Cognitive Processes in composition

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Abstract

This paper analyzes the cognitive processes involved in musical composition. The cognitive research in the field of psychology of music considered primarily mental processes and functions involved in listening, while less interest was dedicated to music composition. In the linguistic field exists a remarkable literature on the production of written text. It was demonstrated that the production of written text involves different processes that are substantially different from those utilized in oral conversation. Writing, rather that an unique ability, can be considered as an articulated whole of abilities that are developed with a good degree of independence. Making reference to the linguistic field, I report a cognitive model for the processes involved in music composition. I also discuss the importance of applying the results of cognitive research to other fields, such as education. Research on writing provides new insights that have important instructional implications. A fundamental issue in education was shifting the methods from analysis of written products to investigation of writing processes. Many inputs can arrive from cognitively oriented research, focusing on the interconnections among thinking, learning, and writing. An educational method based on mental processes instead on products, gave remarkable results in linguistic and could be adopted also in musical composition.

1. Research on musical composition

In the psychology of music field, there are not so many contributions concerning the analysis of the processes involved in musical composition.

The most extended research was done by Sloboda (1985). He dedicated a whole chapter to composition and improvisation in his book « The Musical Mind», proposing also an auto-generated protocol of oral composition.

Davidson and Welsh (1988) realized a research testing the compositional abilities of ten subjects with the aim of studying the differences between skilled and beginners. The authors, considering the data obtained from the observations, pointed out three levels linked to the development of compositional strategies.

Delalande (1989) conducted an experimental research testing the approach used by fourteen composers of electroacoustic music. They were asked to realize a piece starting from a unique resonant cell (germ) of the duration of few seconds.

In the music field, it was not developed a cognitive model concerning the processes involved in composition. For this reason, it is useful doing reference to the research on the production of the written text in linguistic. The problem is to decide if the results obtained in linguistic, could be adapted to the music field.

2. Features of the processes involved in the production of the written text

In linguistic, the students of the field considered deepen the processes involved in reading and comprehension, rather those on the production of written text. This last sector widened only in the latest years. It was the development of cognitive sciences that influenced researchers to consider writing in a perspective of mental elaboration. Writing was examined, on the basis of his complexity, as a problem solving (Hayes e Flower, 1980b). Some authors treated the problem without considering purely linguistic problems, giving more importance to the mental elaboration of informations.

Davidson and Welsh (1988), and Johnson-Laird and Wason (1977) pointed out that also in music is correct an approach that considers composition in a perspective of problem solving. In musical composition would be useful to schematize the processes involved in writing, because it allows to study them better.

In linguistic, the students of the field pointed out that the processes involved in the production of the written text are very different from those involved in oral conversation. When you write a text you can revise it while you are writing, thinking to the coherence of your text. For these reasons it is important to think to the processes involved in the written text at a different qualitative level than those involved in oral conversation. When you write, you do not have the feedback as happens in oral conversation. This involves the ability of explaining all the relevant details for comprehension. Who is writing must consider that the readers could be persons with different backgrounds, and that they do not have the possibility to ask anything to the writer (Bereiter, 1980).

Writing is also a particular form of language that involves some basic abilities, such as grammar and spelling. We must consider that writing is characterized by a whole of norms, such as the division of thinking in sentences, and spelling. You do not need all these abilities for speaking.

Doing reference to music, we can state that also in this field for writing it is necessary to have basic knowledge, such as the laws of harmony. These laws are not essential to the performer, because when he plays a piece of music he needs mainly a good hearing for recognizing the correct pitch and a good articulation, but not some knowledge about how was constructed the music. Writing is also different from listening.

Lerdahl (1988) pointed out that exist many differences between compositive and listening grammars. The first grammar consists of all the abilities involved in writing a piece, while the second consists of all the processes involved in decoding a piece when you are listening to it (Lerdahl, Jackendoff, 1983). Writing is a cognitive ability that involves complex procedural plans, that are not necessarily in correlation between those used in other tasks.

3. Cognitive models for writing processes

Some authors reported models concerning the processes involved in the production of the written text.

Beaugrande (1984) proposed a model with more levels, pointing out a hierarchical structure of the processes.

Augustine (1981) reported the rhetorical decisions that the writer usually takes.

Hayes e Flower (1980a) proposed a cognitive model that considered primarily the cognitive dimension of writing. For this reason it could be useful to the musical field.

