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Crossroads of Humanities and Sciences**

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Music and Dance Representations At the Crossroads of Humanities and Sciences

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Abstract

Music and dance practices have always attracted the interest of scholars of the “two cultures”, humanities and sciences. While researchers in the cultural studies seem to strive to translate dance and music phenomena to texts, computer scientists make a parallel effort to categorize and model patterns of sounds and choreography according to mathematical and physical definitions. In this essay I suggest that the impact of the theories of embodiment in both cultures forced an approximation that produces new representations of knowledge flowing from sciences to humanities and art, without clear borders. In the cultural studies, the demands for narratives that go beyond textual descriptions created a theories that attempt to re-write dance and music phenomena according to its own symbolic elements. In the sciences, the efforts to understand human motor and musical behaviour, fostered the application of non-linear methods and a strong criticism on Cartesian metrics and traditional statistics that provided new multimedia and symbolic representations for dance and music. These new forms of representations respond to the problems envisaged in both fields by making use of information technologies, visualization and human-machine interaction, which disrupt the linear narrative of textual representation while keeping the consistence with the objective structure of the data. We discuss the impact of these tendencies in the related fields and the perspectives of multidisciplinary research, specialization and knowledge.

Keywords:

Introduction

Complexity seems to emerge from every aspect of the production of knowledge. Every fragmentation, fissure, viewpoint or structure of modern knowledge production seems to reserve another universe of possible analyses, fragmentations and endless specializations. The frightening (yet fascinating) process of dealing with complexity is challenging and seems to require more than time or resources. As a problem that involves not only an *object* but also the *questions* and uncertainties that emerge from disciplinary approaches, “complexity” appears to demand a change of the paradigm of disciplines. Chances are that the actual reader has once experienced the sensation of being overwhelmed by too many solutions or representations for problem. A kind of suspended stage, where not only the problem presents itself in ambiguous ways but the methods in use change the object and explanations in many different ways.

Actual processes of dissemination of knowledge such as written language or even graphical two-dimensional representations seem to be too linear and slow for the spectrum possible explanations. These technologies of representation seem to be deeply dependent on the two dimensional possibilities of paper and the linear sequence of discourse of written language. Disciplines seem to be too narrow and unstable for the magnitude of internal and external relationships of the problems. This critical level of ineffectiveness would possibly lead to a bold movement driven by consensus and urge of stability, characteristic of the positivistic nature of Western knowledge industry. But there is no signal of consensus.

The necessity to understand counter-disciplinary actions is far from being evenly understood by stakeholders of current production of knowledge. There is a mixture of consensus, dislike, understanding and inertia in every transdisciplinary proposal. Tensions between disciplinary borders and the anti-disciplinary movement are constant and affect all the aspects of research, production, funding and dissemination of knowledge. Actual research topics are too complex to ignore details of specialization (Klein 2008). Objects of research are too interviewed to avoid the influence of other disciplines. How to cope with the deadlock of current epistemological limbo affecting disciplinary work?

One hypothesis is to continue a sort of “brute force” approach, changing and enriching disciplinary deepness ad-infinitum. Another possibility is to engage into cross-disciplinary negotiations on every aspect of disciplinary work. A third hypothesis would a change of perspective (a post-disciplinary approach) into a problem-oriented approach.

It has been claimed that the excess of specialization produced too many disciplines with specific approaches, which became inefficient from the point of view of problem-solving perspective. Other authors indicate that research has become inevitably complex in each area of specialization and new forms of communication should be developed to connect these areas. Nicolescu (2002), for example, claims that the lack of methods to bridge discipline could

