more pragmatic, participative and applied, transdisciplinarity can be thought of as a method of research that brings political, social and economic actors, as well as ordinary citizens, into the research process itself, in a 'problem-solving' perspective. Actors from outside the scientific field contribute to the construction of knowledge and solution of social problems that fall outside disciplinary boundaries. Finally, it should be noted that transdisciplinarity applies also to the exploration of the complex relations woven in a dialogue between the scientific cultures deriving from the technical sciences, life and natural sciences, and the human and social sciences.

This clarification of concepts shows the progression and interconnections between the different levels in complexity of the links between scientific disciplines. From multi-pluri- to inter- and trans-disciplinarity, there is the same semantic and epistemological dynamic, which consists in grounding these types of approach in clearly identified disciplines while at the same time integrating them into an increasingly dense and interactive network of relations. It is this dynamic that gives inter- and trans-disciplinarity their particular significance: it transcends the simple juxtaposition of several disciplines, as in the case of multidisciplinarity, and represents a stage in the progressive integration of disciplines within a transdisciplinary perspective, due allowance being made for the various definitions applied to the latter. Disciplinary divisions are thereby transcended and reconfigured in and through the dialogue between scientific cultures and the resolution of societal problems.

I would like to take the question of the use of these concepts for describing work carried out between and beyond disciplinary limits as a starting point here. In the research carried out on the inter- and transdisciplinary practices of Swiss universities, we presented the following multiple-choice question to the 65 researchers in our sample ($N = 65$), all of whom claim to carry out interdisciplinary research. They are individually and collectively involved in interdisciplinary projects¹⁰ and belong to institutions which clearly include the objective of ITD in their institutional mission statements: "Which of the following terms do you use to define your approach to working beyond disciplinary boundaries?" Much in line with our expectations, while some researchers reported that they use the terms pluri- and multi-disciplinarity, the vast majority acknowledged that they use interdisciplinarity and transdisciplinarity (see Fig. 1).¹¹

In order to go beyond this seemingly obvious result in relation to the use of terminology, each researcher¹² was then invited to provide a definition of the terms he had used. Apart from some semantic variations inherent to the task of providing individual definitions, in general, the proposed definitions corresponded, even intuitively, to those formulated in

¹⁰ For each case study, the researchers were selected on the basis of their implication in an interdisciplinary research project that they were conducting together. Each project has been documented (application, presentations, publications, etc.).

¹¹ Figs. 1–4 were prepared by Theres Paulsen.

¹² The masculine case refers to both the masculine and feminine genders and is used for conciseness only.

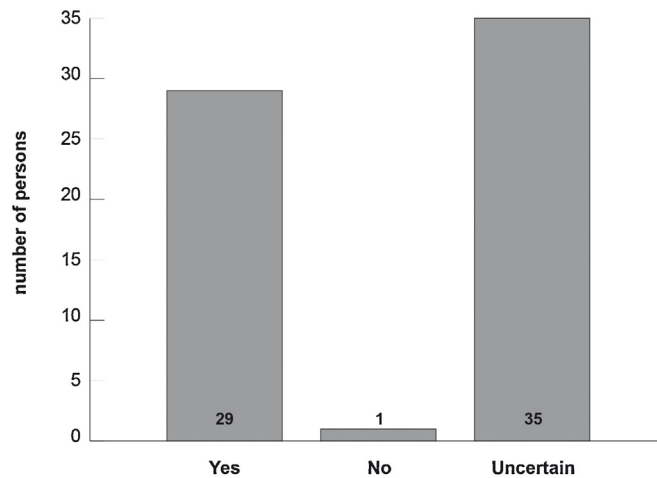


Fig. 2. Conceptual definitions between certainty and uncertainty (N=65).

the literature on ITD and presented above; that is the idea of going beyond mere pluri- or multi-disciplinary juxtaposition to embrace more collaborative and integrative approaches to knowledge between and beyond disciplines. To advance the investigation further, the questionnaire given to the researchers was followed up with the following question: “Do you share the definition(s) you formulated with your research colleagues?” (yes, no or uncertain). The answers provided are particularly interesting (see Fig. 2).

