A Physicist’s view on Chopin’s Études: Op.10 n.3, Op.25 n.1

Massimo Blasone
Dipartimento di Fisica, Università di Salerno

• Historical notes
• Some original ideas/fantasies
Motivations

• Obtain new viewpoint for interpretation;
• Many studies on mathematical structure of music, not really useful for musicians;
• Qualitative approach: using ideas from Physics to understand musical structures;
• Understanding where is beauty in Music…
• Enigmatic character of Chopin’s music (Le Pianiste, 1833).
Chopin’s Études

- Long previous tradition of Études (Clementi, Czerny, Moscheles, etc..) as exercises to develop specific technical aspects;
- Summa of piano virtuosism, very large positions for the hand, new way of attacking the keyboard, etc..
- High artistic level: “perfect fusion of the athletic and aesthetic” (L.Kentner);
- Novel harmonic combinations, large harmonic progressions, instrumental figurations used as themes (cantabile character of figuration);
- Simple form: one or two thematic ideas, often in form of song ABA;
- The collection of 24 Preludes contains similar material.
Chopin’s Études: from Paganini to Liszt

N. Paganini (1782-1840)

F. Chopin (1810 - 1849)

F. Liszt (1811 - 1886)
• Études Op.10 dedicated to Franz Liszt.

• In 1829 Paganini gave a series of 10 concerts in Warsaw which deeply impressed the young Chopin. They met later in Paris in 1837, Paganini much appreciated Chopin’s piano playing.

• Paganini's 24 Capriccios for the violin were a model for Chopin’s Études. The other musical example (also for the Preludes) was the Well Tempered Clavier by J.S.Bach.
Criticism to Chopin’s Études

• Berlin editor and composer Ludwig Rellstab wrote about the Op. 10 Études: "Those who have crooked fingers, can treat them by means of these exercises. But those who suffer from no such ailment would do well to avoid them."

• Franciszek Mirecki criticized the monotony of the themes in the Études, saying that if notes would be colored, instead of black, these scores could be used as wallpaper...
• As a music critic, Robert Schumann immediately recognized the value of Chopin:

  “Hats off, gentlemen, a genius!”

is the famous incipit of Schumann’s review of Chopin’s Op.2 Variations on “Là ci darem la mano” by Mozart.

• He also included Chopin as one of the characters in his Carnaval.

• Chopin’s Etudes op.10 were also very positively reviewed in the magazine Le Pianiste, just after their publication in 1833.
Titles

• Chopin always used only generic titles for his compositions (Etudes, Preludes, Nocturnes, Ballades, etc.) refusing any programmatic intent for his music.

• Nevertheless, many of his composition are very evocative of (subjective) images, and titles remained attached to some pieces in particular (Tristesse, Raindrop, etc).
| Étude Op. 10, No. 3 Tristesse | 3.G major - Vivace (Thou Art So Like a Flower) |
| Étude Op. 10, No. 4 Torrent | 4.E minor - Largo (Suffocation) |
| Étude Op. 10, No. 5 Black Keys | 5.D major - Molto allegro (Uncertainty) |
| Étude Op. 10, No. 8 Sunshine | 8.F-sharp minor - Molto agitato (Desperation) |
| Étude Op. 25, No. 1 Aeolian Harp | 11.B major - Vivace (The Dragonfly) |
| Étude Op. 25, No. 3 The Horseman | 13.F-sharp major - Lento (Loss) |
| Étude Op. 25, No. 4 Paganini | 14.E-flat minor - Allegro (Fear) |
| Étude Op. 25, No. 5 Wrong Note | 15.D-flat major - Sostenuto (Raindrop) |
| Étude Op. 25, No. 6 Thirds | 16.B-flat minor - Presto con fuoco (Hades) |
| Étude Op. 25, No. 7 Cello | 17.A-flat major - Allegretto (A Scene on the Place do Notre-Dame de Paris) |
| Étude Op. 25, No. 8 Sixths | 18.F minor - Molto allegro (Suicide) |
| Étude Op. 25, No. 9 Butterfly | 19.E-flat major - Vivace (Heartfelt Happiness) |
| Étude Op. 25, No. 10 Octave | 20.C minor - Largo – C minor (Funeral March) |

(Arbitrary) names for Études and Preludes (by A.Cortot and H. von Bülow)
• Chopin said about this etude that “In all my life I have never again been able to find such a beautiful melody.”

• “The third one is among the most difficult ones. The melody is beautiful, but difficult to render. I recommend the chromatic scale in diminished sevenths which is new and of good taste; I cannot say the same for the following passage [the one marked *con bravura*] which has not a pleasing effect....”

Chaulieu, Le Pianiste 1833
• The piece has the structure of a song : A-B-A’ with a central section marked "più mosso" where some chromatic scales and a long passage in double-sixths appear, based on diminished seventh chords.

