7 Noise in Spectral Music

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Theoretical Horizon

There is no doubt that from the acoustics point of view sound and noise are part of the same phenomenon. It is also true that there is almost no definition that does not stress – at first – the unpleasant, undesired, unagreeable and disturbing qualities of noise. Some approaches, however, recognize these qualities more as a challenge, as Morton Feldman has pointed out: 'It is only noise which we secretly want, because the greatest truth usually lies behind the greatest resistance' (Feldman 2000: 2). The power to evoke some ancestral dimensions can be found in many other visions of the concept. Reynolds, for example, affirms, 'if music is a language, communicating moods and feelings, then noise is like an eruption within the material out of which language is shaped' (Reynolds 2004: 55). However, all the mentioned views do not seem to be directly pertinent to the definition of noise that composers of spectral music such as Gérard Grisey, Tristan Murail, Hugues Dufourt and Michaël Levinas expressed in their writings and compositions, influenced by the epistemological turn of the so-called age of timbre ['l'ère du timbre'] (Dufourt 2014: 347). A most radical aspect of this turn is the shift from composition *with* sounds (for example, a discrete pitch-space) to the composition *of* sound (acoustic space seen as a continuum), a turn that actually takes place before spectral music. As many scholars stressed, electronic music in the 1950s and 1960s (and, in particular, Stockhausen's *Gesang der Jünglinge, Mikrophonie I* and *II*), on the one hand, and Ligeti's *Klangfarbenkomposition* [composition of sound colours] and Giacinto Scelsi's *Composizione su una nota sola* [composition on a single note] in the 1960s, on the other hand, were some of the most significant contributions to the 'epistemological revolution' later accomplished by spectral music.[1] A convergent perspective, albeit originating from different assumptions, was proposed in the same period by Pierre Schaeffer (Schaeffer 1966). In fact, we can thank Schaeffer for the awareness (shared by Murail 2005) of the central role that percussion instruments, on the one hand, and electroacoustic music, on the other hand, have played in the establishment of timbre as the main field of compositional investigation. However, according to Dufourt,

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the most decisive input was provided in the late 1960s and early 1970s by computer music and music informatics research developed by composers such as Jean-Claude Risset with *Inharmonique*, John Chowning with *Stria* or *Turenas* and researcher David Wessel (Dufourt 2014: 354–355). The experience of computer music grounded in information theory introduces a kernel aspect for spectral music: a means for the control (both in the time and frequency domain) of processes of transformation, which express the formal organization of a work, according to a specific degree of predictability or in Grisey's term 'pre-audibility' (Grisey 1987). The process manifests itself on two strongly related levels: macrophonic and microphonic. They both originate from the idea of acoustic zooming which allows one to observe the sound – conceived as a 'living being' (*être vivant*) and therefore endowed with a birth, a life and a death – from different perspectives (Grisey 2008). The metaphor of 'living being' is grounded in research in acoustics and spectrographic analysis of sound, made possible by changing the scale of observation and developed in those years by Emile Leipp, among others (Leipp 2010). As stated in Grisey's and Murail's writings, and as *a posteriori* brilliantly delivered by Dufourt,

> […] with computer music, music in its entirety has undergone a radical change in scale. The objects of modern music no longer belong to the physics of macroscopic objects. The acoustic parameters on which we operate, the details of the encoded signal we control are in the order of milliseconds. […] By changing the scale, the music also changes language.
>
> (Dufourt 2014: 347; my translation)

The question of new language, new syntax and new rules which permeates the theoretical horizon of the first spectral generation will inform many composers of later generations and will emerge in various forms in their music and theoretical writings (see, for instance, Harvey 1986; Bedrossian 2008; Romitelli [s.d]; Saariaho 2013). The question is deeply correlated to the 'instaurative' function of musical time that gives rise to surface instability, liminality, complexity, in short the metaphor of 'sound as a field of forces, each force pursuing its own particular evolution' (Murail 2005: 122) as a new category of compositional thought. The foundation of spectral technique on the temporal dimension was most innovatively theorized by Grisey. In the presentation notes for the orchestral piece *Le Temps et l'écume* (1988–1989), he points out:

