{C113} DONIN N. & THEUREAU J. (2005) Music composition in the wild: from the horizon of creative cognition to the time & situation of inquiry, EACE 05, Annual Conference of the European Association of Cognitive Ergonomics, Chania, Crète, 57-64}

Music composition in the wild : from the horizon of creative cognition to the time & situation of inquiry

Nicolas Donin

Institut de Recherche & de Coordination Acoustique/Musique
1, place Igor-Stravinsky
F-75004 Paris
donin@ircam.fr

Jacques Theureau

CNRS/IRCAM
Institut de Recherche & de Coordination Acoustique/Musique
1, place Igor-Stravinsky
F-75004 Paris
theureau@ircam.fr

ABSTRACT

The theme of large temporal span of cognition is emerging in cognitive ergonomics. We will consider it through the analysis of a musical composition process: that of *Voi(rex)* by Philippe Leroux. After presenting the data collecting method, we will consider the analysis of the resulting data concerning the writing of two movements of *Voi(rex)*. Such an analysis will allow us: (1) to draw methodological conclusions about the time and mode of inquiry; (2) to set out a series of organised constraints to be respected by a cognition theory in order to deal with the large temporal span cognitive phenomena.

Keywords

Large temporal span of cognition, activity analysis, musical composition, situation simulation, cognition theory

INTRODUCTION

Time is a problem for cognitive analysis. At its very origin, Newell and Simon (1972) proposed to try to represent in some detail a particular man at work on a particular task and to search for a Process Theory of the human system according to three dimensions of variation : tasks , individual differences and time scales in behavioural acts . It is easy, some thirty years ahead, to state that the last one has been poorly explored. However, many activities can be described and explained only if several time horizons are considered. Among them are creative activities, for example the activity of music composition that we will consider here.

The current literature about music composition as an activity points out that, if the instant counts, so do the composition of some meaningful part, the composition of the entire work, and even more its place as part of the composition of a set of works or as part of the composer s intervention in the artistic debates of the time-period.

Among various other theoretical and methodological challenges encountered by the cognitive analysis of this activity (for example: cognition and creation, musical imagination, unique individual cognition), we will stress the large temporal span of human cognition. This theme also emerges in other recent research in cognitive ergonomics, concerning biological research activity (Grison, 1998), appropriation processes of technical devices (Hau , 2004) as well as e-learning activity (Dieumegard, 2004), management activity in the industrial field (Dieumegard et al., 2004) or the activity of consultants in ergonomics (Lamonde, 2000).

1. SITUATING THE INQUIRY: RECREATING THE COMPOSITIONAL SITUATION THROUGH THE USE OF MATERIAL TRACES AND QUESTIONS

During the year 2002, French composer Philippe Leroux composed a work called *Voi(rex)*, for soprano, 6 instruments and electronics, commissioned by IRCAM. What remained of his composition activity? : A printed score, along with an electronic part composed of sound files and a concert patch using Max/MSP (a software created and often used at IRCAM); The manuscript score; Sketches, plans and other manuscripts produced and used during the compositional process; Different computer objects remaining in the composer s laptop (especially *OpenMusic* [a software for music composition] patches and *ProTools* [sequencer] sessions) and screen shots; E-mails exchanged with the singer, etc.

After a preliminary methodological study, we chose to focus on the period of score writing. This period can be distinguished from the whole composition of that piece, which was preceded by an extensive phase of preparation and followed by some local improvements for the concerts.

Data collection was made during 11 interviews of approx. 3 hours each, distributed along 6 months. The interviews took place in a room where the composer s personal computer, his sketches and other documents listed above, were put on a table simulating the composer s familiar space when he s working. Our chronological reconstruction of this activity followed its own segmentation into 5 phases of writing

(corresponding to the 5 movements of the work), so there were approx. 2 interviews per movement.

For each interview, we proceeded in 3 steps: (1) Selection and disposition of the materials needed for the reconstruction of the movement composition activity; (2) Reconstruction of the composer s anticipations at a precisely defined moment (which corresponded to the beginning of the movement and of a meaningful part of it); (3) Verbal and gestural expression over the course of score writing in the simulated past situation.

During this interview, we constantly used the different materials to contradict or support the reconstruction by the composer of his own activity and to help him both to retrieve his past situation of score writing and to quit his present situation of a composer involved in other compositional problems, commenting his piece for his students in composition class or giving interviews for musical journals. Every interview was recorded onto video. The term we give to this type of interview is interview within situation simulation through material traces .

