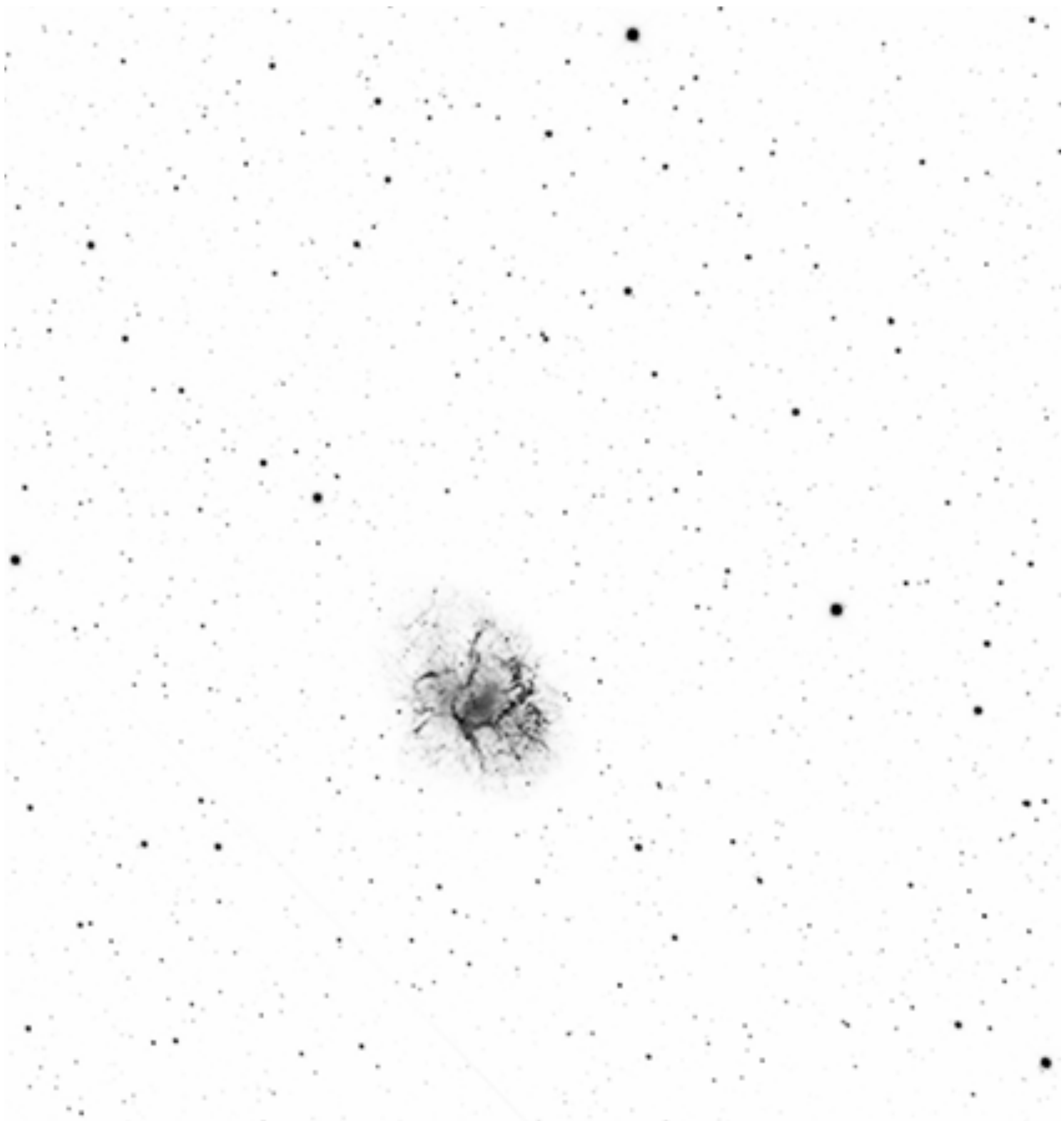
NEBULULLABY READER

lullabies and consciousness altering music



xname 2015

CONTENT

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I. TWENTY-FIVE INITIAL WORDS FOR A VOCABULARY

1. *Extract.* Any action producing a sound that is then recorded on a track of a disc or a tape is an extract. Extracts can therefore be either "live" sound recordings or sound recordings produced from preexisting recordings.
2. *Material classification of sound objects.* It is necessary to define a "material" classification of objects resulting from extraction before even submitting them to a technical or aesthetic analysis. This classification is based on the object's temporal duration and its center of interest, and it differentiates the sample, the fragment, and the element.
3. *Sample.* A sample is an extract of any duration (for example, from several seconds to a minute) that is not chosen for any well-defined center of interest.
4. *Fragment.* A fragment is a sound object of about one to several seconds in which a "center of interest" can be identified, providing it does not display development or repetition. If it displays these, the fragment should be limited to the portion that does not include any "redundancy."
5. *Elements.* If the analysis is taken even further, to the point of isolating one of the components of a sound object (a component that, furthermore, the ear can hear only with difficulty when it is isolated, and which in any case cannot be analyzed directly from sound), we say that the fragment has been broken down into elements. Examples of elements are an attack, a decay, and a piece from the continuation of a complex note.
6. *Musical classification of sound objects.* Once we have defined the "center of interest" that makes up the sound object, simply through limiting its duration, we must make a value judgment about its contents, whether it appears simpler or more complex. Thus we should be able to define the following: the monophony, the group, the cell, and the complex note.

7. *Monophony.* Cutting out in time does not allow us to separate out concomitant sounds. Only the ear can dissociate and separate these concomitant sounds into monophonic elements, which are then studied in themselves, through selective listening. Monophony in a superimposition of sounds is therefore the equivalent of a melody picked out by the ear from a polyphonic ensemble.

8. *Group.* A monophony of some length (a few seconds, or even some tens of seconds), studied for its repetitions or its inner development, is called a group.

9. *Cell.* By definition, a group is formed of either cells or complex notes. A cell is an ensemble with no repetition or development and does not have the definite characteristics of the complex note. Generally cells are dense complexes that develop rapidly (in rhythm, timbre, or tessitura) where even complex notes would be difficult to discern.

10. *Complex note.* Any element in a monophony that has a fairly clear beginning, continuation, and termination is called a complex note, by analogy with a musical note (which always has these simple characteristics).

11. *Large note.* A complex note can just as well be very short or quite long. A complex note is called a "large note" when its attack, continuation, or termination is sufficiently developed. If the development goes beyond a certain point, it will tend to become a group, and it will be possible to analyze its development in rhythm, timbre, and tessitura.

12. *Structures.* The totality of the material a composer chooses at the outset is given the name "structures." These may be cells or complex notes. They can also be ordinary notes, prepared or not, from unmediated, classical, exotic, or experimental instruments.

13. *Manipulations.* Any technique that changes structures before any attempt at composition is called a manipulation. Manipulations may be transmutations, transformations, or modulations.

14. *Transmutation.* Any manipulation that exerts its main effect on the matter of the structure without perceptibly altering its form is called a transmutation.

15. *Transformation.* Any manipulation that is intended to change the form of the structure rather than its matter is a transformation.

16. *Modulation.* If, without particularly aiming for a transmutation or a transformation, the intention is to selectively vary one of the parameters of a structure, or, more generally, if the intention is to develop the given sound in one of the three planes of reference of all areas of sound (tessituras, dynamic, and timbre), there will by definition be a modulation of the given sound, or the structure under consideration, in tessitura, dynamic, or timbre.

17. *Parameters that characterize a sound.* The parameters for variation of a sound can be understood either in the classical sense (there are three of them: pitch, intensity, and duration) or in the concrete sense (there are many more). It is preferable to use the concept of "plane of reference" rather than parameter. (See § II, III, and VIII.)

18. *Planes of reference.* The most complex sound phenomenon that can be imagined or encountered in practice ultimately comprises three planes of reference that can fully define it:

   1. *melodic plane or plane of tessituras* (the development of the parameter or parameters of pitch in duration) (see § VII)
   2. *dynamic or formal plane* (the development of the parameters of intensity in duration) (see § V)
   3. *harmonic plane or plane of timbres* (the reciprocal relationship between the parameters of intensity and pitch indicating the development of spectra) (see § VI)

19. *Performance procedures.* Performance procedures are all the procedures that, starting with given structures, and after the use of appropriate manipulations, make possible the performance of the desired work. There are three of these procedures: preparation, montage, and mixing.

20. *Preparation.* Preparation techniques (necessarily limited to the use of classical or paraclassical musical structures, i.e., notes that are more or less complex) consist in the use of classical or exotic or modern musical instruments as sources of suitable sounds without being particular about using them in the traditional way. Thus a piano can be an almost indefinite source of sounds, going from noise to musical sound, from pure percussion to continuous sound.

21. *Montage.* Montage techniques consist of assembling sound objects by simple juxtaposition, and in particular by gluing fragments of tape recordings end to end.

22. *Mixing.* Montage procedures do not allow polyphonic superimposition. Mixing, on the contrary, consists of superimposing compatible monophonies and recording the result.
23. *Spatial music.* The name "spatial music" is given to any music that is concerned with the localization of sound objects in space when works are being projected to an audience.
24. *Static spatialization.* Any projection that presents any monophony as if it were coming from an easily locatable source is considered static spatialization. This type of spatialization will consequently have been anticipated at the stage of mixing on synchronized but separate tapes, which are projected individually through separate sound sources, real or virtual.
25. *Cinematic spatialization.* The name "cinematic spatialization" is given to any projection that makes sound objects move in space at the same time as they move through time. This effect will therefore have been anticipated when the work was first planned; it is realized before an audience by a conductor-operator responsible for cinematic spatialization, with the help of appropriate equipment (spatial music projector, French patent no. 605467).

II. REVIEW OF ACOUSTIC CONCEPTS: THE THREE DIMENSIONS OF PURE SOUND

A sound signal can always be reduced to the combination of an appropriate number of elementary simple, or *pure,* sounds, which physicists call sinusoidal sounds (fig. 24), which are themselves defined according to their amplitude and frequency. The ear is not directly responsive to these two measures, but, according to a fundamental law of psycho-physics, it is responsive to their logarithm. We shall call the logarithm of frequency *pure sound pitch* and it will be measured in octaves—or their submultiples, *savarts*—and we shall call the logarithm of amplitude *level,* which will be measured in *decibels.* Thus a sinusoidal sound will be defined by its level, its pitch, and its duration, for no signal is of course unlimited, and the idea of a simple or complex *note* rests on the concept of duration.

Level, pitch, duration are the three *dimensions* of sound represented, in figure 25, by a line that shows the evolution of pitch and level in relation

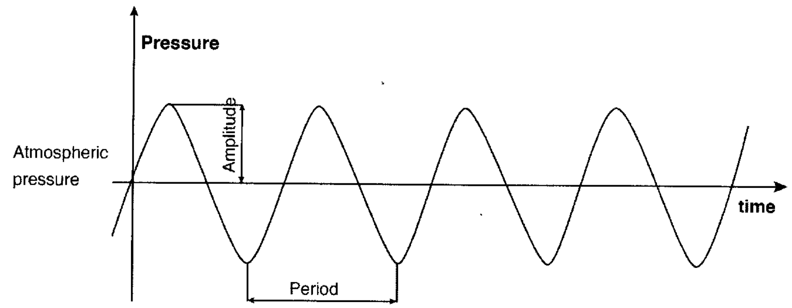


FIGURE 24. [Absolutely pure sound.]

to time: as the note has a finite duration, this line will have a corresponding length. Every complex note will be formed by combining these lines: as each one of the simple sounds evolves within the time under consideration, some of them dying out, others appearing, all the lines together will form a volume representing the evolution of the sound. As it is perfectly clear that a sound does not appear instantaneously but has a continuous development from its initiation right up to its decay, this volume will in general gradually increase from its basic plane and return to it after some length of time. It is this volume that represents the *complex note.*

Thus, a piano note retains a number of components defined by their frequency, and has a perceptibly constant relative proportion over its whole duration, but its overall level will constantly vary in relation to time, beginning with a rapid attack, then decaying very slowly. Figure 25 shows one of these notes with a constant timbre, and we shall call the time-related curve in level the *form* of the sound.[1] Let us on the contrary take the example of a noise such as the hissing of steam, starting suddenly: it will be characterized by the fact that it contains an almost limitless number of components, with levels that vary completely arbitrarily across the whole acoustic range. It is a *statistical* sound, which

1. There is equipment (the logarithmic recorder) that gives the form of the note straightaway.

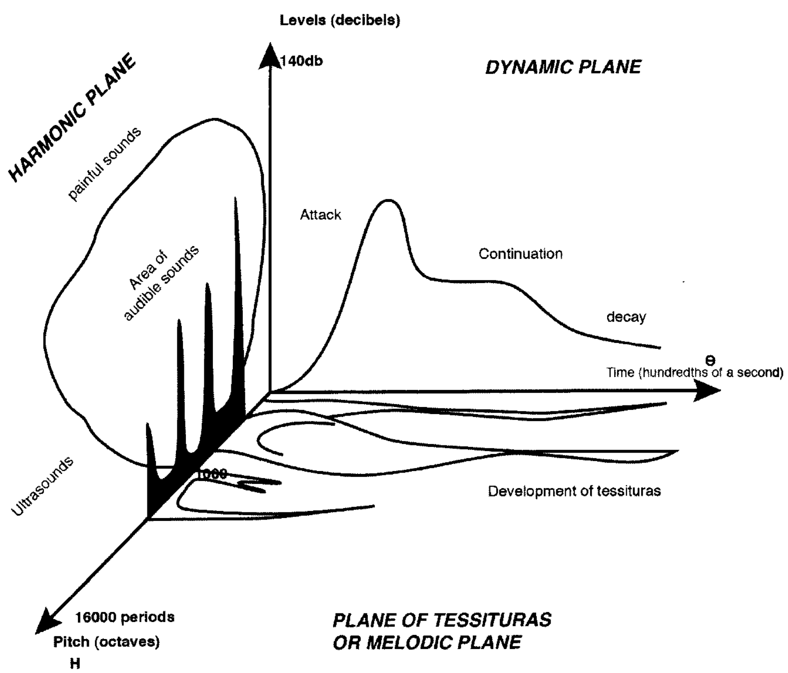


FIGURE 25. [Trihedron of reference.]

could go on indefinitely, but from its continuity we have cut an element of duration—here quite arbitrary—that we shall call a *complex note.* In this case it has a volume with a section that is very close to the whole acoustic sphere, the sphere of audible sounds, shown in figure 26 and remaining statistically constant throughout the duration under consideration. Through the use of technical procedures, it could be given a more or less rapid *beginning,* a *continuation* with a perceptibly constant level, and a very gradual *decay,* providing it with a form that is not so very far removed from the musical note that we used in our previous example. So the main difference between this noise and the note used previously is that the musical sound possessed an *order* evident in a continuity in the distribution of its components, which are perfectly

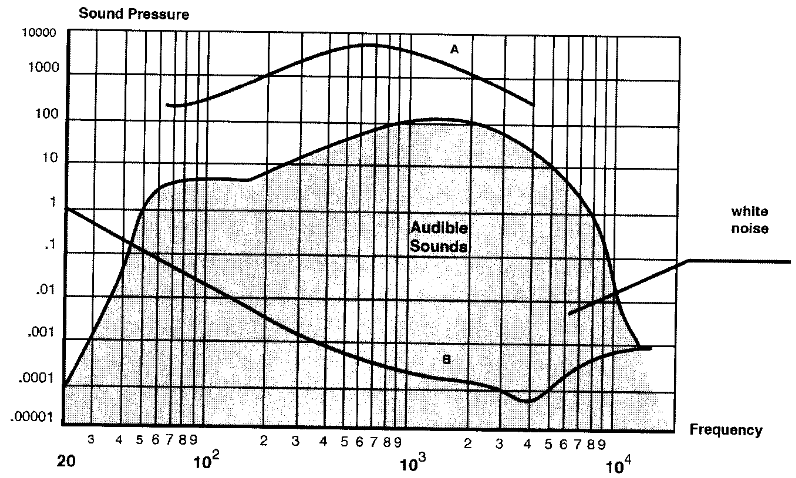


FIGURE 26. [Harmonic plane of a white noise.]

clearly defined. On the contrary, the noise of hissing steam has a huge number of components, in perfect disorder, and totally unpredictable. This is its essential characteristic, which, by analogy with optics, gives it the name *white noise.*

III. GENERALIZATION OF THESE CONCEPTS IN CONCRETE MUSIC: THE THREE PLANES OF REFERENCE OF COMPLEX SOUND

In reality, no pure sound exists, either in Nature or in human art. Sound is called musical, in the classical sense, when a "fundamental" predominates enough for the name of a note, in the tessitura, to be given to it. In addition, this note has fluctuations that make this attribution more or less precise. On the other hand, such a sound is much more complex than most musicians imagine: it comprises not only accumulations of harmonics (and the way they are superimposed is not always stable, but varies in relation to the duration of the note), but also a large element of "noise." Over and above the musical sound, which is the most apparent in the whole sound phenomenon, a note on the piano, the violin, a vocal sound contains elements of noise, i.e., fairly complex "transitory phenomena," which there is no point for musicians to define, since they are all implied in the words "violin," "piano," or "voice" and are inherent in the sound of the instrument and the way it is used. Duration itself, which theorists believe they can manipulate precisely, is no more than an illusion. It is an abstract duration, allotted to the note. In reality, the production of any note does not take place in duration, as manuscript paper would have it. Every note has a beginning, establishes itself, then stops, all this in a great fluctuation of intensity, which gives the sound a *form*. And so the classical musician, because he does not have the power to modify or use them as a means of expression, ignores *implicit* musical parameters contained in the musical note that is reduced roughly to the three dimensions of pure sound. If we wanted to be not only more rigorous but nearer to the reality of music, instead of the three variables or parameters of the physicists, plagiarized by music theory (duration, intensity, pitch), we should use the concept of *planes of reference*, which emphasizes the development of the note itself, in addition to notes in relation to one another.

In other words, it is through an effort of abstraction and simplification—useful, it is true, and adequate until now—that we can speak of the three dimensions of musical sound and the development of a melody, for example, in duration (rhythm), intensity (nuances), and pitch (tessitura), complicated by the fact of harmonics (timbre), which are nevertheless *given* once and for all, as are the secondary phenomena (attacks, touch, vibrato etc. . . .) implicit either in the given instrument or in the performer under consideration.

If, independently of melodic development, we concentrate our attention more on the note, i.e., a single note from this melody, we notice that the phenomenon is not so simple. It may be true that, to the physicist, every sound, and particularly musical sound, can be *analyzed* and broken down into pure sound components, but an analysis like this is a further effort of abstraction, but which, this time, wholly bypasses the sense of hearing and no longer belongs to music, but to acoustics.

If we wish to delve any further into the phenomenon of music, using acoustic data only as a scientific base, and most definitely not as an aesthetic criterion (this is of the utmost importance), the concept of a parameter of melodic musical development must be enriched with parameters that characterize the musical note; and, even if they have a rigorous scientific justification, these new concepts must be accessible to the direct experience of the musical ear.

So, essentially, we must turn to the concept of *duration* and identify an external, or overall, duration that characterizes the note in the classical sense, such as its basic length, in relation to other notes in the melody, and its internal duration, where the passage of time is seen as the only possible indicator of the development of the note within itself.

It may appear surprising that such an important approach has not already been adopted by musicians, and that the need was only felt with the advent of concrete music. Even more, there can be no other explanation for the confusion felt by musicians, of concrete music or not, faced with the first experiments in concrete music than the lack of familiarity and aesthetic experience in this matter. If, for example, we imagine musical notes that resemble notes of a piano, violin, or voice, but in which the proportion of musical sound to noise is gradually inverted, we may easily think that classical music theory is losing its rights and is incapable of providing certainly values, and even an adequate vocabulary to characterize the new phenomena. These, already present in ordinary music, now become prominent.

In addition, wanting to make immediate aesthetic value judgments about the new music when one is incapable of defining, or even naming, the various occurrences of such phenomena is putting the cart before the horse, and wanting to write harmony before even having learned the theory of music. Hence the importance of the new concepts outlined here.

In particular the question "What instruments is this piece played on?" no longer has any meaning. The essential question is to be able to replace the word "instrument," which is widespread and convenient, and also an easy point of reference, with a sound-classification system, or sound characterology, which would enable sounds to be classified into families. Prior to, or together with, a theory, the characterology of sounds appears as the generalization of the concepts of instrument making.

There then arises the question of finding out where a characterology like this will come from. For a long time, musicians engaged with concrete music, wanting to avoid confusing acoustics and music, have attempted to do without the "trihedron of reference," which completely strips down every sound, however complex it may be, through three "projections" onto "planes of reference." Experience showed that it was practically impossible to do without these graphic representations, taken from acoustics. The combinations of sounds developed by the experiments of concrete music are indeed so multiform that a classification by comparison with a few basic types, defined empirically, has shown itself to be impossible.

So musicians have had to take on some of the concepts of acoustics, represented in Cartesian coordinates, on a three-plane projection of the cluster of curves, or even of volume, representing even the most complex sound phenomenon in a three-dimensional space. So the three classical parameters of pure sound into which musical sound was assimilated (duration, intensity, pitch) will be replaced by formal *characteristics*, distributed over three planes of reference by curves representing the development of the note, complex or otherwise. In other words, the classical parameters are considered to be stuck, at least in the broadest sense: the note in question has, generally speaking, a pitch, a duration, an intensity. If it is complex, it can have a whole "package" of pitches, an intensity that varies greatly in the course of its development, and a timbre that can be extremely complicated due to the interaction of fundamentals and harmonics modulated in various ways.

In conclusion, three numbers, representing values of the conventional musical note that are in general simple and arithmetical, are replaced by the three graphic representations of figure 25, representing the development—or, more precisely, the configuration—of the note itself. In some respects this method will give the molecular structure of the musical element.

IV. INDIVIDUAL STUDY OF THE THREE PLANES ENABLING THE COMPLEX NOTE TO BE REPRESENTED

From the definition that we have just given of the three dimensions of the complex note—level, pitch, and duration—we can, by adopting the methods of representation used in geometry, discern three *projections* obtained by combining the three preceding dimensions in pairs. Studying each of these projections will give us a way of understanding the note. We shall use the following terms:

- plane *of forms* or *dynamic* plane for the plane of development levels in relation to time
- plane *of spectra* or *harmonic* plane for the level-pitch plane
- plane *of tessituras* or *melodic* plane for the plane of variations of pitch in relation to time

V. DYNAMIC PLANE

The simplest of them, and the most scantily used in classical music, is the plane of levels in relation to durations or the dynamic plane. The curve representing the projection of the complex note in this plane, which we have called the form of the sound, generally begins at 0, if a complex note with an inner unity in the sense defined above has been isolated, for example by extraction from a closed groove or a tape loop. The note appears, then decays, the level returns to 0, and, generally speaking, we can discern three essential sections in its form:

- the *attack*, the onset of the note, often very abrupt in traditional instrument making (plucked strings, percussions, syllables)[2]
- the *continuation* of the note, during which it retains a perceptibly constant average level, despite some characteristic fluctuations (slow increase or decrease, vibrato, etc.)

2. We deliberately group together within the term "instrument making" all the technical resources of musical instruments, including the human voice, which is a very important instrument.

- the *decay,* the tail end of the note, the beginning of which is difficult to discern because it is not very different from the continuation but which in traditional instrument making is standardized due to the properties of resonating instruments, which give a very slow decay (mute, reverberation)

Concrete music, which is no longer limited by instrumental conditions such as these, will consistently use absolutely random note forms, and we shall give some examples of these, gradually moving away from the sounds of traditional music by relaxing the restrictive rules that arose from the nature of the instruments that limited it.

Attack of the Note

Thus, in the field of attacks, instrument making offered little more than three distinct modes:

a) *Plectrum*—or *plucked*—attack, in which a string was displaced from its initial position, then abruptly released. This is the steepest attack that can be found: the sound comes in immediately at its maximum level.

b) *Percussive* attack (piano): here a hammer hits a string, which vibrates after the time taken for the impulse to spread along the whole string. This attack is less violent than the preceding one, and it is also different from it mainly because the timbre produced is modified.

c) *Aeolian* attack (reed or violin bow), in which a string is made to vibrate very gradually, without any sort of discontinuity, for example by blowing a current of air across telegraph wire, or gradually making a violin string vibrate with a rosined bow. This is the same type of attack, even more gradual, as is made by the reeds of woodwind instruments (organ, harmonium).

Figure 27 a, b, c represents the form of the sound in these three basic examples.

Concrete music will liberate itself from these modes of attack, which we shall call *natural,* and replace them with more complex modes. Figure 27 d, e, f gives some examples of *artificial* modes of attack that we

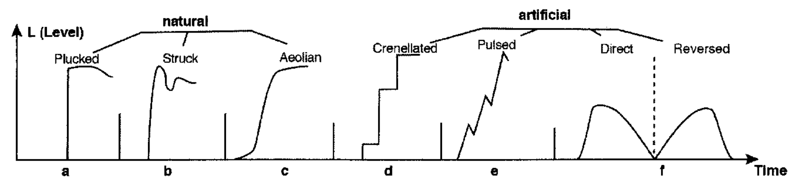


FIGURE 27. [Examples of natural or artificial attacks.]

shall be able to create, and which will supplement the previous ones. Better still, the techniques of concrete music will enable us to dissociate the characteristics of attack and timbre in familiar sounds.

Because of its practical importance we would draw attention to the mode of attack by *inversion* (27f), in which the forms of decay of the note are used systematically as the mode of attack: these forms are very progressive, for the decay of a natural sound is always a very slow phenomenon, and this is what gives music played backward its particular character. By simply adjusting the speed of decay, which can vary between several tenths of a second and several seconds, the whole character of the note will be changed without the general law of attack being altered. This single example shows how rich the contribution of concrete techniques can be in providing new notes or pseudoinstruments.

Finally, concrete music will use *impacts,* i.e., notes that in theory are reduced to *attacks,* with no prolongation of the decay through natural or artificial resonance.

Body of the Note

Here again, the physical rules that determine the functioning of traditional instruments have given only an extremely limited number of combinations: the simplest, of course, is the perfect consistency of the sound level (horizontal form), which seems as if it will go on indefinitely. Such is the case with a laboratory oscillator, for example. It is impossible to attain this indefinite consistency with an instrument controlled by a performer (violin, human voice). The hand trembles, the breath varies. Also, a device of the performer is a *vibrato,* which is generally an undulation of amplitude of about 10 to 15 percent, with five to eight undulations per second, and is used by all violinists and singers to conceal the inevitable fluctuations of their sound level. In this way it has gained acceptance in music and is perceived by the listener as an intrinsic characteristic of the note. Finally, the most apparent characteristic of the body of a note in theory is that it has a clearly defined level that the composer has become accustomed to marking on his score with symbols:

ppp pp p mf f ff fff

corresponding, according to Stokowski, to the following numerical values:

+20 decibels + 40db + 50db + 60db + 75db + 85db + 95db

Overall, the characteristics of the bodies we have just enumerated are very poor, and the simplest devices of concrete music technology will increase them considerably. For example, systematically increasing vibrato, which is impossible in traditionally made instruments because it would lead to unacceptable fluctuations in the pitch of notes, will give rise to so-called *pulsed* sounds, as in figure 28a. This concept will be generalized by also giving the name "pulsation" to every note obtained by rapid (usually artificial) repetition of the same impulse.

We use the term:

artificial, because it cannot be found in normal instruments, for the sound process with a very clear lowest point in the middle of the body of the note, followed by a rapid increase (fig. 28b).