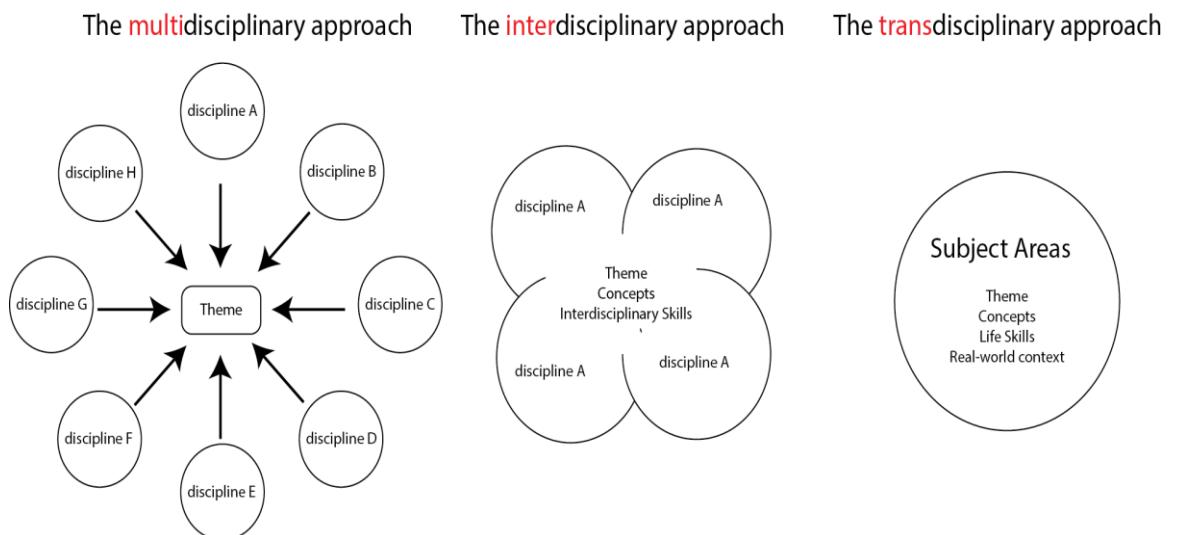
ultimately represent a threat to human civilization: blind disciplinary actions would let to catastrophic misinterpretation of human challenges and problems. For another side, lack of specialities would stop the development in both humanities and in sciences, which would have an impact in many practical areas of the current modern life. In the background of these questions lies a disturbing question: objectivity and subjectivity encoded in our academic disciplines are just unsuited to cope with the complexity of the disciplinary divisions?

In this essay I explore a positive response to these questions: The development of disciplines across local disciplinary foundations may reserve encounters with other disciplinary matrices as a result of the specialization itself. By looking at specific cases showing how cultural studies and movement sciences approach the representation of knowledge in dance, I try to demonstrate how disciplines bridge each other and seem to be inevitably coherent from two radically opposite perspectives.

Disciplinary Models

So far, the counter-disciplinary discourse in both sciences and humanities has evolved into models that acknowledge a range of possible relationships between disciplines. The various prefixes to the “disciplinary” matter indicate how different theories were proposed and how diverse are the alternatives to the current disciplinary crisis (Miller 1982): transdisciplinarity, interdisciplinarity, multidisciplinarity, crossdisciplinarity.

Figure 1. Prototypical Representations of Counter-Disciplinary Models
Adapted from Drake (2004)



Modelling counter-disciplinary research may be a reductionist approach to activities that are diverse and not entirely predictable in research actions and

collaborations groups. However, the models in Figure 1 demonstrate that the axis of analysis of knowledge production is still rooted in the disciplinary divisions and strongly driven by an institutional model of research: the structure the disciplines remain the most important structure to be stressed. Less apparently, the models also show the hidden axis that goes from theoretical to pragmatic perspective of counter-disciplinary actions (or problem-solving perspective). From this trajectory — from theory to problem-solving perspective — emerges another dimension where theoretical divisions of the disciplines become secondary and the capacity to solve real problems a primary element.

The Paradigm of the Problem Solving

As stated in Drake's models (Figure 1), the change to a problem-solving paradigm is supported by a number changes in the traditional discipline-oriented model. An increase in the interaction between disciplines is a result of (or results in) the dissolution of the intrinsic idea of a single "right answer" or "main interpretation" for a given problem. Since fixed theoretical premises present in the disciplines do not guide the notion of knowledge in this case, the presence of ambiguity and uncertainty provoked by parallel methods emerge as a strong trace of this paradigmatic change. A shift to problem-oriented actions appears to be a main characteristic of post disciplinary approaches (Miller 1982; Klein 2008).