Although one single researcher reports that he does not share the definition(s) and or term(s) he uses in his interactions with colleagues and 29 researchers confirm that they share *a priori* the same definitional content, it is interesting to note that over half of the researchers (35) admit to feeling uncertain as to whether or not they share the conceptual world of their colleagues. This is particularly revealing in view of the fact that – beyond the seemingly obvious use of the terms inter- and trans-disciplinarity in a given community of researchers – we confirmed that these conceptual tools are not systematically discussed, negotiated and co-defined in the context of the communicational interaction of the research group. This finding is amply confirmed in the interviews and focus groups conducted with researchers. We can assume that this lack of conceptual thinking is sometimes – but not systematically – the vector of incomprehension and difficulty in the development and implementation of inter- and transdisciplinary projects. This failure to negotiate concepts in advance is not only one of the potential obstacles to the smooth running of interdisciplinary collaboration, it also testifies to the “normal exception” status (Grendi, 1977, p. 512) of ITD in the context of research practice: it appears to be a so-called ‘normal’ and obvious approach to the necessary crossing of disciplinary borders; however, this unquestioned normality often implicitly conceals the abnormal and exceptional dimensions inherent to the inter- and transdisciplinary approach. In effect, this represents – or should represent – a certain rupture with disciplinary routines and it should act as an actual condition of the progress of knowledge as already illuminated by Piaget (1973). This is where the constitutive paradox of researching beyond disciplinary borders lies: although it incorporates the idea of an innovative rupture, it is often perceived as something automatic (unthought) in the university and something whose capacity to transform the actual nature of the mode of producing disciplinary knowledge is not recognized in itself. To allude to a rhetorical stylistic device, ITD emerges as a kind of oxymoron due to the seemingly contradictory alliance between its transformative or revolutionary potential and its supposed conformity to a common practice in the university.

This new ‘rapprochement’ which reduces the transformation potential of the inter- and transdisciplinary approach and involves its neutralization under the pretext of a process of normalization that sounds like a call to disciplinary order constitutes another major obstacle to the development and full recognition of research beyond disciplinary borders. This applies, for example, to the almost ‘schizophrenic’ situations recounted by researchers who play the inter- and transdisciplinarity game while confidently adhering to the institutional displays for the promotion of the dialogue between disciplines and are caught out when the criteria ultimately remain clearly rooted in a purely disciplinary perspective – in relation to evaluation and academic careers. The statements of this nature made by the participants in our study included the following comment by the director (A)¹³ of an interdisciplinary institute in response to a question about this form of contradictory command:

¹³ We refer to the anonymous interviewed by alphabetical letters (A, B, etc.).

“Officially there is an open discourse on interdisciplinarity but it is not serious about interdisciplinarity. It is makeshift. And when a professor is appointed, he cannot be appointed on the basis of his interdisciplinary qualities because that comes later. There you have it. If we recruit someone who is young, he must be highly specialised, highly disciplinary.”

While the academic system generates cutting-edge disciplinary knowledge that is beneficial to the implementation of concerted and negotiated ITD, it also engenders a sometimes persistent lack of communication between researchers who claim to follow unquantifiable conceptual and methodological paradigms between different types of tribes and independent territories (Becher & Trowler, 2001). Despite the transformative capacity of the inter- and transdisciplinary approach, the institutional structure renews and reinforces the vast heterogeneity between disciplinary approaches, the polysemy of terminology and concepts, and the diversity of methods and cultures (Buanes & Jentoft, 2009). The institutional discipline-based organization often continues to hinder the establishment of a knowledge dialogue and its connection and integration between and beyond the disciplinary boundaries. Given the constraints inherent to the excessive disciplinarization of research practices, any attempt to resist – or exceed the limits – must take the diversity of scientific cultures and styles into account (Snow, 1964). If one defines a discipline as a system composed of different institutional, theoretical, epistemological and methodological dimensions, it could be hypothesized that, unlike inter- and transdisciplinary innovation, these mechanisms of resistance can operate partly or completely on these different levels.

2.2. Inter- and transdisciplinarity: a new form of research?

While decoding the descriptions that shape the thinking on the inter- and transdisciplinary approach, as part of our research, we extended the investigation in the direction of research practices. We presented the following multiple-choice question to the 65 researchers in our sample ($N = 65$): “What kind(s) of research does your interdisciplinary work generally involve?” The results (see Fig. 3) show the mixed use of different kinds of research: applied research and fundamental research – both relatively traditional forms of research – emerge as particularly prominent. However, the less widespread forms of action research and participatory research also feature among the research types mentioned.