For example, we shall use the term:

crenellated for the process with a sequence of independent resonances, where it can be seen that very large numbers of combinations can be made from these. This is a sequence of irregular maxima and minima (fig. 28d).

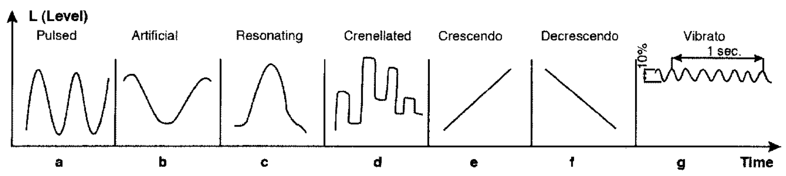


FIGURE 28. [Example of the allure of the body of a note.]

We shall use the term:

resonant for a sound characterized by a single increase in level in the middle of the body of the note (fig. 28c). This resonance can also be equalized artificially with the potentiometer.

rubbed, the process with a sustained action (reed or bow, for example) that gives an intermediary effect between the crenellation and the resonance (fig. 28g).

Finally, many complex notes will not have any definite shape; we shall simply describe their *crescendo* or *decrescendo* development (fig. 28e and f).

Decay of the Note

The decay of sound elements can be much better described in its form than its duration, for if it is quite easy to determine the instant when a sound completely disappears (when it is lost in background noise), it is still quite tricky to define the beginning of the decay, which is generally combined with the body of the note itself. In traditional instruments (violin, piano, voice, etc. . . .), it is a convention to call *period of decay* the moment when the note is no longer sustained, i.e., when energy is no longer being given to the vibrating body. So it gradually expends the energy it contained, as much through sound wave radiation as through inner agitation, and the general laws of acoustics lead to a gradual decline in accordance with a so-called *exponential* law, for which we will use the general term *reverberation,* and which will have a very variable duration—from several tenths of a second to several seconds. This term

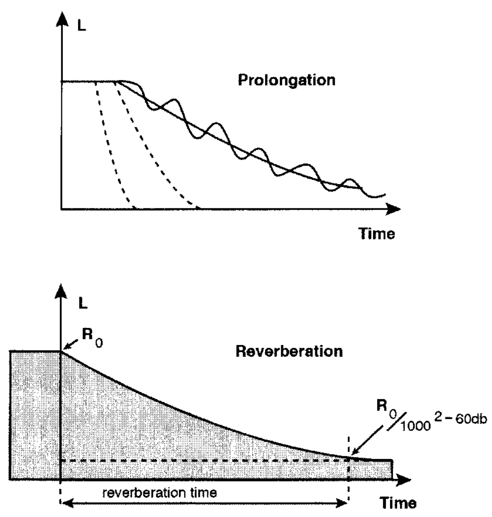


FIGURE 29. [Example of prolongation by natural or artificial reverberation.]

"reverberation" comes from the fact that most sound sources, after they have stopped vibrating themselves, radiate in the concert hall, which maintains the sound for a time, introducing a consistent *prolongation* to the listener's ear. In other words, in general the mode of decay of the concert hall replaces the mode of decay of the instrument itself; it is the former that is usually termed "reverberation."

In this large class of reverberating decays, or prolongations, we shall distinguish *continuous* reverberations, the simplest, and *vibrating* reverberations, which have the same characteristics of vibrato or impulse as the body of the note itself (fig. 29).

In traditional instrument making, the methodological distinction we have just made between attack, body, and decay of the note would be quite artificial, because traditional instrument making can give us only a very limited number of combinations of these various elements. So, for example, all the notes of the piano, attacked percussively, reach an instantaneous maximum, the body of the note is nonexistent, and the decay is very long, comprising only two numerical values, *pedal* or *muted*, which, considering their size, cannot really be modified by the concert hall. The violin note, and this is one of the causes of the richness, the success, and the difficulty of this instrument, has an aeolian type of attack, of very variable steepness (staccato, legato), a well-defined sustain with vibrato, and a fairly rapid decay, which is very subject to modifications from the concert hall.

Concrete music, on the contrary, will be able to dissociate each of these parts, choose its own character on aesthetic grounds, and assemble them, creating a considerable number of combinations, corresponding to an almost indefinite number of pseudoinstruments, and this on the dynamic plane alone, without even considering the planes of tessituras and harmony, which we shall now discuss.

VI. HARMONIC PLANE

The distribution of levels in accordance with the pitch of simple sinusoidal sounds that make up a complex sound, forms what physicists call the *spectrum;* amplitude in relation to frequency, or what musicians call *timbre,* which familiarity with musical instruments leads us to think of as stable within the note, and even as presenting a sort of sameness from one note to another, which leads us to speak of the general *timbre of an instrument.*

Strictly speaking, this concept of timbre will retain only momentary value in the complex note, since the level and pitch of each component develop independently over the duration of the note. In practice, however, various physiological and aesthetic reasons will lead the ear to cut out instants at least 1/20 of a second long from the continuity of the note, in which the spectrum of the note will be permanent enough to be considered as typical.

One of the most consistent characteristics of traditional musical instruments is the use of the vibratory properties of quite simple material bodies (strings, metal sheets, membranes, columns of air), which obey numerical laws, the main one being what is called the *harmonic law:* the frequencies of the various components of an instrumental note are simple multiples of each other or of a larger common divisor, the

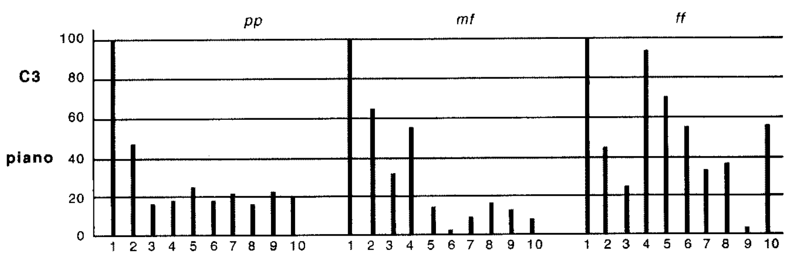


FIGURE 30. [Example of various harmonic resonances of a C3 on the piano struck at various intensities.]

fundamental, these frequencies being termed *harmonics* (fig. 30). Thus the spectrum of a musical instrument will present in the form of a certain number of harmonics—rarely more than about twenty—and their amplitude will generally decrease when the harmonic increase in frequency. Between these harmonics there is nothing: the musical instrument produces only a "discrete" sequence of simultaneous frequencies. The word *pitch* is used for the note given by the instrument, either the fundamental mentioned above, or the most important of the harmonics, and the indecision about this reflects the arbitrariness of this concept.

Outside the limitations imposed by traditional instruments, concrete music considers that every natural or artificial sound can, by reason of its position in a structure, take on a musical character, so it will seek to find a way of representing the immediate timbre of these sounds without turning to the quite arbitrary concept of harmonics. More precisely, we shall have to turn either to new concepts (thickness of sound), or to classical notions as far as timbre is concerned, depending on the extent to which a complex sound, composed of ordinary musical sounds, justifies these concepts, at least by analogy.

So first we shall have to discern whether or not a complex sound comes near to a musical sound, i.e., if it has a "spectrum of lines" or a "spectrum of bands."

The terms "thick" or "thin" will be used for a sound made up of a more or less extensive "package" of fundamentals (fig. 31b). Depending on the timbre of each of these fundamentals, it will be possible to classify the

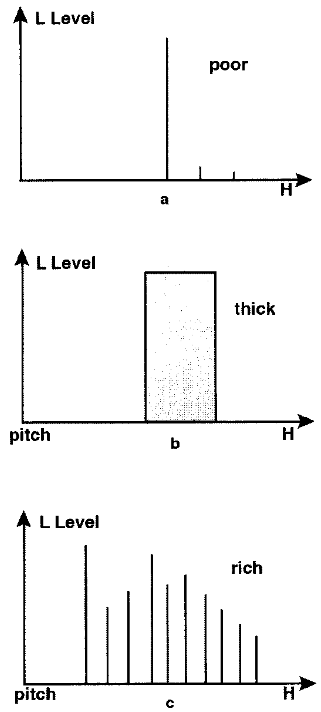


FIGURE 31. [Spectra of a sound that is: a, poor; b, thick; c, rich.]

resulting general timbre either quantitatively (poor or rich) or qualitatively (brilliant, bright, dark).

We shall use the terms:

poor, for a sound with a spectrum made up of only one or a very small number of components of significant amplitude (fig. 31a).

rich, for a sound that has a significant number of harmonics with significant amplitude. It is different from a thick sound in that it has a finite number of components that may be spread across the whole acoustic range instead of a continuous band in one piece (fig. 31c).

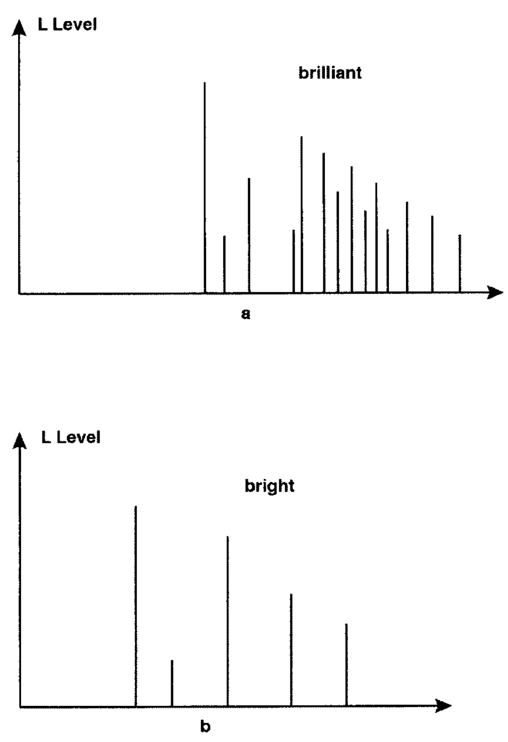


FIGURE 32. [Spectra of a sound that is: a, brilliant; b, bright.]

These quantitative characteristics of timbre will be complemented by the qualitative concept of *color.* We shall distinguish:

brilliant sounds, made up of a large number of harmonics, and where the amplitude does not decrease rapidly with the range (fig. 32a)

bright sounds, which have the same property, but with a very limited number of harmonics (fig. 32b)

dark sounds, which have only a few harmonics, and where the amplitude decreases rapidly with the range (fig. 31a)

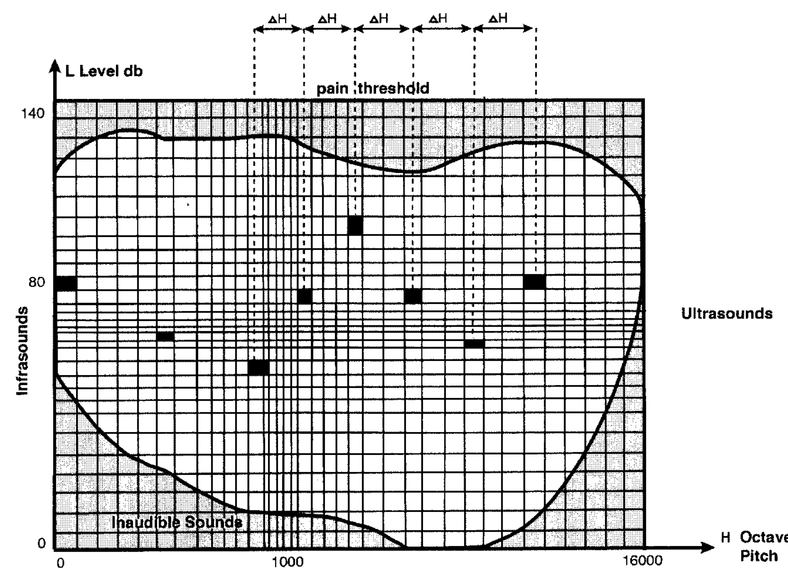


FIGURE 33. [Instantaneous spectrum of a complex sound in the course of development.]

This "instantaneous" spectrum is simply a cutting of the three-dimensional representation of a complex sound through a perpendicular plane on the axis of durations at a moment t.

VII. PLANE OF TESSITURAS OR MELODIC PLANE

Strictly speaking, melodic development in relation to time, i.e., the development of the complete spectrum in duration, cannot be described in simple terms. However, the problem is simplified by a concept that is very important in the psychology of perception: *the thickness of the present,* a duration in which all acoustic phenomena are considered as simultaneous by the listener. This thickness of the present is of the order of 1/20 to 1/30 of a second: during this moment every acoustic element that appears—all the rectangles in the level-pitch spectral diagram (fig. 33)—are perceived simultaneously, and the section of the volume of the note

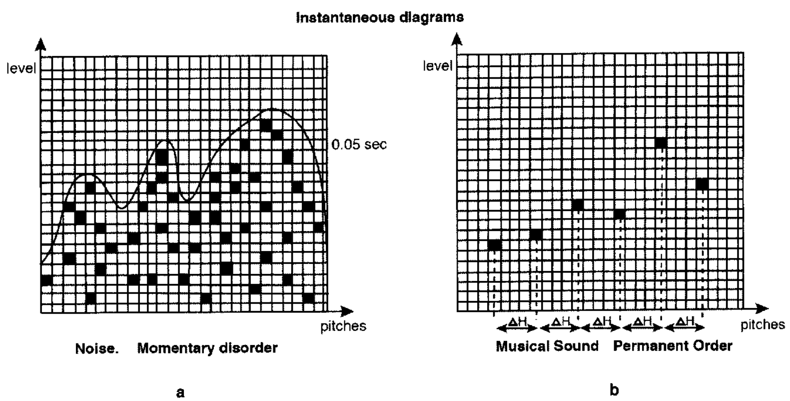


FIGURE 34. [Instantaneous spectrum: a, of a noise; b, of a musical sound.]

through the plane of tessituras, shown on this diagram, describes its melodic development over time.

In practice, the general laws of the theory of information in acoustics allow us to discern two types of very different moments in this development:

1) Very brief moments that in general correspond to periods of attack or very sudden change of form in the complex note on the dynamic plane. During these moments, the spectral diagram is very complex: a large number of rectangles is used simultaneously, forming what is usually called a continuous spectrum—white noise—and these elements have no simple numerical relationships to each other; they follow no or very few of the rules of selection set out in relation to the plane of timbres. They evolve haphazardly, in total disorder, during these short moments. Thus the concept of the transitory is linked to the concept of *noise*, or *disorder*, and this is quite a fundamental result as far as aesthetic perception is concerned (fig. 34a).
2) During the other moments, which constitute the major part of the duration of the complex note, and are separated into sections by the preceding moments, the spectral diagram is much simpler. With fewer elements being used, it develops slowly in duration,

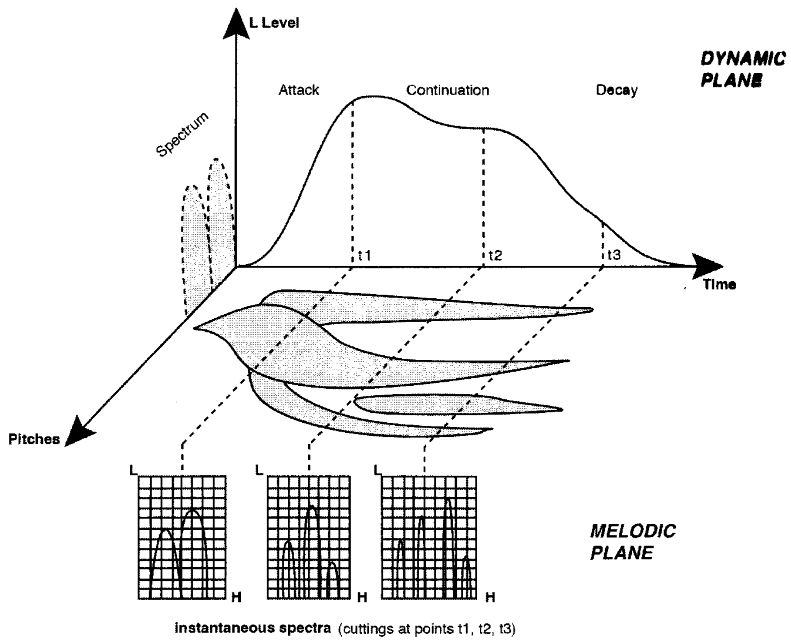


FIGURE 35. [Instantaneous spectrum at the points t1, t2, t3 of a complex sound in the course of development.]

keeping a sort of memory, an approximate permanence, which gives the ear time fully to appreciate its modalities. An average tessitura can be distinguished here, with a perceptibly consistent spectrum (figs. 34b and 35).

So we shall distinguish the following tessituras:

a) *stable* or *unstable* depending on whether the average pitch over time is consistent or not
b) *rising* or *descending*, depending on the development of the average zone of the spectrum over time
c) *extensive* or *narrow* depending on the size of the musical interval (if it is discernable) in which they develop

At a more detailed level, we shall distinguish:

- *vibrating tessituras,* where the nominal pitch has periodic fluctuations, generally at a rhythm of five or six per second, with amplitudes of 1 to 5 percent in pitch, which furthermore correspond to the effects of vibrato already discussed under dynamic plane, to which they are linked by the properties of many instruments or pseudoinstruments: thus, a vibrato on a violin or an ocarina is always simultaneously a vibrato in amplitude and a vibrato in frequency
- *spun tessituras,* where the pitch of the complex sound develops very rapidly within a fairly limited margin during the course of the note, and especially toward the beginning and the end. This is an effect known in classical music with instruments such as the ukulele and the balalaika *(the Hawaiian effect),* or, to a lesser degree, the harpsichord or the zither
- *scintillating tessituras,* where the rapid connections between perceptible sounds, despite their disorder, does not allow them to be easily located
- *indistinct tessituras* (white noise)

VIII. APPEARANCE OF CRITERIA FOR SOUND CHARACTEROLOGY

While keeping the word "parameter" for the variations of the classical note in duration, intensity, and pitch, we can define as *criteria* for characterizing sounds types of symbols used to analyze projections of complex sound on to the three planes of reference. In this way we can finally arrive at a method for classifying complex sounds into families.

We may also, out of curiosity, wonder how many types of sounds, i.e., ultimately how many pseudoinstruments, could be produced through *numerical combinations* of these criteria, by a generalization of musical means such as those at the disposal of concrete music.

On the other hand, we may observe that some of these criteria are not independent, that a certain criterion in the plane of tessituras automatically corresponds to a similar criterion in the dynamic plane. These will be *exclusions,* which will reduce the number of possible combinations.

Finally, we can look into certain families of particularly characteristic sounds that obey certain laws or set requirements. The necessary and sufficient conditions for obtaining such families, or at least for the possibility of obtaining them, will be the *conditions of compatibility,* by analogy with mathematical language.

We shall now develop these concepts one by one:

The main criteria of characterology, in the three planes of reference

The number of possible combinations (without taking exclusions into account)

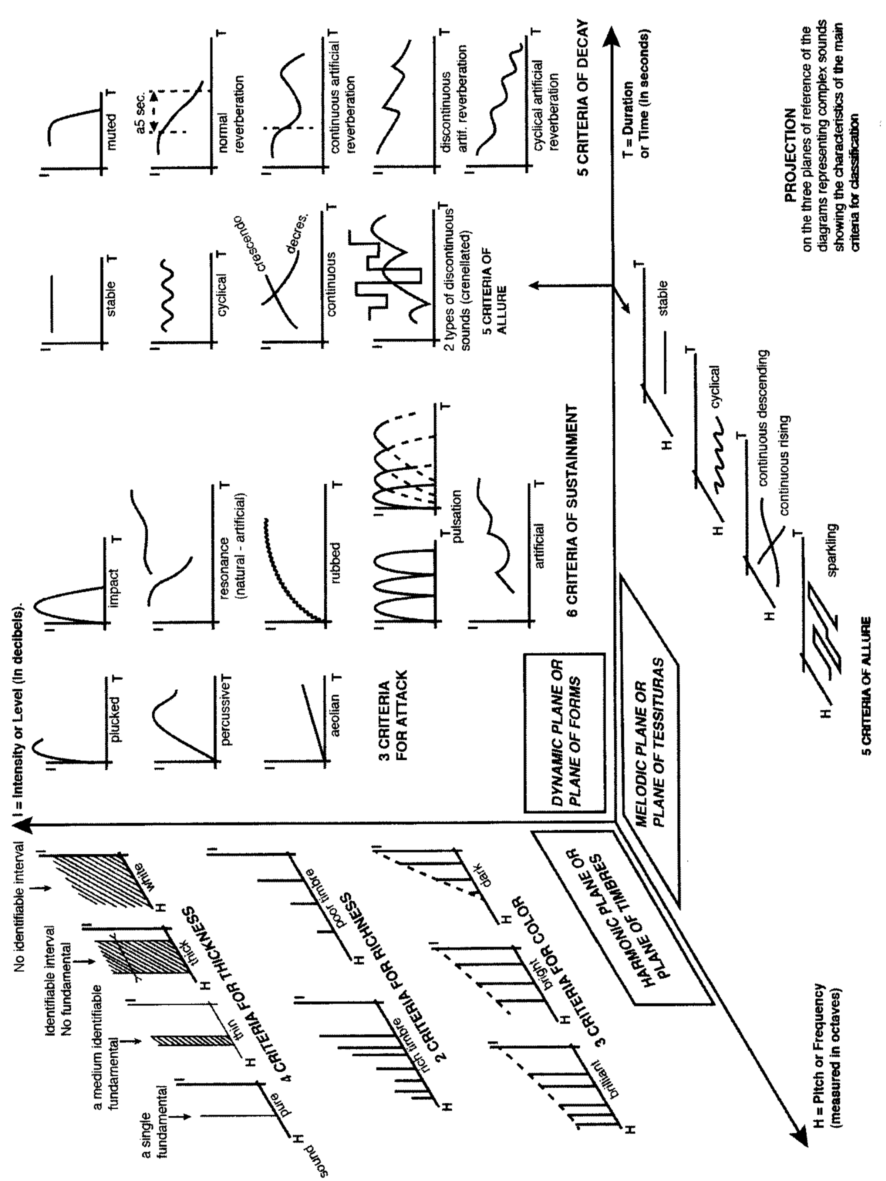
Conditions of compatibility, in certain examples of particular interest

IX. MAIN CRITERIA OF SOUND CHARACTEROLOGY (Fig. 36)

Total no. of criteria

A. *Dynamic plane or plane of sound forms*

1) Criteria of attack — 3
   The attack can be *plucked,*
   percussive,
   aeolian,
   depending on its steepness.
2) Criteria of sustainment, concerning the way the body of the note is sustained — 6
   No sustainment at all; *impact*
   Sustainment by *natural* or *artificial resonance*
   Sustainment of the same type as the attack: *rubbed*
   Sustainment by repetition of the attack: *pulsation*
   Artificial sustainment by montage
3) Criteria characterizing the allure of the body of the note — 5
   Stable (consistent intensity)
   Cyclic
   Continuous varied *(crescendo or decrescendo)*
   Discontinuous (crenellated, etc.)
4) Criteria for the decay of the note — 5
   No reverberation *(muted)*
   Normal reverberation *(reverberating)*
   Artificial reverberation, which may in its turn have the preceding criteria *(continuous, discontinuous, cyclical* reverberation)



B. *Harmonic plane or plane of timbres*

1) *Thickness of sound* (or purity) — 4

So-called *pure* sound (one single fundamental)
Thin sound
Thick sound
White sound

2) Strength of timbre — 2

Poor timbre
Rich timbre

3) Color of timbre — 3

Brilliant
Bright
Dark

C. *Melodic plane or plane of tessituras*

As in the case of the dynamic plane, this concerns the allure of the body of the note:

Stable tessitura (fixed pitch) — 5
Cyclical (vibrato)
Continuous (rising or *falling)*
Discontinuous (scintillating)

No. of main parameters retained: 33

X. THEORETICAL NUMBER OF SOUND FAMILIES

Thus we can allow about twenty criteria of form, about ten criteria of timbre, and four or five criteria of tessitura. These are, in effect, all the terms in italics in the above summary.

The total number of sounds, grouped into families and identifiable as if they were produced by distinct pseudoinstruments, is therefore, in theory, given by the total number of combinations of these criteria. In reality, it should be much bigger if the degree of importance of each of these criteria were taken into account, for example, if we decided to distinguish sounds that were more or less thick or thin, or attacks that were more or

FIGURE 36 *(opposite).* [Summary table of the main sound characterology criteria defined in each of the planes of reference.]

less plucked or aeolian. On the understanding that, to focus our minds, we limit ourselves to an approximate, and very arbitrary, enumeration that gives a provisional idea of both the number and the degree of intensity of each criterion as set down, we can easily calculate the total number of combinations. This is in fact given by the classification into families of all possible sounds that have in common a criterion of attack, sustainment, or allure or decay (dynamic plane), or else a criterion of thickness, richness, or color (harmonic plane), or finally a criterion of allure in tessitura.

The number of these combinations equals:

$$3 \times 6 \times 5 \times 5 \times 4 \times 2 \times 3 \times 5 = 54{,}000$$

that is, about fifty thousand possible combinations.

(Clearly this number is significantly reduced when there are overlaps.)

It goes without saying that the first task of classification that must be done in concrete music is to distinguish from the fifty thousand or so possible sound families those few hundreds that on first sight seem to be the most common.

Two families, or more precisely two groups of families, in any case, are very important:

symmetrical sounds (musicians quite improperly say: nonreversible, whereas they are absolutely identical forwards and backwards)

homogeneous sounds, i.e., sounds that are identical to each other in time, and necessarily present as a closed loop, since they have neither attack nor decay

XI. CONDITIONS OF COMPATIBILITY

A sound is symmetrical if it is symmetrical in the three planes of reference (timbre, dynamic, and tessitura) at the same time.

A sound is homogeneous if it is homogeneous in the three planes of reference i.e., if its timbre, tessitura, and dynamic are constant throughout its duration, or throughout the duration of a certain portion of the sound, which will be a homogeneous fragment.

Homogeneous sounds have important applications in concrete music, where in particular they provide loops for new instruments called *phonogènes* (French patent no. 561. 539).

XII. APPLICATION OF CLASSIFICATION CRITERIA IN CONCRETE MUSIC

The classification of the elementary sound object and the complex note, based on spatial representation of level, pitch, and duration, which we have set out above, is fundamental. But while allowing the problem of characterization to be tackled in an intelligible form, this clearly has serious disadvantages, one of which is the multiplicity of aspects a note can have, a multiplicity that is difficult to grasp through a simple formula. Physical classification, which is done in parallel with this, and which does not come up against this obstacle, cannot really be used in practice except as a rough guide, where a precise numerical expression is required, i.e., for the technician of concrete music.

Generally speaking, in experimental practice and especially in artistic creation, we should be wary of aspects of phenomena that are too precise, not because they are inaccurate, but because they polarize the observer's mind and consequently tend to restrict his imaginative powers, an error that raises the hackles of every experimenter in concrete music. Therefore, numerical or descriptive classification should only be used to set up a more *formal,* direct and comprehensible, even if more superficial, classification using the vocabulary set defined above.

This objective classification seeks to define the essential *apparent features* of the complex note, which can be referred on an individual basis to any of the planes, and to any of the parameters we have discussed previously. So it will try to establish a list of priorities for the questions to be asked in the process of a descriptive definition, or, if you will, the order in which the relevant parameters should be considered. For these purposes, it will be based on perceptual appreciation, which will reintroduce the listener's consciousness as a fundamental element in the apprehension of musical forms.