We will consider here the analysis of the resulting data concerning the writing of two movements°: the third one and the last and fifth one. The reasons for this choice are: During the writing of the third one, many surprises emerged while using the materials already prepared; The use of previous material while writing the last one was dramatic; Many elements were brought forward from one to the other.

Through such an analysis of the composer s writing activity concerning these two movements, presented here with a focus on the issues related to the large temporal span of cognition, we will illustrate both the efficacy of the data collecting method just described, and a number of constraints the empirical phenomena just described set upon cognition theory. We will do this starting from the effects of a rereading of material prepared for the 3rd movement, and then from those concerning the 5th movement inasmuch as the writing of the score is constrained by the conclusive nature of this movement.

Unless otherwise specified, all of the passages quoting the composer are derived from the interviews of compositional situation simulation of the 3rd and 5th movements, which took place on April 2 and 29, 2004, and June 3 and 22, 2004 respectively.

2. EFFECTS, ON THE COMPOSITION OF AN ENTIRE MOVEMENT, OF SITUATION PREPARATION AND REREADING

The composition of the third movement of *Voi(rex)*, in the summer of 2002, involved several periods of elaboration: the accumulation of ideas in view of the composition of a vocal piece, with instruments and electronics, for which the title had not yet been fixed [second half of 2001, beginning of 2002]; work in an IRCAM studio, which was undertaken while the first movement had already begun to be written [spring 2002]; the gathering up of all of the sketches necessary to the composition of the 3rd movement, that immediately preceded the composition of this movement [mid-July 2002]; the first days of the realization of this movement, during a residence at Heiligenstein in Alsace for concerts and master classes [second half of July].

Before beginning to write the score, Philippe Leroux had determined certain characteristics of this movement: to work on the absence of the voice (the general plan of the work indicates voice absent except at the end); to establish various relationships between the 3rd movement and the 1st (notably from a scenic point of view); instrumental writing procedures inspired by a particular type of signal processing, namely spectral inversion (another type of signal processing, frequency shifting, had been reserved for the writing of a fourth movement, which, precisely at the moment of completion of the 3rd movement, was decided to be abandoned); to take two initially identical chords which progressively diverge, one given to the instrumental ensemble, the other to the electronic part (the sheet of ideas for this movement contains schema representing this alteration, and specifies that this alteration proceeds mainly through filtering — these schema already figure in an older sketch which listed ideas for the use of electronics throughout the piece, and in which we read: instrumental held notes and the same pattern put out of phase by the elec[tronics]); finally, the choice of a poem from among those which he had photocopied from the collection by the poet Lin Delpierre.

By collecting material for the writing of the 3rd movement, at the end of June 2002 and copying indications which came from various preparatory documents (this is the case, for example, for the schema of chords) onto his sheet of ideas for this movement, Philippe Leroux is reminding himself of the major guiding ideas which are valid for the work as a whole (notably the ordered list of 26 chords) and he carefully rereads the poem selected for this movement, from which he extracts the idea of being dazzled by white noise (according to his note in the margins of the photocopied text) which evokes for him a process of successive filtering applied to an initial chord, which thus goes from being a rich traditional harmony to a sound with a significant noise component. This rereading stage appears to be essential. All of these materials, initially dispersed (then later gathered together in a folder labelled 3 rd movement) and dating from very different times of constitution, are reread and linked together to form a new compositional situation, while the two first movements are already written, and have created important divergences from the initial plan of the work. To encapsulate it into a formula we could say that during their fabrication, they prepared the compositional situation of the 3rd movement, but they did not predefine this situation.

One of the ideas, which appeals to the composer, is that of swathes of chords [aplats d accords]. Aplats

d accords is written in the middle of the ideas sheet for the 3rd movement:

Swathes of chords, I must have written that in later (than the rest of the sheet of ideas), but I know that there will be swathes of chords, very simple things which come from one of the little notes I had jotted down and I risked my life for it because I was listening [to the radio] while driving on the expressway surrounding Paris, I can still remember a certain bend in the road, and I was busy noting it down at the same time

Not having used the idea over the course of the composition of the two first movements, Philippe Leroux decided to listen to the recording of the chords of *Voi(rex)* which came out of his recording session with the musicians, at IRCAM on April 18, 2002. This recording session took place at the same time as the composition of the beginning of the work (which began at the end of February) but was planned independently of it, and brought together at the request of the composer all of the performers who would be involved in the work s premiere, in order to have them play each of the 26 principle chords of *Voi(rex)*, each one appearing in a dozen-odd forms. This work session allowed the composer to experiment and to test the harmony, which he had already written out, and to constitute sound material which he could appeal to at many stages of the composition.

