György Ligeti’s *Glissandi*: An Analysis*

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ABSTRACT

During the last forty years composers working with electronic and computer technologies have produced works whose analysis cannot be often driven with the traditional canons the musicology offers. After a brief presentation of a possible method of analysis, this paper takes into examination the first electronic music composition of Ligeti, a work which, besides its indubitable musical value, is a true original work within the post-webernian structuralism period.

INTRODUCTION

Before dealing with the subject of this study, it seems necessary to enter into such a little-explored territory as the analysis of electronic and computer music — from now on named synthetic music — to spend a few words on the analysis model used.

Synthetic Music Analysis: A Model

During the last twenty years, namely since thanks to the computer it is possible to perform time-variant acoustic analysis of musical instrument tones, a lot of work has been done by researchers and composers in order to synthesize “interesting” and “natural” sounds. So much electronic music in the Fifties and the Sixties sounded “electronic” and dull. Today we can listen to synthetic music with any perceptual fatigue and our auditory system, sharpened by new sounds, is able to perceive timbral differences once inappreciable. But in such a complex language as music, beyond the simple noticing that something happens, several other processes are involved. Perception is just the first one, followed by the fact that the human being gives a meaning to what he/she hears. At this stage we start up mechanisms which are still almost unknown. In synthetic music, the main purpose being to build up not only new sounds but above all new meanings, we believe that the discovery of these mechanisms is as important as was the discovery of the perceptual ones in the past.

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Looking ceaselessly for new meaningful sounds and new forms, the composer nowadays - but also during the Fifties when, for the first time in music history, he faced the composition of sound - has produced works of which analysis cannot be often driven with the traditional canons that musicology offers.

Psychological research (psychoacoustics) provided helpful results to the composers working with synthetic sounds - and sometimes to conventional instrumental composition too. Likewise for understanding a musical work the conceptual means given by this science can be useful.

One of the most recent approaches to the psychology of music is the cognitive one (Sloboda, 1985). Its main purpose is the understanding of the nature and organization of those mental activities known as perception, attention, memory, language.

In a recent and exhaustive essay on the importance of mental representations of musical dimensions and structures in the light of cognitive psychology, McAdams (1987) presents a theory of the organization processes involved during music listening, which is a new approach for the understanding of the musical experience. Without discussing its merits here, we believe this theory could represent a useful model not only for the creation (Doati, 1988), but also for the analysis of synthetic music works.

This analysis model consists of the main areas included in McAdams’s theory: 1. Reading the acoustic surface; 2. Organization of acoustic information into coherent auditory "images"; 3. Segmentation and extraction of the musical lexicon; 4. Building structural relations; 5. Following a musical discourse.

During the analysis it will of course not always be possible to follow a direct approach between these areas. However, we shall endeavour to reach meaning of the work (area 5) after the study of its materials and form (areas 1, 2, 3, and 4 respectively).

Often the result, rather than an analysis, will appear to us as a description. But a true analysis can only be given, and even better followed, if we have a deep listening experience of the piece analyzed. In fact synthetic music demands special attention for sound images. When we hear a piano tone, a lot of information immediately arises in our ear/brain system. Beyond the perceptual stage, this information concerns more cognitive aspects like the register of the tone, the timbre range in which an instrument can be still identified, the piano literature, etc. At present this is impossible to happen to synthetic tones. The way to achieve the new meaningful sounds mentioned previously is still long, one of the major obstacles being the impossibility to recognize the sound source. Hence also the "simple" description of a work can play an important role in the analysis: before understanding, it is necessary to hear, or rather to know what to hear.

The poor semantic value of synthetic sounds, together with a nearly complete absence of the most important reference point in traditional analysis, the score, leads necessarily to an analysis performed with the help of sound examples. The main purpose of these sound examples is to render concrete what is said using an up till now just a little bit more than evocative verbal language, with a lack of appropriate terminology the lack which could be extended to the whole music world**.

ANALYSIS

György Ligeti: Glissandi (1957).
Instrumentation: electronic music on tape (full track).
Duration: 7'32''.
Realization: Studio für Elektronische Musik - WDR, Köln.
Recordings: Wergo 60076; Wergo 60161-50 (CD)
Score: non-existent.