In practice, we shall study the general characteristics of a sound in the following order:

- First, we shall see if the sound possesses any clear characteristic without bringing in the concept of plane of analysis: an artificial, reversed or dissymetrical sound, for example.
- Then we shall consider whether there are any characteristics that establish a correlation between the planes of analysis above: thus, the "vibrato" is a phenomenon that very frequently occurs simultaneously in the dynamic and the melodic plane.
- Only then, if the complex note being studied resists these attempts at immediate analysis, shall we systematically examine its characteristics in relation to the different planes, taking them in the order in which they draw our attention, or, failing this, in this order: plane of timbres, dynamic plane, plane of tessituras. In fact, it very frequently happens that a sound presents a clear dominant characteristic and the others are only working adjuncts in comparison.
- Only when very similar complex notes need to be differentiated will quantitative notations for each plane be introduced, which will, in any case, in every case enable us to achieve an objective classification, involving, it is true, a complexity that we could still well do without.

XIII. CLASSIFICATION TECHNIQUE

The above outline resolves the problem on the theoretical level, but practice naturally requires the application of these data. A composition of concrete music is ultimately an assembly of structures: complex notes or cells. So at the outset it will use a reserve of "concrete materials" in a repertoire of structures. In general, each of these elements will be in the form of a recording on a disc or tape, carrying a number referring to an index card with an intelligible description of its characteristics.

A concrete music laboratory therefore has, for the richness essential to both theoretical research and experimental works, the greatest possible

number of sound structures from prior experimentation. As experimental discoveries come in unpredictable order, each of them will be card indexed, with recordings in chronological order. They are a purely practical catalog.

As the card index is built up, an analysis of it should be made and kept up to date in order to make the connections necessary for the most interesting structures to be classified into families. It is without any doubt this analytical card index that will enable progress to be made in the understanding of the musical object.

I

"SENSATION"

In beginning the study of perception, we find in language the seemingly clear and straightforward notion of sensation: I sense red or blue, hot or cold. We will see, however, that this is the most confused notion there is, and that, for having accepted it, classical analyses have missed the phenomenon of perception.

[a. *Sensation as impression.*][1]

I might first understand sensation to be the manner in which I am affected and the undergoing [*l'épreuve*] of a state of myself. Perhaps the gray that immediately envelops me when I close my eyes or the sounds that vibrate "in my head" when I am half-asleep indicate what pure sensing might be. I would sense precisely insofar as I coincide with the sensed, insofar as this latter ceases to have a place in the objective world, and insofar as it signifies nothing to me. This is to acknowledge that sensation must be sought beneath all qualitative content, since in order to be distinguished as two colors, red and green – even if lacking a precise location – must already form some scene before me and thus cease to be part of myself. Pure sensation will be the undergoing of an undifferentiated, instantaneous, and punctual "jolt." Since these authors readily concede the point, it is unnecessary to show that this notion corresponds to nothing in our experience, and that for animals such as the chimpanzee or the chicken, the most simple *factual perceptions* that we know have to do with relationships and not with absolute terms.[2] But we must still wonder why they believe themselves authorized *by right* to mark off a layer of "impressions" in perceptual experience.

Consider a white patch against a homogeneous background. All points
26 on the patch have a certain common "function" that makes them into a "figure." The figure's color is denser and somehow more resistant than the background's color. The borders of the white patch "belong" to the patch and, despite being contiguous with it, do not join with the background. The patch seems to be placed upon the background and does not interrupt it. Each part announces more than it contains, and thus this elementary perception is already charged with a *sense*. The objection will be raised that if the figure and the background are not sensed as a whole, then they must surely be sensed in each of their points. This would be to forget that each point in turn can only be perceived as a figure on a background. When Gestalt theory tells us that a figure against a background is the most basic sensible given we can have, this is not a contingent characteristic of factual perception that would, in an ideal analysis, leave us free to introduce the notion of impression. Rather, this is the very definition of the perceptual phenomenon, or that without which a phenomenon cannot be called perception. The perceptual "something" is always in the middle of some other thing, it always belongs to a "field." A truly homogeneous area, offering *nothing to perceive*, cannot be given to *any perception*. The structure of actual perception alone can teach us what it is to perceive. Pure impression is thus not merely undiscoverable, but imperceptible, and therefore is inconceivable as a moment of perception. If it is introduced, this is because, rather than being attentive to perceptual experience, this experience is neglected in favor of the perceived object. A visual field is not made up of isolated visions. But the viewed object is made up of material fragments, and spatial points are external to each other. An isolated perceptual given is inconceivable, so long as we perform the mental experiment of trying to perceive it. Yet in the world there are isolated objects or a physical void.

[b. *Sensation as quality.*]

I will thus give up the attempt to define sensation as pure impression. But to see is to have colors or lights, to hear is to have sounds, to sense is

to have qualities; is it not sufficient to have seen red or to have heard an *A* in order to know what sensing is? Red and green are not sensations, they are the sensibles, and quality is not an element of consciousness, but a property of the object. Rather than providing a simple means of delimiting sensations, the quality, if we consider it in the very experience in which it is revealed, is just as rich and obscure as the object or as the entire perceptual spectacle. The red patch I see on the rug is only red if the shadow that lies across it is taken into account; its quality only appears in relation to the play of light, and thus only as an element in a spatial
configuration. Moreover, the color is only determinate if it spreads across 27
a certain surface; a surface too small would be unqualifiable. Finally, this red would literally not be the same if it were not the "wooly red" of a carpet.[3] Analysis thus discovers the significations that reside in each quality. Might the objection be raised that only the qualities of our actual experience are at issue here, overlaid with an entire body of knowledge, and that we still have the right to conceive of a "pure quality" that might define "pure sensing"? And yet, as we have just seen, this pure sensing would amount to not sensing anything and thus to not sensing at all. The supposed evidence of sensing is not grounded upon the testimony of consciousness, but rather upon the unquestioned belief in the world [*le préjugé du monde*].[4] We believe we know perfectly well what it is "to see," "to hear," or "to sense," because perception has long given us colored or sonorous objects. When we want to analyze perception, we transport these objects into consciousness. We commit what psychologists call "the experience error,"[5] that is, we immediately assume that what we know to exist among things is also in our consciousness of them. We build perception out of the perceived. And since the perceived is obviously only accessible through perception, in the end we understand neither.

We are caught up in the world and we do not succeed in detaching ourselves from it in order to shift to the consciousness of the world. If we were to do so, we would see that the quality is never directly experienced and that all consciousness is consciousness of something. This "something," moreover, is not necessarily an identifiable object. There are two ways of being mistaken regarding quality: the first is to turn it into an element of consciousness when it is in fact an object for consciousness, to treat it as a mute impression when it in fact always has a sense; the second is to believe that this sense and this object, at the level of quality, are full and determinate. And this second error, just like the first, results from

the unquestioned belief in the world. Through optics and geometry we construct the fragment of the world whose image can, at any moment, form upon our retina. Anything outside of this perimeter – not reflecting upon any sensitive surface – no more acts upon our vision than does light falling upon our closed eyes. We ought to thus perceive a sharply delimited segment of the world, surrounded by a black zone, filled with qualities without any lacunae, and subtended by determinate size relations like those existing upon the retina. But experience offers nothing of
28 the sort, and we will never understand what a *visual field* is by beginning from the world. Even if it is possible to trace a perimeter around vision by beginning at the center and gradually approaching lateral stimuli, the results of such a measurement nonetheless vary from one moment to the next, and the precise moment at which a previously seen stimulus ceases to be seen can never be identified. The region surrounding the visual field is not easy to describe, but it is certainly neither black nor gray. In this region there is an *indeterminate vision, a vision of something or other*, and, if taken to the extreme, that which is behind my back is not without visual presence. The two straight lines in the Müller-Lyer illusion (see Figure 1) are neither equal nor unequal, this is only an essential alternative in the objective world.[6] The visual field is this strange milieu in which contradictory notions intertwine because the objects (the straight lines of Müller-Lyer's illusion) are not here placed in the domain of being where a comparison would be possible, but are rather each grasped in its own private context, as if they did not belong to the same universe.

Psychologists have for a long time gone to great lengths to ignore these phenomena. In the world taken in itself, everything is determinate. There are of course confused spectacles, such as a landscape in the fog, but even so, one still admits that no real landscape is in itself confused – it is only confused for us. Psychologists will contend that the object is

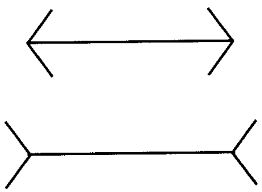


Figure 1

never ambiguous, that it only becomes so through inattention. The limits of the visual field are not themselves variable, and there is an absolute moment in which the approaching object objectively begins to be seen; quite simply, we fail to "notice."[7] But the notion of attention, as we will show more fully below, has for itself no evidence from consciousness. It is but an auxiliary hypothesis concocted to preserve the unquestioned belief in the objective world. We must recognize the indeterminate as a positive phenomenon. Quality appears within this atmosphere. The sense that it contains is an equivocal sense, and more a question of an expressive value than a logical signification. The determinate quality by which empiricism wanted to define sensation is an object for, not an element of consciousness, and it is the recently introduced object of scientific con- 29
sciousness. For these two reasons, the notion of quality conceals rather than reveals subjectivity.

[*c. Sensation as the immediate consequence of a stimulation.*]

The two definitions of sensation that we have just tried out were in fact direct definitions in appearance only. As we have just seen, they were modeled upon the perceived object. They were thereby in agreement with common sense, which also defines the sensible through the objective conditions on which it depends. The visible is what we grasp *with* our eyes; the sensible is what we grasp *through* our senses. Let us follow the idea of sensation on this terrain[8] and see what becomes of this "through," this "with," and the notion of sense organs at the first level of reflection, namely, at the level of science. Although we have no experience of sensation, do we at least find some reasons in its causes and in its objective genesis to maintain it as an explanatory concept? Physiology, to which the psychologist turns as if to a higher authority, is in the same predicament as psychology. It too begins by situating its object in the world and by treating is as a fragment of extension. They lose sight of *behavior* by focusing on the reflex, that is, the elaboration and the formulation of stimuli; behavior is hidden by a longitudinal theory of nervous functioning that makes each element of the reaction correspond in principle to an element of the situation.[9] As in reflex-arc theory, the physiology of perception begins by assuming an anatomical trajectory that leads 30
from a determinate *receiver* through a definite *transmitter* to a recording post,[10] which is itself specialized. The objective world being given, it is

assumed that the world confides messages to the sense organs that thus must be carried, then decoded in such a way as to reproduce in us the original text. From this it follows that there is, in principle, a point-by-point correspondence and a constant connection between the stimulus and the elementary perception. But this "constancy hypothesis"[11] enters into conflict with the givens of consciousness, and the same psychologists who posit it also acknowledge its theoretical character.[12]

For example, the intensity of a sound is made to lose its pitch under certain conditions; the addition of auxiliary lines renders two objectively equal shapes unequal;[13] and a colored area appears uniformly colored even though the chromatic thresholds of the different regions of the retina ought to make it red here and orange there, and in certain cases even achromatic.[14] Should these cases in which the phenomenon does not adhere to the stimulus be kept within the frame of the law of constancy through additional factors – attention and judgment – or should the law itself be rejected? When red and green presented together give a resulting gray, it is conceded that the central combination of stimuli may immediately give rise to a sensation different from what the objective stimuli would require. When the apparent size of an object varies with its apparent distance, or when its apparent color varies with the memories that we have of it, it is conceded that "sensorial processes are not impervious to central influences."[15] In this case, then, the "sensible" can no longer be defined as the immediate effect of an external stimulus. Is not the same conclusion applicable to the first three examples that we cited? If attention, more precise instructions, rest, and extended practice finally bring perception into conformity with the law of constancy, this does
31 not prove its general validity, for, in the examples cited, the first appearance had just as much of a sensorial character as the results obtained in the end. The question is whether the attentive perception, the concentration of a subject on a point in the visual field (such as the "analytical perception" of the two principal lines in the Müller-Lyer illusion), rather than revealing "normal sensation," does not substitute an exceptional arrangement for the original phenomenon.[16] The law of constancy cannot, against the evidence of consciousness, make use of a single critical experiment in which it itself is not already implied, and it is already presupposed wherever it is believed to be established.[17]

If we return to phenomena, they show us that the apprehension of a quality – exactly like the apprehension of size – is tied to an entire

perceptual context, and the stimuli no longer give us the indirect means that we sought for delimiting a layer of direct impressions. But not only does the physical stimulus elude us when we seek an "objective" definition of sensation. The sensory apparatus itself, as modern physiology imagines it, is no longer appropriate to the role of "transmitter" that it was made to play by classical science. Non-cortical lesions on tactile organs certainly dilute the concentration of points sensitive to hot, to cold, or to pressure, and also diminish the sensitivity of the points that remain. But if an extended enough stimulation is applied to the damaged organ, detailed sensations reappear; a more energetic exploration by the hand compensates for the increased threshold.[18] At the elementary level of sensibility, we catch sight of a collaboration among partial stimuli and between the sensorial system and the motor system that, through a variable physiological constellation, keeps the sensation constant, and thus rules out any definition of the nervous process as the simple transmission of a given message. The destruction of the visual function, regardless of the location of the lesions, abides by the same law: at first, all colors are affected[19] and lose their saturation. Next the spectrum becomes simpli- 32
fied, being reduced to four colors and shortly thereafter to two. In the end, a gray monochrome is reached, without the pathological color for that matter ever being equated with any normal color at all. Thus, in central lesions just as in peripheral ones, "the loss of nervous substance results not merely in a deficiency of certain qualities, but rather in the transition to a less differentiated and more primitive structure."[20] Conversely, normal functioning must be understood as a process of integration in which the text of the external world is not copied, but constituted. And if we try to grasp "sensation" from the perspective of its preparatory bodily phenomena, we do not discover a psychical individual, a function of certain known variables, but rather a formation already tied to an ensemble and already endowed with a sense, which is only different in degree from more complex perceptions and which thus does not move us forward in our delimitation of the pure sensible.

There is no physiological definition of sensation and, more generally, there is no autonomous physiological psychology because the physiological event itself obeys biological and psychological laws. It was long believed that peripheral conditioning provided a reliable way of identifying the "elementary" mental functions and of distinguishing them from the "higher-level" functions less strictly tied to the bodily infrastructure.

A more precise analysis discovers that the two types of functions intertwine. The elementary is no longer that which, when added together, will constitute the whole, nor is it a mere occasion for the whole to constitute itself. The elementary event is already invested with a sense, and the higher-level function will only achieve a more integrated mode of existence or a more valuable adaptation by utilizing and by sublimating the subordinate operations. Reciprocally, "sensory experience is a vital process, as much as procreation, breathing, or growth."[21] Psychology and physiology are thus no longer two parallel sciences, but rather two characterizations of behavior, the first concrete and the second abstract.[22]
33 When the psychologist asks the physiologist to provide a definition of sensation "through its causes," we said that he rediscovers on this terrain his own problems, and now we see why. For his part, the physiologist must rid himself of the realist prejudice that all of the sciences borrow from common sense and that hinders them in their development. The change in the sense of the words "elementary" and "higher-level" in modern physiology announces a change in philosophy.[23] The scientist must also learn to offer a critique of the idea of an external world in itself, since the facts themselves suggest to him that he must give up the idea of the body as a transmitter of messages. We grasp the sensible *with* the senses, but we know now that this "with" is not merely instrumental, that the sensory apparatus is not a conductor, and that even at the periphery, the physiological impression is engaged in relations that were previously considered to be central.

[d. *What is sensing?*]

Once again, reflection – even the second-order reflection of science – obscures what was believed clear. We thought we knew what sensing, seeing, and hearing are, but now these words pose problems. We are led back to the very experiences that these words designate in order to define them anew. The classical notion of sensation was not itself a concept derived from reflection, but rather a recently developed product of thought turned toward objects; it was the final term in the representation of the world, the furthest removed from the constitutive source, and thereby the least clear. In its general effort toward objectification, science inevitably comes to a conception of the human organism as a physical system in the presence of stimuli themselves defined by their

physico-chemical properties, seeks to reconstruct actual perception[24] upon this basis and to close the cycle of scientific knowledge by discovering the laws according to which knowledge itself is produced, that is, by establishing an objective science of subjectivity.[25] It is, however, also inevitable that this attempt should fail. If we think back to the objective investigations themselves, we discover first that the exterior conditions 34
of the sensory field do not determine it part for part and only intervene by making an autochthonous organization possible – this is what Gestalt theory shows – and second, that structure in the organism depends on variables such as the biological *sense* of the situation, which are no longer physical variables, such that the whole escapes the well-known instruments of physico-mathematical analysis to open onto another type of intelligibility.[26]

If we now turn back, as is done here, toward perceptual experience, we observe that science only succeeds in constructing a semblance of subjectivity: it introduces sensations, as things, precisely where experience shows there to already be meaningful wholes; it imposes categories upon the phenomenal universe that only make sense within the scientific universe. Science requires that two perceived lines, like two real lines, be either equal or unequal, and that a perceived crystal have a determinate number of sides,[27] without noticing that the nature of the perceived is to tolerate ambiguity, a certain "shifting" or "haziness" [*bougé*],[28] and to allow itself to be shaped by the context. The lines in Müller-Lyer's illusion cease to be equal without thereby becoming "unequal" – they become "different." That is, an isolated objective line and the same line considered in a figure cease to be, for perception, "the same." The line is only identifiable in these two functions by an analytical perception that is not natural. Likewise, the perceived is composed of lacunae that are not merely "non-perceptions." I can know that a crystal that I see or touch has a "uniform" shape without having, even tacitly, counted its sides. I can become familiar with a person's face without ever having perceived, for itself, the color of the eyes. The theory of sensation, which composes all knowledge out of determinate qualities, constructs objects for us that are cleansed of all equivocation, that are pure, absolute, and that are the ideal of knowledge rather than its actual themes. This theory only works for the recently developed superstructure of consciousness. This is where "the idea of sensation is more or less fulfilled."[29] The images that instinct projects before itself, the images that tradition recreates in each generation, or even mere dreams, appear at first as if on equal footing with perceptions properly so called, and true, actual, and explicit perception is gradually distinguished from phantasms through a work of critique. The word "perception" indicates a *direction* more than a primitive function.[30] We know that the constancy of the apparent size of objects for variable distances, or the constancy of their color in different lightings, is more perfect in children than in adults.[31] That is, perception is more strictly tied to the local stimulus in its mature state than in its early state, and it conforms to the theory of sensation more for the adult than it does for the child. Perception is like a net whose knots progressively appear more clearly.[32] A depiction of "primitive thought" has been given that can only be understood if we relate the responses of primitive people, their utterances, and the sociologist's interpretations back to the fund of perceptual experience that they all attempt to express.[33] What prevents spatial, temporal, and numerical wholes from being articulated in manipulable, distinct, and identifiable terms is sometimes the adherence of the perceived to its context and as if to its viscosity, and sometimes the presence in the perceived of a positive indeterminacy. We must explore this pre-objective domain within ourselves if we wish to understand sensing.

Aesthetics seems to thrive on controversy, even to demand it; on the conflict, typically, of new and old, of simplicity and complexity.
—Edward Lippman (1992)

If styles and genres did not suffer exhaustion, there would be only one style, one genre in each art.
—Jacques Barzun (1961)

An encounter with aesthetic philosophy is unavoidable in composition. To pick up a gold-tipped fountain pen and inscribe a treble clef and key signature on onionskin staff paper is to import a system of composition. It entails a selection from an enormous range of possible approaches to making music, a palette of sounds, their combinations, a mode of performance, and even the audience. Every subsequent compositional decision further articulates the chosen aesthetic.

No less a decision is taken in launching a program for granular synthesis, which implies another context for creation, performance, reception, and evaluation of the resulting work. The differences between these choices, which are but two out of innumerable others, are differences of aesthetic philosophy. An aesthetic philosophy is nothing more than a collection of ideas and preferences that inform the artist's decision-making. This collection does not determine every artistic decision, but it guides the general direction. Nor is it static. Music is in a constant state of change. The aesthetic sensibility of the creative artist is continually evolving.

The purpose of this chapter is to try to identify the main aesthetic issues raised by composition with microsonic materials. It is a worthwhile exercise for a composer to formulate an aesthetic philosophy. Such reflection forces one to think through issues that may have been taken for granted. Reflection upon aesthetic ideas may lead to compositional ideas, and vice versa.

No matter how deliberately one composes, the aesthetic ramifications of a piece escape total control by the composer, who often has no power over the theatrical presentation and the acoustical environment in which a work is performed. Even more important is the listener's mood, a narrow filter imposed on the sonic sensation.

Before continuing, I should state that I do not mean to prescribe my aesthetics for others. My goal is simply to explain preoccupations that have guided my own musical experiments.

Aesth

Aesthetic Premises

Every doctrine of aesthetics, when put into practice, demands a particular mode of expression—in fact, a technique of its own. (Stravinsky 1936)

The present practice of electronic music composition rests on a foundation of aesthetic premises. Some are old, others have emerged only recently. This section presents several of these premises.

The Philosophy of Organized Sound

Edgard Varèse opened up a new path of exploration of musical sound when he proposed, in the 1920s, a philosophy of "organized sound." He was encouraged by the early advances in music technology in electronic instruments such as the Telharmonium, the Thereminovox, and the Ondes Martenot (Cahill 1897; Rhea 1972, 1984; Chadabe 1997; Weidenaar 1989, 1995). For a time, Varèse also championed the experimental performances of the Futurist musicians, builders of "noise instruments." The Futurists wrote an emotional manifesto, *The Art of Noises*, in which Luigi Russolo observed:

Musical sound is too limited in its variety of timbres. The most complicated orchestras can be reduced to four or five classes of instruments in different timbres of sound: bowed instruments, brass, woodwinds, and percussion. Modern music flounders within this tiny circle, vainly striving to create new varieties of timbre. We must break out of this limited circle of sounds and conquer the infinite variety of noise-sounds! (Russolo 1916)

The philosophy of organized sound extended the boundaries of accepted musical material, and hence the scope of composition, to a wider range of acoustic phenomena. (See also Cowell 1930; Cage 1937.) Creative musicians sought beauty not only in the traditional, but also in the strange, in the formerly overlooked:

I insist upon the charm of combinations of noise instruments. But to appreciate this quality, the most absolute silence is necessary in the concert hall. No one can imagine what charm is attained with harmonic modulations and held chords produced, for example, by the blend of low and medium howlers, low whistler, and hummer. What a marvelous contrast results if a high crackler suddenly enters above this group to inflect a theme, or a gurgler to hold some notes or point up the rhythm! It is an effect that is completely unknown in orchestras, since no orchestra but that of the noise instruments can produce this sensation of excited and pulsing life, exalted through the intensity and rhythmic variety found in the combination of [the noise instruments]. (Russolo 1916)

What critics dismissed as unmusical noise is now a potent element in the composer's palette. Broad acceptance of this was slow in coming and Varèse encountered much rejection (Chou Wen-Chung 1966; Stuckenschmidt 1969). After World War II, the musical avant-garde embraced him, though the general public did not. Criticism and controversy surrounded his final projects, *Déserts* (1954, orchestra and tape), and *Poème électronique* (1958, electronic tape). Varèse died in 1965.

Many post-WWII-generation composers sensed a great aesthetic crisis in music. The twelve-tone ideas of Schoenberg and his followers had contributed to the feeling that traditional methods of harmonic and rhythmic organization were nearly exhausted:

> *The history of music and of musical thought is the story of artificial systems, their inception, bloom, and decline, their absorption or replacement by other artificial systems.... Recent developments in the field of musical composition have shown that the limited and conditioned system of musical elements, considered musical material for several hundred years, has now entered the administrative stage, where all possible permutations will no longer possess any new meaning.* (Brün 1970)

Simultaneous with this sense of crisis, new types of music were emerging out of new musical materials. These included Pierre Schaeffer's musique concrète, and electronic music based on impulses, sine waves, noise generators, and eventually, computer-generated sounds.

The aesthetic of organized sound places great emphasis on the initial stage of composition—the construction and selection of sound materials. This may involve synthesis, which often begins with microsounds, furnishing the elementary components used in the assembly of higher-level sound objects. Just as the molecular properties of wood, thatch, mud, steel, and plastic determine the architectural structures one can construct with them, so sonic microstructure inevitably shapes the higher layers of musical structure.

The middle layers of musical structure—mesostructure—arise through interaction with the material. That is, to sculpt sonic material into gestures or phrases involves mediation between the raw waveforms and the will of the composer. This mediation is not always immediately successful, which is part of the struggle of composition. If the initial result is unsatisfactory, the composer has two choices. The first is to develop new materials that will more easily fit a preconceived phrase mold. The second choice is to abandon the mold, which means following the "inner tensions"—to use Kandinsky's phrase—of the sonic material (Kandinsky 1926). In this case, the material suggests its own mesostructures. Later, the composer may intervene to reshape these structures from the vantage point of another time scale.

These interrelationships between sound and structure confirm what musicians have known all along: material, organization, and transformation work together to construct a musical code. It is in this context that a given sound accrues meaning and beauty.

Expansion of the Temporal Field

Music theorists have long acknowledged a multiplicity of time scales in compositions. Today we can extend this awareness to the micro time scale. The call for an expanded temporal field was first issued in the 1930s by composers such as Henry Cowell and John Cage, who said:

> *In the future . . . the composer (or organizer of sound) will be faced not only with the entire field of sound but also with the entire field of time. The "frame" or fraction of a second, following established film technique, will probably be the basic unit in the measurement of time. No rhythm will be beyond the composer's reach.* (Cage 1937)

By the 1950s, electronic devices had opened paths to the formerly inaccessible territories of microtime. In electronic music studios, one could assemble complex sounds by splicing together fragments of magnetic tape. Composers such as Stockhausen and Xenakis began to explore the temporal limits of composition using these tape splicing techniques where, at a typical tape speed of 38 cm/sec, a 1 cm fragment represented a time interval of less than 27 ms.

The analog signal generators of the 1950s let composers create for the first time sequences of impulses that could be transposed to different time scales by means of tape speed manipulations. Designed for test purposes, the analog signal generators were not meant to be varied in time but favored a timeless wave approach to sound. Their multiple rotary knobs and switches did not allow the user to switch instantly from one group of settings to another. Because of the weakness of their temporal controls, these devices imposed strict practical limits, which, with assistance and a great deal of labor, one could work. (The creation of Stockhausen's *Kontakte* comes to mind.)

By the 1970s, voltage-controlled analog synthesizers had become available, manufactured by Moog, Arp, Buchla, and other small companies. Analog synthesizers offered control through low-frequency oscillators, manual keyboards, and analog sequencers, but they could not provide for fine control at the micro time scale. Neither was analog tape an ideal medium for organizing microsonic compositions, owing to its inherent generation loss, linear access, and razor-blade splicing. It was only with the dawn of computer synthesis and digital audio techniques that a micro approach to sound could be explored in depth. (See chapter 2.)

Illusions of Continuity and Simultaneity

If events are absolutely smooth, without beginning or end, and even without modification or perceptible internal roughness, time would find itself abolished. It seems that the notions of separation,... of difference, of discontinuity, which are strongly interrelated, are prerequisites to the notion of anteriority. In order for anteriority to exist, it is necessary to be able to distinguish entities, which would then make it possible to "go" from one to the other.... Time, in a smooth continuum, is illegible. (Xenakis 1989)

Science has taken thousands of years to determine that the fine structure of matter, space, and even time, is discontinuous and quantified (Hawking and Penrose 1996). Human sensory organs set strict limits on our ability to perceive the discontinuity beneath the apparently hard surface of all phenomena.

Discontinuous variations on the micro time scale of music melt the frozen abstractions of traditional music theory such as pitch, instrumental timbre, and dynamic marking. Even such sacred notions as tone continuity and simultaneity reveal themselves to be illusions. The micro time scale defrosts these frozen categories into constantly evolving morphologies.