A nice surprise awaited him when he listened to the recordings: the instrumentations, which he had hastily noted a few days before the recording session, produced interesting sounds, in particular because several of the takes by the ensemble sounded like synthesized sound or else like acoustic sounds modified electronically in real time. Listening to these sound files in his usual work environment for sound processing, the software *ProTools*, Philippe Leroux is at the point of reworking them: He separates them onto different tracks of a *ProTools* session in order to try various combinations (The first thing I do is to introduce the first chord and to have it followed by the same chord but played backwards). As the first trials of this type were convincing, the composer decided to make the recordings with the musicians from April 18 the principle material of this movement, and it is at this point that he adds the mention swathes of chords in the middle of his sheet of ideas: what was supposed to constitute a single element, a section, or a category, becomes the all-encompassing logic of the movement. This extension of the place given to the idea of swathes of chords leads him also to give pride of place to one particular kind of signal processing, frequency shifting, which he had initially reserved for the writing of the fourth movement, with the corollary of minimizing spectral inversion, which had been initially assigned to this movement. Frequency shifting did not seem appropriate until after having begun work with *ProTools*. It is at this point that Philippe Leroux drew a line indicating that the indications frequency shifting and spectral inversion were to switch places relative to the 3rd and 4th movements, and he added the mention or frequency shifting to the mention spectral inversion around which he drew a box in the sheet of ideas for the 3rd movement. A box of this sort, according to his personal convention, defines in his plans and idea sheets for each movement the principle modes of sound processing attributed to that movement.

By manipulating the sound files arranged in the *ProTools* work session, Philippe Leroux discovers the value of conserving the original durations of certain sounds: during the recording he felt the need to have notes held quite long in order to be able to work with them later, and also, conversely, to have very detached notes ; but in no way did he think at that time that he would use the maximal time of the held note, for example 15 seconds , in the process of concretizing the idea of swathes — it is only to be safe that he asked the musicians to hold their notes for a considerable length of time. Once he was in the compositional situation, he exploits this particularity in order to play with the listener s sense of orientation: on the *ProTools* session, he links up the first 15 second sound with the same sound backwards — the pivot between the two being imperceptible at first hearing — in order to put in place the play of imitations between the instrumental ensemble (which, in concert, does play the fragment of the score used in the April 18 recording session) and electroacoustic sounds (which, in concert, will prolong the sonorities produced by the ensemble in such a way as to make it impossible to situate clearly the transition between the two).

This creates an unusual compositional situation with respect to the work on the preceding movements:

It is a movement which I composed principally on the computer, by simulating what was going to happen. [ ] For the electronics, there is going to be a constant interplay between the real and the false chords — which are in fact the same.

The composer puts into action a logic of imitation and of reciprocal simulations by using the grid of the *ProTools* interface, each track of his *ProTools* session tending to have a special function: a sound to be played by the ensemble (track 1), a sound file to be played directly (track 2), extra sound files which facilitate the pivot between the two preceding tracks (track 3), ornamentation and additions to certain passages which are richer in electroacoustic material (other tracks). It is only later, over the course of the writing of the first minute of music in *ProTools*, that Philippe Leroux begins writing onto the pages of the score, not so much as a way to fix the scoring of the instrumental part (which is largely based on the orchestration of the sheet of initial chords), but rather as a way to place the voice, which was until then not taken into consideration, the absence of which right from the second page had to be taken into account in the realization of the play between instruments and electronics (since the electronics will develop throughout the movement).

Over the course of these first days of work, more and more sound files from the original recording session are used: either conserved and placed with more or less precision (depending on whether they are located closer

or farther from the beginning), or else cast out (deleted or relegated to the end of the *ProTools* session). In this way, the entire movement starts to take shape:

> At the beginning, I finish one chord, then would go on right away to the next [ ] [but] later I project things through time, I go on to realize - but not to finalize — a little passage, at [for example] the 2 minute point.

At the same time, the relationship between the *ProTools* work session and the score becomes more complex: certain reworked sounds (notably through the *freeze* function**)** are themselves used as models to be copied by the instrumental ensemble — in other words, in the writing of the score, Philippe Leroux undertakes dictations into musical notation of sound files which have been modified through various electroacoustic manipulations which have rendered them considerably distant from any instrumental idiom. The play of imitations and simulations is progressively integrated into the score, leading the composer to experiment with types of writing with which he feels unaccustomed — with the result that the next phase of writing, during the month of August, takes place for the most part on the score itself.