Glissandi is the first electronic music composition that Ligeti did. It precedes the better known Artikulation (1958). It is a work that the composer nearly refuses, maybe because it differs from his others of the same period. And yet, besides its indubitable musical value, it is a true original work in the production of the WDR studio, dominated by the post-Webernian structuralism. This work already reveals Ligeti’s tendency – which will be theorized later on (Ligeti, 1960) – to depart from the “main street” traced at Darmstadt during the early Fifties. In fact in Glissandi Ligeti does not seek to draw the overall form from the “atomic” composition of sound – sinus tone being the sound atom – which was possible for the first time thanks to the electronic means. Instead it seems to have made its own statements, several of Luciano Berio’s (1956) he quotes in “Metamorphoses of Musical Form”. Among his notes (sheets 1 & 4) we find, in fact, tables with ordered parameters such as sound density, texture, “register ratio”, distribution density, motion density.

The glissando is a particular material of electronic music. Although voice and strings can easily perform it, the few examples of instrumental music before the Fifties in which something more than a simple portamento or a sound effect appears are works by Edgar Varèse (i.e. Amériques (1922), Hyperprism (1923), Ionisation (1932)).

Why does Ligeti, well known in particular for the creation of “static music” – inspired too by electronic music experience – choose the glissando as a sole sound element for a piece? An answer could be sought in Ligeti’s interest in speech – above all its articulation, the richness of which will suggest to him the composition of Artikulation and Adventures. As a matter of fact, in the study of prosody, smooth pitch movements are thought to be important for their “culminative function” (Trubekzoy, 1939)?

** For those interested, a cassette containing the sound examples can be ordered from Unicopi, via Verona 9, 20135 Milano (I).
Furthermore, for Ligeti, the glissando, as will be the cluster, proves to be an ideal means to determine what for him represents the overcoming of the serial procedure: the end of the predominance of the melodic interval (Ligeti, 1960).

The glissando has a particular importance in the electronic music history. At the beginning of our century for several composers it was the symbol of freedom from the equal-tempered system, of means which could be overcome, for Varèse, only through the use of electronic music instruments. Not by chance do we quote here Varèse. He was the first composer to use the sirens as a true musical instrument and, the few times he had an opportunity, he made use of electronic means, e.g. the Theremin for *Equatorial* (1933-34). We may also remember here Olivier Messiaen's works for Ondes Martenot — e.g. the beautiful *Fête des belles eaux* (1937) — in which electronic sounds assume indeed a vocal nature, both in timbre and prosody.

The sound materials for Glissandi are those typical of pure electronic music: sinusoids, filtered white noise, harmonic and subharmonic complex sounds, all of them susceptible to frequency transposition and reverberation.

In the creation of what in the Introduction we called “images”, there is nearly a correspondence between images and sound materials. No wonder. Has not Ligeti by any chance stated “in music, anything which is shaped is already a ‘form’ in itself and not a material”?

It may be said that there is only one image, the glissando, and that Ligeti generates different qualities of it. We can indeed recognize with their own characteristics:

- **upward and downward glissandi in the mid-high frequency range:**
  sound example 1 (0-15")

- **downward glissandi in the mid frequency range with harmonic spectra which sound “nasal”**. In contrast with the bartokian beginning of the composition, these glissandi present an ironic nature:
  sound example 2 (56")

- **coloured noise glissandi**. Of particular interest is the realization of these pitch glides. It takes place not through a frequency variation, but just widening and narrowing the filter bandwidth for a white noise:
  sound example 3 (58")

- **upward-downward glissandi achieved with a tricky technique**: manually regulating the playing speed of a recorded tape. The resulting sound is then shifted in the high frequency range and reverberated:
  sound example 4 (1'18" - 1'20")

- **sinusoidal glissandi**, in the mid-high range, always in pairs yielding a sort of two voices counterpoint. Actually they evoke the image of a *portamento* rather than a free movement in the pitch domain. This is maybe a heritage of the experiences of the composers preceding Ligeti had with instruments such as Theremin and Ondes Martenot. It is worth mentioning here that the first electronic musical instruments used at the Cologne studio — Trautwein’s Monochord and Bode’s *Melochord* — were designed by protagonists of the beginnings of musical application of electronic technology. Therefore their aim was to satisfy the needs of composers still devoted to the reality of the keyboard concert instruments and of “conventional” performances:
  sound example 5 (1'44")

Excluding the above-mentioned “two-voices counterpoint”, the shape of the glissandi is always a “sinusoidal” one. This is due to the fact that the frequency variation is manually realized acting on the oscillator potentiometer. Therefore the envelopes do not change too much, because a sinusoidal-like shape is the most natural to produce when acting on a knob. Most of all, what is difficult to avoid is a constant speed motion. It may be said that at that time a true creative and varied performing ability was not yet developed (and never would be before the voltage control advent, for with such a technique it is possible, without “turning the knob”, to modulate any sound parameter through the desired control functions provided by one or more electronic generators).