Continuity of tone is an auditory illusion. The mechanics of human hearing smear streams of discrete events into an illusion of continuum. (See the section on "Perception of Microsound" in chapter 1.) When we examine apparently continuous tones under a microscope, we see gaps scattered throughout, like the spaces between the threads of a blanket. These silent spaces—on the order of milliseconds—are not perceived as temporally discrete events but as fluctuations of a continuous tone. When two identical tones desynchronize on the same time scale we perceive only a "phase shifting" effect, if anything at all.

A related illusion in music is simultaneity. As Xenakis (1989) observed, a measurement as to whether two events occur simultaneously (or occupy the same spatial position) depends entirely on the scale of observation. A detailed analysis of onset times for supposedly simultaneous attacks in musical performance might reveal asynchronisms on the order of dozens of milliseconds.

A Multiscale Approach to Composition

A multiscale approach to composition allows for compositional intervention on every time scale. The power of this approach comes from the fact that different temporal zones interconnect. Operations on one time scale generate structures which may be perceived on other time scales. This suggests the possibility of working on the micro time scale in order to generate high-level musical structure. Iannis Xenakis predicted such an approach:

Suppose that each point of these [granular] clusters represents not only a pure frequency . . . but an already present structure of elementary grains, ordered a priori. We believe that in this way a sonority of a second, third, or higher order can be produced. (Xenakis 1960)

Interaction between the microtemporal scale and higher time scales is especially intriguing. To cite a simple example; a gradual change in particle durations results in timbre variations on a higher time scale. Certain signals cross from one time scale to another, such as a descending glissando that crosses the infrasonic threshold, turning from tone to rhythm.

For some composers, part of the attraction of composing with microsound is the way it blurs the levels of musical structure:

The task of microcompositional strategies can be described as one of letting global morphological properties of musical structure emerge from the local conditions in the sonic matter. (Di Scipio 1994)

In an approach that favors "emergent properties" or second-order sonorities, sound objects emerge from a composer's manipulations of microstructural processes (Di Scipio 1997a). This is also known as a bottom-up compositional strategy, since the composition takes its shape from microsonic interactions. This stands in contrast to a top-down strategy in which a composer fills in a preplanned form (e.g., sonata).

The bottom-up strategy can be fascinating, partly because its results cannot always be predicted in advance. On the other hand, why limit the scope of compositional decisions to a single time scale? To navigate the widest possible zone of creativity, the creative composer wants to float freely across time scale boundaries. To insert, delete, rearrange, or mold sounds on any time scale, this is the multiscale approach to composition.

Differences Between Time Scales

In the 1950s, a few serial composers tried to invent a system of composition that could uniformly apply to any time scale. Their aim was for a kind of ideal logical coherence. This did not take into account the nonlinearities of musical perception. As chapter 2 indicates, a main lesson of Stockhausen's 1957 essay "How time passes" is precisely how awkward it can be to apply a proportional series developed for one time scale (e.g., pitch periods) to another time scale (e.g., note durations). (Specifically, it does not make much sense to transpose the intervallic relations of the chromatic scale into the domain of note durations). Little music corresponds to a geometrically pure and symmetric hierarchical model. As Vaggione has stated:

The world is not self-similar.... Coincidences of scale are infrequent, and when one thinks that one has found one, it is generally a kind of reduction, a willful construction. The ferns imitated by fractal geometry do not constitute real models of ferns. In a real fern there are infinitely more accidents, irregularities and formal caprices—in a word—singularities—than the ossification furnished by the fractal model. (Vaggione 1996a)

Strictly hierarchical and symmetrical note relations are not necessarily perceived as such (Vaggione 1998). Gyorgy Ligeti (1971) pointed out the difficulty of organizing all time scales according to a unitary scheme, owing to a lack of correlation with human perception. The musicologist Carl Dahlhaus (1970) adopted a similar tack in his critique of serial pitch rule applied to the organization of microstructure.

Sound phenomena on one time scale may travel by transposition to another time scale, but the voyage is not linear. Pertinent characteristics may or may not be maintained. In other words, the perceptual properties of a given time scale are not necessarily invariant across dilations and contractions. A melody loses all sense of pitch, for example, when sped up or slowed down to extremes. This inconsistency, of course, does not prevent us from applying such transpositions. It merely means that we must recognize that each time scale abides by its own rules. A perfect hierarchy is a weak model for composition.

Density, Opacity, Transparency

The expansion of sonic possibilities adds new terms to the vocabulary of music. We can now shape sonic matter in terms of its particle density and opacity. Particle density has become a prime compositional parameter. Physics defines density as the ratio of mass to volume. In music this translates to the ratio of sound to silence. Through manipulations of density, processes such as coalescence (cloud formation), and evaporation (cloud disintegration) can occur in sonic form. Opacity correlates to density. If the density of microsonic events is sufficient, the temporal dimension appears to cohere, and one perceives a continuous texture on the sound object level. Thus by controlling the density and size of sound particles we have a handle on the quality of sonic opacity. Coalescence takes place when particle density increases to the point that tone

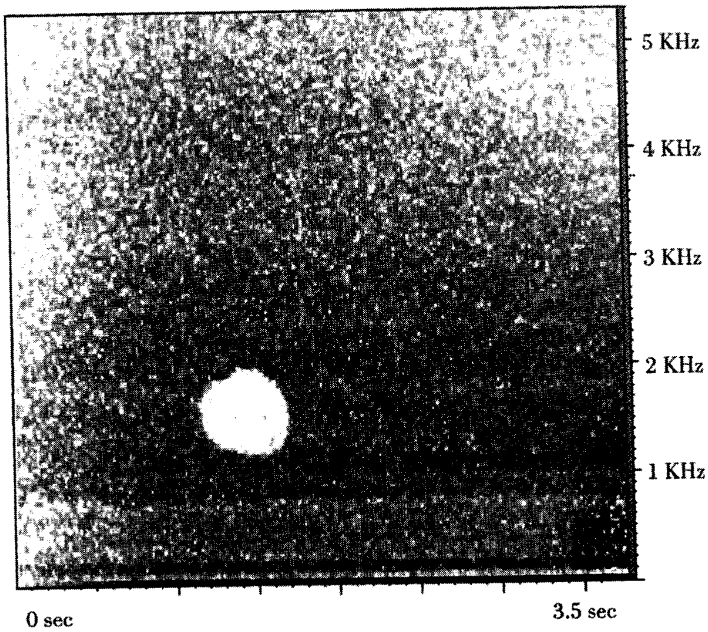


Figure 8.1 A hole in a broadband sound, sculpted by a sonogram filter. We can carve time-frequency gaps on different time scales.

continuity takes hold. An opaque sound tends to block out other sounds that cross into its time-frequency zone.

Going in the opposite direction, we can cause a sound to evaporate by reducing its particle density. A sparse sound cloud is transparent, since we can easily hear other sounds through it. A diaphanous cloud only partially obscures other sounds, perhaps only in certain spectral regions. For example, by means of sonogram filtering we can create transparent holes in the spectrum of a sound (figure 8.1) which might provide a window onto another layer of sound beneath.

Stationary, Stochastic, and Intermittent Textures

Many complex musical textures resemble what statistics calls *stationary processes*. A stationary process exhibits no trend. The texture has a fixed mean value and fluctuates around the mean with a constant variance. A stationary process is not necessarily static in time, but its variations remain within certain limits, and are therefore predictable. We see these characteristics in many sound-mass textures created with particle synthesis. Consider a dense cloud of grains scattered over a broad zone of frequencies. It scintillates while never evolving, and is therefore a stationary texture.

Stationary textures are fertile material for composition. One can place them at low amplitude in the background layer, where they lend depth to the musical landscape. Positioned in the foreground, their constant presence introduces dramatic tension and sets up an expectation of change. The ear notices any change as a deviation from the stationary.

Changes in texture appear as slow trends or sudden intermittencies. To impose a trend is to gradually change the texture. This may take place over time periods associated with the meso time scale (i.e., many seconds). A trend converts a stationary texture into a *weighted stochastic texture*. One can introduce a trend by opening or closing the bandwidth of a cloud, by altering its center frequency, by filtering, or by any other perceptible time-varying operation.

Sudden changes create intermittent texture. The intermittencies break up the stationary texture by injecting loud particles or silent micro-intervals. This latter technique—composing with silence—remains largely unexplored, but can be effective. The idea is to begin with a multichannel stationary texture and introduce silent intervals into it, working like a sculptor, carving rhythmic and spatial patterns by subtraction.

Composition Processes on the Microsonic Level

Interactive digital sound editing originated in the 1970s (Moorer 1977a, 1977b), but did not become widely available until the 1990s. It seems so taken for granted today, I am not sure that musicians recognize its profound impact on the art of electronic music composition. The possibility of editing sound on any time scale has opened up a vast range of transformations. For example, through selective gain adjustment it is possible to magnify a tiny subaudio fluctuation into an intense microsonic event (see the description of transient drawing, chapter 4). We can shape the event through microsurgery or filtering on a micro time scale (chapter 5). By replicating the event on the micro time scale, it can be transformed into a pitched sound object (see the description of particle cloning synthesis in chapter 4). Through time-stretching it can be magnified into a long, slowly unfolding texture (pitch-time changing chapter 5, and sound transformation with the phase vocoder, chapter 6). Then through granulation we can decompose it once again into small particles, "from dust to dust" (granulation, chapter 5).

Such manipulations open up a catalog of new compositional processes:

- Variations (contrasts, increases, and decreases) of particle density
- Coalescence (cloud formation) and evaporation (cloud disintegration)
- Time stretching to extend a microstructure into a large-scale event
- Time shrinking large events into microsounds
- Hierarchical variations of the same event structure on multiple time scales
- Lamination of a cloud through multiple layers with microtemporal delays
- Particle spatialization (scattering particles in space)
- Granular reverberation
- Precise polymetric pulsations in space, created by superimposing multiple metrical streams
- Multiple formant streams, each with its own frequency and spatial trajectory
- Spectrum evolution via manipulation of particle envelopes
- Microsurgery on the Gabor matrix to extract the chaotic, harmonic, loudest, softest, or other selected particles within a sound and reassemble it with alterations

Such operations change the practice of composition, and mandate a rethinking of compositional strategy and architecture. This cultural process has only just begun.

Heterogenity and Uniqueness of Sound Materials

In the 1950s, certain composers began to turn their attention toward the composition of sound material itself. In effect, they extended what had always been true at the phrase level down to the sound object level. Just as every phrase and macro form can be unique, each sound event can have an individual morphology. This creates a greater degree of diversity—of heterogeneity in sound material—without necessarily losing continuity to other objects. Chapter 3 showed how we can extend the concept of heterogeneity even further, down to the level of microsound, where each sound particle may be unique. The microstructure of any sound can be decomposed and rearranged, turning it into a unique sound object.

Simultaneous with this shift in musical thinking, certain researchers have shifted their focus from the analysis of periodicities to the analysis of singularities (Arneodo et al. 1995). They have turned from the analysis of continuous signals to the analysis of intermittencies, that is, from stationary and homogeneous emissions to nonstationary and nonhomogeneous distributions of energy.

The variety of sound opened up by electronic music comes at a high price: the loss of note homogeneity and with it, the foundation of traditional abstract musical language. To adopt the universe of heterogeneous sound objects is to be cast into a strange new land without conventional language. The terrain of this land is nonhomogeneous, pocked by fractured disjunctions (intermittencies) and nonlinear transitions from one perceived state to another. A simple linear change may trigger such a percept, such as a pulse train whose frequency is smoothly increasing from 5 to 50 Hz. In the midst of this change, listeners perceive a series of rhythmic pulsations passing through an ambiguous zone between rhythm and pitch into a continuous tone. An asynchronous cloud of grains cross the threshold (from discontinuity to continuity) as the density increases from five to one hundred grains per second. Many other examples of nonlinear thresholds could be cited.

Aesthetic Oppositions

It seems inevitable that we seek to define and understand phenomena by positing their opposite. High cannot be understood without the concept of low, and so with near and far, big and small, etc. A given aesthetic tendency can be seen as confronting its opposite. The question is whether such a simplification can lead to a clarification. This section explores certain aesthetic oppositions raised in composing with microsound.

Formalism versus Intuitionism

In composing with microsound, we face an ancient conflict: formalism versus intuitionism. Formal models of process are natural to musical thinking. As we listen, part of us drinks in the sensual experience of sound, while another part is setting up expectations—hypotheses of musical process. To the envy of the other arts, notation and logical planning have been part of music-making for centuries. As Schillinger (1946) demonstrated, we can make a music generator out of virtually any mathematical formula. Lejaren Hiller's pioneering experiments with automated composition in the 1950s proved that the computer could model arbitrary formal procedures (Hiller and Isaacson 1959). Computer programs sped up the time-consuming labor associated with systematic composition. This led to a surge of interest in applying mathematical procedures to composition (Hiller 1970).

Since the start of music notation, it has been possible to manipulate musical materials as symbols on paper, separated from the production of sound in time. Herein lies a fundamental dichotomy. Because formal symbols can be organized abstractly, such manipulations have been closely identified with the organization of sound material. Music, however, is more than an abstract formal discipline. It must eventually be rendered into sound and heard by human beings. Thus it remains rooted in acoustical physics, auditory perception, and psychology.

One cannot escape formal control when working with a computer. Every gesture translates into an intervention with a formal system. This system is encoded in the logic of a programming language and is executed according to the algebra of the machine hardware. The question is at what level of musical structure do such formalisms operate? The pianist practicing on a digital piano is interacting with a computer music system. She is not concerned that her performance is triggering a flurry of memory accesses and data transfers. The familiarity of the keyboard and the sampled piano sounds makes the interaction seem direct and natural. This is a great illusion, however. With a change of formal logic, the same equipment that produces the piano tones could just as well synthesize granular clouds, as we saw with the Creatovox (chapter 5).

Applied at different strata of compositional organization, formal algorithms can be a powerful means of invention. An algorithm for spawning sound particles can handle enormous detail in a fraction of a second. Other algorithms can iterate through a collection of variations quickly, offering the composer a wide range of selections from which to choose. Interactive performance systems try to balance preprogrammed automation with spontaneous decisions.

While formal algorithms enable interaction with a machine, formalism in composition means imposing constraints on one's self. The formalist composer follows a logical system from beginning to end. This logic exists only in an ideal conceptual plan. The plan must ultimately be translated into the real world of acoustics, psychoacoustics, and emotional response. It is in this translation that the game is often lost.

Coherence versus Invention

Coherence must bear some relation to the listener's subconscious perspective. But is this its only function? Has it not another of bringing outer or new things into wider coherence? (Ives 1962)

In academic theory, formal coherence is one of the most vaunted characteristics of musical composition. In general, coherence signifies "logical integration and consistency." This quality is not always easy to measure in practice. In its most obvious form, coherence manifests itself as a limitation in the choice of compositional materials and a consistency in the operations applied to those materials.

One can easily place the organization of microsound under the regime of a formal system. In this case, the operations that produce the composition ensure that it always remains within the boundaries of the formal rules. Such an approach makes for a tidy package, free from anomalies and logical inconsistencies. The compositions it produces can be proven to be "coherent" in a formal sense, even if they are dull or incomprehensible.

The problem here, as we have stated before, is that music is not a purely logical system. Rigor is not synonymous with perceived musical coherence. Music is rooted in acoustics, auditory perception, and psychology. Musical coherence seems to be a poorly understood psychological category. It is one of those ubiquitous terms in aesthetic discourse that everyone uses subjectively and no one has ever studied from a scientific viewpoint.

As Horacio Vaggione (1997) observed, by convention, a "rule" must necessarily be followed many times. But the artist can invoke a rule only once! Thus we might focus our attention on other criteria in the way that we compose with microsound. Inventiveness, I would suggest, is at least as important as coherence.

Spontaneity versus Reflection

We find in electronic music new examples of a venerable opposition in music-making, pitting the immediate spontaneity of improvisation in performance against the careful, reflective process of studio-based composition. This confrontation is particularly sharp in the case of real-time systems that spawn a constant swarm of sound particles. To control this flow in such a way as to make interesting musical gestures is not easy. The musician's interface can either help or hinder this process.

Barry Truax's granular synthesis programs GSX and GSAMX (Truax 1988) incorporated several types of controls:

low-level grain parameters—center frequency, frequency range, average duration, duration range, delay (density)

presets—groups of stored grain parameter settings

ramps—patterns of change in grain parameters, stored in a ramp file

tendency masks—graphic control shapes that are translated into ramps and presets, stored in a tendency mask file

The composer could override any of these stored parameters in performance, intermingling planned functions with spontaneous gestures.

Our Creatovox instrument (chapter 5) takes another approach to the problem of particle synthesis in real time. Designed as a solo instrument for virtuoso performance, it is played using a traditional keyboard, with additional joystick, fader, and foot pedal controllers. In the Creatovox, each keystroke spawns a cloud of grains, whose parameters can be varied with the real-time controllers.

PulsarGenerator (chapter 4) was not intended for the concert-hall, although we anticipated that it would be used in this way, because it could be operated in real time. We wanted a program which would allow improvisation as a fast way to explore the wide range of pulsar textures, but which also allowed for careful planning through control by envelopes and stored presets.

Despite the attractions of real-time music-making, the studio environment is the ultimate choice for the musician who seeks the maximum in creative freedom:

- The possibility of editing allows any previous decision to be revised or retracted in the light of reflection.
- Rehearsal of all gestures permits refinement.
- In contrast to real-time improvisation, where the focus tends to be local in scope, studio decision-making can take into account the entire range of time scales.
- An arbitrary number of independent musical threads can be superimposed carefully via mixing.
- The sound structure can be monitored and manipulated on a particle-by-particle basis, which is impossible in real time.

A potential hazard in studio work is over-production. An over-elaborate montage may result in a stilted and contrived product.

Intervals versus Morphologies

Atomism compels us to give up the idea of sharply and statically defining bounding surfaces of solid bodies. (Einstein 1952)

Linked to a wave-oriented view of sound is a classical aesthetic—dating back to the Greeks—that assigns great value to works of art that conform to certain numerical proportions and intervals. This aesthetic imprints itself throughout the history of music, particularly in the domain of pitch relations. It is also implicit in the treatment of metrical rhythms, with its scale of durational values based on duple and triple divisions of the beat.

Intertwined with intervallic thought is the notion of scales. As Karlheinz Stockhausen indicated (1957, 1962), any continuous musical parameter (spatial position, filter setting, etc.) can be subdivided into an arbitrary scale and then manipulated in terms of intervallic relations. The twentieth century saw the introduction of serial, spectral, and minimalist aesthetic theories, all of which were intervallic. The main differences between them concern which intervals and which scales are most important.

Acoustic and perceptual reality stand in contrast to the simplications of intervallic thought. The momentary frequency of most acoustic instruments is constantly changing. Noise is ubiquitous. Difference thresholds limit all aspects of perception. Masking and other nonlinear effects complicate perception. Training and mood strongly influence musical hearing.

To think in terms of microsonic materials and procedures is to shift the aesthetic focus away from sharply defined intervals toward curvilinear and fuzzy morphologies. Just as it has become possible to sculpt habitats from fiberglass foam, the flowing structures that we can create with microsound do not necessarily resemble the usual angular forms of musical architecture. On the contrary, they tend toward droplike, liquid, or cloudlike structures.

Sound particles dissolve the solid notes into more supple materials which cannot always be measured in terms of definite intervals. As a result, sound objects may have "fuzzy edges," that is, ambiguous pitch and indefinite starting and ending times (owing to evaporation, coalescence, and mutation). Microvariations melt the frozen abstractions of traditional music theory such as continuous tone, pitch, instrumental timbre, and dynamic marking, reducing them to a constantly evolving stream of particle morphologies. Intervals may emerge, but they are not an indispensable grid, there is instead an interplay between intervallic and nonintervallic material.

Within these flowing structures, the quality of particle density—which determines the transparency of the material—takes on prime importance. An increase in density induces fusion. It lifts a cloud into the foreground, while a decrease in density causes evaporation, dissolving a continuous sound band into a pointillist rhythm or vaporous background texture. Keeping density constant, a change in the characteristics of the particles themselves induces mutation, an open-ended transformation.

Smoothness versus Roughness

The shapes of classical geometry are lines and planes, circles and spheres, triangles and cones. They inspired a powerful philosophy of Platonic harmony.... [But] clouds are not spheres.... Mountains are not cones. Lightning does not travel in a straight line. The new geometry models a universe that is rough, not rounded, scabrous, not smooth. It is the geometry of the pitted, pocked, and broken up, the twisted, tangled, and intertwined.... The pits and tangles are more than blemishes distorting the classical shapes of Euclidean geometry. They are often the keys to the essence of the thing. (Gleick 1988)

Microsonic synthesis techniques contain a dual potential. On the one hand, they can create smooth and pitch-stable continua, characteristic of the formants of the voice and resonant instruments. On the other hand they can create intermittent particles and nonstationary textures, which in the extreme tend toward chaotic noise bands.

The determinants of pitched continua are stable waveforms, round envelopes, and long particle durations. In contrast, the determinants of noisy signals are irregular waveforms, jagged envelopes, and brief particle durations. The opposition between smooth and rough textures can serve as an element of tension in composition, akin to the tension between *consonance* and *dissonance*, with transitions between these two extremes acting as a bridge.

Attraction versus Repulsion in the Time-Domain

Astronomers from the Paris Observatory have detected the densest mass of galaxies that is visible in the southern hemisphere, which may constitute the central element of the Great Attractor. Predicted in 1987, the Great Attractor would be an enormous concentration of galaxies that attracts other galaxies in its environment—including our own—at speeds on the order of 500 to 600 km per second. (Associated Press France 1997)

The universal principle of attraction and repulsion governed the primal cosmological explosion of the Big Bang as well as the inner structure of atomic particles. It manifests itself in physical biology as the experience of pleasure and pain, and in the psychological experience of love and hate, of lust and disgust. It rules over individual human relationships as much as relationships between tribes and cultures.

The principle of attraction and repulsion also plays a role in music. For example, Igor Stravinsky used attraction as a means of organizing the time structure of a composition:

Composing leads to a search for the . . . center upon which the series of sounds . . . should converge. Thus if a center is given, I shall have to find a combination that converges on it. If, on the other hand, an as yet unoriented combination has been found, I shall have to find a center towards which it will lead. (Stravinsky 1947)

Edgard Varèse thought that it might be possible to adapt the principle of repulsion as an organizing principle:

When new instruments will allow me to write music as I conceive it, taking the place of the linear counterpoint, the movement of sound-masses, or shifting planes, will be clearly perceived. When these sound-masses collide, the phenomena of penetration or repulsion will seem to occur. (Varèse 1971)

Temporal attraction takes three forms: *attraction to a point*, *attraction to a pattern*, and *attraction to a meter*.

Attraction to a point refers to when numerous particles gravitate toward a specific time point, and the clustering results in a climactic explosion. Its conceptual opposite is emptiness or silence, or the repulsion of sound objects away from a central point. I have applied these concepts in my piece *Clang-tint*, where points of attraction control the density of sonic events (see chapter 7).

Attraction to a pattern refers to a strong tendency toward reoccurrence of a given rhythmic motive. The isorhythms of ancient music exemplify this phenomenon. Repulsion from a pattern refers to the absence or avoidance of regularity in motivic figuration.

Attraction to a meter means alignment to a regular pulsation. A strong metric beat attracts a metric response. It is easy to synchronize multiple layers on top of a regular pulse. The opposite of metric attraction is metric repulsion, found in the rich realm of ametric (or aleatoric) rhythms. It is difficult to overdub synchronously on top of an ametric rhythm. An ametric rhythm is not the same as syncopation; syncopation reinforces meter by emphasizing various of its subdivisions.

Parameter Variation versus Strategy Variation

In electronic music, every technique of synthesis is controlled by a number of parameters. This invites a process of composition based on parameter variation. Consider the technique of frequency modulation synthesis (Chowning 1973). The timbre of many computer music pieces of the 1970s and 1980s relied on variations of essentially two parameters: the index of modulation and the carrier-to-modulator ratio. In granular synthesis, variations in grain spacing and grain density lead to time-stretching and time-shrinking effects, while variations in grain duration lead to spectrum transformations. A prime example of parameter variation is Barry Truax's composition *The Wings of Nike* (*Perspectives of New Music* 28 compact disc, 1990). Here two phonemes, each about 170 milliseconds in length, iterate over a 12-minute composition, a repetition-expansion by a factor of four thousand.

As a compositional strategy employed to the exclusion of others, parameter variation reflects an obsession with consistency. It can take the form of a preoccupation with deriving every sound from the previous one, or from a source sample. If this is carried out only through variation of a single algorithm, it may lead to a monochromatic timbral palette. It may also result in a restricted range of gestures, since no morphological developments can occur that are not derived from parameter variation.

Alternatively, the compositional strategy can itself be the subject of variations. Even a simple change, such as switching to a different synthesis technique, alters the parameters. Another strategic change is a step up or down to a different level of structure. Juxtaposition refreshes the brain, breaking the cycle of closed permutations and combinations.

Simplicity versus Complexity in Microsound Synthesis

The synthesis instruments presented in chapters 3 and 4 are simple in structure, reflecting my own approach to the synthesis of microsound. Certain basic sounds, like the magical sine wave, can be made expressive with only a touch of vibrato and tremolo, and perhaps a dash of reverberated ambiance. Most other interesting sounds, however, are more complicated in their time-varying behavior.

From the standpoint of the composer who is also a programmer, the question is whether to embed such complex behavior within a synthesis instrument, or whether to separate the behavior from the instrument. My tendency is towards the latter. Rather than designing a latter-day Wurlitzer organ controlled by dozens of parameters, I prefer to build a library of small distinct instruments, each with its own articulators and modes of performance. In this approach, the score serves as the primary point of control. Therefore, the score is the source of synthesis complexity. As in the traditional practice of orchestration, it is by selecting and combining different instruments that one achieves a broad palette of timbral colors. The score interweaves these colors in detail. In electronic music, of course, the score does not necessarily take the form of a five-line staff. It can be a collection of sound events and envelopes, as in the note lists of the Music *N* languages, or the graphical regions of a sound mixing program (e.g., Digidesign's Pro Tools).

When particles assemble into sound objects, it is their combination *en masse* that forms the morphology of the sound. By controlling this combination from a high level, we shape the sound's evolution. High-level controls imply the existence of algorithms that can interpret a composer's directives, translating them into, potentially, thousands of particle specifications. An early example of such an algorithm is my 1975 grain generator program PLFKLANG, described in chapter 7. This trend is now re-emerging in the form of high-level generators of microsonic behavior. A recent example is the program Cmask (Bartetzki 1997a, 1997b). This is a stochastic event generator which works in conjunction with the Csound synthesis language. The program reads a composer-specified parameter file and generates a score file that Csound can immediately read. For every parameter of an event, Cmask selects a random value from a time-varying tendency mask. CMask also provides other methods of parameter generation, including cyclic lists, oscillators, polygons, and random walks. A different method may generate each parameter of an event.

James McCartney's SuperCollider language provides another set of high-level event generators, called Spawn, Tspawn, OverlapTexture, and XFade-Texture which generate a variety of behaviors that can be edited and adjusted by the user. For example, OverlapTexture creates a series of overlapped sounds, where the sounds are generated by a user supplied synthesis instrument. By adjusting the parameters of the OverlapTexture, and randomizing some of them within specific limits, one can create a wide variety of ambient textures.