Under the “other” category, the researchers reported the use of forms of research that largely coincide with the proposed categories while also presenting some semantic and methodological variations (“applied basic research”, “practice-oriented research” and “targeted research”). While all of the researchers acknowledged that they use relatively common forms of research in different combinations, it is particularly interesting to note that one researcher specified “interdisciplinary research” as another possible option, and hence acknowledged its entirely separate status as a form of research. This intuitive observation was quickly also confirmed in the answers to the next question concerning whether – from the perspective of the researchers – the inter- and transdisciplinary approach was either: (1) a separate form of research that complements the forms of research presented in the previous question; (2) a form of research that could arise within each of the other forms of research; or (3) a new form of research that reconfigures the divides between the forms of research (see Fig. 4). Although the idea of the existence of an inter- and transdisciplinary approach is implicitly recognized by the researchers and there were several positive responses to statements 1 and 3, the results are clear and particularly symptomatic of a situation, in which ITD is not clearly identified as a specific form of research with its own tools, methods and practices (1). The surveyed researchers only acknowledged in part that ITD has the capacity to move – or reconfigure – the boundaries between the more canonical forms of research (3). On the contrary, they broadly understand ITD as an approach that is likely to arise in the context of fundamental research, applied research, action research and participatory research (2). The researchers seem to recognize ITD’s ability to intervene in existing forms of research. However, they do not give it the status of a relative autonomous form of research or the ability to transform the boundaries between the more classical forms of research. Although no knowledge – even interdisciplinary – is created *ex nihilo* (it is quite often based on proven forms of research), the

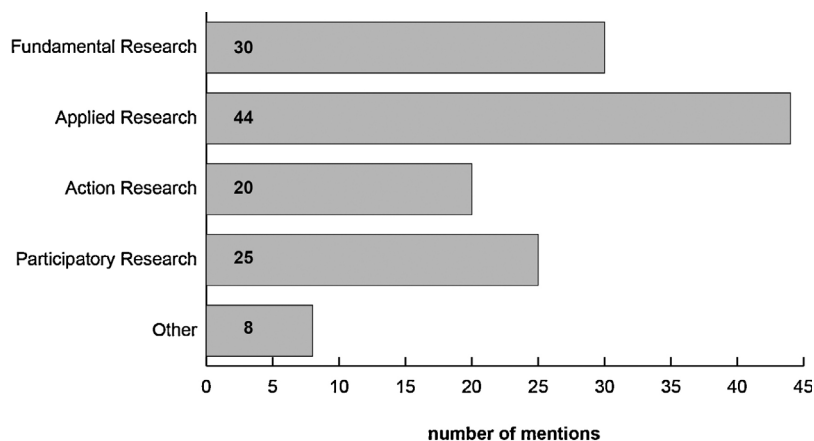


Fig. 3. Forms of research ($N = 65$).

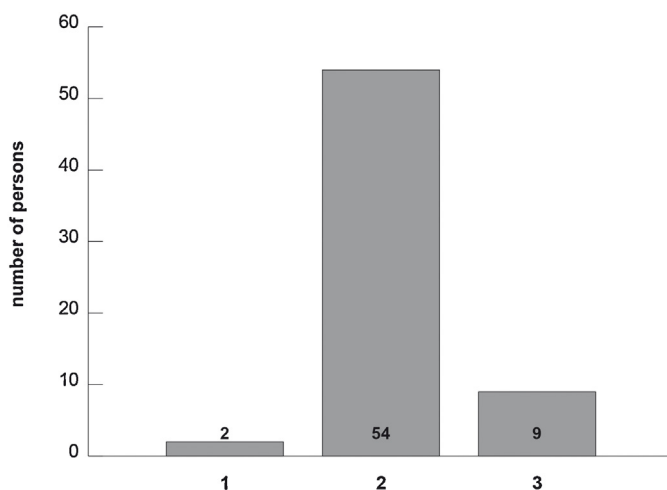


Fig. 4. Inter- and transdisciplinarity as a form of research (N = 65).

failure to recognize the specificities of ITD can be an obstacle to the development of new forms of research that transgress current practices.