This progression would have been for the most part circumscribed by the compositional situation of the first days, whose situation was itself prepared extensively beforehand. The relevance of the recorded chords which Philippe Leroux listens to at the moment in which he begins the writing of the movement only obtains because the context of this writing is suitable for them, i.e. because having gathered *a priori* the constituent elements of the movement to be written, the composer searched for a means of crystallizing them — to put a great number of them into a network, or to fuse some of them together. In this case, it is the application of the idea of swathes of chords (exploiting the rich material obtained from the recording sessions with the musicians from April 18) to the entire movement and not only to a single determined passage, which allows for the elements to be instantaneously put into relation with one another.

The following will then be undertaken: the schema of the two chords becoming progressively out of phase with each other, the play of reciprocal imitations between the ensemble and the electronics, being dazzled by white noise , and the development of unexpected writing situations which stimulate the invention of the composer (in particular the idea of instrumental˚simulation of sound files, starting from a reworked musical dictation). At the same time, many of the initial ideas for this movement are abandoned:

> There are things which I didn t do. For example, I had intended to use certain chords to which I had given the name chords which are good in themselves , but in fact I didn t use them/ there were a few instances in which I wanted to use these chords in the piece, either as interludes between the movements, or even in this movement itself; but in the end I didn t do it, I didn t use them at all.

The unexpected writing situation, stimulating the invention of the composer, which has just been analyzed, might only have been of interest for him relative to the writing of this particular movement in this particular piece. But in fact it marks in his mind the acquisition of a new tool of musical writing — a stylistic innovation in relation to a new procedure — whose value seems to him to be attested by the success obtained here and now:

> Freezing a chord, shifting the window inside an arpeggio, I don t see any operation of instrumental writing that is similar to this in the past. It inaugurates then something that is very new on the level of writing, at least in part. However, my starting point is sound. It is not like with MIDI instruments, in which the notes are already there, and the rhythms, and all you need to do is to adjust things, or to rework the timbre. And neither is it purely electroacoustic sound in which you have to reinvent everything.
>
> I wrote things that I would never have written on my own. For example, that little violin thing, there, all alone in the middle [bars˚243-244]. By myself, [ ] I would never have written that [ ] It starts to be really fantastic then, because [after] the very hard work of inner listening, to try to really hear what s going on, to adjust things, etc., after all that, I have really gained a new writing tool which I can use in fifty pieces to come, pieces which won t [necessarily] have anything to do with electronics.

This writing procedure is however not absolutely new. It already existed in emergent form or, in the composer s words, globally :

> In terms of a global approach, I ve used it before. [...] For example, I used it once for a piece that I wrote for four wind instrument MIDI controllers. It was really unusual. Later I made an instrumental version of it which is called *AAA*. But in that case they were MIDI instruments, so there was already a part of it which was automatically written out. Here I start from the complete sound files which come from instrumental sounds processed through electroacoustic techniques. This is a different case altogether.

Retrospectively, the composer relates moreover this compositional innovation to a large family of procedures already utilized, going all the way to pure musical dictation of a sound file, which is a procedure which is far from being specific to him:

> While the fifth movement is almost pure musical dictation, here [in the writing of the 3rd movement], there is some dictation but at the same time, in the end, I frame many things rhythmically on *taleas*. In fact, what the electronic layer is doing here is something like [hums], a little haphazard. And then I rewrite everything in order to get the right notes, the right pitches, within the framework of the *talea*, my rhythmic theme.

Even if this innovation is in the end only relatively new in terms of its content, it is by its potential for synthesis and imagination that it opens the way for future promising applications.

3. THE LAST MOVEMENT. THE DYNAMIC OF ACCUMULATED CONSTRAINTS

The reconstitution of the activity of composition of the third movement which was just presented shows that the initial plans — even when they are no longer valid, the little notes containing jotted down sound ideas — even when they were recopied elsewhere, the computer generated material — even when it was already used in a past context, are all resources for the action situated at the moment of composition itself.

This remark applies just as much to the fragmentary preparation of any given situation (fragmentation in time and also by the multiplicity of retentional media, as to the global conception of a movement at the beginning

of its composition — even if, contrary to the 3rd movement, it had already been defined with precision in previous stages.