To conclude, a synthesis technique is a means to an end. In my work, synthesis is the starting point for sound design, which is itself only the beginning of composition. I inevitably edit (cut and paste) and alter raw sound material with a variety of transformations. This editing involves trial-and-error testing and refinement. Because of this, it would be impossible to bundle into a synthesis algorithm.

Code versus Grammar

If played and heard often enough, every musical gesture is prone to be interpreted by musicians and listeners, as a gesture of musical speech. As the gesture becomes familiar, and thus recognized by society, the composed structure, in which the context generates the meaning of its components, will be misunderstood, instead, as one in which the components give meaning to their context. (Brün 1983)

Traditional western music is characterized by a familiar—yet fundamentally incomplete and ambiguous—musical grammar. This grammar describes the materials employed in pieces (pitches and timbres) as well as many aspects of their organization. In contrast, in new music, particularly pieces that employ microsonic synthesis, the audience does not necessarily know the grammar in advance. Here, it is the task of each new piece to establish its own code, with perhaps only a few symbols inherited from the past. The term "code" distinguishes the provisional nature of the communication protocol, as opposed to a more established language with its grammar.

When we can recognize a familiar unit of musical structure, we might say that it is a cliché. The popular understanding of "cliché" is that it is equivalent to "overly familiar." Yet frequency of exposure seems to have little to do with the issue; lovers of Mozart never tire of their hero's recognizable sound. Cliché is a pejorative in colloquial English, where it is a synonym for "hackneyed." Its meaning is more neutral in its original French, where it may also refer to a template—an original from which many instances can be derived.

The danger of clichés, in the narrow, popular sense, is omnipresent. The naive presentation of trite formulas (as if they retained any freshness) creates a negative impression. The definition of what is fresh and what is trite is subjective, however, and varies with fickle artistic fashion. Music history shows a constant struggle between progressive and reactionary trends, in which the ascendence of each alternates every few years. As progressive movements stop evolving, they become reactionary, while trends that formerly seemed hackneyed, seem suddenly fresh or even daring in comparison. (A classic example is the rise of simple tonal music in the 1970s and 1980s after the peak of serialism.)

In artificial intelligence research, the term "cliché" has been used with another meaning, and it is this sense that I would like to emphasize here. In this context, a cliché is a unit of knowledge that corresponds to a formal structure such as a *semantic network* (Winston 1984). Semantic networks offer a formal structure for capturing the essential properties of a known class of objects or situations, enabling programs to recognize instances of them. If, for example, we define a table as an object with a flat surface supported by one or more legs, a program should be able to classify all such objects, in many shapes and sizes, as instances of a single cliché. David Cope (1996) uses the term "signature" in a manner similar to my use of "cliché."

The notion of cliché or signature in music refers to memorable units of musical structure, and implies a process of recognition on the part of the listener. It is important that the cliché be memorable. Given enough of the cliché we can "fill in the blanks" and substitute missing pieces. As with the table example, we can spot a cliché in many guises.

Naturally, to spot a musical cliché requires sensitivity and erudition. Neophytes cannot spot clichés as readily as experts and some clichés are stronger or easier to recognize than others. But the ability to recall entire pieces of music from fragments of as few as two or three notes—more or less instantaneously—reminds us of how human perception is attuned to cliché (Buser and Imbert 1992). Perhaps the notion of cliché can be applied in a practical agenda to make computers more musically intelligent.

Through the accumulation of clichés over time, understandable codes inevitably emerge from the magma of artistic creation. Strange musical landscapes become more familiar. The vintage sonorities of early electronic music, for example, are no longer novel. The basic textures of granular synthesis are becoming familiar. The practice of composition with microsound must eventually shift from the creation of novel sonic effects to the construction of compelling new musical architectures.

Sensation versus Communication

Within a fraction of a second after the eyes, nose, ears, tongue or skin is stimulated, one knows the object is familiar and whether it is desirable or dangerous. How does such recognition, which psychologists call preattentive perception, happen so accurately and quickly, even when the stimuli are complex and the context in which they arise varies? (Freeman 1991)

Sound waves speak directly to our senses. They can be likened to the immediate perception of touch, if touch could penetrate to the inner ear. The experience of music is a cognitive reaction to a perceptual reaction. It reaches directly toward emotions and associations. Intellectualization is a side effect.

Traditional musical languages abide by familiar grammars. This familiarity acts as a framework for setting up small surprises. In creative electronic music, which attempts to extend musical expression itself, the goal is often the opposite. Since so much is new, little is expected. The surprise comes in finding familiarity.

In this music, the role of the composer is to create a pattern of acoustic sensations in the form of a code that organizes them into a meaningful structure. (I will not attempt to define "meaningful" here.) The intellectual challenges and emotions experienced by the composer in creating this structure may be very profound and intense (or not). In any case, they are independent of those experienced by the listener. The composer cannot hope to account for the mindset carried into the concert hall by the listener. Acoustic sensations are inevitably filtered by the listener through the extremely narrow sieve of subjective mood and personality. These interpretations trigger a reverberant halo of emotions and reflections unique to each person.

The ideal of musical communication would imply a direct transmission of emotional and intellectual experience from composer to listener. This is probably quite rare. Is direct transmission the point? The point seems to be to stimulate the listener with organized sensations. The composer takes the listener on a fantastic voyage. Let each person make up their own mind about what they experience.

Summary

Every work of art aims at showing us life and things as they are in truth, but cannot be directly discerned by everyone through the mist of subjective and objective contingencies. Art takes away the mist. (Schopenhauer 1819)

Art, and above all, music, has a fundamental function ... It must aim ... toward a total exaltation in which the individual mingles, losing consciousness in a truth immediate, rare, enormous, and perfect. If a work of art succeeds in this undertaking, even for a single moment, it attains its goal. (Xenakis 1992)

Art music is designed according to an aesthetic vision. It is formed by a blend of pure sensation and logical organization. The joy of composition derives from the free interplay between goal-driven intellectual and emotionally driven intuitive modes of working. The act of composition cannot avoid expressing philosophical attitudes, even if these are vague (ambiguous) or even contradictory (ironic).

In recent years, the concept of microsound has taken root in the musical world. Readily available software generates and manipulates microsound. This in turn has sparked a great deal of experimentation on the part of musicians. Judging by the number of compositions that have appeared employing granular techniques, one could say that these methods have enjoyed a certain vogue. Is a fascination with the microsonic domain a passing fancy? For some musicians, this is probably the case. Yet as a resource for expressive sounds, the mine of microsound is far from exhausted.

Certain timbres produced by granular synthesis have a recognizable signature. These familiar textures can function as memorable units of musical structure. The manipulation of recognizable elements or clichés is an integral part of composition. Musical material is never entirely new at every level of musical structure. Even the most advanced realms of musical expression eventually accumulate a storehouse of clichés, and this accumulation is a natural historical process of music. It is akin to Herbert Brün's concept of "decay of information," in which familiarity leads to increased legibility at the expense of freshness (Hamlin and Roads 1985). Although Brün warned that "understanding, familiarity, and communicativity" are not necessarily positive aspects, the composer of electronic art music remains in no immediate danger of being smothered by the hazards of social success.

Chapter 2

Music and Altered States of Consciousness: An Overview

Jörg Fachner

Altered states of consciousness

> Our normal waking consciousness, rational consciousness as we call it, is but one special type of consciousness, whilst all about it, parted from the filmiest of screens, there lies potential forms of consciousness entirely different. (James 1902, p.228)

The term 'altered states of consciousness' implies that there is a consciousness that is unchanged, or 'normal'. Tart, as well Dittrich (1996) or James (1902) discuss consciousness as a complex psycho-physiological system of states whereby our so-called 'normal' consciousness is only a specific construction in the sense of a 'specialized tool' for everyday purposes (see Tart 1975, p.3). With this tool, we find orientation in our social and physical environment but consciousness may be intentionally changed and altered by various influencing factors. According to the 'Thomas Theorem', there are no altered states of consciousness: 'If men define situations as real, they are real in their consequences' (Thomas 1927). There is a continuous flow of changing situations and situative definitions of persons in various contexts where intensities of conscious states take changing forms dependent on the individual's attention, intention and situation, as well as his cultural background.

Nevertheless, everybody experiences altered states of consciousness; that is, in a waking but altered state, we are aware of changes that may be observed by others as well (Roth 1994). Tassi, from a neuropsychological stance, differentiates between, on one hand, 'physiological states of consciousness' depending on spontaneously changing levels of vigilance, arousal and biological rhythms, and on the other, intended and therefore 'evoked states of consciousness' induced by psychotropic drugs, meditation, sensory deprivation, etc. (Tassi and Muzet 2001, p.185). This notion of a personal intention to evoke altered states of consciousness positively stresses the voluntary character of an induced change, but disregards states that are changed because of pathology or traumatic events. Dittrich further differentiates between sleeping and waking consciousness and coins the term 'altered states of waking consciousness' to distinguish 'states of consciousness in sleep as e.g. REM dreams or related psychic activities' (Dittrich 1996, p.1). To distinguish a normal waking state from an altered state of consciousness Glicksohn (1993) discusses personal modes of meaning during altered state cognition and stresses that altered states of consciousness are primary cognitive events. He denies a definition that reduces altered states of consciousness to vigilance changes only. An altered state of consciousness is 'any mental state...recognized...as representing a sufficient deviation in subjective experience...from certain general norms... during alert, waking consciousness' (Ludwig in Glicksohn 1993, p.2).

Ludwig (1966) describes the following 'general characteristics of altered states of consciousness': alterations in thinking, disturbed time sense, loss of control, change in emotional expression and body image, perceptual distortions, change in meaning or significance, a sense of the ineffable, feelings of rejuvenation and hypersuggestibility.

Dittrich (1998), in his international comparison of altered states of consciousness, finds that independent of the stimulus, there are five core experiences of altered states of consciousness: Oceanic Boundlessness (OSE), Dread of Ego Dissolution (AIA), Visionary Restructuralization (VUS), Auditive Alteration (AVE) and Vigilance Reduction (VIR).

Measuring instruments and cartography of altered states of consciousness

Cartographies of the variety of human experiences (Fischer 1971; Fischer 1976; Scharfetter 1995) and topographies (Grof 1993) of altered states of consciousness have also been suggested for scientific and therapeutic purposes. Fischer maps deviations from 'normal' conscious states and

divides them into a continuum of ergotropic (exciting) and trophotropic (damping) states.

> Varieties of conscious states mapped on a perception–hallucination continuum of increasing ergotropic arousal (left) and a perception–meditation continuum of increasing trophotropic arousal (right). These levels of hyper- and hypoarousal are interpreted by man as normal, creative, psychotic and ecstatic states (left), and Zazen and samadhi (right). The loop connecting ecstasy and samadhi represents the rebound from ecstasy to samadhi, which is observed in response to intense ergotrophic excitation. The numbers 35 to 7 on the perception–hallucination continuum are Goldstein *et al.*'s (1963) coefficient of variation, specifying the decrease in variability of the EEG amplitude with increasing ergotropic arousal. The numbers 26 to 4 on the perception–meditation continuum, on the other hand, refer to those beta, alpha, and theta EEG waves (measured in hertz) that predominate during, but are not specific to, these states. (Green, Green and Walters, cited in Fischer 1971, p.898)

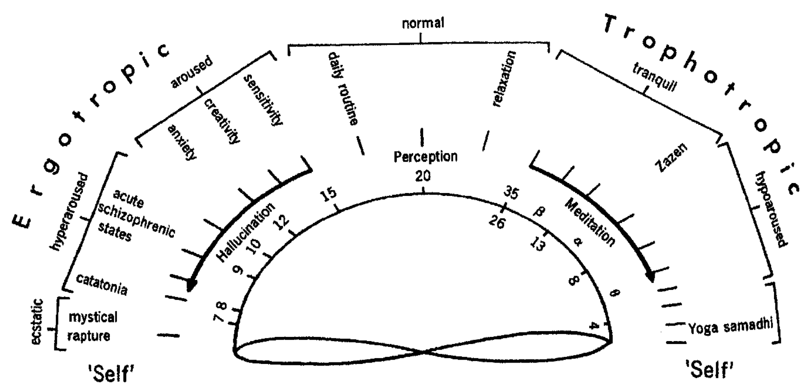


Figure 2.1 Varieties of consciousness states according to Fischer (1971). Reprinted with permission from Fischer, R. (1971) 'A Cartography of the ecstatic and meditative states.' *Science 174, p.898. Copyright © 1971 AAAS.*

Fischer writes[1]: 'The mapping follows along two continua: the perceptive hallucinatory continuum of increasing central nervous (ergotropic) excitement, and the perceptive–meditative continuum of increasing (trophotropic) damping' (Fischer 1998, p.48). 'Along the two continua, the sensory/motoric ratio increases. This means: the further you go along one continuum, the less will it be possible to verify the sensory element through random motoricity.' (Fischer 1998, p.51)

Psychometrics

Interview manuals and tests have also been designed for a psychometric evaluation of the experience of altered states of consciousness: Phenomenology of Consciousness Inventory (PCI) by Pekala (1991); 5D-APZ (questionnaire on abnormal psychic states) by Dittrich (Dittrich 1996; Dittrich, Lamparter and Maurer 2002); Stanford Hypnotic Susceptibility Scale: form A+B+C (SHSS: A–C) by Weitzenhoffer and Hilgard (1959; 1963); Harvard Group Scale of Hypnotic Susceptibility (HGSHS) by Shor and Orne (1962; 1963); and during some drug investigations the Subjective Drug Effects Questionnaire (SDEQ) by Katz, Waskow and Olsson (1968) and Waskow, Olsson, Salzman and Katz (1970) has been used.

Trance

Rouget, in his groundbreaking book *Music and Trance: A Theory of the Relations between Music and Possession*, differentiates between trance and ecstasy. For him, 'Trance is always associated with a greater or lesser degree of sensory over-stimulation – noises, music, smells, agitation – ecstasy, on the contrary, is most often tied to sensorial deprivation – silence, fasting, darkness' (Rouget 1985, p.10). Table 2.1 lists the subcategories and characteristics for both altered states of consciousness types.

Rouget's definition serves as an example for the fact there are many different and, in part, contradictory definitions of the term 'trance' (from the Latin *transire* for 'passing through') or 'ecstasy' (from the Latin *exstasis* for 'to be out of one's head') in the literature (Meszaros, Szabó and Csako

1 Author's translation from German

Table 2.1 Differentiation of ecstasy and trance according to Rouget 1985, p.11

Ecstasy	*Trance*
Immobility	Movement
Silence	Noise
Solitude	In company
No crisis	Crisis
Sensory deprivation	Sensory over-stimulation
Recollection	Amnesia
Hallucination	No hallucination

Reproduced with permission from Rouget, G. (1985) Music and Trance: A Theory of the Relations Between Music and Possession. *Chicago, IL: University of Chicago Press. Copyright © University of Chicago 1985*

2002; Pekala and Kumar 2000; Rouget 1985; Winkelman 1986). This reflects the difficulties in defining distinct topics of altered states of consciousness, especially when facing altered states of consciousness in the field of music. Trance seems to have a more direct relationship to the body, its functions and vigilance states, while ecstasy seems to be more concerned with mental activity like meditation and contemplation.

Various depths of trance can be observed associated with many motor components: for example, the 'Mevlevi Sema' in Sufi dervishes, which can be distinguished from passive trance (or *enstasis* as defined by Fischer 1971), or trance with few motor elements, as in classical hypnosis (Hess and Rittner 1996a). This passive–active spectrum is reflected in Fischer's cartography of ergotrophic and trophotropic states as outlined above. The trance spectrum reaches from everyday and mini trances, e.g. daydreaming, over-hypnoid trance in autogenous training, or the religious trance of a Tibetan oracle, to obsession trance where for a short period human bodies are obsessed, or possessed, by other beings like spirits or gods (Oohashi *et al.* 2002; Rouget 1977; Rouget 1985). A characteristic of intensive trance and obsession trance in particular is subsequent amnesia, which means the 'obsessed' do not remember anything, and experience deep psycho-physiological personality changes for the duration of the trance. The same phenomenon occurs in hypnotic amnesia.

Various inductive techniques like relaxation, imagination, or motor activities produce an increasing focus of attention on inner processes and narrow down the field of perception aiming at a more intensive introversion with a simultaneous exclusion of external factors.

Trance, music and ritual

Trance during rituals in ethnic ceremonies has been often associated with music. In the late 1960s, Rouget (1985) analysed ethnographies on the use of music and trance and concluded that there is no universal law that determines the relationship of music and trance. Trance is a context-dependent phenomenon relating to the cultural meaning of symbols and action during ceremonies. Every trance occurs in a ritual context and receives its power from the particular music used during the different progressions of such ceremonies. The function of music is to provide atmosphere, to evoke identification processes in ceremony groups and to induce a trance (invocation) or to accompany or to lead a trance. This happens according to cultural beliefs, and therefore music and trance are connected in as many ways as there are cultural beliefs. There are no common features of music causing trance. All trance music varies culturally, no matter whether it is melody (see Rouget 1985, pp.94–9), analysis of invocation songs for certain spirits, or rhythm. 'No rhythmic system is specifically related to trance' (Rouget 1985, p.317).

Rouget differentiates emotional, communal and shamanic trance (Rouget 1985, p.315ff). Emotional trance has the most direct relation to music, because it draws its power out of a high degree of correspondence between words and music, a sophisticated art of poetry and music. To create such a relationship in perfect harmony overwhelms the listener (Rouget 1985, p.25).

In communal trance, music induces or maintains trance through the use of increasing and decreasing rhythms and volume: further, specifically sung religious hymns, songs, spells and formula. 'Music – singing and dancing combined – seems to have the function of creating excitation' (Rouget 1985, p.317).

Shamanism uses specific body techniques as a repertoire of biological methods to establish communication with gods or spirits.

> To shamanize, in other words to sing and dance, is as much a corporeal technique as a spiritual exercise. Insofar as he is at the same time singer, instrumentalist, and dancer, the shaman, among all practitioners of trance, should be seen as the one who by far makes the most complete use of music. (Rouget 1985, p.319)

In shamanic trance the function of music is similar to that in theatre, loaded with symbolic and emotional qualities. Singing as a communication with the audience and as an invocation of spirits transcends the imaginary world of the shaman. It is mostly songs, ceremonial or mundane, which induce trance. As Eliade (1954) points out, the shaman's voice imitates animal, ancestor or nature sounds with an attitude of incantation or is symbolized in the use of falsetto. The shaman goes on his trip to the spirits and gains control over them, incorporating such procedures during the shamanic trance in front of those present at the ritual. Music creates the context, which fosters the onset of trance, regulates the form and process of trance and makes it more foreseeable and controllable. As it is not possible to produce an automatic onset of trance with the use of music and dance, some shamans tune in by taking drugs at the beginning of their trip into the other worlds. This happens both in order to remember their shamanic crisis more intensively and to be more sensitive to any encounters and experiences with spirits, and to maintain control over such processes (Rouget 1985, p.319).

Emotional trance develops out of listening to poems and music, whereby the invocatory character of a guided communal trance and the incantatory music of a shamanic trance act via the corporeal techniques of theatre, music and dance.

In obsession, playing music for the obsessed induces trance. The obsessed has to identify with the culturally mediated, different form of God, to represent this identification during dance and, possibly, to entice the invocated spirit through characteristic movement. During obsession, the spirit incorporates in the body of the obsessed person and reveals itself to other participants, in a ceremonial theatricality, through figurative or mimic dances. Here – much more than in other trance forms – music and dance serve as means of communication between the obsessed, the attendees of the ceremony and the gods. During obsession it is believed that gods or spirits might sing or play through the obsessed (Rouget 1985, pp.35, 103, 105–108).

The most common musical features (see Brandl 1993) during such ceremonies are: continuous accelerations, mostly in tempo and volume; a focused use of accelerando and crescendo (see Rouget 1985, pp.82–86), but also extreme constancy and monotony during ecstasy; long duration (over hours); simple forms with minimal variations and many repetitions; bordun or ostinati; no exact motives but step-by-step progressions; a play around tones often with slow glissandi and a narrow tonal range. Occasionally, there are complex parts and crossings of voices, which do not allow a unifying resolution. A constant timbre, low, pulsating structures, but also sharp high-pitched modulations (suspension, acoustic 'roughness') seem to be appropriate and support trance induction. Acoustic triggers of trance are mostly certain transitory processes and accentuations, as well as slow, constantly increasing and decreasing amplitude curves.

> There is no mystery to it at all…if we must seek for an explanation of this, it might be found in the overriding power of a certain conjunction of emotion and imagination. This is the source from which trance springs. Music does nothing more than socialize it and enable it to attain its full development. (Rouget 1985, p.326)

Hypnosis, suggestibility and trance

The literature on hypnosis frequently uses altered states of consciousness synonymously with trance or hypnosis. But it should be noted that hypnosis in this context is the way into a state of trance while trance defines the altered states of consciousness.

In the discussion of hypnosis, Meszaros *et al.* (2002, p.502) distinguish between 1) hypnotic susceptibility, 2) the hypnotic context and 3) changes in subjective experience. Hypnotic susceptibility appears to be an individual trait and may be determined quantitatively and qualitatively through psychometric tests. The question of whether trance is a state or a personal quality, whether hypnotic susceptibility is accompanied by individual suggestibility or depends on attitudes or factors of state or context, reflects the state–trait discussion in psychology and is addressed in the discussion and research on hypnosis (Brady and Stevens 2000; Kirsch 1997; Meszaros *et al.* 2002; Pekala and Kumar 2000; Pekala and Pekala 2000).

Context influences subjective experience in altered states of consciousness and in connection with these is discussed as influences of set (psychosocial context, personal memories, moods and attitudes) and setting (temporal–spatial, symbolic and physical context) (Eisner 1997; Rätsch 1992b; Zinberg 1984).

Altered subjective experiences may be explored through tests, narrative inquiry, standardized interviews and correlated neurophysiologic changes as accessible through electroencephalograms (EEGs) (see Fachner 2004a). Available EEG studies on hypnosis do not directly address music and trance but analyse individual differences in the trance experience (Brady and Stevens 2000; Crawford 1994; Guttmann 1990; Jaffe and Toon 1980; Sabourin *et al.* 1990). Persons with high hypnotic susceptibility show increased theta activity in frontal brain regions even in rest EEGs (Brady and Stevens 2000; Graffin, Ray, and Lundy 1995), which suggests a cognitive mechanism of selective suppression (inhibition) of certain cognitive functions during trance (Park *et al.* 2002). This is accompanied by a focusing of attention and increased hypnagogic imaginations (Schacter 1977). Hypnagogic states refer to dream states beginning before sleep, while hypnopompic states define the transition from sleep to wakefulness.

Hypnosis and music

Mesmer used music (mostly a glass harp) to stage his demonstrations of hypnosis and therapy sessions (Bowers, 1983). For our purposes of therapy and research here:

1. music in hypnosis may serve as a context factor of limited effect (see above) to support induction and maintenance and influence hypnotic susceptibility (Biasutti 1990; Maurer *et al.* 1997; Meszaros *et al.* 2002)
2. in the debate on susceptibility to hypnosis, music is discussed as an important factor for the ability of absorption (exclusion of surrounding factors and more intensive concentration on imaginative stimuli, e.g. music) in highly hypnotizable persons in hypnosis (Hilgard 1974; Nagy and Szabó 2003; Snodgrass and Lynn 1989; Tellegen and Atkinson 1974);

3. music and post-hypnotic suggestions may be used for therapeutic suggestions, to enhance mood, creativity and artistic performance (Biasutti 1990; Kelly 1993; Mellgren 1979).

Hypnotic susceptibility, context and monotonous drumming

As repetition of simple and monotonous sound and rhythm to induce trance has been discussed, monotonous drumming has become the focus of various experiments. A test group of 29 people without previous hypnotic experience were to be sent on a 'shaman trip' through the underworld, according to Harner (1990), in a dark room for 15 minutes while listening to synthesized monotonous drumming (210 bpm). A comparison of the hypnotic scores (SHSS/B) between verbal induction and monotonous drumming revealed that drums make subjects as suggestible ($r=0.89$; $p<0.001$) as verbal induction (see Meszaros *et al.* 2002, p.506).[1]

In a study based on these findings, Szabó (see Chapter 4 in this book) tested participants' subjective experience with a computer-based content analysis of verbal reports after sessions. He found direct or indirect links to rhythmic activity in the experienced imaginations using drums. In comparison with the same setting without drums, however, the experience had a different quality and rhythm played a noticeably smaller role.

Maurer *et al.* (1997) used Pekala's Phenomenology of Consciousness Inventory (PCI) to test 206 persons who listened to monotonous live drumming prior to or after hypnosis induction for 15 minutes. They were asked to reflect their experience of the last four minutes of drumming with the PCI. These last four minutes are considered as particularly important for trance induction (see Maxfield 1992). An analysis of the Harvard Group Scale of Hypnotic Susceptibility (HGSHS) showed that drumming prior to or after hypnosis induction did not influence objective depth of trance. The subjective depth, however, as measurable with the PCI was more pronounced when drumming preceded hypnosis. Those persons with high

1 'r' is the multiple correlations coefficient, and measures the degree of correlation, here between drums and suggestibility. 'p' is the probability value, here the degree of probability that change of consciousness state is induced by drumming.

scores on both scales (PCI and HGSHS) reported in narrative interviews on their subjective experience of relaxation states and shaman impressions while listening to the drums (Maurer *et al.* 1997).

In a subsequent experiment with 47 inexperienced subjects, Meszaros *et al.* (2002) first determined their susceptibility to hypnosis, and then attempted to influence students' fear of examination with suggestions and relaxing music. He compared the scores of hypnotic susceptibility (HGSHS: A) and the depth of relaxation with a test (Relaxation Experience Questionnaire). He found that persons of high, medium, and low susceptibility to hypnosis had the same experience of relaxation, focused attention, altered consciousness and depth of experience while listening to relaxing music, subsequent suggestions and again relaxing music. However, significant differences ($p<0.05$) between the three groups (particularly between high and medium degree of susceptibility) were found for the factors of imagination/hallucination (see Meszaros *et al.* 2002, p.510). A difference was found between the three groups in their preferences for the hypnotic setting. Highly susceptible persons preferred verbally induced hypnotic suggestion to reduce examination anxiety, whereas persons with low susceptibility tended to opt for relaxation through music. Consequently, context factors appear to be not significant for persons with high or medium susceptibility to hypnosis. In general, however, Meszaros concludes that the context of experiences in altered conscious states deserves particular attention.

Absorption

Snodgrass and Lynn (1989) looked for correlations between persons with high, medium and low susceptibility to hypnosis and their degree of imaginative absorption while listening to highly and less imaginative music. The imaginative quality of music considered important for hypnosis and imagination was first polarized with a rating procedure. A test group of 49 people categorized a total of 12 pieces of classical music as 'highly' or 'less imaginative'. They rated as highly imaginative Stravinsky's 'Danse Infernale' from *Firebird* and Mussorgsky's 'The hut of Baba Yaga' and 'Great Gate of Kiev'; and as less imaginative Handel's 'Sarabande' from the eleventh suite, and J. S. Bach's 'Kleine Fuge für die Orgel in G-moll'. They were also interviewed about their musical preferences and attitude to classical music. Irrespective of imaginative qualities, highly hypnotisable persons reported markedly more absorption than people with low susceptibility to hypnosis. In written reports of imaginative experiences, however, all the respondents revealed clearly higher imaginative performance with highly imaginative pieces compared to less imaginative music. Differences in imaginative performance were found between people with high hypnotic susceptibility while listening to highly imaginative music, but not with less imaginative music. Highly hypnotizable 'fans' of classical music showed significant ($p<0.01$) correlations between absorption and hypnotisability. Absorption scores correlated ($r=0.57$) with attitudes towards classical music. The qualities may also be interpreted as subjective identification performance in the course of the research process. 'It is possible that hypnotizable subjects, relative to low hypnotizables, may see themselves as hypnotically talented and possessing seemingly related abilities such as creativity, imaginative abilities and so forth' (Snodgrass and Lynn 1989, p.51).