My intention here is not to wrongly generalize this observation which, moreover, comes close to ITD's status as a "normal exception" as noted above in relation to the more or less explicitly negotiated use of the concepts of multi-, pluri-, inter- and trans-disciplinarity. Instead, it would appear to be of interest in this context to interpret it as an indicator of the difficulties still encountered by the implementation of the inter- and transdisciplinary approach in research practice. Of course, nobody explicitly denies its existence. However the question arises as to whether researchers, their institutions and the bodies that support research are ready to allocate it the status of a separate form of research, whose modes of production, evaluation and valuation (in particular in terms of academic careers) should be fully empowered.

Given the reality of support for and progress made by this approach, as noted above, there is no pessimism lurking behind the observation of the potentialities and limits of ITD presented here. However, it does reveal a tension between conformism and innovation that is not always acknowledged but is nonetheless very real. This was already highlighted by Bachelard: "When it presents itself to scientific culture, the mind is never young. It is very old, in fact, as old as its prejudices" (Bachelard, 1938, p. 14). While inter- and transdisciplinary research is not created *ex nihilo*, outside of all disciplinary roots, on the other hand, it remains frequently caught in the field of attraction of disciplinary positioning that are "as old as their prejudices" when faced with the new practices that go beyond them and clearly extend beyond their scope. In contrast, opting for ITD means being able "to grow younger in mind and spirit" and to "submit to a sudden mutation that must contradict the past" (Bachelard, 1938, p. 14). ITD is a vector of innovation. It provides space for the incubation of new ideas through the introduction of nomadic concepts, theories and methods located between seemingly separate disciplinary spaces (Darbellay, 2012). Departing from the fragmentation of the scientific field into disciplines and sub-disciplines, inter- and transdisciplinary research operates through the creative recombination and hybridization of new areas. This discovery-based work is mainly carried out on the periphery of the disciplines (Dogan & Pahre, 1990). Beyond the advances and actual successes of ITD, this awareness of its innovative dimension invites us to rethink its foundations and, particularly, its ambiguous relationship with disciplinarity (Origgi & Darbellay, 2010).

3. A metamorphosis of identity and thought style

3.1. Indiscipline and hybrid identities

The pupil or disciple (*discipulus* in Latin) is one who submits to a master, is bound by obedience and allegiance, and accepts the need for the lash of the 'discipline' (*disciplina* in Latin), i.e. the whip comprising thin cords or chains used as an instrument of penitence, mortification or coercive self-discipline. While leaning on the disciplines, the inter- and transdisciplinary researcher responds, in contrast, to a desire to free himself from disciplinary constraints, and sometimes engages in acts of indiscipline (Robinson, 2008) and disobedience vis-à-vis the mainstream visions of his original disciplinary community or communities. This type of posture can be observed when we consider, for example, the (auto-)biographies and career paths of researchers in different scientific fields (see, for example, Lemay & Darbellay, 2014). Without engaging in over-simplification, it could be said, however, that – in contrast to standard disciplinary communities who occupy bounded *positions* in the academic arena – inter- and transdisciplinary researchers frequently opt for more atypical *postures* which are negotiated at the intersection of two or more disciplines. In effect, the disciplinary *habitus* establish an *orthodox* vision of the dominant scientific practices guided by shared epistemological and methodological frameworks, based on

which inter- and transdisciplinary researchers should define themselves. Whereas “the central players, the orthodox, the continuers of normal science” in the sense of Bourdieu ([Bourdieu, 2001, p. 87]) try to monopolize positions in the institution of the university, in contrast the *heterodox* create new trajectories beyond disciplinary limits. It is “the marginal, the heretics, the innovators who are often situated on the boundaries of their disciplines (which they sometimes cross) or who create new disciplines on the boundaries of several fields” (Bourdieu, 2001, p. 87).