So it is with the 5th movement, which the composer now characterizes as the concatenation of three different movements of the initial plan: movements VI, VII and VIII. This 5th movement was constructed in several stages beginning from these three, in particular during two distinct stages of the composition of *Voi(rex)*.

Right from the moment that the 3rd movement was finished, the composer decided to modify the general plan of the work: to discard movement IV, to preserve V (which would become the 4th) and to concatenate the last three movements conceived as a single movement (the 5th). This concatenation was conceived as a unified integration of the guiding ideas of each of these movements (on the general plan scat , propagation of figures and multiprocesses are the words which figure just below each movement number). As the composer himself states after the fact, this logic of concatenation endangered the unity of the last movement:

Because as a movement, this 5th movement is not very coherent in the way that it is constructed. But taken as a part of the piece as a whole, it is absolutely coherent. But I think that I would have liked it to be more coherent in and of itself. At times it almost approaches mere juxtaposition of certain things at the end. But since everything comes from far back and was very much prepared, it works.

In the second step of concatenation, before writing the 5th movement, the composer goes back to the sketches for movements VI, VII and VIII as they were initially planned, and he recopies the significant elements onto a unified sketch of the movement that he is about to work on; in so doing, he updates his vision for their fusion at the time of the revision of the general plan. By recopying onto his new plan for V the selected guiding ideas, he makes clear what he intends to preserve and reorders the elements into an order different from the one in which they would have occurred had he decided to preserve the three movements.

He goes from a logic of movements in which the concept of scatting would have been used for the whole movement , to a synthesis of heterogeneous elements:

Now that [the scat] is no longer a movement, it has to be a part of a gesture, a musical content , which leads him to make it the central section of the new movement, which contains successively elements from VII, VI and VIII.

In order to continue, that [plan for V with a list of elements taken from the last three movements] is the most important, because I see there that I am saying: from VI I m going to keep the scatting, I m going to keep the melody which follows the shape of the letters and uses rhythmic elements from III, I m going to keep moments of rest with the swathes of chords (but in fact, that s not what I did), and also some Doppler effects and some breaks in the scatting, things which hover a little (marked floating [planements]). Next, from VII, I keep the propagation of figures, delay patterns/

The question of unity does not only come into play in the issue of the order of succession, but also in the proportions of the movement. While the proportions between movements had been carefully defined before the writing of the work, and then progressively taken less into account as the writings of the movements progressed, the 5th movement was different. Although he has now acquired a rough idea of its global duration, the durations of its sections had not been defined, neither with respect to the proportions defined for the former movements VI, VII and VII, nor by any other means:

I knew that I could not keep the initial proportions, and since I abandoned the idea of using multi-processes, it wouldn t have made sense to keep them. On the other hand, I now have a vision of the piece as a whole, so I have a good idea of the global duration. I can t be mistaken about the duration of the 5th movement, give or take a minute. [ ]

The writing of the 5th movement proceeds in the same way as the 3rd: the situated writing of a movement depends on the writing of preceding movements. But here this idea is all the more evident because it is the last movement to be composed : Philippe Leroux begins this movement with a determinate knowledge of the work, which he puts in relation to what he prepared to this end and with what he had decided at the start of the composition.

As the writing of the 5th movement progresses, it confronts the difficulty of making concrete the relationship between this movement and the ones which preceded it. From the moment of the rereading which preceded the writing, it is said that operations and local elements should refer back to passages from previous movements:

[In this sketch] I am simply imagining the beginning of the 5th movement, exactly what is going to happen. As I spoke of swathes of chords, I do want swathes of chords, but I want them to be triggered by a figure (because I want the figure to propagate later), which I take from the Doppler effects which I made right at the beginning, in the first Doppler effect patch which was made long before the writing of the 1st movement and all that. Except that I apply it to a precise chord and to a precise letter [a reference to the 2nd movement in which the composition is marked by the use of the calligraphy of the letters of the poem as a gestural model for the melodic writing of the score, using *OpenMusic*], the letter which will determine the speed of the Doppler effect.

From the preceding paragraphs, we see that the problem of unity is posed on two levels simultaneously throughout the writing of this movement: on the level of the movement (for which the unity must overcome the heterogeneity of the previously planned but abandoned movements from which it emerges) and on the level of the work as a whole (for which the concluding movement must give closure and/or complete, in a balanced manner, the network of relationships springing from the resemblances and contrasts between the preceding movements).