Cognitive research on the production of the written text utilized the same procedure used in the field of problem solving. The general problem is that processes are only partially observable. One of the most used method is the protocol analysis. It consists in asking to the subjects to describe orally all the things that they were doing when they were writing a text.

Subjects were asked to report all the details, also the most insignificant. Subjects were also informed that to the protocols would not give a score, and they were considered for research aims. These kind of research were conducted using a recorder, in this way it was sufficient that subjects spoke about what they were doing while they were writing. After, the researcher transcribed the tape recordings reporting also the rests between one word and the other, and the reflexive sound expressions (such as «um»s and expletives). The transcription of the tape is called protocol.

The method of protocol analysis was utilized primarily with adult, subject that developed an high level of independence of the processes. With younger subjects, results were less interesting. This is due to the fact that these subjects had some problems in understanding the task. It involved a double level: subjects had to write down a text and, at the same time, speaking about it.

4. Hayes and Flower model

Hayes and Flower (1980a) proposed a cognitive model of the processes involved in writing. It was developed considering a series of data obtained from protocol analysis, asking to subjects to write an expositive text. The materials were examined with great care for evidence that may reveal something of the processes by which the writer has created the essay. In general, the data were very interesting and gave stimuli in such evidence. Hayes and Flower (1986, p.1107) reported that subjects typically gave many indications of their plans and goals, e.g. «I'll just down ideas as they came to me»; about strategies for dealing with audience, e.g. «I'll write this as if I were one of them»; or about criteria of evaluation, e.g., «We better keep this simple.»

The model considered mainly the processes, giving less importance to the discussion of linguistic problems. For this reason Hayes and Flower's model could be fit also for other fields, such as music.

Recently Hayes and Nash (1996) proposed a new model that considered also other relevant factors in writing, such as motivation. In this approach the cognitive dimension is less relevant, and for this reason I prefer doing reference to first Hayes and Flower's model. Presenting the model, I explain the major theoretical issue proposed by Hayes and Flower, and I discuss the relevance for the musical field.

Figure 1. Cognitive model of writing processes (Hayes and Flower, 1980a).

The model reported in figure 1 is composed by a central part that includes the process of writing and by two external blocks, that are strongly connected with the central part. They are the task environment and the long term memory, and they have an influence on all the activities.

In the task environment we have the writing assignments and the text. The writing assignments are the elements that define the text, such as the topic, the audience and the motivation cues. Topics, audience and motivation are related.

The topics are variables and could be assigned by another person or decided by the writer.

Concerning the audience, in music it has a double function, because we can consider both the performer, the person that play the piece, and the listener. The composer could write a piece considering the necessity of these two figures, e.g. if the performer is at an high level the piece could be difficult, if he is a beginner, the piece must be easily playable. The composer considers also the context in which the piece will be played. There are different aims and techniques involved in writing a piece for a Festival of new music, for a movie, for the theater or for a children opera. The composer is also conditioned by the instruments utilized such as a solo instrument, a chamber group, an orchestra or a computer. If he is writing for full orchestra he must know the characteristics of all the instruments involved.

When the writer begins to work, the task environment includes also the text under elaboration. The writer defines the topic and then he actives the long term memory for having all the knowledge related to the topic and the audience. In the long term memory there are also general knowledge about music, such as esthetical and formal principles. We can find also the norms about the techniques involved in composition and about the instruments. The composer uses all these knowledge for organizing the material and writing the pieces. In conclusion, knowledge are stored into writing plans.

In the linguistic field we have the distinction between procedural and declarative knowledge that was developed also in the musical field by Dowling (1993). The writer have knowledge concerning specific topic, and have the ability to conform them into procedural plans.

In the Hayes and Flower model, the long term memory and the task environment are external than the other functions. This is helpful for better specifying their functions, but we must consider all the processes as a whole. The students of the field (Sommers, 1980; Gould, 1980; Bereiter, Scardamalia, 1987; Scardamalia, Bereiter, 1986) consider writing processes not linear in the sense that the sequences indicated in the model could happened without following the same order. Planning is an important step that starts before translating, but sometime could be done also later. In the same way, reviewing could be done not only at the end of the draft but also while the writer is elaborating the paper.