On the other hand, the fact that the title of the composition is the material’s name, denotes an experimental aspect of the piece. The composer cannot give a demonstration of virtuosity producing glissandi because he has not yet acquired a full ability. The work represents the first stage of exploration of the new element.

For two reasons, therefore, we could say that, even though the glissando is a true meaningful sound image, it has been little developed by Ligeti. First, because at the time it was a new “lexical” element, at most used as a sound effect. Secondly, for the limits yielded by the manual control. The most personal glissandi — those which, more than others, are the results of a true compositional thought on the sound — are the noisy ones and the “choral” glissando which ends the piece with a texture similar to the one Ligeti will use in *Lux Aeterna*.

Again, as in *Lux Aeterna*, all the images here — not including the “nasal” glissandi and a brief “percussive” moment — have not a quick onset, but come in smoothly. Nevertheless, in Glissandi the sound images do not fuse, as happens to the voices in the choral piece, but always remain well separated. This is a special feature of the work. One of the big problems in sound synthesis, during the 80s as well as today, is to keep the perception of a timbre constant when the fundamental frequency moves from the register wherein it has been created. Now the glissando often changes continuously from one register to another. It is thus very easy that timbre changes too — even though, compared to the constant pitch sounds, the glissando has the advantage of being perceived as a single sound during the changing of the register.

The sound images in Glissandi are always perceptually separate from each other. Whenever they are fused, it is only by means of the merging effect of
dynamic variations, especially during the last three minutes of the piece. This segregation is also due to the definition of several orchestration laws. For instance, each image moves in a frequency range which goes unchanged through the whole composition. This means that Ligeti was interested in maintaining the same timbre for each image.

With regard to the pitch space, Ligeti choose to cover the whole chromatic space not with his original cluster conception - widely used in his “static” works - but with the movement of four/five images which remain in the range to “explore” they were enclosed since the beginning.

It has been said that, rather than by material development, a very important role in this work is played by dynamics - this is true if we exclude the first two minutes where Ligeti shows particular attention to formal articulation. As well as the choice of glissando as “protagonist” of the piece has been previously explained with Ligeti’s great interest in spoken language, the same we can account for dynamic variation. As in speech, in Glissandi often fast loudness changes, similar to real stress, have the function to establish contrasts within the musical “chain” and sometimes to point out an image in conflict with others. In support of this hypothesis, we remember the complex loudness envelopes sketched by Ligeti for Artikulation to simulate the high degree of speech articulation.

Controlling the dynamics - by hand, like frequency, for lack of any automatism - Ligeti shows the extraordinary performing ability we noticed he needed to vary the envelopes of the glissandi. To make the simultaneous presence and merging of different sound layers even more perceivable he adds a carefully balanced reverberation. It is musically relevant that in Glissandi this kind of sound manipulation, even if used very often, will not yield the timbral levelling that usually results. In fact, for their temporal characteristics - slow attack, long duration - the sounds which undergo the treatment cannot generate those coloured “after-effects” typical of analog reverberation.

Figure 1.

Proceeding with the segmentation, we can recognize a three-part division (Fig. 1). The first one is divided into four different sections (a,b,c,d) and introduces, like a summary, all the sound images which will appear in the work. The second one has a linking role, while the third is exclusively devoted to the dynamics virtuosities.

Part I
a) 0 - 1'22": this section presents a very rich formal articulation. It is characterized by an opening crescendo, achieved through the accumulation of similar timbre glissandi (0-40). A long pause - between 40" and 48" - is succeeded by another accumulation process. This time its content is denser. Heterogeneous images give rise to a rich polyphony ending with the sound event of the manually moved tapes. This section makes us think that the piece will be anything but static:
sound example 6 (0-1'22")
b) 1'22" - 2'30": at 1'45" the two-voices counterpoint comes into the foreground within the mid-high register, “dry” at the beginning and then reverberated;
c) 2'30" - 3'20": because of its great dynamic variations, this section can be seen as an anticipation of Part II;
d) 3'20" - 3'45": a “percussive” episode. Both figures and background are built with coloured noises. Speeded up glides and short time shapes underline and articulate longer reverberated glissandi. The pitch space extremes are outlined, in the overhigh register by little and slow pitch changes, and in the low register once more by coloured noises:
sound example 7 (3'20"-3'45")