The inter- and transdisciplinary researchers belong to the heterodox family who are prone to shifting the institutionally established boundaries between the disciplines. It should be mentioned that any heterodox posture, in turn, is likely to stabilize in a new disciplinary field (a new orthodoxy), in which researchers share a relatively stable theoretical framework and methodological tools. This is for example the case of the ‘Studies’ referred to as multi-disciplinary fields while sometimes performing a new disciplinarization of knowledge (e.g. gender studies, visual studies, postcolonial studies, geopolitical studies, porn studies, etc.). In this context, it is relevant to reflect that the actual concept of the *discipline* mainly provides the basis – like a fixed threshold – from which an inter- and transdisciplinary approach is constructed, however it is rarely questioned in itself and never radically challenged. Does this mean that it remains too risky to challenge the question of disciplinarity within the university? Is the mere question taboo? Are the disciplines untouchable? On the contrary, it is essential that we take the risk of highlighting the central question of the fact of disciplinarity. In effect, the disciplines and researchers who claim to represent them should be questioned about their own disciplinary identity, which reflects a seemingly fixed, consensual and homogenous image. When subject to closer scrutiny, every discipline presents a configuration of currents and schools of thought that traverse it from one end to the other as though through fragmentation and internal diversification. Dialogism and interdisciplinary otherness are at work at the heart of disciplinarity. The acknowledgement of this intra- or infra-disciplinary dynamic involves rethinking the disciplinary identities which do not prove to be as solidly rooted as the academic organization would sometimes like us to believe. In the context of our aforementioned research on inter- and transdisciplinary practices, we asked researchers about their academic career paths and it generally emerged from our sample that – beyond the institutional disciplinary labelling – identities undergo processes of change or “become diluted” as metaphorically expressed by this researcher (B):

“My disciplinary identity is a bit fundamental, it is sociology. [...]. And then, it dilutes itself in the course of interdisciplinary encounters. We no longer have the time to remain strictly disciplinary [...]. We are becoming more and more open to others and are even becoming a bit diluted ourselves. I myself no longer have the time to pursue pure sociology.”

As another researcher (C) demonstrates, the relativization of the effect of disciplinary enclosure also allows the idea of inter- and transdisciplinary trajectories and more hybrid identities and profiles to emerge:

“I started by doing physics, not to become a physicist, but I was simply passionate about the history of science from a relatively young age, and at the time it was said that you had to do science before you could do history of science. I became involved relatively quickly in rather amateur epistemological enquiry because I was young and I remember that, at the time, we established a group with biologists and physicists etc. who were interested in epistemological questions. And then, finally, I clearly realised that what I was interested in was the humanities and social science but in conjunction with the natural sciences. [...]. What characterized this career stage was always, let us say, its hybrid nature, I was never in a single field. A career always characterized by the hybrid, a life in different biotopes. [...]. In the absence of an institutional mechanism for interdisciplinary research, it must be said that it is essentially the relationships with people that give rise to projects. [...]. I do not consider myself in the slightest a *Homo academicus*, the question of academic identity has honestly never been a problem for me. [...]. I never set myself up as being disciplinary, I never made any claim to being disciplinary.”

From the perspective of the academic career path, all basic disciplinary positions are prompted to evolve through contact with other disciplines. The disciplines are not in the process of disappearing. However it is important to be fully aware that they are changing and transforming against a background of continuity, and that, accordingly, they can no longer operate as a simple argument for resistance to the innovative progress of ITD. Given that otherness is at work at the heart of the disciplines, ITD ultimately represents the guarantee of the progress and endurance of disciplinary knowledge.

Of course, the disciplines are focused on their own objectives and disciplined language, their intradisciplinary “intimacy”. However, at the same time they are inevitably coupled with an inverse process of extradisciplinary “extimacy”. Adopting the concept of “extimacy” in the sense of Tisseron (2001), one could say that every discipline is called on to disclose the intimacy of its concepts, theories and methods while making its own challenges visible and while turning outwards to enter into dialogue with the other disciplines. Hence, one discipline exists through the lens of another which it mobilizes for its own enrichment, thereby reinforcing the reciprocal respect of the researchers involved in this dialectical process. This inter- and transdisciplinary opening is not an act of exhibitionism each disciplinary perspective towards the others. On the contrary, it is the bringing into play of the capacity to decentre and identify with the disciplinary other (the *alter*) which works at the heart of its own discipline. As Foucault aptly said (Foucault, 1971), although a discipline is the principle that controls the production of scientific discourse and is “defined by groups of objects, methods, their corpus of propositions considered to be true, the interplay of rules and definitions, of techniques and tools” ([Foucault, 1971, p. 32]), it is simultaneously a fluid system which evolves through contact with the other disciplines: “For a discipline to exist, there must be the possibility of formulating – and of doing so ad infinitum fresh propositions” (Foucault, 1971, p. 38).