Hayes and Flower (1986) consider writing as a goal directed activity, as emerged from the protocol analysis. The writer has some major goals to obtain, such as to discuss a particular interpretation or to propose a new theory. To these goals are connected also subgoals, that are helpful for achieving the major aims. Also the subgoals could have their own subgoals. For example if you are writing a paper about the differences between generations, your subgoals could be the political and the philosophical implications. Under each of these subtopics, the writer can specify others subtopics. Thus, goal was expanded into a hierarchical structure of subgoals. Writing is a process that has goals that are hierarchical organized. Goals, subgoals and evaluative comments are articulated in complex systems. These systems are rich of connections between each other, because all the topics are linked. The difference between an expert writer and a novel one, is that the expert can develop a more articulated plan of work.

In many cases, the writer evidenced in his protocol that he was following a hierarchical

structure. Even if the writers did not explain this process in an explicit way. For example, before starting to write, some writers need a period for planning the development of the whole write form. To do this, they may first try to generate ideas freely. When they had product suffcent ideas, they try to organize them into an outline following plans.

In figure 1, the writing process is represented by four blocks: planning, translating, reviewing and monitor. While planning, translating and reviewing have an active function in the process of writing, the monitor has only a control and supervisioning function.

Writer uses principally three process in achieving his goals: planning, sentence generation and revising. In planning, the writer generates ideas and organizes the into a writing plan. In sentence generation, he produces sentences that are connected with the plan. In revising, he corrects in many ways his text. These processes are strongly interwoven. The processes could be articulated in performing a single part of the draft, in this way the writer plans, generates, and revises a first paragraph, then plans, generates, and revises a second paragraph, and so forth. The writing process could be applied also recursively. Revising his paper, the writer could interrupt the process because he decided to add a new sentence for better explaining the concept. For producing a text, the writer uses all these major processes.

Presenting the model, Hayes and Flower gave also a description of the subgoals, proposing flow charts for generation, organization, translation and revising.

Before discussing in detail the model, it is important to think if it has a validity also for the musical field. The main processes proposed by Hayes and Flower are planning, sentence generation, and revising. Also if we have few experimental data (Davidson and Welsh, 1988; Delalande, 1989; Sloboda, 1985; Truax, 1996a, 1996b) we can argue that they could be also the main processes in musical composition (Biasutti, 1998).

4.1. *Planning*

Planning could be considered as a sequence of actions that are important for obtaining a goal. In planning it is important to discover the correct paths to follow for explaining in a good way the ideas. Planning is developed considering the goals and the contest.

Planning could be divided into the subprocesses of generating, organizing and goal-setting. Generating ideas and organizing them in an outline are parts of planning. The process of writing is developed following goals. Goals direct the work and define also the standards for reviewing. The generation of idea follows the plans and consists in the production of the staff for the draft.

The writing plans could have a sequence (first I explain A and after B) or a hierarchy (in A I explain A1, A2, A3) or to be mixed.

There are many differences between linguistic and music: in linguistic there is a semantic and a meaning that must be explained, in music this process is not necessarily involved. In music there are not semantic references that direct the writer. The plan could be elaborated following also psychological, or mathematical principles.

Concerning the articulation of the processes, there are two main hypothesis in linguistic: the first consider that there is a generation of many ideas that are later articulated into plans. The second hypothesis considers all the plans articulated from a unique idea. In music both the two hypothesis could be valid: some composer (e.g. Stravinsky) elaborated isolated ideas and musical fragments such as sequences of chords and rhythm schemata, that were later conformed into plans. Biasutti (1991) noted that other authors composed pieces starting from a unique idea.

There are also other two kind of processes involved in planning: serial and simultaneous processes. In serial processes the composer considers one variable per time, in simultaneous

processes the composer considers more variables at the same time. Simultaneous processes involves more cognitive effort, and a mastery of skills.

4.2. *Translating*

The translating processes are those that allows to pass from plans to written text. This is one of the most interesting and complicated phases. Hayes and Flower did not analyzed deeply this process, probably for avoiding to discuss about the complex linguistic abilities involved, such as grammar, spelling and semantic. They preferred discuss only about the cognitive dimension of writing.

In translating, the writer adapt the writing plans into formal prose. The writer organizes thinking in sentences. That work involves explaining briefly sketched ideas, interpreting nonverbal material in verbal form, and carrying out instructions. Hayes and Flower believe that thinking is not necessarily in linguistic form.