However, this viewpoint is also subjected to criticism. Miller (1981) argues that problem oriented approaches do not "provide a conceptual framework for its own analysis, but has to be provided by the investigators" (Miller, 1981). More importantly, the focus on the problem seems to downplay the importance of the disciplinary methods, practices and, by consequence, the notion of certainty, right or wrong. In the humanities, the shift seems to be related to the dissolution of the notion of "truth". In the sciences, this criticism is rendered in the perception that centrality, superficial interpretation of statistic significance and causality are not working in some contexts. In both "cultures" of knowledge, the notion or a "right solution" or a competitive race for the "best explanation" for the problems appear to be stranded in a kind of epistemological inertia: curricula, methodologies, institutions, authorities and many other versions of disciplinary divisions impose obstacles to the emergence of a new forms of scholarship and inquiry. Souza Santos (1992), provides an insightful account of this problem:

In modern science knowledge advances by specialization. Knowledge is ever more rigorous as its object is restricted. Indeed, herein lies what is today recognized as the basic dilemma of modern science: its rigor increases in direct proportion to the arbitrariness with which it straitjackets reality. As a disciplinary knowledge, it is prone to be a disciplined knowledge—that is to say, it organizes

knowledge by policing the borders and repressing all trespassers. It is recognized today that the extreme fragmentation and disciplinarity of scientific knowledge turns the scientist into a specialized ignorant person—a negative development whose effects are visible primarily in the applied sciences. Technology today is concerned about its destructive impact on the ecosystems. (de Sousa Santos 1992, p.37)

Disciplinary Changes as a Result of Political Movements

Even a superficial look at the literature of counter disciplinary models reserves intriguing observations. Disciplines seem to be strongly characterized by changes operated by active individuals and groups, as if the very same disciplinary notion of impersonality and blindness of academic scholarship was absent from the knowledge production itself. Miller (1982), for example, indicates that disciplinary principles are acquired by individuals and become filters:

“In fact, disciplines in any field are characterised by their special filtering and interpreting devices. Over time, the members of a particular discipline acquire a shared set of principles by which their inquiries are directed” (Miller 1982, 4)

Klein (2008) evaluated interdisciplinary research by discussing a number of issues concerned almost entirely to collaborative insights and institutional results. Borrego and Newswander (2010) examined different definitions of interdisciplinary research and identified five categories of learning outcomes for interdisciplinary education: (a) disciplinary grounding, (b) integration, (c) teamwork, (d) communication, and (e) critical awareness. It is interesting to observe that most of the critical analysis in the field or any counter disciplinary action are put in movement by political negotiations between groups, individuals and institutions. Although these processes comprise methodological and organisational mediations that are inherent to research practices, the drive that motivates interdisciplinary efforts seem to be guided by political decisions of stakeholders, not even influenced by the construction of knowledge itself or moved by contributions to the understanding of problems. Are the counter-disciplinary models another political attempt overturn in the institutional state of the disciplines?

Convergence in Overflowing Disciplines

Two opposite relevant concerns seem to emerge at this point. First, it seems ingenuous to deny that disciplinary specialization often results in real contributions and developments to the construction knowledge. Second, more evidences show that the capacity to deal with modern problems is increasingly

dependent of interactions between disciplines. If these premises reflect the reality, it would be reasonable to expect that the flow of specialization would have to reach a state of **intrinsic interdisciplinarity** (e.g.: Austin, Park, and Goble 2008): a state where developments in the knowledge could only proceed by extending specialization to other disciplines. In other words, a state where transdisciplinarity is the convergence of a stage of deeper specialisation. In this case, the specialized knowledge would overflow from the disciplinary limits across different external disciplines as a continuation of the internal developments.

Another possibility is that representations, problems and results inside the disciplines would become more similar and negotiable simply because their contribution to approaching the problem reaches the same structural understanding. Such a process would be a result of internal drive of production of knowledge and would be present in the state-of-the-art of the specialization areas in the form of concurrent or parallel representations of knowledge, questions or problems. This form of spontaneous interdisciplinary movements realized as parallel developments would be extensively facilitated by the use of more generalizable descriptions of knowledge (e.g.: graphs, math, schemes) and by more efficient searching/discovering technologies.