3.2. A new thought style

The production of knowledge between and beyond disciplines does not amount to a simple cumulation of juxtaposed disciplinary perspectives. On the contrary, it consists in the exceeding of the principle of the accumulation of disciplinary knowledge piled up in a spirit of erudition to give free rein to an encyclopaedic way of thinking in the etymological sense of *enkuklios paideia*, that is a learning process that sets knowledge in motion. As Morin noted, this effectively involves putting knowledge in circulation, “that is to say learning to articulate the disjointed points of view of knowledge into an active cycle” (Morin, 1977, p. 19). By going beyond the disciplinary congealing of ideas, concepts, theories and compiled methods, inter- and transdisciplinarity represents an original thought style. The idea of a “thought style” (*Denkstil*) formulated by Fleck in 1935 (Fleck, 1979), designates the collective configuration of norms, concepts, theories and values shared by a scientific community at a given time in its development (a “collective thought”/*Denkkollektiv*). The proximity of this collective version of the thought style to the notion of the “paradigm” as used by Kuhn (Kuhn, 1996) is clear; moreover, the latter was directly influenced by the work of Fleck. The development of a particular thought style is based, therefore, on a collective thought that is rooted in a socio-historically located community of researchers who interact intellectually and exchange ideas, concepts and methods.

From this perspective, ITD could be described as a new thought style in the sense that this approach has become a focus of interest for researchers who organize themselves in national and international networks as demonstrated in the introduction (Section 1), and hence constitute a community of researchers who contribute to the emergence and development of a new field of study. According to Fleck (Fleck, 1979), however, a thought style has the tendency to constrain the individual through an external determinism that would be impossible to resist. Hence it is necessary to guard against blindly applying the notion of collective thought style to the specific case of ITD, in that the idea covers a certain normativity, in the face of which the individual researcher would be thwarted in his desire for the emancipation and creativity that would, indeed, enable a thought style evolve. If ITD can be defined as a new thought style, it is not only in the sense in which it partakes in a collective thought in the course of development and growing in the scientific community, but also in the sense that it gives researchers the possibility to go beyond their disciplinary limits to develop original trajectories in the production of hybrid knowledge. Hence there is not merely one thought style but a plurality of styles which co-exist in the inter- and transdisciplinary dynamic (e.g. a collaboration of academic as well as non-academic thought styles in the process of problem solving) (Couix & Hazard, 2013; Pohl, 2011): circulation and exchange even exists between thought styles. Indeed, as we noted in the introduction (see Section 1) and as read through the definition of the concepts of ITD (see Section 2.1), there is not one paradigmatic and homogeneous ITD thought style, but complementary ways to implement dialogue and integration between disciplines. As Fleck clarified in the context of the comparative theory of knowledge, it is important to focus on the way in which the conceptions and idea circulate from one thought style to another, thereby demonstrating the profound variation and plasticity that drive the production of ideas on the interface between disciplines. This both collective and individual thought style is close to the idea of the episteme developed by Foucault (Foucault, 1969, 1994): it designates the space of formation and transformation of knowledge which cannot be reduced to an accumulation of information at a given moment in scientific development, and which, on the contrary, takes into account “the divergence, the distances, the oppositions, the differences, the relations” (Foucault, 1994, p. 676) forged between the multiple scientific discourses that constitute it: “it is an open and indefinitely describable field of relationships” (Foucault, 1994, p. 676). Hence, we can also recollect with Foucault that “knowledge, as the field of historicity in which the sciences appear, is free of any constituent activity, disengaged from any reference to an origin or to a historico-transcendental teleology” (Foucault, 1994, p. 731).