• Such chords are symmetric ones, each made of four notes. In our tonal (equal tempered) system, based on the division of the octave interval into twelve equally spaced intervals (half-tones), there are three such chords, exhausting the 12 notes:
The symmetric phase
Tonal phase transition

• With respect to the original symmetry among the twelve tones of the tempered system, the choice of a given tonality represents a breakdown of such symmetry, establishing a “reference frame” to which we refer when listening a piece.

• We can thus regard the first section as an ordered phase (crystal), in which the symmetry is broken by the affirmation of the tonal area of E major.

• The central section contains a progressive dissolution of the tonal structure, up to the symmetric, effectively atonal double sixths passage (where all 12 tones are present).

• The return to E+ (via the dominant B+) is obtained by breakdown of the tonal symmetry by insisted repetition of a minor sixth interval, by a C♯.

• It follows a section where the accumulated energy gets dissipated.
• It is very remarkable that such a C♮ re-appears at the end of the piece, in the main theme, adding a nostalgic feeling to the melody.

• One can thus have the following vision freely inspired by the Kibble-Zurek mechanism of defect formation: the crystal goes into the fire where it melts, then it crystallizes but defects appear (C♮)

• Tonal phase transition (with defects)

• Note dynamical markings: ff, con fuoco, con bravura, f.
Scriabin: synesthesia

A. Scriabin (1872 - 1915)
Three Centuries of Color Scales

Isaac Newton 1704
Louis Bertrand Castel 1734
George Field 1816
D. D. Jameson 1844
Theodor Seemann 1881
A. Wallace Rimington 1893
Bainbridge Bishop 1893
H. von Helmholtz 1910
Alexander Scriabin 1911
Adrian Bernard Klein 1930
August Aeppli 1940
I. J. Belmont 1944
Steve Zieverink 2004

Drawing by I. Newton representing the correspondence between colors and sounds.
Symbolism in Scriabin

• C (Red) - Human will
• D (Yellow) - Happiness
• E (Light Blue/green) - Dream
• F (Dark Red) - Creativity
• A (Green) - Matter
• B (Dark Blue) - Contemplation
Scriabin’s color code for musical notation (using MuseScore)
• Final image for the Etude op.10 n.3:

   *Blue crystal (Turquoise) with red spots.*

• OK, but then yet another title !!

• Not just a title, rather an analogy with a *physical process*.

• Possible meaning: metaphor of an internal trip from an adolescent age of unlimited dreams, through some dramatic event, to a later stage in which same emotions/images are necessarily different.

• Perhaps physical processes describe well music because musical structures resonate with structures already present in our brain (aesthetic experience), which are previously created as image of natural phenomena.

• Music as a probe for brain dynamics.
• The blue crystal
• The symmetric phase (note all colors are present)

• Symmetry breaking by repetition of C (bar 62)
• The blue crystal with red spots (bars 104-105)
R.Schumann on Etude op 25 n.1:

"Imagine that an aeolian harp possessed all the musical scales, and that the hand of an artist were to cause them all to intermingle in all sorts of fantastic embellishments, yet in such a way as to leave everywhere audible a deep fundamental tone and a soft continuously-singing upper voice, and you will get the right idea of his playing.

But it would be an error to think that Chopin permitted every one of the small notes to be distinctly heard. It was rather an undulation of the A flat major chord, here and there thrown aloft anew by the pedal.

Throughout all the harmonies one always heard in great tones a wondrous melody, while once only, in the middle of the piece, besides that chief song, a tenor voice became prominent in the midst of chords. After the Etude a feeling came over one as of having seen in a dream a beatific picture which when half awake one would gladly recall."

• Small notes are just color, anticipation of Impressionism (Debussy);

• Phase-number uncertainty relation:

$$\Delta n \Delta \varphi \geq 1/2$$

The distinct perception of the internal structure (small notes) is not compatible with the perception of the whole.

• Coherent states, with free, unperturbed, dynamics in the first part of the pièce.

• Approaching the modulation to the distant A+ key, the dynamics becomes very strong due to gradients in the harmony (potential) and the coherent states deform (squeezing).

• At the end first decoherence and finally evaporation take place.
• Unperturbed dynamics
“Potential well”: higher voice cannot reach F# until sufficient energy is provided (by gradients in the harmony)
• Perturbed dynamics (squeezing)
• Decoherence

• Evaporation
Another example of coherent states: Prelude op.28 n.8

Similar structure to Etude op 25 n.1. Non-compact case.
Other ideas and perspectives

• Fractals, (harmonic) horizons, attractors, etc..
• Definition of a potential based on harmonic relations dynamics (forces);
• Tempo as a function of dynamics;
• Pedagogical use of colors in musical notation.