In this paper, we look at parallel insights and demands realized in the culture of sciences and humanities when facing the problem of dance representation. We describe how the focus to the problem of representation of human movement results in the developments of similar approaches in radically different methodological branches, in sciences and humanities. Rather than proposing a classical evidence for the hypothesis of concurrent representations, the characteristics of the fields are analysed in the search of parallels viewpoints to the same object. These insights show that the post-disciplinary tendency may not be an extraneous political change in the academic world, but rather a result of an unparalleled effort to produce meaningful understanding of the real-world problems, which is the main hypotheses raised here.

Humanities: The Muted Knowledge of Dance

Dance studies, and great part of art studies, have been naturally attracted to the humanities field. Dance has also attracted scholars orbiting the humanities to an active role in the development of dance scholarship or even performative roles. The forces that drive the interaction between humanities, dance and art are mostly driven by the strong subjectivity attached to the performance practices, choreological and choreographical viewpoints on gestural movements and its relationships with culture and society¹. In special, the lack of widely accepted notation or registering method for dance in all its significant

¹Although there are no clear consensus about the inclusion of sociology in the field of humanities we consider it as a part of the subjective approach to the dance matter in humanities

elements for performance has contributed to a dissociation of dance studies of generally accepted systematic analysis. Dance studies, however, form an object-oriented discipline, which approaches dance practices through number of methods, techniques or disciplinary filters (Miller 1982) elected by the scholarly community. Hanna et al (1979), for instance, proposed a model based on a combination of disciplinary methods found in anthropology.

Music and dance traditions — as seen from a Western perspective of culture and performance — are identified in almost all human cultures. Although dance seems to occupy a space that is similar and concomitant to music studies, dance has its own specificities. Dance is less subjected to linear annotation or notation. Its medium, the body and its visual display, imposes a figurative, ever-present image of the performance. The acoustic medium of music is not visually present and acoustic displays are framed and influenced by the idea of silence. Dance is performed and displayed through the common structure of the body, making it a powerful carrier of messages due to the human capacities of mirroring and imitation actions (e.g.: mirror neurones and imitation theory, Gallese 2001).

So far, the framing of dance practices in the humanities conducted the dance studies to a research practice based in written language in which attempts to describe movements became merely illustrative. The tendency to “mute” the dancing body in the translation of dance into the humanities is somewhat counter intuitive (if not disruptive) in the perspective of a dancing knowledge, as clearly expressed by Desmond:

“(...) Even the now popular subfield of critical work on “the body” is focused more on representations of the body and/or its discursive policing than with its actions/movements as a “text” themselves. In part this omission reflects the historical contours of disciplinary development within the academy. In addition, the academy’s aversion to the material body, and its fictive separation of mental and physical production, has rendered humanities scholarship that investigates the mute dancing body nearly invisible.” (Desmond 1994, 34)