The writing of the 5th movement accumulates relationships with older periods of activity, during which plans as well as material were elaborated, at the same time as ideas and projects which did not yield any inscription or leave any traces. These ties range from the realization of a passage which had been planned long before, to seizing a good opportunity to create a relation

a posteriori with an element from a preceding movement.

A detailed analysis of the anticipation of the idea of the scat which was previously presented, would show that even when dealing with an essential idea of the work like that of the scat, it can only be defined and given content in the lead-up to the movement in which it occurs.

However, anticipation can be more determinate in terms of its content and more indeterminate in terms of the suitable moment for its future use. This is the case with occasional links made with preceding movements: every opportunity is used to make reference in a detail of the writing to characteristics and/or ideas from one of the preceding movements — a drone which makes reference to the 1st movement, a melodic profile of a letter which refers back to the 2nd and 4th movements, etc. These anticipations are generally only formulated at the instant of their being filled in the situation. But the writing of the 5th movement also leads the composer to complete, modify, or to tally up lists of things to do. He does so by basing himself on elements carried over, from the writing of a preceding movement, from a sketch concerning this movement to elements reserved for what was to come next:

There are several things that I wrote when I was working on the 3rd : for the voice, folding over of the high notes (for conjoint motion) , reuse elements from the rhythmic writing of III , make moments of calm with swathes of chords cf. III .

He also does so by verifying retrospectively an aspect of the composition by making a list (by putting a dot on those real time techniques that I used in the preceding movements — in order to see what I was going to reuse at the end).

Without using notations produced over the course of the writing of a preceding movement, the composer can also make use of elements already used in the course of the writing of a preceding movement but which were in the end not included in it, having been replaced by variants which were more appropriate to the context. This reuse of elements strongly linked to the context of another movement allows him, when he uses them for other purposes in the 5th movement, to exhaust material which he judged to be particularly interesting and which constituted for him a reservoir of potentially applicable elements. This is especially true of elements produced via computer, because the computer allows for the identical reproduction of objects which can each be altered in a different way while still conserving some of its previous aspects.

Therefore, this reuse of elements, often undertaken directly on the technological medium which allowed them to be generated, explores possibilities which were not relevant beforehand, but which were already available and at-hand. The *OpenMusic* patch in which the composer can produce melodic profiles by crossing a set of notes with the contours of a drawing (in this case the letters of the alphabet), constitutes at once a tool and the memory of these operations:

Where are [the melodies imitating the letters of the alphabet used in this passage of the 5th movement]? [searches in the computer, opens the *OpenMusic* program] Oh wait! No, I didn t rewrite them because I already had them. For example, i of chord 1. I must have changed the chord, I removed this one and imported chord 1, and then I took the unfolded letter.

It is the use of the operation Save as which allowed the composer to select the most successful letter-drawings when he was working on the 2nd movement, which made use of this procedure; and it is this very same operation which allows him to adapt the results which were obtained at that time for a new harmonic context (i. e. by crossing the same profile with a new chord) which is what he does in the 5th movement.

Engaged in creating numerous connections with preceding movements, the composer goes about reusing an element from the 3rd movement which is neither a sound file, a patch nor a motive, but a structure — a structure resulting from the 3rd becoming the infrastructure of the 5th. The fact that it was saved into a different file of the session(s) of the 3rd allows then for a recycling of the structure of the 3rd as a formal guide for the writing of the 5th:

In point of fact, you re following, section by section, the structure of the 3rd movement. Do you then have [*the corresponding passage in the score*] *in front of you? How do you do it?*

No, what I have in front of my eyes is the [*ProTools*] session of the 3rd. I don t reuse elements from the writing of the 3rd.

That session, you rework it a lot, you remold it as you like. So you have the intact session of the 3rd in front of you?

Yes, and from time to time I take something from the 3rd, I look at it in detail, and I put it into the 5th. In the work session on the 5th, I have the session of the 3rd (at the beginning) in its entirety; and then what I did was either to enlarge some things, or/ ( ) I recopied many things in order to do my dictations in a practical way/

The exploitation of this procedure on the scale of a large part of the 5th movement is tied to elements from the compositional situation of this movement such as the need to save the voice before the scat section and the desire to establish solid ties with the 3rd movement. It must also be understood as a confident exploitation of the compositional innovation of the 3rd movement, but on a larger scale than the first time around. In this sense, this innovation is confirmed to be fruitful in this test situation defined by the urgency to finish the manuscript in order to submit it to the publisher, without spoiling the efforts of preparation of the three movements initially planned, nor to reduce the relationships between the 5th and the preceding movements. Our characterization of this new writing tool in the analysis of the 3rd movement would not have been complete if we had not taken into account this second time around which confirms a process of emergence-creation-recognition of innovation.