As a thought style, ITD is a combinatorial style which aims to connect different styles of scientific reasoning. In his studies on research styles and methods (Crombie, 1994), Crombie distinguishes six “styles of scientific thinking”: (i) the simple method of postulation (mathematical sciences); (ii) the deployment of experiment both to control postulation and to explore by observation and measurement; (iii) the hypothetical construction of analogical models; (iv) the ordering of variety by comparison and taxonomy; (v) the statistical analysis and the calculus of probabilities; (vi) the historical derivation of genetic development. These different styles of investigation and scientific demonstration evolved throughout the history of European science. They emerged successively, but did not succeed each other or simply erase one another. They are not necessarily mutually exclusive and are often combined in the history of science. Each style produces new questions and leads to the development of new research objects. This generalizing classification shows the diversity of methods for the construction of scientific objects that have existed and more or less persisted in the history of science. Following Crombie’s studies, Hacking lists some of the styles that dominate in philosophy and the history of science (laboratory style, statistical style, probabilities style and the style of classification in humanities and social sciences) (Hacking, 1992). These styles cover different ways of thinking, questioning and searching. The development of a new style is related to the emergence of new issues that need explanation and understanding and require new epistemological criteria. It is interesting to recall – especially in the case of ITD – that several styles can coexist within the same scientific community or a group of researchers or even carried by an individual researcher. Finally, inter- and transdisciplinary research takes into consideration the tangled plurality of styles of scientific reasoning or “schemas of intelligibility” (Berthelot, 1990) that are constitutive of epistemological pluralism. We can also question the prevalence of a particular style of reasoning in ITD work. For example, the style comparison and taxonomy allows setting a dialectic of concepts, theories and methods from different disciplines and from there a more or less shared framework can be produced. The analogical style (construction of analogical models)

would be particularly powerful for the circulation of ideas and concepts between and beyond disciplinary boundaries, producing new models through boundary crossing (Darbellay, 2012).

Due to the scope of this contribution, I will not undertake a comparative analysis of these attempts at identifying and typologizing styles of scientific reasoning, however I will keep in mind the basic idea that inter- and transdisciplinary work attempts to link several epistemological postures, several ways of thinking about and carrying out research in theoretical and methodological terms for the co-construction of a negotiated and shared object of knowledge. The inter- and transdisciplinary style works on what is between (*inter-*) and beyond (*trans-*) the disciplines, on the variation and divergence in counterpoint with the disciplinary norm. It creates a space for dialogue, etymologically a *dialogos* – of *dia-* through the *logos* (the word, the thought), a process characteristic of an act of intelligence from the Latin *intellegere*, that is the capacity to link (*legare*) ideas with (*inter*) each other. The inter- and transdisciplinary thought style presents a dual nature; it is both collective and individual: *collective* in the sense that the research community more or less agrees on what an inter- and transdisciplinary approach can or should be; *individual* in the sense that the researchers are always likely to follow relatively original theoretical, conceptual and methodological trajectories between and beyond disciplinary boundaries. Thus, ITD is similar to a kind of research practice that today tends to regulate itself in its mechanisms of production and evaluation while remaining a space of variation and individual divergence with regard to this desire for regulation-normalization of the diversity of practices.

In spanning a standardized system of rules for scientific production and the more or less marked transgression of all canonical vision, the inter- and transdisciplinary style aptly covers the dual sense of the word style, i.e. the Greek sense of *stylos* as a system of rules and the Latin sense of *stilus*, which refers to the individuality of all personal expression. The inter- and transdisciplinary style is one and many; it works on the boundaries of the disciplinary norm while constantly reconfiguring it. Aware as we are that creative marginality through the hybridization of several disciplines is a source of innovation and creativity (Darbellay et al., 2014; Dogan & Pahre, 1990; Giri, 2002) that invites us to rethink disciplinary identities as demonstrated above (Section 3.1), and inasmuch as one would like to analyze and understand the mechanisms of production of ITD while establishing good practice and also examining the more or less marginal practices in relation to what would replace the norm, this consideration of the dual – individual and collective – nature of the inter- and transdisciplinary thought style definitively invites us to develop a stylistic form of interdisciplinary research practice.

4. Conclusion

The key ideas developed in this paper show that the inter- and transdisciplinary approach has certainly experienced and still experiences promising advances in education and research, but that it must at the same time face institutional, epistemological and methodological barriers. These obstacles cannot be removed as long as ITD is taken for granted. In the same way, the inter- and transdisciplinary research is probably not a form of research in addition to more conventional forms (fundamental, applied, etc. research). It is a form of research in its own right and needs to be recognized and valued as such; it must be negotiated and shared among all the actors of the higher education system. This opening movement can also be seen in the researchers' transformed and hybrid identities that lie between and beyond disciplinary boundaries and participate in the development of a new thought style.