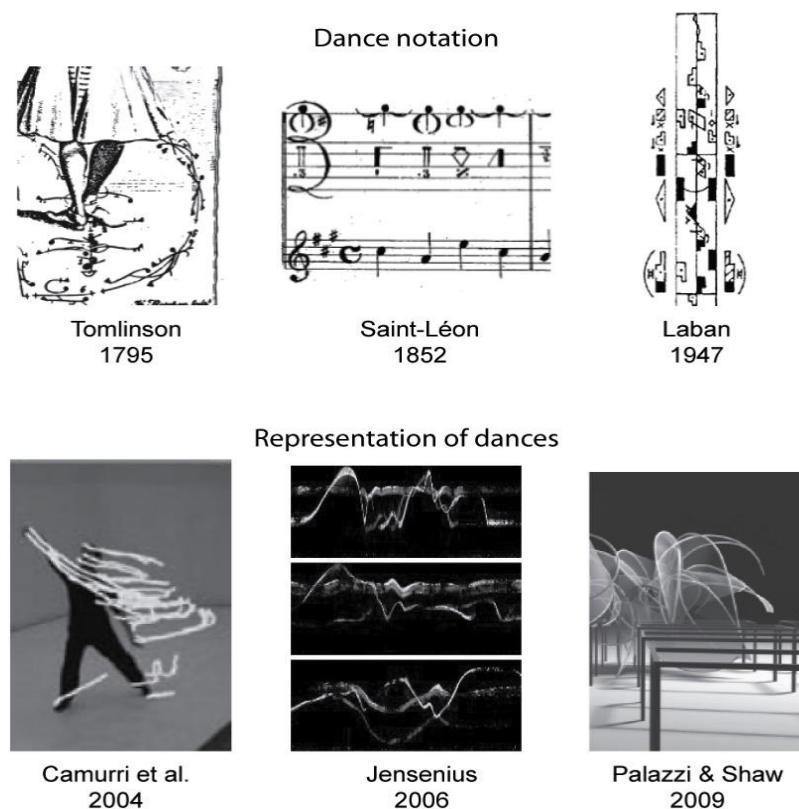
As envisaged in the counter-disciplinary literature, the problem-oriented or object-oriented perspective of dance studies exposed the fissures of disciplinary divisions. By contrasting problem and object *dance* to disciplinary contours of the humanities the dance object shed light to the division between mind and body and a missing link, deeply humanised, between representation of the body actions and the body actions itself. Nevertheless, the clash between the dance and humanities declares the need of an epistemological change that pushes the humanities into a quest for a field of humanities beyond written text. A practical (and obvious) attempt to see the body as medium, support and place of knowledge in dance. Although a strong criticism was imposed to the influence of embodiment theories, the body movement inside humanities represents a tendency towards a more precise and consistent form of

representation of human subjectivity, which somewhat contrasts with the dominant relativistic concepts inside the humanities itself.

The criticism to traditional Cartesian mind-body divisions and the reorientation of knowledge formation to presence of a body enacting knowledge are typical premises of the embodied mind theories (e.g.: Merleau-Ponty 1962; Varela, Thompson, and Rosch 1991). The clashes between dance studies and the modus operandi of humanities might be seen as one of the many battles operated in the theoretical and pragmatic fields proposed by the embodiment theories and enriched by many insights realised in the second half of the XX century, in different fields of knowledge.

However, it would be a historic omission to claim that a qualitative change in the humanities operated the changes in the dance studies. Many dancers and scholars have attempted to overcome the limitations of linear written forms of knowledge in history of dance. Figure 3 shows the evolution of dance representations proposed in the course of XX century, which demonstrates the existence of a clear problem of representation. A problem of **translation** of the physical, embodied, multimodal modes of knowledge formation in dance, into a language that could be understood outside the domain of physical performance.

Figure 2. Examples of Representation of Dance



In the recent years, the reproduction of the division of the body and mind in the humanities (and sciences) became an obsolete paradigm of knowledge. For Boaventura Santos (2010), however, the isolation of the body as a nonexistent modes of knowledge can be considered a form of “epistemological fascism” operated by political action. Rather than a complex epistemological question, the asymmetric relationships between modes of knowledge are fundamentally a result of political decisions, as much as disciplinary divisions are built to protect disciplines:

“The limits and possibilities of each way of knowing reside, thus, ultimately, in the existence of other ways of knowing. They can only be explored and valorised in comparison with other ways of knowing. (...) The comparison is difficult because the relations among ways of knowing are haunted by an asymmetry. Each way of knowing knows more and better about itself than about the others. This asymmetry I term epistemological difference. It occurs among ways of knowing within the same culture and more intensely among ways of knowing existing in different cultures. It is also complex because, even though it is an epistemological asymmetry, as regards the praxis of relations among ways of knowing, it does not manifest itself simply as an epistemological question. Actually, it is experienced predominantly as a political question. That is to say, the asymmetry of ways of knowing overlaps the asymmetry of powers. As concerns ideal types, there are two opposite modes of activating this asymmetry. The first one is to maximize it by pushing to the utmost ignorance regarding the other ways of knowing, that is, by declaring the latters’ nonexistence. This I call epistemological fascism, because it amounts to violent destruction or concealment of other ways of knowing. Epistemological fascism exists in the form of epistemicide.” (de Sousa Santos 2009, 116)

By looking at the political and anthropological movements inside the university and special, the humanities, Santos develops the concept of “Ecology of knowledge”, which represents the diversity of ways of knowing by the humanity. In order to face the epistemological fascism, this ecology would have to overcome two challenges: “(a) how to compare ways of knowing given the epistemological difference; (b) given that the plurality of knowledge is infinite, how to create the set of ways of knowing that partake of the ecology of knowledge”. Creating ways to comparing knowledge would be a process of “translation”.