> My research […] is motivated by the impossibility of composing an extended time without both expanding the harmonic field (chords become spectra) and the depth of this field (the pitch is no longer coloured by the instrument, it is the imaginary instrument – the instrumented spectrum – that makes the pitch necessary and fixes both its colour and its rank on the dynamic scale.
>
> (Grisey 2008: 153; my translation)

It is in this context that the abolition of limits emerges as imperative and the continuum between 'pitch and noise, rhythm and frequency; harmony and sound colour' therefore entails new rules for integrating the 'totality of sonic phenomena' (Murail 2005: 124). Since the very beginning the means that allow composers of spectral music to accomplish 'synthetic composition' is the technique of instrumental synthesis influenced by additive synthesis used in electronic music, here transferred to instrumental devices.[2] The separated, correlated and simultaneous control over frequency and amplitude for each harmonics or partial of a spectrum, as well as the reciprocal and mutual change of velocity of their transformation, so common in electronic music practice, creates a wide area for experimentation of the formal, timbral and harmonic levels once the technique had been transferred to the acoustic dimension of 'traditional' instruments. In this domain, knowledge from scientific research and experience from electronic music created new challenges since the fusion or segregation principles showed all the complexity of the timbre multidimensionality control and the subtle threshold between timbre and harmony turned out to be more complex than expected (Harvey 1986; Saariaho 1987). In the timbre continuum which is delineated by opposing sonic states (sine wave – noise), the very place of experiencing the instrumental synthesis is represented by the plurality of inharmonic spectra and, more generally, by the concept of inharmonicity as the manifestation of the sound's internal life, dynamism and complexity. This perceptual and cognitive ambiguity (Lerdahl 1987, Pressnitzer and McAdams 2000) shows a strong formal potential, as stated by Smalley:

> Inharmonic ambiguity allows spectral change in two directions. Firstly one can move into intervallic and harmonic (tonal) spectra. Secondly, like the spectral compression […] inharmonic saturation – the adding of spectral components – can be a means of moving toward noise. Inharmonicity can therefore occupy a useful middle ground which allows movement towards harmonicity and intervallic pitch on the one hand, and noise on the other.
>
> (Smalley 1997: 120–121)

Once again, noise is positioned on the opposite side of the timbre continuum, and as such, it expresses a liminal situation, which is hard to inhabit or sustain for a long time due to its saturated nature. Paradoxically, in Grisey's words, noise evokes the same undifferentiated perception as absolute periodicity does (1987: 245). As the examples will show, the process of integration of inharmonic spectra and complex sounds up to complete noise in various spectral and post-spectral works is determined by the idea of experiencing instability in a sort of accumulative process which tends to saturation, obtained by various techniques aimed at increasing inharmonicity. This, concerned with density, 'saturated spectral state which cannot be resolved into intervallic or relative pitch' is defined 'saturate noise' by Smalley

(1997: 120). It is a state that represents the maximum of complexity and from a hierarchical point of view – as theorized by Lerdahl – the maximum of tension and dissonance (1987: 141–143). As such, it represents a strong, temporally oriented element of the large-arc formal organization and can be obtained on various levels of temporal zoom. In the first spectral works, or more generally speaking in the spectral works of the 1970s and early 1980s, the saturation process overlaps with the form itself due to the stretched musical time and slow, teleological transformation of the spectral content. Works from the 1990s (both by spectral and early post-spectral composers) regain the temporal dimension of speech and thus explore processes of saturation embedded in new forms of syntactic articulation. This chapter will show how this change in temporal dimension focuses attention on the construction of each element of the new speech, that is each 'vowel' and each 'consonant', in order to build a new syntax able to integrate various types of saturate noise in a coherent way. More or less linked to the experience of electronic music and sound synthesis, saturate noise is not the only type of noise that the composers interested in sound synthesis actually explored. There is also a second type that emerges through an increasing and structural role of percussion. For this category, Smalley uses the term 'granular noise' and the definition is qualitative: '[…] non-pitched roughness, granularity or grit. […] Granular noise is textured impulses, and need not be dominant in spectromorphology' (1997: 120). This second category will be explored, as the examples will show, through different techniques of organizing both the syntax and form.