Nagy and Szabó (2003) addressed the question of whether personal interest and involvement in music is a characteristic of individuals and determines their musical experience. The test group listened to classical music by Holst ('Venus','Mars'), easy listening by Kitaro, and techno music. Highly involved persons had more trance and altered states of consciousness experience compared to less involved persons who mainly reported memories and relaxation. Following Gabrielsson's (2001) classification scheme of categorizing emotional experience, Kitaro's music produced the most positive emotional statements and Holst produced regression, negative and conflicting emotions, while techno music evoked visual perceptions and movement. Intensity of involvement and musical style has a measurable influence on musical experience in this experiment.

Suggestions and improved musical performance

Kelly (1993) used individually preferred music with positive emotional attributes to couple desired emotional states in hypnosis. As a result of therapeutic suggestions, patients were able to hallucinate certain pieces of music. As a post-hypnotic effect, those pieces were intended to evoke the desired emotional states through an inner hallucination of the pieces of music coupled via suggestion; in the six case studies presented she appeared to have succeeded.

The physician Mellgren (1979) demonstrated in his hypnotherapy research that post-hypnotic suggestions may improve a musician's performance. He suggested to musicians in a light to medium trance that after waking up they would feel lighter and more secure and would play with confidence and inspiration. Prior to and after hypnosis a piece of music was recorded on tape and played to three independent critics without indication of the phase in which the piece was recorded. In 30 out of 36 cases, expert opinion concurred with that of the musician in regard to improved performance after post-hypnotic suggestions.

In 1900, Rachmaninoff was treated with hypnosis because he had a 'creative block'. After suggestions, in light trance, that indicated change and improvement, there followed, after a short period, an extremely creative phase. His piano concerto in C minor is dedicated to the hypnotherapist Nikolai Dahl (Walker 1979). Rhodes appears convinced that hypnosis gives singers, instrumentalists and actors a new personal perspective and better voice control.

Therapy, music and altered states of consciousness

Altered states of consciousness are also used within therapy. Applications of therapy-intended altered states of consciousness with music in single and group sessions are: 1) guided imagery while listening to music, 2) trance inductions with voice and instruments in receptive and/or active form, and 3) combinations of hypnotic techniques and music.

The unconscious, dreams and music

Walker (1979) reports compositions by Schumann, Stravinsky and Tartini that were heard by those composers in dreams and written down after waking up. Some compositions, however, were created after more or less chance events in the lives of Schoenberg, Haydn, Mahler and Manuel de Falla. Such occurrences caused a 'subconscious motivation' to process them creatively (Walker 1979). Diaz de Chumaceiro (1996) discusses the sudden and unintentional emergence of melodies with or without memories of texts on the background of Freud's 'Psychopathologie des Alltagslebens' (Freud 1904). Musical memories appear to emerge out of the subconscious in certain contexts and may be useful starting points for psychoanalysis or even keys to repressed complexes. For processes of transference and counter-transference in particular, the subconscious of both people involved in a therapeutic relationship may trigger memories, so that for example the therapist, in talking to the client, feels reminded of a song and realizes that this song is of specific relevance to the dialogue situation or the patient's state (Diaz de Chumaceiro 1996).

Coma, music and consciousness

Music also appears to be a successful way of entering into contact with patients with brain injuries or in coma. A characteristic of coma is unconsciousness. Nevertheless, the ability to feel and perceive and to distinguish – although to a smaller degree – (see Jones *et al.* 1994) acoustic stimuli remains possible; but the cognitive powers of the waking state are almost eliminated. Coma patients experience sounds on an intensive ward like a dream, but in a differentiated, psycho-emotional way, as may be seen from the following description: 'The sounds of the computer were ship sirens, the noises of hemofiltration were marching soldiers' (Gustorff and Hannich 2000, p.29).

Aldridge, Gustorff and Hannich (1990) describe music therapy with a comatose patient on an intensive care ward. For the duration of music therapy all unnecessary sounds of the ward were reduced. Soft, empathic, wordlessly phrased singing in the rhythm of a patient's pulse and breathing sought access to him and succeeded in guiding him out of the comatose state. The therapists observed changes in heart frequency (slower at the beginning, then accelerating), deeper and slower breathing frequency, and an acceleration (desynchronization) of EEG waves from slower to quicker frequencies, in addition to small hand and head movements after the onset of therapy.

The comatose state is possibly also a changed state of consciousness that represents an adaptation of the organism to its environment after trauma. Music therapy permits the evaluation of the remaining perceptive abilities of patients with serious brain injuries (Herkenrath 2002). Traditional oriental forms of music therapy consider trance as an important aspect of the healing process (Tucek, Auer-Pekarsky, and Stepansky 2001).

Music, relaxation and imagination: Guided Imagery in Music (GIM)

Helen L. Bonny (1975; Bonny and Savary 1973) developed a concept that uses music and guided altered states of consciousness for therapy purposes. Working at the Maryland Psychiatric Research Center in Baltimore, US (with Stanislav Grof, among others), she combined a music programme – empirically developed from the Baltimore research project of psychotherapy ('psychedelic therapy') based on hallucinogens (e.g. LSD) (Bonny and Pahnke 1972; Grof 1994) – with the technique Guided Affective Imagery ('Katathymes Bilderleben') in the sense of a guided imaginary trip designed by H. C. Leuner (1974; Leuner and Richards 1984). The programme consists of introductory deep relaxation, concentration exercises to focus attention, and a subsequent client-specific music programme – mostly classical music on tape – intended to produce free or guided associations, images or daydreams; the client reports these either immediately or subsequently in discussion with the therapist who then asks pertinent questions. Such 'self' encounters and imaginings by patients are interpreted on the basis of Freud's concept of the mental apparatus, individual maps of experience, or Fischer's cartography. While Grof developed a concept of ergotropic trance induction, the access proposed by Bonny was more in the nature of a trophotropic trance (see Bonde 1999).

A further important reference was Jung's theory of archetypes for the interpretation of induced imaginings (Short 1997). Music is used to find access to subconscious or repressed emotional complexes of the psyche or to transpersonal experiences that give the client a new perspective on his problems. Music serves here as a projection technique that stimulates the inner world of images (see Bush 1988, p.219). Although the music is selected specifically for each client, GIM therapists use a standardized catalogue of classical music with individual works that in the course and empirical development of this approach generate characteristic imaginings to be used almost as tools in practice (for further details see Grocke 2005)

Sound trance

At the beginning of the 1980s some experienced music therapists in Germany perceived a growing interest in the effects of music from outside Europe and started experimenting with trance-inducing effects of monochromatic sounds of the monochord, gong, didjeridoo and sound bowl

(Bossinger and Hess 1993; Hess and Rittner 1996a; Strobel 1988; Timmermann 1996).

The function of music in therapy from this perspective is to induce, control and withdraw the sound trance as an altered state of consciousness (Hess and Rittner 1996b). Music serves not only to induce altered states of consciousness but also to 'maintain and structure them in order to open the healing potential of trance states for the therapy process' (Bossinger and Hess 1993, p.239).

> In musical psychotherapy with sound trance, music...is effective in two directions: (i) physiologically stirring (ergotropic) towards ecstasy by intensified rhythm in the field of perception...or (ii) physically calming and internalizing (trophotropic) towards enstasis with reduced field of perception and focusing via monochromatic sounds. (Hess and Rittner 1996a, p.401)

Altered states of consciousness may be induced by live or recorded music, but also by free improvisation in a corresponding ritual context (Bossinger and Hess 1993). Rituals provide a structure to the suggestive context of set and setting and 'open the biological door' (Hess and Rittner 1996b). A perspective of the self that has possibly been changed through such an experience may enhance consciousness beyond the horizon of everyday consciousness and trigger healing processes. The experience of (partial) loss of control or reduction of affective control during sound trance may stimulate effective therapeutic experiences and creative resolution processes with a long-term pain-reducing effect (Risch, Scherg and Verres 2001). 'The tremendous trance experience then has the function of a deposit or implant, with a marked and structure-giving effect' (Haerlin 1998, p.233). Haerlin sees sound as an inductive background for the spontaneous productions of the subconscious. For interpreting imagery and experiences, mostly psychoanalytical explanations are used, particularly those by Jung, concepts of Grof's perinatal matrix and also Wilber's transpersonal psychology (Haerlin 1998).

The therapist strives for a 'non-conventional, healing state of consciousness' (Haerlin 1998, p.238) in single or group sessions with sound instruments (sound bowls, gongs, monochord, etc.) and pulsation instruments (drums, rattles, etc.). Timmermann (1996) underlines the significance of a monotonous repetition of sounds as a core element of trance induction. The duration of sounds, taking their effect on a client, appears to be important for trance induction. According to Arrien, 'most individuals need 13 to 15 minutes in order to be influenced or carried away by drums' (Haerlin 1998, p.239). Haerlin writes that the main effect of trance-inducing instruments is the 'induction of an empty trance matrix that reduces the noise of thought and more or less suspends the normal and pathological frame of beliefs and references' (Haerlin 1998, p.240).

Efforts to base trance on the sounds of instruments alone deny the influence of set and setting, i.e. the uniqueness of situation and context, of the personality and history of the receiving client and also the specific social situation of the persons involved in the therapeutic process and their attitudes. 'Instruments are useful only if they constitute musicalized and rhythmicized relation, or if they prepare contact' (Haerlin 1998, p.223). From a psychodynamic perspective, Strobel (1988, p.121) writes: 'Strictly speaking, it is not only the sound, but the therapist via the sound who affects the client, and the client re-influences the therapist with his responses.' In the patient–therapist relationship, the 'unspecific trance effect' (p.134) of the sound has a bridging effect. Dependent on the type of instrument, the 'sound archetype...without sharply delineated significance area' (p.122) as guiding 'analogy between the themes of the experiencing subject and the physical sound phenomena' (p.124) in the 'sound-guided imagination' (p.121) causes the altered state of consciousness of an 'inner attention' (p.127), a 'meditation accompanied by the therapist'. Not only instruments but also the voice as the primary expressive form in humans may induce trance, and may enchant a client – as of Odysseus by the sirens (Rittner 1994; Rittner 1996; Timmermann 1996).

Fachner and Rittner (2004) made an explorative attempt to represent such interdependencies of set and setting, sound and trance through electrophysiological correlation in the topographic spontaneous EEG. They opted for a trance induction with a body monochord in the context of a group ritual. In comparison with uninfluenced rest, they found individual, but not necessarily induction-specific, changes in spontaneous EEG. Trance reactions to sound were seemingly more determined by the person's different hypnotizability as measured with Pekala's PCI than by sound alone. The low hypnotizable participants exhibited an ergotropic reaction with an overall desynchronization of the EEG marked with right fronto-central increase of beta-II waves. The high hypnotizable participants exhibited a trophotropic reaction, marked with a synchronization of EEG in left parietal-occipital brain regions.

Electrophysiological studies of music-related altered states of consciousness

EEG has become established as a measuring instrument in neurology, psychiatry and consciousness research. In neurology, it serves as an indicator of epilepsy, brain cancer and damage of cerebral lobes (Niedermeyer and Lopes de Silva 1993). In psychophysiology, it is sensitive to personality factors, linkable to psychological test batteries and is interpreted as a somatic indicator of psychological processes (Becker-Carus 1971; Empson 1986; Hagemann, Naumann *et al.* 1999). Because of the time-locked occurrence of EEG, it has been used to show cerebral changes of music perception and experience compared to rest. Therefore, we have a dynamic indicator that is sensitive to personality, situation and cognitive cerebral strategies and also shows inter- and intra-individual differences to music perception (Petsche 1994).

Results of an EEG experiment are mostly shown in a distinct brainwave pattern exhibiting wave ranges like alpha (α), beta (β), theta (ϕ) or delta (δ). Such topographic activation patterns differ on frequency ranges. This is an important feature of the EEG, because dominant brainwave frequency ranges represent arousal and vigilance states, that represent different consciousness aspects of the measured experience (see Fachner 2004a).

Slow delta waves dominate in dreamless deep sleep; theta and slower alpha waves increase in changed consciousness states like meditation (Kohlmetz, Kopiez, and Altenmüller 2003; West 1980), music and dance-induced trance (Oohashi *et al.* 2002; Park *et al.* 2002), or with various psychedelic drugs like LSD, mescaline and cannabis, but are also present in falling asleep or waking-up states (Schacter 1977). The quicker alpha and beta waves are dominant in waking consciousness. Hans Berger, who discovered EEG, identified coffee as a beta wave booster (Berger 1991). It is hoped that by understanding fast waves, we will begin to answer the question of how processes of consciousness are constituted physiologically (Lehmann *et al.* 2001; Tassi and Muzet 2001).

Hypnotizability, laterality and music

Wackermann *et al.* (2002) studied the differences between states of beginning sleep, a monotonous visual and acoustic 'Ganzfeld' stimulation (waterfall rushing on both ears and red light stimulation on both eyes without other visual percepts), closed eyes and sleep itself. The 'Ganzfeld' stimulation produced a slight acceleration of alpha frequencies. In beginning sleep, time intervals were assumed to be longer, compared to waking state and 'Ganzfeld' stimulation. Asked for subjective experience and imaginations, the test group reported mostly visualizations connected with water or similar liquids (Wackermann *et al.* 2002, p.132).

Meszaros differentiated according to hypnotizability and interpreted the test group's EEGs for differences in hemispheres; he described a primarily right-hemispheric, parieto-temporal EEG reaction of the alpha and beta band in highly hypnotizable persons. He concluded that right-hemispheric changes were to be expected in the 'mainly emotion-focused hypnotherapies' (Meszaros *et al.* 2002, p.511).

Brady and Stevens (2000) tested the variability of individual suggestibility in persons with high, medium and little susceptibility to hypnosis with a presentation of two slightly different notes and frequency--modulated 'pink noise' ('binaural beats'). Both notes – heard via earphones – make a rhythmic pulsation perceivable. Depending on the frequency combination, these rhythmic sounds have a relaxing or stimulating effect on a listener and consequently are experienced as an altered state of consciousness. The inventors of this Hemi-Sync technology aim at a synchronization of both hemispheres and use it for therapeutic purposes (Atwater 1995). In five of the six examined subjects, the EEG shows an increase of frontal theta waves in the brain while they listen to music. The sound-induced altered states of consciousness produce increased hypnotizability in persons with medium and low suggestibility.

Trance and obsession

Park *et al.* (2002) discovered changes in the EEG of a Korean Salpuri dancer during rest, listening to music, and trance memory. They found EEG differences between a remembered trance state of dance and music perception. The memory of an ecstatic trance passage in dance produced – in comparison with rest – significant frontal increases of deep alpha frequencies (8–10

117) and frontal–occipital theta increase. In comparison with rest and listening to a piece of pop music (Celine Dion's 'The Power of Love'), the frequency and amplitude of high alpha frequencies rose significantly (10–12.5 Hz) over the entire cortex, while 9.5 Hz was identified as the global top frequency in rest and dance memory, with an increase in amplitude energy during the dance memory. While the subject listened to music, the main frequency rose to 10 Hz and high beta frequencies increased. The lower alpha band (8–10 Hz) is related to the continuity of attention processes, while the upper alpha band represents differentiation powers and memory processes (Klimesch 1999; Krause *et al.* 1999). While the dancer recalls his state, he directs attention to this experience, whereas in music he differentiates and compares structurally. Park assumes that the Salpuri dancer 'reaches the altered state of ecstatic trance via suppression of frontal cortex functions and activation of sub cortical functions' (compare Park *et al.* 2002, p.961); accordingly, trance is characterized by theta frequencies (the dominance of which in the EEG suggests such activation).

Neher (1962) claims that Obsession Trance and its phenomena resembling those of epilepsy in ceremonial drumming are causally evoked by drumming mainly with bass frequencies and certain frequency patterns. He calculates the number of drumbeats and their frequency per second as analogous to the EEG frequency (oscillations per second). Neher hopes to prove an 'auditory driving' in his laboratory experiments with the same frequency range as the epilepsy-producing effect of 'photic driving' (through rhythmic light emissions). But his findings show (which he hasn't acknowledged) that the possible drum frequencies are in the theta range (4–8 Hz), while the 'photic driving' is in the alpha range (8–13 Hz) and for technical reasons this is almost impossible to achieve with drums (compare Neher, 1962, pp.153–4). Rouget (1985, pp.167–183) considers such explanations of a 'trance mechanism' as incomplete since the experimental laboratory situation for trance cannot be compared with the real situation.

Oohashi *et al.* (2002) was the first to produce a naturalistic EEG image of an Obsession Trance ('Kerauhan') in a ceremony in Bali with a radio system, specific software and attached electrodes. At the culmination of the ceremony, one test participant fell into trance (see Oohashi *et al.* 2002, p.438). In the trance phase analysis they found a distinct increase of theta and alpha frequencies.

In summary, theta increases – specifically in frontal brain regions – and alpha changes may be physiological indicators of a trance state.

Trance in music performance

Kopiez *et al.* (Kopiez *et al.* 2003) analysed a piano performance of Erik Satie's *Vexations*, which has a duration of almost 29 hours, for tempo and loudness. The entire performance was observed and recorded. Parallel to the music, an EEG was taken at the back of the pianist's head (P3+P4), and he was interviewed in the short intervals and after the performance.

The pianist reported that he was rather alert at the beginning but went into trance, and towards the end, a tired state. After fourteen hours, at the beginning of the trance, the pianist experienced a confusing reality comparable to a dream; he lost control of his body, had extra-physical experiences, the musical piece dissociated into single tonal groups, errors occurred more frequently, sections were mixed up, and improvisations sprang up. For about a two-hour period (19–21 hrs), he felt very tired. After 25 hours of performance, in a permanent slight trance, time seemed to pass more slowly, he varied themes and sequences of the piece freely and forgot what he wanted to play. Ultimately, he believed that he underwent a Buddhist rite, thinking that he might have been given a new name at the end of the performance, and ended the music as if obeying an inner command (Kohlmetz *et al.* 2003).

An analysis of performance data revealed that these states influence the parameter's volume and tempo. They were stable for the first 14 hours; in trance, the tempo was increasingly accelerated, and uncontrolled changes in volume were noticeable at the end of the trance, after approximately 19 hours. However, acceleration was not equivalent with volume changes, and faster play did not necessarily mean higher volume. Volume was reduced gradually over the first 18 hours and became more dynamic at the end of the trance. Accordingly, the fluctuating de-synchronization and disintegration of tempo and volume increased continuously, and the pianist's exhausted state was marked by consistent instability and reduced control (Kopiez *et al.* 2003). A comparison of waking and trance phases, however, did not show any significant change in the medium duration of a chosen sequence. Sensory-motor performance remained astonishingly stable in trance. Probable explanations for this are free neural oscillators that, in interaction with the circadian rhythm, permit reliable timing for motor functions but themselves are influenced by altered states of consciousness. As known from studies on meditation, the trance phase in EEG is marked by synchronization and a significant increase in the frequency of low alpha waves (8–10 Hz) and also an increase of lower beta waves (13–15 Hz). Delta waves increased continuously over the entire performance. Increases of alpha and delta waves were observed mainly in the left posterior hemisphere around the EEG measurement point P3, which suggests a reduction of left hemispheric in favour of right-hemispheric brain functions (Kohlmetz *et al.* 2003).

Summary

Music and altered states are connected in various ways concerning context, personal set and socio-ecological setting, and cultural beliefs. Altered states of consciousness are induced or evoked for various purposes. We might divide these into two broad categories of socio-cultural and individual reasons for altered states of consciousness. There are ritualistic, therapeutic and hedonistic meanings but a clear distinction is not possible because altered states of consciousness depend on the depth of involvement, experience, meaning and purpose according to specific contexts.

Individually differing degrees of hypnotizability seem to be a factor determining personal onset time, quality and depth of altered states of consciousness. In hypnosis and suggestion, music may serve as a contextualizing factor, helping focus on the music-related induction that absorbs and denies external objects. Induction-specific vigilance changes, combined with the intensified, narrowed or broadened focus of attention, may result in a different emotional profile of meaning experienced with music and its symbolic, metaphoric and physical content.

Still the question remains open as to whether there is a 'trance mechanism' directly related to music. Cognitive processing of music changes its modes of awareness of musical elements during altered states of consciousness. Rhythm, pitch, loudness and timbre and their sound staging in the perceptive field of a person seem to culminate in a certain sound that – corresponding to the cultural cognitive matrix – induces altered states of consciousness. Repetition, long duration, monotony, increase and decrease of patterns, volume and density, high pitch and frequency ranges, rescaling of

intensity units are observed with some trance phenomena but there is no clear causal explanation for the induction of trance. The connection of time and space perception alterations and the resulting changes of music perception are important. Therefore, rhythm remains the target of discussion for altered states of consciousness induction.

Music might be visualized in certain imagery systems, which become more vivid when focused intensively or might become experienced 'as if' it happens in the real world, mediated and evoked via an increased amount of cross-modality. Intensification of emotional qualities and meaning, change of cognitive processing (frame of reference) and enhanced cross-modal perception promotes a 'unity of the senses' experience, which is dependent upon cultural context. It might be a psycho-physiologic mode of uncensored sensual processing, a broadened attention span for intensively focused objects of the mind and through enhanced imagination and visualization experienced in a form of synaesthesia.

The holistic experience of music can only be a personal event and is by itself ineffable. To adapt all the necessary ingredients for the individual to transcend his or her own being demands the art, knowledge and experience of a guide. Some reported experiences, as in obsession trance, alter internal perception of loudness or acoustic relations and do not fall readily into the categories of natural science explanations.

Chemically induced altered states of consciousness (see Chapters 7 to 11) together with music, can be studied as psycho-physiological models of altered states of consciousness and might help us to understand altered states of consciousness processes *in vivo*. Electrophysiological studies have revealed theta changes as indicative for altered states of consciousness. Music and drug action are processed in the same limbic brain areas, a region associated with low-frequency generations. The question of whether gamma frequencies might indicate altered cognitive modes needs more research.

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Higher Dimensionality

We find ourselves in a universe that is at least four dimensional. To be sensible to us an event must have a displacement in both space and time. A piece of paper having only two or three dimensions, that is having no thickness, or existing for an imperceptibly short time, could not be part of our universe. Although we commonly think in terms of a three dimensional reality, this must be at least a four dimensional reality, even if time does appear to have a different quality to our perception. We often forget to include time in our conceptions because we take simultaneity for granted; we assume that things exist in the same time frame and that they will persist.

Suppose for a moment that there were a fifth dimension that we were unable to perceive with our senses. Suppose also that all phenomena were five dimensional. How could five dimensional phenomena appear to our four dimensional perception? A point from the fifth dimension would not be perceivable in four dimensions. This may explain why fundamental particles or quarks cannot be observed singly. Higher dimensionality might also solve other problems in physics like parity violation and certain properties of the vacuum. A line from the fifth dimension would appear to us only as a point. A five dimensional surface would appear as a line in our reality. A five dimensional "solid object" would be perceived as a surface, and the things which appear to us as solid objects in our reality would be the manifestations of true five dimensional solids for which we have no name. Now, points, lines, surfaces, and "solid objects" do not actually exist in this fifth dimension anymore than points, lines, and surfaces exist in ordinary four dimensional geometry, except as idealizations.

It therefore follows that if there were five dimensions, all the things we perceive as existing solid objects in "our reality" are merely the way that five dimensional objects appear to us. This may seem a nonsensical complication, but it was raised to demonstrate that we might be living in a five dimensional reality, yet be unable to perceive it as such. What would be the consequences if this were so? It would actually explain a great deal beyond some obscure problems in fundamental physics. Firstly, it would explain why we seem to live in a world of effect rather than a world of cause. We seem only able to measure effects. We have no idea how anything causes anything else in a final sense. All our so-called physical laws are merely catalogs of effects we have come to expect. Our power to actually cause events is illusory. We merely arrange things to make certain effects more probable, but we can't get hold of the root causes themselves. This is hardly surprising if we are unable to interact with the full dimensionality of an event. As the Kabbalists have said, the causal world exits as a hidden dimension.

A fifth dimension to which the psyche had some limited access could explain all magical and occult phenomena without exception. Information moved through a fifth dimension could

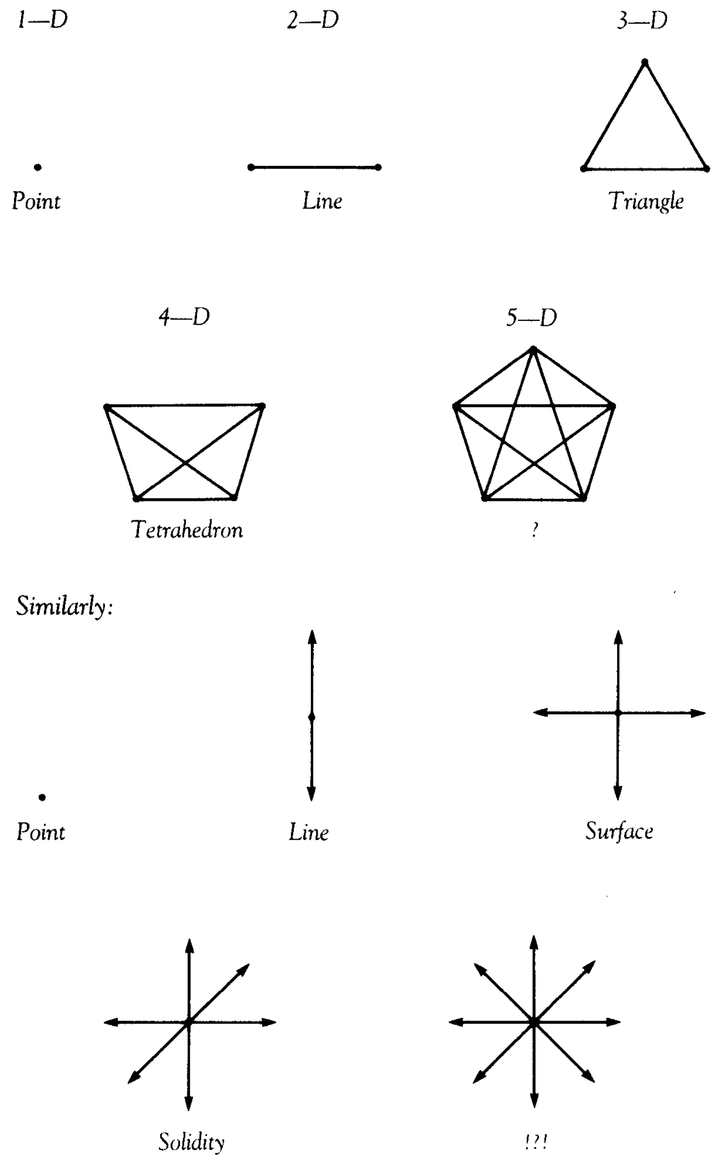


Figure 1. The evolution of forms through various dimensional levels.

manifest at any point in ordinary time or space. Telepathy, necromancy, clairvoyance, and precognition are explained at a stroke. Transformations caused in the fifth dimension would appear as effects in ordinary reality; telekinesis and all forms of spell casting and enchantment are thus possible. Trying to make things happen in the ordinary world by arranging for effects is a laborious and time consuming business. If we could gain access to the causal world, infinite power and possibility might be available at a whim, if we were still interested.