4. QUESTIONS OF METHOD AND CONSTRAINTS FOR THEORIZATION

For Newell & Simon (1972), the phenomena of human problem solving in the laboratory asked for a methodology that is Empirical, Not Experimental and Non-statistical : Because of the strong history-dependence of the phenomena under study, the focus on

the individual, and the fact that much goes on within a single problem solving encounter, experiments of the classical sort are only rarely useful. [...] Thus, the analysis of verbal protocols is a typical technique for verifying the theory... . Following these authors, what kind of methodological consequences have the characteristics of long temporal span cognition phenomena?

For these authors, the same phenomena asked also for a theory that is Dynamically Oriented : The natural formalism of the theory is the program, which plays a role directly analogous to systems of differential equations in theories with continuous state spaces . What kind of a theory, the phenomena of long temporal span cognition asks for?

It is these two questions which we will now consider.

A/ On the Method and Time of an Inquiry

Phenomena of large temporal span of cognition seem to us to point towards a methodology of analysis of verbal protocols collected within a situation simulation through the material traces of the activity that we presented here above. The kinds of analytical elements which we have presented are not presently available to music listeners. They were not immediately available to the composer himself either, at least not in detail or in their construction. They show how fruitful the investigation situation that was practiced in this study turned out to be. The validity of the data collected is essentially assured, during the interviews and after them, through the confrontation of the affirmations of the composer on the one hand between them, on the other hand with the material traces available. This fruitfulness and this validity, which are of course not without limits, although nevertheless efficacious, we anticipated them from past theoretical and methodological experience concerning the analysis of the activities in work situations, in sports and in education (Theureau, 2003).

What we did not anticipate at first is that it was only during the reconstitution of their use in the composition of the 5th movement that we were informed that during the writing of the 3rd movement but in preparation for the 5th, the composer noted (in sketches for the movements VI, VII and VIII which were replaced by the 5th), certain elements intended for the 3rd which he removed from that movement, as well as developments envisioned for other elements of the 3rd. Despite our asking the composer to document all of his activity, these elements produced in relation to activity themes appealed to punctually, whereas the dominant activity theme was the writing of the 3rd, were only mentioned when reconstructing the moment of their final utilization:

> I wrote that at a point in which I was writing the 3rd movement; I said to myself: what I am doing at this moment, such and such an operation, for example, possesses such and such a development which will fit in perfectly at the end [Interview about the writing of the 5th movement].

The fact that they were forgotten during the situation simulation for the composition of the 3rd movement shows the limits of the simulation situation: the de facto monopoly accorded to the activity theme that was dominant. What is remarkable is that the access by the same methods to their effects during the writing of the 5th allowed them to be recovered.

Similarly, it is only during the compositional situation simulation for the 5th movement that the process of compositional innovation of the 3rd movement turns out to be made explicit and thus recognized (as an operation common to the two stages of writing with a wide interval of time between them).

One thing that we could anticipate in principle but not in terms of its realization is that the compositional situation simulation of certain movements allows us to discern certain globally shared characteristics of the activity of composition. This is particularly true of the 5th movement. For example, it sheds light on the intimate knowledge for a movement that the composer gained after the writing of the preceding ones:

> There is a very important thing there, and there s no trace of it anywhere; that s the fact that I just composed the four first movements, so I have intimate knowledge of the time of my piece: I reread it often, and what s more, for the 3rd, a simulation in time is available, so I feel / I see very well the balance / if such and such a section might tend to unbalance the piece as a whole, I would feel it right away. It is at the beginning, perhaps, that that type of thing is the most critical. After, I could almost continue with my eyes shut. [ ]

Also by way of example, the logic of collecting, transferring and transforming which is put to use by the composer is particularly evident in the writing of the 5th movement because it gives closure to *Voi(rex)*. Actually, its characteristic of being a concluding movement shed light on the properties of the activity of composition over the course of the writing of all of the preceding movements.

These interviews within situation simulations through material traces, could obviously be held throughout the writing of a work (or any other long term cognitive process). This is as a matter of fact the method we are adopting today as part of a new research project on the activity of musical composition.