Noise as a Saturated State of Inharmonicity

Périodes for seven instruments, composed by Gérard Grisey in 1974, is a sort of *manifesto* of the first spectral period for the exemplarity of its form – articulated in a constant cycle of three states analogous to the respiratory rhythm (inhalation, exhalation, rest) – and for the processes of the 'becoming of sound' embodied by each of them.[3] In this nearly 13-minute piece, the first – chronologically speaking – of the monumental cycle *Les Espaces Acoustiques*, the process of gradual increase of inharmonicity reaches the point of maximum saturation in only two points of the work. The first one corresponds to rehearsal numbers 13–14. Here, the playing techniques of each of the seven instruments – such as exaggerated bow pressure for strings, multiphonics, singing into the mouthpiece, flutter-tonguing for winds and changing the trigger position in the trombone – are oriented towards a maximum of timbre instability and complexity. This saturated state alternates (according to a specific scheme of irregular durations and accentuation) with a low *E* harmonic spectrum in a process where the durations of the former prevail over those of the latter to the point where only complex sounds remain. Once the field is saturated, internal movements occur in strings (bow position from AST to SP),[4] in

woodwinds and trombone (flutter-tonguing), but no new gestures appear. The energy of saturation, once experienced and sustained for less than 15″ at maximum level, decreases gradually through dynamics and by reducing the number of instruments one by one (flute, clarinet, trombone, double bass, cello, viola) for another 'long' 30″ (approximately) until only the violin remains with a *C*5 in *piano* and AST. A first moment of silence of the whole piece absorbs the exhausted energy of the first saturation process. The famous theatrical interaction between violin and viola players that follows expands in a new cycle which closes with the second saturated section (rehearsal numbers 22–23). The saturation process in this final section is due to the gradual compression of the harmonic field in the low register (only trombone, double bass and cello remain); the proximity of the low frequencies together with the already mentioned extended playing techniques in *fff* enhance the roughness. The saturated energy here is not oriented towards dissipation, but, on the contrary, it transforms into a generative, iterative gesture by double bass and trombone, from which the opening low *E* harmonic spectrum of *Partiels* grows.[5]

Partiels (1975) and *Prologue* (1976) develop some of the already mentioned techniques by introducing new ways of internal articulation of saturated states as well as the processes for their introduction and dissipation. *Prologue*,[6] in particular, represents the expansion of the idea of timbre continuum since the whole formal project develops a 19-minute unique trajectory (based on three different gestures) from a five-note arpeggiation of the low *E* spectrum up to the maximum of saturation (*fff*, bow pressure, very high register, double strings, glissandi) and backwards, with a final cadential 'retrospective' section. The new aspect introduced by *Prologue* is the internal articulation of the one-minute saturated state modelled upon the structural elements of the whole form, as the global profile of the glissando corresponds to one of the 'neumas' of the arpeggio gesture (Féron 2016; Baillet 2000; Haselböck 2009). In *Prologue*, the curve for the increasing inharmonicity corresponds better to the idea of the scale of complexity (in particular, the category of discontinuous dynamics) theorized by Grisey (1987: 244). It is worth mentioning that the piece was also conceived as a version for viola and acoustic resonators vibrating in sympathy and enriching the global timbre by various 'granular' qualities (Féron 2016), an aspect that will be discussed in the next paragraph.