Hayes and Flower (1986) noted that the knowledge that a writer wants to express in a draft, may be stored in a wide variety of forms. Some knowledge is stored as language, perhaps in auditory form, such as a proverb, some is stored as meanings that may be expressed in a variety of linguistic forms, some is stored as images or as skills that are harder to translate into language. In conclusion, there are processes that translate knowledge in a linguistic form.

A similar problem exist also in music. We do not have many research about the representation of knowledge and translating in music. It would be interesting to study if a composer thinks only in an acoustic way or also utilizing other kinds of stimuli. Considering how some composers described their works, we could argue that they toke inspiration from other topics, such as psychology, physics or mathematics. Sometime they fit mathematical principals in to music (Xenakis, 1961, 1971, 1976). The composer must translate ideas elaborated with other kind of skills into sound ideas and notes. Many time the composer have not only to translate and to articulate his sound ideas into musical sentences and musical meanings, but also pass from a modality (for example visual), to an acoustical one. Translating in music requires the ability of knowing the notes and how to write them. The composer have to fit his ideas into musical plans and adapt them to the musical grammar.

4.3. *Reviewing*

Reviewing is the phase in which the writer try to improve the draft. We can divide reviewing in two different processes: reading and editing. They can intervene in more time during writing, not only at the end. Reading is considered the phase in which the writer read his draft and found some errors or incorrect sentences. Editing is the systematic process, usually realized at the end, used by the writer for checking errors.

Reviewing is a general process: it concerns not only with formal errors, but also to general plans. Reviewing a new composition, we can change a false note, but also deciding to change a general plan of articulation of the piece.

In contemporary music there are many problems concerning reviewing: there are not references such as tonal music, because the composer decides new rules.

In music, reviewing is more complex than in linguistic. In linguistic is sufficient to read the draft. In music we can also read the draft, but another way for checking the validity of the piece is listening to it. In this way we can control the piece using an acoustical medium, verifying if it sounds good. The composer usually uses a piano for performing the piece, but

this is not possible all the time. Many scores are for a full orchestra, and in this case it is very difficult to perform them in a realistic way with a single piano. There is the same problem when a composer wrote new instrumental effects that are unperformable with different instruments than the original. For example a flute piece with particular breath sounds could be not reproduced with the piano.

In music is difficult reviewing the draft with the sensorial modality naturally involved, hearing. Reviewing could be done both imagining the sound effect and comparing it with the starting ideas, or checking the score and the notes comparing them with the plans and the principles defined.

Now the scientific and technical development gave new possibilities to composers. For listening the piece, the composer could use a computer that allow an automatic reproduction of the work. Also in the electroacoustic music field reviewing is mainly due using listening.

5. Conclusions

The study of cognitive processes involved in composition is very important, because it allows to schematize the single processes of writing. It has many implications also for education, because it can influence a new approach in teaching. There is a great difference between an educational method based on the analysis of products and a new one based on the development of the processes. An approach based on the processes is more difficult than an approach based on the product, because it involves the solution of a series of problems connected with planning the activities, (Bereiter, Scardamalia, 1982; Scardamalia, Bereiter, 1983), but it allow a qualitative improvement of education (Hillocks, 1984).

Some students of the field (Beaugrande, 1982; Boscolo 1990; Flower, 1985; Flower e Hayes, 1981; Hayes, Flower, Schriver, Stratman, Carey, 1985) searched to pass from a theoretical dimension to a practical one, elaborating a series of exercises that exemplified modalities emerged during research. It was also developed an educational training based on strategies of problem solving. It is a new approach to teaching that it was not still applied in music, and that it could bring us to a new definition of the concept of composition in education. It is better working on single skills, because it allows to develop single abilities that are lacking or are not used.

Knowing the cognitive processes involved in musical composition is useful to the composers, because it allows them to develop skills for improving the level of consciousness in the task resolved. It is important to stimuli the metacognition processes, because they allow to understand all the abilities that we have and that are involved in composition.

Lastly, we can argue that the field of investigations of writing processes in music results flourishing. In particular, as perspective for future research, it would be interesting to investigate the modalities of representation of knowledge that we can have in music, considering the fact that a composer could take inspiration from also other fields, such as psychology, mathematics and physics. Studying the representation of knowledge and how happens the translation of ideas from one modality of thought to the other, result useful for developing strategies to utilize in the compositional field.

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