The purpose of this study is not to rehabilitate science and magic, but to demonstrate that there are alternatives to irrationalism when it comes to erecting the theoretical basis of a magical *modus operandi.* If science ever did begin to make serious enquiry into magic, the result would be disaster. Humanity has proved itself totally incapable of handling even a moderately dangerous substance like plutonium with responsibility. Imagine what it would do with machine-enhanced sorcery or even simple, reliable telepathy. It is in the interests of the survival of the species that occultists continue to ridicule and discredit their own arts in the eyes of orthodox science.

The author has a certain preference for paradigms of higher dimensionality, if only because the evolution of the simplest regular forms through increasing dimensionality leads one to profoundly familiar symbols shown together in figure 1.

Most magical paradigms envisage a total universe made up of three realities.

Primary Reality: The Void, Chaos, Ain Soph Aor, God, the Empyrean, Universe B, the Meon, The Pleroma or Plenum, Mummu, the Nagual, the Archetypal or Formative World, the 5th Dimension, Cosmic Mind, the Hologram, the Night of Pan, Hyperspace, Acausality, Quantum Realm.

Second Reality: The Aethers or Astral, Probability, the Gods, Morphic Fields, the Shadow World, the Side, the Wind, the Astral Light, Potentia, Aura, Middle Nature.

Tertiary Reality: The Physical or Material World, Malkuth, Universe A, the Tonal, the 4th Dimension, the Body of God, the Holograph, Causality.

And it is a further characteristic of all magical paradigms that there is an equivalence between the microcosm and macrocosm. As above, so below. Thus man contains a part of primary and secondary reality in addition to his physical being.

CHAPTER 12

THE ORIGIN OF CONSCIOUSNESS

A hundred years ago, when the psychologists still took introspection seriously, William James wrote, "The universal conscious fact is not that 'feelings and thoughts exist,' but 'I think' and 'I feel.' "[1]

The conscious *I* is the most immediate thing we experience. It precedes all other experiences. It is the point from which each of us as a modern human being sees the world that created us.

But where does the *I* itself come from?

In 1976, Julian Jaynes, of Princeton University, proposed a shocking theory: Three thousand years ago, man had no consciousness, Jaynes asserted in *The Origin of Consciousness in the Breakdown of the Bicameral Mind.*

"If our reasonings have been correct, it is perfectly possible that there could have existed a race of men who spoke, judged, reasoned, solved problems, indeed did most of the things that we do, but who were not conscious at all."[2]

The great epics of ancient Greece, Homer's *Iliad* and *Odyssey*, are about people who do not possess consciousness but are as if automatons who act on the basis of the gods' speech through them. But the *Odyssey*, especially, was written during the period in which consciousness began to mark human life: The origin of consciousness is a historical process, which can be traced in the evidence surviving from the oldest civilizations, Jaynes claimed.

Consciousness, he explained, is not at all so essential to a human's functioning as is thought. Consciousness is a relatively new invention: a historical phenomenon. The notion of the *I* is part of the historical product that consciousness constitutes. Consciousness and the notion of the *I* were created historically and can therefore be changed historically.

Julian Jaynes's theory aroused attention—and opposition. Both because the theory changes our understanding of consciousness and because it changes our understanding of a whole range of events in historic time. Jaynes reinterprets the history of mankind, with the origin of consciousness as a central theme.

His idea is as follows: In the very old days, more than three thousand years ago, no consciousness existed, no notion of the *I*, no idea that people had a mental space inside them. This did not mean there were no social structures, experiences, or language. But it meant that the perception of man's actions was completely different: People acted at the gods' command, not because of their own urges. Emotions, desires, and decisions were the result of the gods' working through man: They were caused by divine intervention.

According to Jaynes, the human mind was bicameral—had two chambers, corresponding to the right and left hemispheres of the brain. All the nonlinguistic activity in the right brain half was passed on to the left brain half in the form of voices talking inside people's heads. Just as schizophrenics can hear voices when there are none, these ancients could hear the gods speaking inside them, telling them what to do. Through the bicameral mind, the social order could speak to the individual in the form of divine voices. Nowadays we call such voices hallucinations.

The central difference between this and our own view of man was that there was no independent reflective activity in people's heads: no consciousness and no decisions. The gods—called demons—looked after that kind of thing.

Men had no free will at all in those times; they did not even have will, in our sense. "Men and women were not conscious as are we, were not responsible for their actions, and therefore cannot be given the credit or blame for anything that was done over these vast millennia of time," Jaynes wrote.[3]

But how could this be possible? How could people have built cities, ships, and roads without consciousness? How was man able to function?

It is actually not that hard to imagine, even though the thought does seem strange. Think of a trip through town, using the form of transport to which you are most accustomed and a route you travel almost every day. Think about how the trip takes shape: You move along, you are not much aware of the traffic, but you may be thinking about what you will do when you arrive. Or about the weather this morning, or quite another matter. The actual transport more or less takes care of itself; you have lots of time to let your mind wander while your legs and arms manage the rest. Obviously you are not completely out of touch with the traffic en route, but your mind is on other things. A whole range of functions take place without your being aware of them. Your consciousness is elsewhere.

"Now simply subtract that consciousness and you have what a bicameral man would be like," Jaynes wrote.[4]

Precisely because as a rule we think about something other than what we are doing, our consciousness does not mean much for our normal functioning. After all, if it did, we would not be able to think about anything except what we were doing.

So a human being without consciousness is simply just like us but without an ongoing flow of thought that is about something else. The only difference arises when something unexpected or tricky occurs—e.g., a traffic jam. An individual is then forced to pay attention: be conscious about what is happening and what needs to be done. Conversely, a human being with a bicameral mind has to wait for instructions from the gods: an inner voice that tells him what to do. His experience of life will be expressed not in the form of conscious recollection and reflection but through the voices of the gods from his nonconscious.

One can certainly function without *I*-consciousness. In fact, most of us function most of the time without *I*-consciousness. We just do not know it, because we are not conscious of it while we do so. For if we were, we would not be without consciousness of it: We cannot be conscious of not being conscious. Only the conscious is conscious.

"The gods were at the same time a mere side effect of language evolution and the most remarkable feature of evolution of life since the development of Homo sapiens himself. I do not mean this simply as poetry," Jaynes wrote. "The gods were in no sense figments of the imagination of anyone. They were man's volition."[5]

But in the long run it did not work. In the end, the gods deserted man. "My God has forsaken me,"[6] runs one of the oldest surviving texts from Mesopotamia, "My goddess has failed me and keeps at a distance. The good angel who walked beside me has departed."

There were hard times in the penultimate millennium B.C. (2000–1000 B.C.). Natural disasters, wars, and mass migration led to upheaval and chaos throughout the civilizations of the Middle East. People became acquainted with other races, written language weakened the power of speech, the old wisdom that had been expressed in the speech of the gods had grown too old; the world was being transformed.

The bicameral mind collapsed, and an enormous cultural shift led to the origin of consciousness, according to Jaynes's theory.

The idea of reading the Greek epic poems as evidence of the development of the structure of the human mind is not in itself new; the psychoanalytical tradition has long mooted this view: in Freud, for example, through the myths about Oedipus (Oedipus murdered his father and married his mother) and Narcissus (who fell in love with his own reflection).

In 1949, an explicator of the psychoanalytical tradition founded by C. G. Jung, Erich Neumann, described the *Odyssey* as a key document in our understanding of the origin of consciousness. The *Odyssey* is the tale of King Odysseus from Ithaca, who had made his mark in the Trojan War, most notably by conceiving the hollow horse to smuggle troops into the besieged city. On his way home, he ran into countless difficulties because he had displeased Poseidon, the sea god. Many of these difficulties were in the form of temptations, which Odysseus overcame thanks to his willpower and cunning: siren songs, evil giants, and a seductress who turns suitors into swine.

In the American historian Morris Berman's summary of Neumann's interpretation, we can read, "Again and again, Odysseus experiences the enormous pull of that great unconscious, undifferentiated female power, the desire to melt or merge back into it, to go unconscious, as he once was as a very young infant or a fetus. But what makes him a hero is that he refuses that option. He is not interested in the dark energy of the unconscious, and his 'victory' over this is symbolized by the blinding of the Cyclops, whose eye is the 'third eye' of intuitive understanding."

Berman continues: "With the birth of the hero, which is really the birth of the ego, the world becomes ambivalent. It gets split into masculine and feminine, black and white, left and right, God and the devil, ego and conscious, and this becomes the great drama that all cultures (accordi to Neumann) have to deal with."[7]

But the *Odyssey*, in this view, is still only the tale of the earliest origi of consciousness and the temptations the unconscious subjects it to.

The most precise historical dating of the origin of consciousnes traced by Jaynes to the Greek statesman and legislator Solon of Athe who lived from about 640 to 560 B.C. Solon introduced democracy Athens in the century when Greek philosophy was founded by figur such as Thales, Anaximander, and Pythagoras.

It is known with certainty that Solon used the word *noos* as an expr sion for a subjective mind. One of the dogmas attributed to him b also to many other contemporary Greek thinkers is the famous "Kn thyself"—an expression that makes sense only *if one has an idea of one seen from without.* Seeing oneself from outside is an advanced men operation that presupposes an idea of who one is.

Jaynes finds signs of the origin of consciousness in many civili tions: the Greek, the Indian, the Chinese, and the Egyptian. Of all t remarkable cultural breakthroughs that occurred on the planet once, in many different cultures, about half a millennium B.C., Jaynes's view it is the Old Testament that contains the best text description of the origin of consciousness. There the whole story is t in one go, from the disappearance of the gods to the taking over of t mind by consciousness.

Moreover, the religion of the Old Testament involves *monotheis* Religions with lots of gods correspond to the bicameral mind, whi those with a single God correspond to the conscious mind.

For the really huge difference between polytheism and monothei is not so much superstition, hallucinations, or rain dancing: The b difference is the perception of who the real executor of hum action is.

Prior to the era of consciousness, in the period of the bicamer mind, people did not have free will; they had no will at all, in fact. Aft the advent of consciousness, man was given free will—to a certa extent. The problem of ethics arose, and Moses descended fro Mount Sinai with the tablets containing God's Ten Commandments.

Suddenly there was something to think about: how one ought to ac The hugeness of the contrast between "Know thyself" and moral direc tives on the one hand and the freedom from responsibility of th

bicameral mind on the other are apparent from this passage from Jaynes's book:

"An old Sumerian proverb has been translated as 'Act promptly, make your god happy.' If we forget for a moment that these rich English words are but a probing approximation of some more unknowable Sumerian thing, we may say that this curious exaction arches over into our subjective mentality as saying, 'Don't think: let there be no time space between hearing your bicameral voice and doing what it tells you.' "[8]

The idea that people are happiest when they feel free to act freely, without intervention from the consciousness, can be traced in this ancient quotation.

Translated into the language of this book, the Sumerian proverb would sound thus: "Avoid vetoes—make your *Me* happy." But this involves a dramatic shift in meaning, for nowadays we do not hear the gods (and we lock up anyone who does). So the focus is not on following an inner voice but on acting without too much consciousness and prior reflection.

But the assertion itself—act without conscious consideration—was probably no less absurd to the ancient Sumerians than it is today, if we isolate it from its context and adopt it as a rule of conduct.

During the transformation from the bicameral mind to the conscious mind, a long period of transition occurred, in which the voices of the gods may not have spoken through very many people but many listened to anyone who could still hear them.

"Greek oracles were the central method of making important decisions for over a thousand years after the breakdown of the bicameral mind,"[9] Jaynes writes. The oracle at Delphi, the most famous of them all, consisted of young women who through frenzied mouths and bodily contortions gave answers to the questions put to them. The questions were not trivial but concerned: colonies, war, legislation, hunger, music, and art. Just as remarkably, "The replies were given *at once*, without any reflection, and uninterruptedly," Jaynes writes, then asks, "How was it conceivable that simple rural girls could be trained to put themselves into a psychological state such that they could make decisions at once that ruled the world?"[10]

One may wonder how unschooled the priestesses at Delphi really were. It is said, for example, of Aristoxenus, who was a student of Aristotle and who wrote a biography of the mathematician and philosopher Pythagoras, that "Aristoxenus says that Pythagoras got most of his ethical doctrines from the Delphic priestess Themistocleia."[11] One may also question how categorical were the answers the young priestesses gave. Heraclitus writes, "The lord whose oracle is in Delphi neither speaks out nor conceals, but gives a sign."[12] So the young women may have given answers, but they had to be interpreted before they were of any use. But whatever the details, it is remarkable that Greece could be ruled through consultations at Delphi.

The explanation, Jaynes thinks, is a general pattern in which a common faith is expressed through specially chosen individuals, who can, through rituals and trances, establish contact with powers (in themselves) with which other people are no longer in contact. The whole range of sorcerers, medicine men, oracles, witches, fortune-tellers, and their modern successors express a longing for the contact the bicameral mind had with the gods. As history unfolds, mankind is losing his faith in the chosen few who can still sense the will of the gods. Or perhaps the message is now conveyed in another guise.

The epoch of the bicameral mind came to its conclusion: Man's image of himself had changed—and with it, his view of the divine. The panoply of Greek deities gave way to Christianity, which is the religion of consciousness. "A full discussion here would specify how the attempted reformation of Judaism by Jesus can be construed as a necessarily new religion for conscious men rather than bicameral men," writes Jaynes. "Behavior now must be changed from within the new consciousness rather than from Mosaic laws carving behavior from without. Sin and penance are now within conscious desire and conscious contrition, rather than in the external behaviors of the decalogue and the penances of temple sacrifice and community punishment."[13]

Jaynes does not pursue these considerations of religious history, but the fundamental point is the same as that which arose from a comparison of Judaism and Christianity based on Benjamin Libet's veto principle: Where Judaism affects man's mind from without, through social ceremonies and moral prohibitions, Christianity tries to change the mind from within, by demanding that people have a disposition that is itself capable of exercising the controls formerly located outside the mind, in the social fellowship. Christianity is the religion of consciousness because it makes consciousness—instead of something from outside—the regulator of human behavior.

This suggests a tripartite division of the historical process. First there is a *preconscious phase,* where people do not possess free will but act directly and without reflection upon the gods' commands. A *socially conscious phase* follows, in which free will is regulated via a social contract (the Ten Commandments) pronounced by a human being (Moses) with special abilities to hear God; focus is on the community and ceremonies. In the third phase, a *personally conscious phase,* the relationship between man and God is again internal (as in the preconscious phase) but now is conscious: Free will implies the possibility of sin in mind as well as deed.

Polytheistic religions all belong in the first phase, while Judaism and, in part, Roman Catholicism belong to the second; Protestantism is a pure cultivation of the third phase.

The question, though, is whether the attempts by the Christian tradition to render man totally conscious and transparent can succeed. If Benjamin Libet is right, and consciousness can veto nonconscious urges so they are not implemented in real life but it can never control the origin of urges, man is quite simply not so transparent as Western philosophy and religion since the Renaissance have made out. From the total absence of consciousness in times of yore, the modern era has been an attempt to insist on the absence of nonconsciousness.

Two very important concepts in Jaynes's analysis of the origin of consciousness are those of "I" and "me." An "I" arises at the same time as the idea of a world. When you have a picture of an outside world that you can think about, you can also think about yourself in that world: You can see yourself from without; you can think your way into situations and ask how you would react. The "I" concept is closely associated with seeing yourself from without: having a map of the world where you, too, are present. The "Me" concept, which Jaynes himself admits is unclear compared to the "I" concept,[14] also in Jaynes involves a self seen from without.

In the light of the *I/Me* distinction, we could put things another way: A preconscious person is only a *Me,* whereas a conscious person believes he is only an *I.* Man has moved from a period in which there was only a *Me* to a period where there is apparently only an *I*. In the *Me* period, behavior was controlled by voices, while in the *I* period, consciousness thinks it controls everything.

Once it has arisen, the *I* must necessarily insist that it has control of the person. That is the very idea of an *I*. The idea of an *I* with free will is irreconcilable with a bunch of gods operating through commanding voices. Because then it would not be the *I* doing the deciding.

But conversely, the *I* faces the problem that it cannot explain or necessarily accept all that happens in the person covered by the *I*. The *I* view, which would claim that the *I* supervises and sees through everything, runs into the problem that this is obviously just not the case. Neither the happiness and joy a person can feel nor the hatred and vileness he or she can contain are anything the *I* can explain.

The *I* must necessarily bow and kneel to something greater than itself. But it is a central characteristic of an *I* that this greater thing cannot be the person him- or herself, for that is controlled by the *I*.

The solution is monotheism: the idea that there is one, and only one, God.

The notion of God is the *I*'s salvation when it is confronted with characteristics of the *Me* that it cannot explain: a power that is far greater than the *I* and that operates through every thing and event in the world. Divine intervention can be used to explain everything the *I* cannot explain in the person that the *I* ostensibly sees through and controls.

We can go even further and make the following assertion: The concept of God covers everything about the *Me* that is not the *I*. Instead of acknowledging subliminal perception, nonconscious thinking, and a pile of other activities in a person that the *I* cannot explain, the *I* can say it is not the person that embodies this providence and these abilities: It is a divine principle.

The inability of the *I* to explain the *Me* is thus shielded by the notion of God, a notion that permits an irrationality that the *I* claims does not exist in the person.

Consciousness cannot accept that it does not have control of the person. On the other hand, consciousness has to admit that it does not quite have tabs on everything. Hence monotheism.

Almost every monotheistic religion contains more or less dominant traditions that "heaven is inside you"—that the divine principle is in every man: not just out there but also in here.

In his attempt to summarize millennia of religious thought in *The Perennial Philosophy*, Aldous Huxley emphasizes precisely this God within: "God within and God without—these are two abstract notions, which can be entertained by the understanding and expressed in words. But the facts to which these notions refer cannot be realized and experienced except in 'the deepest and most central part of the soul.' And this is true no less of God without than of God within."[15]

The religions have cultivated the fact that the *I* must necessarily realize there is something that is greater than itself. They have also cultivated a series of methods to help the *I* gain composure toward this something. The religions offer a fellowship to people who wish to cultivate these factors.

One may interpret prayer and meditation, ceremonies and blessings, as contact to this divinity within. But we can go a step further and assert that what the *I* tries to contact via prayer, chanting, and scriptures is the very *Me* that the *I* must consciously deny the existence of.

A very significant part of what Huxley refers to as the "God within" is the aspect of man that consciousness cannot explain. If we claim as much, we can say that the theme of the religions is really a reworking of the theme of consciousness and thus the theme of the *I*: equanimity toward the fact that we are more than we ourselves can know.

There are thus good reasons for taking the experiences of religion seriously; from an atheistic point of view, too, one must say that religions involve something real and genuine that is concerned not merely with a yearning for the simplicity and innocence of the bicameral mind but with a highly contemporary authentic drama: the relationship between consciousness and nonconsciousness in a person. Atheists also have to live with the conflict described by the religions. Religion is far too important for atheists to leave to the religious.

The American Julian Jaynes is far from the only person to have explored the origin of consciousness. German and French *mentalité* historians have studied the history of *I*-consciousness. Their conclusions do not always accord with Jaynes's.

The European studies indicate that establishing consciousness apparently did not go as smoothly as Jaynes claimed it did in his 1976 theory that consciousness first arose about 1000 B.C. Later on, *consciousness disappeared again!*

This occurred in about A.D. 500 and lasted for over five hund years. Morris Berman writes of recent studies of this period: "Hu self-awareness, for reasons not entirely clear, seemed to disappear d ing this time and then mysteriously reappeared in the eleventh cent Behavior during the period A.D. 500–1050 had a kind of 'mechanic or robotic quality to it."[16] The view of crime also changed: "There w virtually no discussion of the issue of intentionality in a criminal act was only the *act* that counted, the overt physical behavior."[17]

The end of the Middle Ages is characterized by the reappearance consciousness, the breakthrough of self-awareness. Berman descri the period around A.D. 1500 in the following remarkable terms: " find a sharp, simultaneous increase in self-awareness and in the qu tity and technical quality of mirror production."[18]

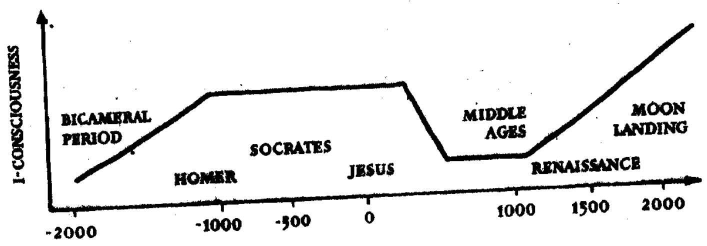
The use of mirrors became widespread during the Renaissance, period imprinted with the rebirth of the individual—the beginning the modern age. Looking at oneself in a mirror, seeing oneself fr without, was a literal communication of self-awareness or *I*-awaren Likewise, books of etiquette began to spread, instructing people in h to behave in the presence of others: how to eat, dress, converse, and general be *cultured*.

It may seem completely absurd to interpret the proliferation of m rors this way. But the mirror is precisely an instrument that allows y to see yourself the way you appear to others. The preconscious pers only saw the world, and his own actions in the world, from within. T idea of comparing oneself to other people presupposes that one c see oneself the way others see one. Mirrors permit that.

(Or do they? In a mirror, we see ourselves *reflected* in two senses: n just optically, but also socially. We do not actually see what everyo else sees, because we see a person who sees no one but himself. It i closed circuit; there is no sociality, as when we look at someone else.)

The French *Annales* school of historians, the German Norbert Eli and many others have explored the peculiar historical detail that t mirror and consciousness go hand in hand. The important thing is course not the mirror in itself; the important thing is the reflecti After all, we can look deeply into a smooth piece of water if we want see ourselves. Mirror technology, like so much other technology, merely a method of ensuring that we ourselves can determine when w want to achieve an effect—in this case, the effect of seeing oursel from without—and not just when there is a calm sea.

The ancient Greek myth about Narcissus, who fell in love with his own reflection, can be read in many ways and has many levels. In the most widespread version today, the myth is about a human being who falls in love with his own reflection and is therefore not interested in the deeply interested and interesting woman, Echo. He thus incurs the wrath of the gods and gets turned into a flower.



Major events in the history of consciousness

In this context we can interpret the myth as expressing the risk inherent in being too absorbed in oneself seen from without—the way others see one. One thereby loses the ability to sense one's needs immediately and directly. Narcissus' problem is not love of himself; it is love of himself in the eyes of others.

With self-consciousness and the mirror and good table manners, a problem arises: A person's sphere of action is no longer limited to what his desires urge and the law permits; suddenly the gaze of others becomes important. The *I* unavoidably gains control, for it is only the *I* that can imagine what other people might be thinking; the *Me* knows only its own impulses.

The British psychoanalyst Donald Winnicot has pointed out that the mother's face is the infant's first mirror. "In individual development, the precursor of the mirror is the mother's face,"[19] Winnicot wrote. Studies reveal that the infant's expression becomes hectic and disorganized unless the mother's face registers emotion when she looks at her baby.

But the infant has no sense of itself. "There is no such thing as an infant," Winnicot asserts in a famous remark. The infant exists only together with the mother or other people. The notion of an "I," an identity, does not appear until the third year of life. The original state of the infant is an experience of nonseparation, nonidentity.

Morris Berman labels this learning of the difference between oneself and other people as "the basic fault" in modern man's view of the world. "Exactly where one comes to consciousness is totally arbitrary; the thing that remains constant is the awareness that 'I' am 'here' and that 'that' (whatever one is looking at, or is outside of one) is 'there.' "[20]

The establishment of a distinction between an *inside* and an *outside* is the trademark of consciousness—and the problem. "Up to this point [in life], all of us feel ourselves more or less continuous with the external environment. Coming to consciousness means a rupture in that continuity, the emergence of a divide between Self and Other. With the thought 'I am I' a new level of existence opens up for us," Berman writes.[21]

It is not a painless process. In 1951, Winnicot suggested that one could interpret children's use of teddy bears as *transitional objects* between the inside and the outside. To smooth the passage between the self and the rest of the world, children use comforters and teddy bears. Later on, more advanced things take over: art, religion, alcohol, pills, and books. The fundamental angst arising from the idea that we are separated from the world is dulled by whatever means we can find.

In his remarkable book *Coming to Our Senses*, Morris Berman employs this childhood separation as the key to understanding why we deny our own body and the feelings we register in it. For when we distinguish between our self and the rest of the world, a conflict arises: How do they relate to each other? We may deny the existence of our consciousness (and experience an ecstatic sense of oneness with the world by forgetting ourselves), or we can deny the existence of the outside world and its *differentness*, allowing the consciousness and the *I* to rule without being contradicted.

Against the background of his knowledge of a wide range of psychoanalytical and philosophical traditions, including figures like Winnicot, Elias, the psychoanalyst Jacques Lacan, and the philosopher M. Merleau-Ponty, Berman claims it is the latter strategy that is dominant in our culture. The distinction between self and *differentness* becomes a recurrent theme in history: We learn to distinguish between friend and foe, tame and wild, worldly and heavenly. The more or less desperate attempt to keep alive the idea that we possess control over ourselves is manifested in national states and standing armies (which arose at the same time as the mirror and self-consciousness).

But the real drama is not these outer conflicts; to Berman, the real drama is the inner conflict: You are a person with a body, but you do not want to acknowledge that body, for it is uncontrollable, weird, and revolting. What really terrifies is everything you cannot control: spiders, sexuality, emotions, angst, and your body.

In other words, everything the *I* cannot control, however much it would like to. The result of this denial of what you cannot control is a feeling of intense emptiness, an inner disturbance that constantly needs compensating for with transitional objects. Like dictators who finally go mad because nobody dares contradict them, the *I* ends up in a lifelong despair: Everything uncontrollable is a threat to the *I*, and we seek to eradicate it through intensive use of pesticides, zoos, and television. We have got to get the *different* under control, for "The mere idea of an Outside is the real source of angst," as the German philosophers Max Horkheimer and Theodor Adorno wrote in 1944.[22]

"While in one sense the body is the most abiding and inescapable presence in our lives, it is also essentially characterized by absence," the American philosopher Drew Leder wrote in his book *The Absent Body* (1990). He asks "why the body, as a ground of experience, yet tends to recede from direct experience."[23]

Leder builds upon the so-called phenomenological school in twentieth-century philosophy, founded by the German philosopher Edmund Husserl, who tried to find the basis of all knowledge in science and everyday life. Husserl started by studying "the phenomena"—what we experience immediately. In about 1913, he began to describe all experiences from the basis of a "transcendental I." The word "transcendental" indicates that Husserl is talking about something that transcends the experience itself and precedes it. The transcendental I is not the same as the empirical I, a person, but rather—in the language of this book—the principles for the simulation behind the user illusion. But the vital thing was that Husserl showed that one could analyze the human experience—the phenomena we immediately perceive—and not just abstract concepts.

The Frenchman Maurice Merleau-Ponty emphasized that these immediate experiences are anchored in the sensations of the body. We can sense things only because we have a body.

But Drew Leder goes further than Husserl and Merleau-Ponty. For their tradition mainly involves perception and "motility." "It is through these modalities that we directly experience and act upon the world," Leder writes. "Yet such functions arise within a series of impersonal horizons: the embryonic body prior to birth, the autonomous rhythms of breathing and circulation, the stilled body of sleep, the mystery of the corpse. It is precisely because such bodily states involve various forms of experiential-absence that they have tended to be neglected by philosophers of experience."[24]

To Leder, the fundamental problem in philosophy's view of the body is that the philosophers' distinction between body and mind means they have never understood the body's fundamental ties to the world. We eat, breathe, and experience; we move, dance, and wave. The body is connected to its surroundings in a way we do not experience, because we are not aware that we breathe, and officially do not want to be aware that we go to the lavatory.