The early 1970s also saw the first spectral works by Tristan Murail who was interested in the composition of complex sounds through instrumental synthesis, but with even more 'electroacoustic' origins than Grisey. As he states,

> it was inevitable that the development of electroacoustic techniques, and of our understanding of acoustics, would affect traditional compositional techniques. Indeed, electronic music produced a more or less deliberate proliferation of instrumental and orchestral music, which as

> a result proposed new schemes, new forms, new ideas as far as the use and combination of instruments, etc.
>
> (Murail 2005: 123)

In this new horizon of possibilities, Murail develops his own field of references in both the scientific research on sound and the technique of instrumental synthesis. From this point of view, *Mémoire/Erosion* (1976) for horn and nine instruments is an emblematic example. Here, the idea of an instrumental simulation of the analogue studio technique known as the 'reinjection loop' is used in order to explore a gradual deterioration of the initial gesture and the increase of disorder and inharmonicity up to the final sections (H–I–J) where the process results in a saturated acoustic space unable to restore any harmonic element. It ends with an abrupt interruption. This final gesture, even if related to the technique of the 'reinjection loop', also shows a radical formal function of noise as expression of an energetic maximum which has no potential to generate other gestures than silence.

Tristan Murail's *Désintégrations* (1982) for ensemble and electronics is the last example of the category of noise as the expression of a saturated state of inharmonicity that will be discussed here.[7] This piece is emblematic for the plurality of modes with which the technique of instrumental synthesis based on acoustic models derived from the computer analysis of various instruments was applied both to the instrumental parts and to the magnetic tape (Hirs 2009: 104–118). In its 11 sections ('stages' – to use Murail's words – that evolve from the harmonic to the inharmonic or vice versa), linked in various ways to the idea of destroying and building timbres, the first part of section IV and the final part of section V explore the universe of inharmonicity and complex sounds in a particular way. Here, all the elements (acoustic instruments including percussion, magnetic tape, dynamics, register, spectral content, rhythmic articulation of gestures) contribute to the process of saturation. However, this example prompts the two following observations. The duration of each process is noticeably shorter than in all the examples discussed above. The global duration is, therefore, articulated by gestures with different coefficients of 'harmonicity'. This fact considerably influences the way in which relationships between harmonic and inharmonic content are perceived, as specific harmonic elements persist in the perception of the complex sound areas, even if not present physically. Repetitions and short distances between events make the sound globally differentiated by various levels of complexity. This persistence of 'tension' gives the rare moments of pure harmonic spectra an expressive brightness and radiance. In this piece more than in any other discussed above, a feature emerges which reflects the ambiguous nature of complex sounds and noise. As Smally points out:

> Noise is relative rather than absolute – it exists because we have a concept of pitch. Intervallic pitch is an absolute – we can perceive and name intervals precisely – whereas noise is a generality and has to be

> considered spectromorphologically in terms of its motion, texture, and behaviour if we are to be able to describe its riches. On the other hand, noise can occur in narrower or wider bands, and become coloured and resonant so that pitch (either relative or absolute) becomes blended in. Therefore, while intervallic pitch and noise are in one sense extremes, noise can take on a pitch identity, just as pitch can take on noise content.
> (Smalley 1997: 120)

This ambiguity between the states of sound matter which, especially from a psychoacoustic point of view, has been shown to possess many liminal zones in which various blending and masking phenomena intervene becomes an important field of exploration in the following decades during which a decisive impulse comes from digital technology for sound analysis and synthesis. The focus shifts to many possibilities of transferring typical electronic processes (FM synthesis, ring modulation, cross-hybridity, filtering and so on) to instrumental synthesis (possibly of orchestral sound) of a variety of inharmonic spectra. Kaija Saariaho's production is an example of this shift towards a new phase of spectral composition dominated by inharmonicity, thus more oriented to the formal and syntactic possibilities that no longer only belong to the sound/noise axis but also to that of harmony/timbre. In her 1980s and early 1990s works (*Verblendungen*, *Lichtbogen* and *Solar*), the role of spectral analysis software such as Iana, CHANTS or transkaija, in the preparatory phase of the creative process, and thus the growing role of technology (increasingly available thanks to the founding, among others, of IRCAM in 1976 and with a whirlwind development at the turn of the 1980s and 1990s) becomes more and more evident (Morrison 2021). The shift towards the 'age of timbre' swept through both the production of the spectral composers themselves, whose works of the 1990s clearly showed this transition (see Grisey's *Vortex temporum*, Murail's *Le Partage des eaux*, Dufourt's *L'Espace aux ombres* or Harvey's *Cello concerto*) and that of the middle generation of composers such as Philippe Hurel, Marc-André Dalbavie, Magnus Lindberg, among others, who were exploring the new horizon. In little more than ten years, the scenario changed and continued to change in the increasing fusion of technological, psychoacoustic and compositional discoveries, leading to an increasingly integrated vision of the acoustic space in which the sound/noise axis no longer represents the core aesthetical and compositional challenge in the production of the new generations. But before describing this point of arrival, the next paragraph returns to Smalley's idea of fluid boundaries between sound and noise and focuses on the challenges of composing noise (in Smalley's words 'granular noise') in spectral works.