B/ Constraints for Cognitive Theory

The analysis which we have presented here of the activity of composition of the 3rd and 5th movements reveals also some empirical constraints which a cognitive theory interested in the large temporal span of human cognition should take into account:

- Not only must the training-development be described, but also the appropriation-individuation of existing tools and procedures;
- A central place must be given to the perception-action loop and to its development into a discovery-creation loop; this applies just as much to the realization of a work (surprises from inner or auditory hearing — writing and electroacoustic signal processing) as to the procedures of composition;
- An essential role must be given to anticipation and especially to the vague anticipation which characterizes

ideas , as is the case for the different types of sound and musical ideas, for which the possibility of realization at various degrees is left open;

- In relation to this vague anticipation, at least two types of long-term emergence must be described: the emergence of claims and actions, and the emergence of procedures;
- Next to the resolution of problems imposed on the actor one must give a place to the construction by the actor of stimulating problematic situations for creation, in relation to certain ideas ;
- The notion of the preparation of a situation must be developed, rather than that of plan: in the preparation to the writing of the work s score, the composer is not so much planning as preparing situations which will only become defined at the moment of writing, thus taking into account all that has been written up to that point; in the writing itself, the goal is at the same time to write the given passage of the score and to pursue the preparation of future writing situations;
- A place must be given to the constant redefinition of the past: if there is a separation for the composer between the preparation before the writing and the writing itself, certain operations of preparation (especially that of rereading) can be redefined by him as constituting the beginnings of writing;
- An essential role must also be given to memorization (anticipated or aimed at by the totality of operations of inscription), to remembrance and to forgetting (in the rereading and in the writing);
- A particular skill of Philippe Leroux must also be considered, which consists of a technique of self-listening which allows him to let a musical impression that could be potentially productive to his compositional work just come to him , and to note its essential features as rapidly as possible;
- Lastly, cognition must be considered as situated in the strong sense: there is a constant embedding in the dynamic situation at hand of the materials prepared previously in and of themselves or as reminders.

CONCLUSION

Through this empirical study of Philippe Leroux s activity of musical composition of *Voi(rex)*, large temporal span of human cognition appears as a challenge in terms of data collecting methods and cognitive theory.

This empirical study is undertaken in relation with a technological project known as signed listening (Donin, 2004), which aims at the development of active listening multimedia environments (in particular the production of and the listening capabilities for imaginative variations concerning aspects of the given work), in this case inspired by the composer listening to his own work. This technological aspect of the study is in relation with all of the empirical challenges raised by it (cf. the introduction) and not only to that of the large temporal span of cognition which is presented here. Its publication is forthcoming.

REFERENCES

Dieumegard, G. (2004). *Possibles significatifs et construction d assertions garanties en e-formation — Contribution l tude de l activit d apprenants dans un dispositif institutionnel*. Diss., CNAM, Paris.

Dieumegard, G. & Saury, J. Durand, M. (2004). L organisation de son propre travail˚: une tude du cours d action des cadres de l industrie. *Le Travail Humain*, 67, 1, 157-180.

Donin, N. (2004). Towards organised listening˚: some aspects of the "signed listening" project, Ircam. *Organised sound*, 9(1), 99-108.

Donin, N. & Theureau, J. (2005). *Voi(rex)* de Philippe Leroux, l ments d une gen se. *Dissonanz-Dissonance*, 90, June, 4-13.

Grison, B. (1998). *Structures de raisonnement dans un laboratoire de neurobiologie du d veloppement˚: tude dans une perspective d cologie cognitive*. Diss., EHESS, Paris.

Hau , J.-B. (2003). *Conception d interfaces grand public en termes de situations d utilisation˚: le cas du multi-acc s* . Diss., UTC, Compi gne.

Lamonde, F. (2000). *L intervention ergonomique: un regard sur la pratique professionnelle*. Octar s, Toulouse.

Newell, A. & Simon, H. (1972). *Human problem solving*. Prentice-Hall, Englewood Clifs.

Theureau, J. (2003). Chapter 4˚: Course-of-action analysis & course-of-action centered design. Hollnagel, H. (ed.), *Handbook of cognitive task design*. Lawrence Erlbaum Ass., Mahwah, New Jersey, 55-81.

Theureau, J. & Donin, N. (to appear). Comprendre une activit de composition musicale˚: essai m thodologique sur les relations entre sujet, activit cr atrice, environnement et conscience pr r flexive dans le cadre du programme de recherche cours d action . Barbier, J.-M. & Durand, M. (ed.), *Les relations sujets-activit s-environnements*. Presses Universitaires de France, Paris.

Translated from the French by Jonathan Goldman