Part II
3'45" - 4'10": this part has a pivot function between Parts I and III. The dynamic variations on a glissandi polyphony - similar to the opening one of Part I - are very fast and large. The coincidence of dynamic and pitch variations gives the impression of moving sounds in an illusory acoustical space. In fact the Doppler effect (i.e. the pitch change heard by a listener due to the relative motion of sound source and observer) corresponds to these shifts. As concerns Ligeti's interest in moving sound sources - both within the microstructure and the macrostructure (cf. Stoianova, 1985) - it is worth noting that, although in his notes he indicates clearly stereophonic movements of sound (sheets 5 & 7), the final result is a monophonic tape:
sound example 8 (3'45"-4'10")

Part III
4'10" - 7'32": the formal elements built in the two previous parts, and sometimes real fragments of these parts, are composed in a kind of bas-relief by means of jagged amplitude envelopes which in a very suggestive moment seem to follow the frequency changes. At one minute to the end, a substantial stop of six seconds acts as a mirror of the long pause in Part I. In fact, both separate the rest of the composition from a particular episode. This very last event is the ending "choral" glissando in crescendo previously mentioned as an example of truly “personal” glissando made by Ligeti.
NOTES

1. Without discussing here the merits of their contents, I would like to mention some of the recent contributions to the discussion on electronic music analysis; Delalande, 1986; Garépy & Décarie, 1984; Stroppa, 1984; Thies, 1985.

2. The proposed model has been used by the writer for the analysis of music during a computer music master class held in Como (I).

3. The "auditory image" is a metaphor introduced by McAdams (1982) and defined as "...a psychological representation of a sounds entity that exhibits an internal consistency (or coherence) in its acoustic behavior."

4. In the course of the previously mentioned master class (see note 2) a peculiar listening chart has been set up. It contains several questions to answer during and after the listening session. A descriptive skeleton to perform on the analysis is then built on these answers.

5. It is worth mentioning here that Ligeti's first texture music is Pièce électronique Nr. 3 (1957-58). This work, even though the composer used in his composition a detailed realization score - which remains unique in his electronic music production - was not realized with electronic means, but with traditional instruments. Furthermore, this piece assumed its original title: Atmosphères.

6. As suggested by Herman Sabbe (personal communication), from an historical point of view Giuseppe was preceded by Karl Goeyvaerts' Composition n. 7 aux naxeaux convergents et divergents which was realized in 1953 at the Kölner studio with the same material of Ligeti's work: glissandi. In spite of its short duration (1'30") and abrupt ending, this work holds a compositional thought which goes beyond its experimental original nature.

7. The culminating function is carried out by a phonic element that within the discourse allows to point out several articulations. It is not by chance, thus, that the glissando will remain an important element also for the composition of Artikulation.


9. This use is due to the learning that Varèse did in Berlin, in 1905, of the experiments with sirens performed by the physicist and physiologist H. von Helmholtz.

10. Subharmonic sounds are particular of Ligeti's electronic pieces. They are inharmonic sounds; the frequency of the components which are obtained through - instead of multiplying, which yields harmonic sounds - the fundamental frequency by the natural number set. For instance, if the fundamental is 1000 Hz, then the components of the subharmonic spectrum will have frequency rates of 1000 Hz, 500 Hz, 333.333 Hz, 250 Hz, 200 Hz, etc.

11. In his notes for Glissandi (sheet 6) Ligeti writes that the piece will end with a gradual transition from white noise "...to human voice."

12. The timbral constancy will cease to be a problem only when we shall be utterly well acquainted with the new timbres - which thanks to digital synthesis, we can generate - to keep them permanently in mind. Exactly in the same way to what happened to Western culture with traditional musical instruments. Or different the registers in which these timbres could appear need to be parts of this kind of stored repertory. How many people could say, hearing a clarinet for the first time in their life, that it is still the same instrument when playing in high, mid and low register?

13. The analysis model here adopted being based on the perception of acoustic information, the segmentation has been done without taking Ligeti's sketches too much into account. In fact they show a six-section partition, not perceivable when listening to the piece. It is also likely that duration and content of several sections had been changed during the realization, both for aesthetic reasons and the empirical global sound manipulations used at the time, such as magnetic tape cutting and splicing.

REFERENCES


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