Noise as a Granular Quality of Inharmonicity

The starting point for the discussion of the examples chosen for this category will be the already mentioned definition of granular noise as textured

impulses, which 'need not be dominant in spectromorphology' (Smalley 1997: 120). In this category only rarely do we find examples derived primarily from the control of acoustic space in terms of frequencies, and in this case, they can be linked to the idea of the beating effect due to the critical band width that influences the roughness quality or even the separation of perceived pitches.[8] This effect is explored by Grisey in *Partiels* (rehearsal numbers 12–22) and *Modulations* (rehearsal numbers 23–31) where the rhythmic activity of the percussion is derived from the difference of two low frequencies, the subtraction of which results in frequencies lower than 16 Hz, thus expressing rhythm (the number of pulses in a given temporal unit, see Pustijanac 2017). However, this technique is not the main field in the exploration of granular noise. Other possibilities have been developed by spectral composers, considering the fact that granular quality can be obtained or generated by a variety of means that often originate in percussion instruments. In fact, thanks to the long tradition of works for percussion going back to Edgard Varèse's emblematic *Ionisation*, through the production of Iannis Xenakis (*Persephassa*, *Psappha* and so on) and spectral composers themselves such as Dufourt (*Erewohn*, 1972–1976) and Grisey (*Tempus ex machina*, 1979), the exploration of the timbral and syntactic qualities of the variegated percussion family reaches a new richness in the integrated spectral approach. Percussion instruments are, from this perspective, on a par with the different modes of sound expression obtained on pitched instruments by means of extended techniques, enhancing certain timbral specificities, ambiguities or latent qualities. Used in the crucial attack phase of the sound, they can contribute to masking the specific instrumental source; integrated in the sustain phase, they can bring out instability of intonation or timbre as well as expand the decay phase through timbrally coloured resonances. The presence of percussion (with or without the percussive use of pitched instruments) develops the compositional technique more towards a complex vision of the acoustic space, which is evaluated on the basis of observable multidimensional relations that can be expressed, for example, through so-called spectral descriptors (McAdams 2019).

One of the emblematic examples of a smooth but pervasive role of noise is Michaël Levinas's *Appels* (1974) for 11 instruments. In this piece – shaped from the idea of sympathetic vibration – the sound of wind instruments activates the vibration of snare drums. This complex sound is captured by a microphone and spread in the hall, reinforced by the brass instruments and tam-tam. The evocative character of this piece is due to the 'call gesture' of the horn, each repetition of which is followed by silence allowing resonance appreciation. The process is oriented by a progressive saturation of the acoustic space due to the intensification of activity in all instruments, projected into a more and more inharmonic field and enriched by extended playing techniques. In this example, the harmonicity and noise not only coexist but form each other's projection space.

The expansion on a large scale of this principle is represented by the orchestral piece *Saturne* written in 1979 by Hugues Dufourt. Grounded on the composer's previous monumental work *Erewohn* for 150 percussion instruments and six percussionists, *Saturne* expands the timbre space by employing a group of 12 wind and brass instruments as well as a large group of electronic instruments such as two electric organs (including two Ondes Martenot) and two electric guitars, along with a large percussion section (see Laliberté 1995). In this work, the richness of timbre and the harmonic and rhythmic relationship between the different instrumental families show a more limited application of the granular noise concept. One has the same feeling when listening to another monumental orchestral piece such as *Le Temps et l'écume* (1988–1989) by Grisey, a piece in which the percussion section is integrated in the very archetype of the work: two gestures – sound/noise – explored by changing the scale of observation. Once again, the granular quality is part of the global timbre, and the saturation as observed in the early works is more and more integrated into a complex acoustic space. As in the previous case, the closer we get to the present day, the more the spectral experience of the 1970s and 1980s seems to be internalized in a sort of global approach to sound that can consequently manifest itself in different facets, accumulated by an increased awareness and sensitivity towards the continuum of acoustic space in the time and frequency domain (from a mathematical point of view) and, at the same time, towards a new appreciation of all the discontinuities due to perception and cultural diversity.