Overview

The overview of the study of dance across humanities demonstrates that a criticism inside the humanities specialisation was able to raise open forms of

transdisciplinary questions. The result of the change of the paradigm towards the dance object resulted in internal disturbances inside the humanities itself. The attempt to situate methods of the study of the body in a more stable ground provided a common place to share with the embodied theories. Although for the humanities, the human actions would remain fundamentally subjective, the stability of the common generalizable body represents a first order contradiction not easily adapted to the disciplinary bounds of the humanities. In this perspective, the humanities somewhat recognises the limits of its methodological practices (such as writing and mental work) and points at the possibility to discuss and develop humanities with other forms of representations and knowledge. A kind of humanities that is made up representations of movements, kinaesthetic experiences, visual references and, most probably, attempts to translate these experiences.

Sciences and the Variability of Human Experiences

The stereotypes built around disciplines of sciences often reproduce an idea of disciplines that are supported by classical models scientific rationality. Scientific rationality is also strongly present in the core concepts of academic institutions. It has influenced the modern humanities in some extent and was able to pose quite subjective questions and approaches. The sciences and, in special, the development and application of the modern scientific knowledge are very dynamic processes of knowing, whose shades of disciplinary actions are definitely reaching the frontiers with humanities, arts and philosophy. Although it sounds reductionist to characterise the traditions of sciences in a set of characteristics, the impact of the scientific rationality takes advantage of some core practices: an efficient description of the reality as a small set of problems, application of systematic approaches to problems and the economically efficient promotion of the notion of truth (often a single truth), epitomised in the quest for causality, often described by *statistical significance*.

Causality is one of the main principles of scientific research. It is an intrinsic property of models that scientists build by collecting and analysing data. The typical framework involves the proposition of a hypothesis, the selection of variables and assumptions, data collecting and the organisation of statistical analysis. Statistical significance and the paradigm of linear regressive analysis show relationships between variables and if mean values could be accepted as a valid representation of the observations. Typical applications include all sorts of physical phenomena that can be fit in a model where there is a context for control and manipulation of variables.

Modelling a phenomenon requires underlying assumptions. Any kind of statistic procedures involves assumptions, and violations of these assumptions imply in lack of validity of the procedure. Assumption of independence and homogeneous variance are important underlying aspects of the statistical notion of significance. The assumption of independence requires that the data collected at different points is independent: one observation should not be

influenced or connected by the tendency of other observation. The assumption of homogeneity of variance requires that we assume that any deviations of the mean value should be assumed to be a result of random disturbances.

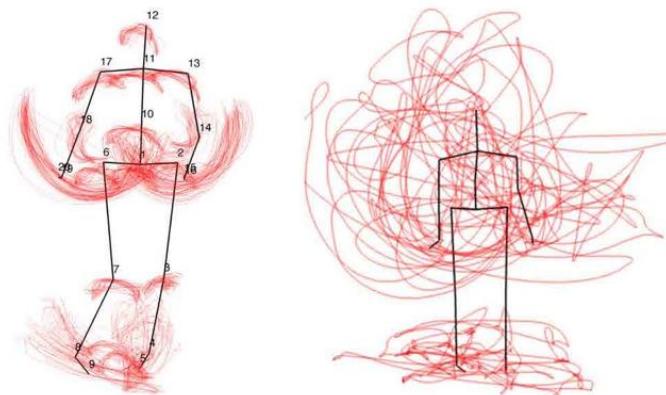
These assumptions are easily understood if we imagine typical controlled systems, such as testing the properties of a physical object. However, how scientific methods respond to human actions and intentionality? How to guarantee independence of the measurements when a person tries to perform an action? How to assume that human errors in a task are due to random, non-intentional disturbances? What is the function of independence, dependence and error in artistic actions realised by the subjectivity of human actions?