Beyond the fad for research outside of traditional disciplinary limits and the observation of its more or less successful institutional establishment, no academic is in a position to declare the existence of a golden age of a new ITD thought style based on peaceful relationships between disciplines. This irenic aspiration remains utopian in referring to an ideal place. In this place, the creative innocence of researchers open to dialogue between disciplines would be given due recognition compared to the support given to disciplinary careers. They would benefit from the allocation of an abundance of resources for the pursuit of their objectives. As is the case for all other paths, the joy of working across disciplines is within reach, however it is not without its share of difficulties arising from interpersonal, communicative, epistemological, methodological and institutional obstacles that await anyone who has the intention of going beyond disciplinary limits. And this is undoubtedly where lies the entire interest of the inter- and transdisciplinary style experiment.

ITD is not perhaps experiencing its golden age or ideal; on the contrary – if we extend the metaphor of the Greek myth of the ages of humanity – neither will it experience the age of iron that would lead to the pure and simple irreversible deconstruction of disciplines or other anti-university crimes and acts of violence. The inter- and transdisciplinary approach draws its entire meaning in the 'inbetween' of the disciplines – "inter", which is between, at the interface, "trans" which traverses and transgresses – between disciplinary order and undisciplined chaos. This state of equilibrium arises at all levels of university life: it grapples with the institutional structures and reciprocal positions of the disciplinary communities with their epistemological prejudices and their theoretical and methodological *a priori*. The calls for the decompartmentalization of the disciplines resonate like an invitation to a lack of discipline within the constraints of rigour so as to create a constructive dialogue between the researchers who intend to rethink and renew their own conceptual and analytical tools.

Inter- and transdisciplinary researchers – both young and experienced – offer new academic profiles for the multiple and hybrid identities that take the risk of working on the boundaries of disciplines (Horlick-Jones & Sime, 2004) and the skills associated with them should be supported, enhanced and valued (Bridle, Vrieling, Cardillo, Araya, & Hinojosa, 2013; Lyall & Meagher, 2012). These new profiles evoke the figure of the inter- and transdisciplinary hacker who would like to change academe from within without causing its collapse, and hence even share cognitive ethics which battle against all libercidal behaviours. In the light of an academic organization that is still enormously hierarchized in terms of disciplines, should ITD

be understood as a disruptive innovation strategy or as a means of evolutionary transformation of universities? Seen as a hacker, the inter- and transdisciplinary researcher is not a lawless hoodlum but the scientific citizen of the world who is moved by the values of information-sharing, passion, pleasure and the circulation of knowledge outside of the logics of hierarchical power. This “hacker attitude” (Himanen, 2001), which is based on the true ethics of the hacker, would enable the researcher to act within the academic system to modify its disciplined functioning – locally and globally. In contrast and based on a disruptive logic, the “cracker” would be the one who attempts to intrude into the system without authorization and with the intention of causing its collapse through disruption and destruction, causing an unthinkable crash of the university system.

To “hack the academy” (Cohen & Scheinfeldt, 2013) is to become aware of the obsolescence of university structures which see their development solely in the context of the disciplinary regime while the modes of production of knowledge are undergoing a complete transdisciplinary transformation, driven by the impetus of the digital turning point in particular. The reflections on inter- and trans-disciplinarity, which envisage its future (Lawrence & Despres, 2004) and rethink its foundations as a return to the future (“Back to the Future”), encounter the logic of the network today, the sharing and exchange of knowledge in the age of information and communication. Hence, it is a matter of studying the way in which knowledge is woven between them through a “hyphological” approach (*hyphos* is Greek for veil or net and the spider’s web) in accordance with Barthes’ neologism (Barthes, 1997/1973), or examining the production of knowledge “in the interlacing of codes, formulae and signifiers, in the midst of which the subject places himself and is undone, like a spider that comes to dissolve itself in its own web” (Barthes, 1997/1973, p. 817). In this digital context, the medium and long-term sustainability of our universities will depend on their capacity for innovation between and beyond disciplinary divides based on a dual logic of continuity and transformation.

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