Conclusions

From the plurality of cases examined, an aspect emerges with particular urgency: the presence of noise as part of a larger context, determined by a variety of dimensions that the spectral technique introduced under the influence of the many domains mentioned in the first part of this chapter. On the other hand, a discourse about specific, discrete elements of a musical language grounded on the principle of continuum also appears as a 'virtual' and imposed distinction of well-integrated dimensions, as the division into two categories of noise – in itself useful but forced considering the fluidity of intermediate states – has shown.

However, what can be observed from a more general point of view is the fact that the presence of both categories of noise in the next period (after 1986, the year of Grisey's *Talea* and symbolic threshold of the early spectral period) functions in a more and more 'harmonic' context in which the initial idea of a revolution of complex sounds and their integration into a new language and new syntax gives way to a deeper exploration of the acoustic model concept and its role on the formal level (timbre as structuring force), while the question of noise and saturation remains in this embryonal stage. The challenge will be taken up by the so-called saturationist composers of younger generations who recognize the potential of the initial idea and develop new ways of integration

(Rigaudière 2014). Among them, Franck Bedrossian and Raphaël Cendo are particularly aware of their 'spectral' roots:

> During the Sixties and the Seventies, and even before under other forms […], an attempt had been made several times to integrate complex sounds into musical writing. I also think of Iannis Xenakis and some pieces by Gérard Grisey. Back at that time, many new musical materials were invented. But it seems to me that their inventors did not always know what to do with them, how to compose with them. What you had was the raw material, a marble block which had never been hewn, but you still could not see any shapes. A certain number of pieces of that time have not gone beyond the level of experiment.
>
> (Bedrossian 2008: 85)

From a historical distance, the early spectral period appears as an opening towards a new horizon of an 'age of timbre', grounded in scientific research on acoustics and psychoacoustics. This huge amount of information, together with the development of the personal computer in the late 1980s, strongly conditioned the path of the first-generation spectral composers, who gradually abandoned the exploration of liminal noisy states. Their heritage has been taken up by new generations and is flourishing today, nurtured by the awareness of the expressive potentialities of this unstable and overwhelming energy.

Notes

1 As the variety of contributions in the present volume shows, the horizon is considerably more complex and articulated.
2 Gérard Grisey, 'À propos de la synthèse instrumentale' (Grisey 2008: 35–37) and 'Structuration des timbres dans la musique instrumentale' (Grisey 2008: 89–120).
3 For more analytical information see Féron (2010); Eller (2017); Utz (2017).
4 Grisey indicates bow positions according to the following scheme: AST – alto sul tasto [as high as possible on the finger board, very near to the fingers of the left hand], ST – sul tasto [on the fingerboard], ORD – ordinario [normal], SP – sul ponticello [near the bridge], ASP – alto sul ponticello [very high on the bridge].
5 The extent to which performance style influences the more or less 'aggressive' quality of the inharmonic material in sound-based compositions has been investigated by Christian Utz on the very example of *Périodes* and *Partiels* (Utz 2017).
6 For more analytical information on *Prologue* see Baillet (2000: 99–112); Haselböck (2009: 68–79); Féron (2016), Pustijanac (2016) and Pustijanac (2017).
7 For more analytical information see Hirs (2009).
8 Roughness is an elementary timbral attribute based on the sensation of rapid fluctuations in the amplitude envelope. It can be generated by proximal frequency components that beat with one another. Dissonant intervals tend to have more such beatings than consonant intervals. As such, a fairly direct relation between sensory dissonance and roughness has been demonstrated (McAdams and Giordano 2016: 77).

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