Movement Sciences

The early depictions of dancing body in the experiments of Lumiere brothers, demonstrate how dance performances have attracted the interest of scientists and being subjected to different analytical attempts. Dance represents a fascinating case study for the analysis of the limits and structure of the human body. The dance objectively explores the possibilities of a limited physical body. Dance makes use of all limits of subjectivity and human intentionality, physical directionality and abstract forms of decision and action.

In the field of movement sciences, the direct application of statistical methods and scientific rationality to strictly goal oriented human actions led to a collapse of traditional methods and concepts applied to physical phenomena. From basic statistic treatment to the separation between perception and action, the impact of the *real-life* body actions demanded a number of new approaches to the subject and to the concepts. The analysis of movement actions indicated that simple objective tasks realised by highly skilled subjects resulted in larger amounts of variability, or *errors*, as seen from the viewpoint of brute statistics. How it is possible to assume that a simple act of grabbing a pen in a table does not affect its subsequent repetitions (assumption of independence)? How to assume that eventual changes in the way the hand travels towards the pen are resulted from random influences and not from gaps of attention, muscular fatigue, expressive ways of moving, repeated movements? How to impose traditional scientific methods to a dance tasks, which, by nature and purpose, is developed across subjective dependences and suggestive errors? Figure 2 shows the trajectories of a dancer performing Charleston and the trajectories of a dancer performing an improvisation.

Figure 3. Stick Figure and Trajectories of Dancer Performing Charleston and the Trajectories of a Dancer Performing an Improvisation



In this stage, the movement sciences and its true drive for insightful rationality attempts to reach other forms of knowledge by translation. The scientific practice overflows into a subjectivity and uncertainty in the search for a reasonable frame for the reality of the dancing body. The pervasive variability of human movement actions led to insights into the scientific traditions and exposed the apparently monolithic query of rationalism for single-responses to a universe of uncertainty, ambiguity and subjectivity. Stergiou and colleagues (Stergiou and Decker 2011; Stergiou, Harbourne, and Cavanaugh 2006), for example, faced the challenge to develop new methods and concepts in order to cope with the variability of human actions. More specifically, Stergiou proposes a model that suggests that healthy systems are directly associated to an optimal level of variability. In these systems, an optimal combination of complexity and predictability would allow adaptation in richly variable environments. Total repetition (rigid behaviour) or total chaos are considered states of abnormal development.

The paradigmatic change caused by the body framed in the scientific knowledge is similar to many other contemporary problems in which information about human actions are produced in an unprecedented rate. Thought some would claim that this process produces a negative reification of the society and relationships it is also transforming the technology and scientific methods to a more flexible, diverse and subjective discipline. Carlsson (2009), specifically referring to problems with large datasets, claims that more quality is needed and summaries or maps of information are more relevant than individual parameter choices.

Concluding Remarks

The tendency to represent data in maps avoiding superficial single-response parameters; the necessity to extract summaries and the need for more quality information about the data, all indicate another sort of translation, as

Boaventura Santos proposed before. As in the humanities, the field of sciences seem to produce its own transdisciplinary bridges across the deepness of disciplinary specialisation. The focus on the generality of visual representation described as “maps” indicate that this translation is also less mathematical and more visual or geometric.

The magnitude of epistemological changes and hypotheses reported in this study demand, from a rationalistic point of view, much more evidences than two separate cases. The ideas presented in this study suggest that part of the counter-disciplinary movements might be a result of deep disciplinary movements applied to real-world problems. The reactions of traditional methods in humanities and sciences to the problems proposed by the dance demonstrate that knowledge formation can be intrinsically transdisciplinary.

The proposed action of translation of forms knowledge to visual forms of communications denotes the emergence of alternatives to traditional forms of knowledge fixation such as writing. The interest for a sort of knowledge that is not framed into the boundaries of sciences or humanities is also an indication that the environment for new forms of knowledge is not only open but also necessary.

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