"Almost all spiritual traditions use posture and gesture as a means whereby we enter into relation with the divine," Leder writes. "This body's roots reach down into the soil of an organismic vitality where the conscious mind cannot follow."[25]

The body knows a link to the world that the consciousness cannot sense. That is why almost all spiritual traditions involve body positions and many therapeutic traditions body attitudes. One might say that our bodily attitudes to the universe express far more than our consciousness knows: By crossing our arms we display closedness toward our fellow human beings; by stretching we experience well-being and show trust, because one is vulnerable when one stretches.

In 1981, the Danish psychologist Olav Storm Jensen formulated a theory of "the two bodies," which expresses many of the same points as Leder. Storm Jensen distinguishes between a body that is controlled by consciousness ("the cognitive-voluntary body" or "the ego-body") and one that cannot be consciously controlled ("the emotional-vegetative body").[26]

The consciously controlled body deals with everything to do with willpower and thinking: everything "one can do" with one's body if one wants. The other body does everything "one" cannot control: It deals

with the circulation, the reflexes, digestion, sexuality, and emotional reactions.

The most important bridge between the two bodies is respiration. Normally, this is controlled totally by the nonconscious body. We do not think about the fact that we are breathing; we do not even think about the fact that we sometimes hold our breath in excitement or surprise (indeed, we do not even think about the fact that breathing is a very important part of a telephone conversation). But we can control our breathing consciously. Many mental and spiritual techniques are based on just this: developing our breathing.

Another important bridge is sexuality, which cannot be controlled by the conscious body alone but has a tendency to go off on its own (frigidity, impotence, neurotic fear of the body, and other dysfunctions).

But characteristically, the conscious body cannot prevent the nonconscious body from carrying out its functions: We cannot hold our breath for more than a minute or so; we cannot hold water for more than a few hours; we cannot halt the sexual functions, whether we want to or not.

We can express this fact in another, rather macabre way: It is very difficult to commit suicide. In the final analysis, the part of the body not regulated by the consciousness does not allow us to hold our breath long enough to kill ourselves. Similarly, it is hard to refrain from bodily contact and sexuality, eating and drinking, going to the toilet, and sleeping.

Consciousness, then, has only limited control of the person. "The other body" lives its own life, which consciousness cannot control. The *I* cannot get the *Me* to do whatever it wants it to do. A vast number of processes take place that handle a vast amount of information the consciousness never hears about.

To some extent we can control whether the consciousness is to know what is going on. We can—if we direct our attention there—feel that we have clothes on our bodies or that we are sitting in a chair. But we cannot feel the way our immune defenses are routing an ordinary virus this very minute (we feel it only when there are such major problems that steps are taken to reinforce the immune defenses, such as by raising our body temperature). Nor do we feel the way the blood moves through our left thigh.

Some people, who have worked on it for a very long time, using

Eastern concentration techniques, for example, can bring vital bodily functions—blood pressure, body temperature, etc.—under the control of the consciousness to a certain extent. Western techniques such as visualization and biofeedback have been introduced to the treatment of disease in recent years and have yielded promising results. Directing his attention to parts of the body that are seats of disease or unbalance, the sufferer imagines the healing function of the body and so is aware of the abilities of the body to heal itself. In recent years, the study of the link between the psyche and the immune defenses has become an important area of medical research: psychoneuroimmunology.

But fundamentally, the nonconscious body is not under the control of consciousness. Whether we want it that way or not. The body is part of a biological metabolism with the living system on the planet—and this participation is not subject to the power of the consciousness. We do not have access, via the body's own means, to changing the role each of us plays on earth. We are part of a living system to which we are so adapted that there is no freedom to get off.

As the Chinese savant Lin Yutang put it, "Even the most spiritually dedicated man cannot help thinking about food for more than four or five hours."[27]

The body is in a state of interaction with the world: We eat, drink, and dispatch matter back into the cycle of nature. In no more than five years, practically every atom in the organism gets replaced. The vast majority of atoms are replaced far more often. Identity, body structure, appearance, and consciousness are preserved—but the atoms have gone.[28]

The feeling of individual continuity is real enough, but it has no material foundation. Material continuity is to be found only in a greater cycle.

In 1955, the American physicist Richard Feynman put it thus: "The atoms that are in the brain are being replaced; the ones that were there before have gone away. So what is this mind of ours: what are these atoms with consciousness? Last week's potatoes! They now can remember what was going on in my mind a year ago."[29]

The memory, the *I*, the personality and individuality, are a dance, a pattern, a whirl in the world: a pattern in a stream of matter.

"All bodies are in a state of perpetual flux like rivers, and the parts are continually entering in and passing out," wrote the visionary German philosopher Gottfried Wilhelm Leibniz in 1714.[30]

At the end of the seventeenth century, Leibniz formulated a number of contributions to mathematics, physics, and philosophy. A recurrent theme was his study of the significance of tiny differences, stemming from his view that every change in nature takes place smoothly and not in abrupt movements. The study of the human mind also concerned Leibniz. As the Danish philosopher Harald Høffding relates:

"Leibniz was the first to draw attention to the importance of infinitesimal elements in psychology (as he did in mathematics and physics). . . . Using the unconscious elements (which he calls 'petites perceptions'), he explains the individual's connection with the whole universe, to which the individual is far more profoundly related than he is conscious of."[31]

Subliminal perception and nonconscious mental activity mean that man's link to the world is far stronger than consciousness suspects. Leibniz knew this, and psychology knew it at the end of the nineteenth century. But the twentieth century has been a story of forgetting this link; of regarding consciousness as the whole story of man's connection with the world.

Now the wind is changing, and people are again realizing that they are far more than they themselves can know.

The beauty of science has often filled scientists with wonder. But the scientific tradition was founded in the attempt to understand the divine principles behind the world. As Julian Jaynes sees it, the origin of science lies in the study of omens, which started in Assyria during the breakdown of the bicameral mind. In ancient Greece, Pythagoras studied mathematics because he wanted to find the divine principle expressed in the world of numbers. The great figures of modern science were often deeply motivated religiously: Kepler, Newton, Einstein. As Jaynes put it, "Galileo calls mathematics the speech of God."[32]

Thought is not conscious; scientific thought is not conscious either, but our concept of consciousness encompasses everything we human beings are proud of in ourselves, which means, not least, science.

But perhaps it is not so strange that beauty can play such an enormous role in scientific work. For it is not the conscious *I* that thinks at all, but the nonconscious *Me*. Everything the *I* cannot explain.

So we can continue the exchange at the end of Chapter Ten:

Boltzmann: "Was it a god that wrote these signs?"

Maxwell: "No, it was me!"

God: "Yes, it was me."

16

Hypnotic Dreaming

TO DAYDREAM is to go into trance. We have all experienced it hundreds of times. Daydreams and fantasy can be the stuff of creative genius, or they can shackle the dreamer to an unfulfilled life of empty yearnings. Some of us don't daydream enough; others daydream more than is helpful. Either way, for most of us, daydreams just come and go at will—*their* will, rather than our conscious will. We get what we need or want from them and then "wake up" and move on with daily life orientations.

For some, daydreaming or "hypnotic dreaming," another Deep Trance Phenomenon, has become a habitual response that functions so autonomously that it impedes adult living. The hypnotic dream is used to resist experiencing the present. Dreams of this nature are deeply layered in the age-regressed "child within" and become a prime impetus for entire adult lifestyles. The unaware adult incessantly and impotently daydreams about the future, not realizing that it is the "child within" who is creating and sustaining the over-idealized dream.

As with all other Deep Trance Phenomenon, hypnotic dreaming was created by the child to protect and maintain his integrity. In response to a stressful series of interpersonal interactions, the child dissociated from the outer environment as well as the inner self (who is afraid, in pain, unhappy, or whatever), went into an *intra*personal trance and created a dream or fantasy. Whenever a child is denied the essential ingredients for living, he will attempt to counter or neutralize the deprivation. This attempt may take the form of the creation of a dream character who gives the child the experience of security and wholeness he is seeking. I call this "externalization": needed experiences are dissociated and externalized or projected onto the outer world via imagination, dreaming, and fantasy.

Both the "child within" doing the dreaming and the dream itself remain time-frozen and dissociated. As the child grows older, the "dream" becomes increasingly inappropriate and unreal because it is a product of a young child's world, not the present adult world. The age-regressed "child within" can only interact as a child attempting to complete itself, not as an adult meeting his own needs. In addition, *intra*personal dreams lack *inter*personal feedback, which means that the dream continues without a reality check in the outer world.

For example, as a five-year-old girl is repeatedly spanked by her authoritarian father, she begins to defend herself from within by splitting off from the outer actions and by splitting off from the inner turmoil, and creating a dream in which she is rescued by a kind man who takes her to his royal kingdom where she is hailed as a princess. This dream brings her comfort—or, that is, it brings the dissociated "child within" comfort—and she begins to use it automatically, whenever she wants to feel better.

Twenty years later the child has become a woman who wants to have a serious relationship. But the "child within" continues to fantasize. Ironically, the dream itself draws her to abusive relationships because before she can be rescued and instated as a princess, she must first find herself in peril. Obviously, neither child nor adult recognizes the "dark" part of the dream that is the very genesis of the dream itself! Yet it is this dark (by *dark* I mean hidden—implied but not seen) part that actually winds up manifested.

The hypnotic dream is so woven into the fabric of her consciousness that she accepts it as a "given." For her, unconsciously the dream portrays what she has experienced to be the nature of reality, so she does not look for answers anywhere else. Furthermore, the "child within" is always operating, always ready to

generate the rescue dream as salve, so there is no need to reach for something better.

Everyone has an inner child. Ideally, however, we are not dominated by it. We can become playful and silly at will, and then stop being playful and silly. We can cuddle and be cuddled, and also feel fine if we are not. The question to ask is, Am I automatically being thrown by this "child within" who... *has to have* an ice cream cone, who *has to be* held and cuddled, who *has to buy* a new dress? Or can I choose not to act? For the adult locked into hypnotic dreaming, there is no sense of choice—only of domination and compulsive need. Stated another way, the dreams and fantasies happen automatically, whether we want them or not.

The Feedback Loop Linking Dream and Context

Sometimes an adult's hypnotic dream will be manifested in his "real" outer life. This happens when the person has the talent and abilities to make the dream real. There is still an underlying process of dissociation and an ongoing trance of hypnotic dreaming sustaining the current success, but the person usually does not experience that as a problem.

For example, a young boy surrounded by quarreling parents who do not value education discovers that the one thing that gives him pleasure is books and the process of learning. Despite the hostile environment, which undermines rather than supports this passion, the child finds ways to learn as much as possible. Meanwhile, the Deep Trance Phenomenon of hypnotic dreaming is used to stave off the stress and unhappiness of a brutal father and an intimidated mother. The young boy is forever daydreaming of the time when he will have his own library, will write his own books, will give lectures and be heralded for his work. Even when his school performance is so poor he is put in the "dumb" class, his hypnotic dream sustains him.

If this child was not gifted in the directions he daydreamed, he would probably grow into an adult for whom hypnotic dreaming had become a symptomatic trance state. Being suitably gifted, however, the child begins to find ways to make the dream real.

Slowly, a "feedback loop" between the dream and his interpersonal world is formed. Over the years, the dream and the young man's lived life gain increasing correspondence. He may still be trying to prove that he is not "dumb"—and in that sense, he is still being dominated, to some degree, by his dream trance and by the unconscious hypnotic identity of "I'm dumb." But the fact that he *is* able to manifest the dream greatly diminishes its problem-generating powers.

More often, there is no feedback loop to support the dream. It floats in space, utterly disconnected from real-life experience. Los Angeles is like a magnet for hypnotic dreamers of the entertainment variety, who experience repeated rejections yet persevere with astonishing tenacity. Everyone is going to be an actress or an actor or a director or a screenwriter, but the feedback loop still has them working in restaurants, driving taxis, selling insurance. The closest they get to their dream is to take a course now and again.

I knew one embittered man who had read for parts in television and film hundreds of times over a ten-year period. He had not gotten one part, yet if you asked him what he did for a living, he would reply, "I'm an actor. I'm just doing real estate for the time-being." There is certainly nothing wrong with persevering to become an actor. The problem was that he denied having the job that netted his livelihood and paid his bills. He dissociated from his co-workers and felt unfulfilled at the workplace. Rather than dealing with this difficulty directly, he preferred to dream. He ignored the interpersonal loop of not receiving a part and felt unappreciated, unloved, and angry.

This man described a childhood dominated by *not having*. His parents were good people, there was no brutality in the house, but they lived in deprivation—which he loathed. To survive a chronic condition of impoverishment, he used hypnotic dreaming to give him a reason to live. As a child, he had developed the habit of dissociating from his undesirable surroundings and fantasizing glamorous ones. Interestingly, this very same mechanism is what kept him locked into failure in a profession for which he was entirely unsuited: Just as the child had dissociated from the feedback loop of *not having*, the adult dissociated from the feedback loop of *not getting*. Each time he was rejected for a part, he automatically flipped into his hypnotic dream. This is the point at which hypnotic

dreaming, unsupported by a confirming feedback loop, becomes a symptomatic trance that impedes successful adult functioning.

Chronic adult "dreamers" rarely recognize that their fondest dreams are a trance state at the source of their problems. The hypnotic dreams that were created during childhood usually have been heavily reinforced with years of amassed "data" that supposedly supports the dream. Yet when the adult is confronted with the "fact" that the dream has never been manifested and is, in fact, quite cut off from real life, she will often react quite defensively, marshalling many "logical" explanations. In a way, the dreamer has a kind of co-dependent relationship with her dream: she can justify any flaw or failure with great facility! The dream represents an old ideal that was protective of the child's self, and the child does not want to give it up. In working with a client's hypnotic dream, efforts to integrate the other side of the dream (Prince Charming comes home late and drinks too much; rock stars are hounded by thousands of people; corporate presidents have no life of their own), feelings of grief, disillusionment, discontentment and confusion will arise. The dreamer does not want reality polluting her dream! The task for the therapist is to allow these emotional responses while not merging or becoming *entranced* by the client's emotional logic in support of the childhood dream. A brief example is discussed below, under Step 1 of "Treatment."

The Need for Hypnotic Dreaming

Hypnotic dreaming is a naturalistic trance phenomenon that can benefit us as long as we remain in charge. The question to be asked is, *Am I creating this dream or fantasy knowingly and purposefully, or is it happening "automatically"*? Healthy use of this Deep Trance Phenomenon lies in our ability to exercise creativity and choice. Choice means the ability to create or let go of our hypnotic dreams at will. For most people, their hypnotic dreams function on "automatic pilot" and are derivations of unfinished childhood issues. Restoring choice—*not* removing or suggesting away the dream itself—is the therapeutic task.

Clients may present with the opposite problem: a complete inability to dream or fantasize. If we recall a basic premise that a symptom is the *non*-utilization of unconsicous resources, then being unable to dream, daydream or fantasize also becomes a liability. I worked with a man who, as a result of being unable to daydream, lived in an overly linear, over-focused, over-identified state. He was criticized in his job for being "unimaginative" and warned that some improvement was expected.

He was extremely anxious when he arrived for his first session, explaining that he feared his job was "on the line" for something he had no control over. He firmly believed that he was incapable of daydreaming about anything and contended that "that kind of thinking that goes off into unreal, never-never lands" was foreign and even frightening to him. He rushed to explain that his father had been an alcoholic who terrorized their household of five. Being the oldest, he had assumed primary caretaking duties in an effort to give his mother some relief. To him, going off into a daydream meant abandoning everyone to the possibility of the father's rampages. His trance-response to the environmental and interpersonal stress was to remain hyper-alert at all times to be able to read the signs and take protective action at a moment's notice. This type of hypervigilant identity is often characteristic of homes where alcohol or drug abuse is present. An adult-child of an alcoholic often has to stay so *present* because to let go and fantasize could mean catastrophe.

Daydreaming is the wellspring of imagination and creativity. As an adult, this man needed to develop his ability to daydream, with *choice* added as the key ingredient. Both he and the obsessive daydreamer have the same therapeutic goal: to make use of this trance resource of hypnotic dreaming by choice rather than being barred from it or compelled into it.

I asked the client to sit comfortably and to breathe and look at me. Since he was used to being hyper-vigilant, it seemed easy for him to narrow his focus as I suggested. However, his familiar pattern was automatically broken by the added task of *breathing*. In his "unedited" hypervigilant state, he would hold his breath and tighten his muscles as he surveyed his surroundings. Now he was being asked to look *and* breathe at the same time. After a few minutes, his pupils began to dilate and his focus diffused to a distant set-point even as he continued to "breathe and look at me." Now I asked him to pick an image from nature that he liked and to see it in his "mind's eye." He picked a sea gull but said he couldn't see it. To

depotentiate his negative ("I can't see it"), I assured him: "You're not supposed to be able to see anything but my face and the furniture yet. I don't know how long it will take to. . .see the sea gull inside your mind. Just continue to breathe and look at me."

A few minutes passed when he softly stated, "I can see it—faintly, behind a gray mist."

I immediately asked him to stop seeing the sea gull, and to see only those things that were "really" in his visual range. He looked puzzled but mumbled "okay."

"What do you see as you breathe and look at me?" I asked.

He responded by naming a few pieces of furniture.

Next I asked him to stop seeing the furniture and resume watching the sea gull as he breathed and looked at me.

He nodded absently and mumbled that the fog had cleared and there were actually three sea gulls now.

We continued this process for about 20 minutes, alternating between "real-world" sight and "inner-world" sight.

When he returned the following week he reported that he had felt "disoriented, but in a pleasant sort of way" throughout the week. As he spoke, I got an image of neurons being turned on in his brain for the first time. Nothing spectacular had happened—he hadn't suddenly wowed his boss with an ingenious solution to some corporate problem—but he nonetheless had the feeling that "something important was going on."

We continued to build these fantasy "highways" each session, adding on elements as he grew accustomed to the process. First he had to become accustomed to the experience/sensation of seeing with his "mind's eye" rather than with his physical eyes. (Visualization is not an automatic ability in people and can seem quite foreign and daunting. In my experience it has to be slipped in—with no special name or explanation and with no long descriptions of what it is.) Next he learned how to let the visualized image move and change a bit, but at a fairly uncomplicated level. Eventually, he was able to allow an entire "dream-story," as he called it, to unfold.

Meanwhile, back on the job his attitude changed subtly, which was enough improvement for his supervisor to give him some time and space. He began having an entirely new experience in which ideas "just floated" into his thoughts. He made no conscious connection between being able to see sea gulls inwardly and these new floating thoughts. He was simply excited by it, said he felt much better, and quit therapy! Six months later he phoned to ask "if the sea gulls had anything to do with his new brain" and to tell me how pleased he was with his new ability.

Treatment of Hypnotic Dreaming

I. Returning Choice to Interruptive Hypnotic Dreaming

The overall therapeutic goal in working with hypnotic dreams that function automatically and disruptively is to re-unite the dream with its "other" more realistic side and join or integrate it with the "child within," the self, and the larger interpersonal context. I'll illustrate using a case example.

A man came to therapy with the complaint that he was always "in the red" and it was causing marital problems. He said he wasn't "*that* concerned" about his finances, except for occasional bouts of anxiety when the bills really accumulated. His wife, however, was "fed up" and gave him the ultimatum of therapy or divorce. It was she who was paying for the therapy.

He explained that he was "New Age" and that he didn't expect me to understand his thinking. I asked, "What is your thinking?" "I *imagine* money coming my way; I meditate and visualize all my bills being paid, and abundance surrounding us."

I said, "That's great, but do you *do anything* to manifest that belief in the outer, physical world?"

He said, "I spend money whenever I begin to worry about it—that manifests my belief in abundance."

"Oh, but do you look for employment? Are you adequately trained to work in the real world?"

"Not really."

"Would you like to be able to match your belief with your living circumstances?"

"Sure."

"Do you think it's possible you're leaving out an element or two in this cosmic approach—since you're not exactly abundant?"

"I suppose I must be. Do you know what it is?"

"I think it's *integration*, in a nutshell."

I have no quarrel with New Age teachings about the importance of beliefs, but what I do find amusing is how *disconnected* the teaching gets from the material, physical world. Hypnotic dreamers are prime candidates for this distortion, and this man was a classic example of the hypnotic-dreamer-turned-New-Age-disciple.

Because the dreamer is addicted to his childhood dream-state, which leaves the dream in a completely dissociated realm, the first goal in therapy, as mentioned above, is to reassociate or re-integrate four different planes of functioning: the "child within" who created hypnotic dreaming in the first place, the "opposite side" of the hypnotic dream itself, the self or ever-present core of the individual, and the outer world. *You do not want to simply discard the dream or even reframe it*—you want to integrate it or "ground" it (in Bioenergetic terms) into the body and the entire landscape of the person's psyche and social network.

In order for the intrapersonal trance of hypnotic dreaming to occur, the body must become ungrounded. This ungrounded feeling is a cornerstone of trance. Pioneer bodyworkers Wilhelm Reich and Alexander Lowen believe that the basic life energy must be discharged through the feet (as well as through orgasm). If this life energy does not have an avenue of discharge, it goes upward to the mind and creates thoughts, dreams, and fantasies. Reich believed that the less life energy was charged and discharged through the body, the less feelings could be experienced. Moreover, the greater the inhibition of energy discharge, the greater the tendency to mystify the world. The energy had to go somewhere, so it went "up," creating fantasies of gods and goddesses in extreme cases. This line of thinking also explains the practice of celibacy among the spiritual: the more celibate the life, the less discharge of life energy; and the less discharge, the more mystification.

Step 1: Integrate the "Opposite Side" of the Dream

I had a client whose dream was to be taken care of for the rest of her life by a wealthy millionaire. She firmly believed such a situation would solve all her problems of self-dislike and emotional instability. In trance I suggested to her that nobody is perfect, and chances are high that she would encounter the same round of trials and disappointments with her millionaire benefactor as any of us encounters with a spouse. Perhaps he will be a womanizer, staying out all night from time to time; perhaps he will be a workaholic who travels three-quarters of the month; perhaps he will expect her to cater to him hand and foot; perhaps he will behave quite dictatorially. The one sure bet is that no human being, including a millionaire, is going to be perfect; and the larger her dependency on him, the greater the chances of serious problems.

Needless to say, my client did not want me to talk along these lines. She recognized the hit of reality immediately and moved rapidly to resist it. She began by trying to name wealthy individuals from history who had also been "great human beings." When I suggested that she knew nothing of these men's personal lives, she admitted that was true and added, "but *surely* they were good to their wives!" Then she began to cry, which was her first real breakthrough. I had an image of her tears gently breaking up the unity of the dream.

A week later she came to therapy feeling more grounded in who she was, what she wanted, and most importantly, in the context that was available to her. Her feedback loop to the interpersonal world was leading her out of her intrapersonal fantasy.

Step 2: Create a Symbol

Typically the hypnotic dream is turned to in times of stress, so I begin by asking the person to duplicate the sensation of stress or pressure. In the case of the "New Age" client, I asked him to vividly recall the last time he sat in front of his bills and to describe his physical sensations "as you breathe and look at me." When he began to re-create the anxiety symptoms I said to him:

"I'd like to ask your unconscious mind for an image symbol of the YOU who is larger than the anxiety—perhaps you think in terms of 'higher self' or 'essential self' or 'soul' or 'spirit.' Whatever word you use, let your unconscious give you an image of it. Perhaps it is a mountain, or a river, or an animal—I don't know what it will be. But it will be interesting to see what image your unconscious gives you."

A good thirty seconds passed before he answered softly, "I see a tree."

Step 3: Place the Symbol inside the Body

Next I asked him to place the image of the symbol in some part of his body.

Another lapse of time and he responded almost inaudibly, "It goes in my heart."

Recall the discussion of expanding the context of the symptom to encompass the body, the self, and the social network in Chapter 6. Here, the symptom is not a localized pain or even a specific relationship. It is an intangible dream that is completely disconnected from the person's reality as a physical being. So I want to get him into his body, so to speak; I want to get him reconnected to the physical world. While the dream functions autonomously, there is no alignment between his Self, his body, and the outer world. The "spine" of this flow is out of kilter, so to speak.

Why don't I simply begin by giving him some practical suggestions for going out on a job interview? Because he is too dissociated to take that kind of action yet. He would just say, "Great, sure, yeah," and then go home and fantasize. First I want to integrate the dissociated trance by reconnecting it to an intrapersonal feedback loop in his body.

Step 4: Integrate Dream with the "Child Within"

Next I want the client to connect with the time-frozen "child within" who created the dream in all its varied forms, so I begin weaving back and forth between the image, the self, the child:

"As I look at the tree inside your heart I see a little child over there. . .a child climbing on a tree, in a tree house, looking down from the tree house. And there's Dad over there, but the child is way over here inside the tree. How safe it is to be in the tree, and what a nice game for a little child to play while in a tree house."

Step 5: Integrating the Social Network

To solidify the process of integration or grounding, I now extend the context of the therapeutic work to encompass a larger social network:

"And now, look, the child can see a tree inside of Dad. . .and there is that third-grade teacher, and she has a tree inside of her. . .And there is a tree inside of that little girl, Suzy. And as you sit there, isn't it nice to know that you can experience yourself in that tree inside your own body looking out and seeing another tree. And there are so many trees in the world, and so many woods, and the birds fly off and communicate to other trees and to other birds. And you can send birds from birds to birds, and how nice it is to know that you can house a whole family inside a bird's nest inside a tree."

Step 6: Integrate Image in Here-and-Now

To complete the process of re-integrating the trance of hypnotic dreaming, I suggest to the client that he visually place his resource in various locations in the room we are in, in his house, in his office, and so forth. The image of the self thus also becomes a symbol of this integration.

II. Facilitating Hypnotic Dreaming in Non-Dreamers

Step 1: First Visualizations

Have the client get into a comfortable position and ask her to "begin to imagine a pleasurable environment—perhaps the woods, the shoreline, a lake, a willow tree in a meadow." Explain to the client that this visualization is experienced by people in very unique ways: some "see" the scene quite vividly, while others might re-create it more kinesthetically by getting the sensations in the body. Still others who are more auditory in their sensory preference might hear the visualization more than see it.

Step 2: View from Above

Next have the client take a "look" from above so that he sees the outer edges, the boundaries, of the imagined scene. Placing a boundary around the new visualization helps to solidify it in form, making it more tangible, more discernible, and more manageable.

Step 3: View from Within

Now ask the client to step into the imagined scene and feel what it feels like to be part of the dream. Having the client merge with the characters in the dream—feel what it feels like to be them, hold their point of view, ideas, opinions, feelings, bodily sensations—makes the experience of the dream more grounded and real. Suggesting that they see the ocean, sky, land, or whatever, from behind the eyes of the dreamer gives the dream more substance and helps to dispel the disclaimer, "It was just a fantasy."

Step 4: Night Dreams

Suggest to the client that she ask her unconscious to allow her nighttime dreams to be remembered. As an exercise, write down the first conscious thought upon awakening. Do this for a period of several weeks and notice the accuracy of the insight from the dreams.

An advanced technique is to present the unconscious with a particular problem before falling asleep, and ask for a dream containing a solution.

Hypnotic dreaming is not "wrong." It is simply disruptive when it is allowed to function autonomously because the individual loses connection to his own body, to his deeper self, and to his interpersonal context. It is by re-establishing these interconnecting pathways that the individual can once again feel "in charge" of the automatic fantasizing rather than feeling like a victim of his own created trance phenomenon.

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Lullabies and Simplicity: A Cross-Cultural Perspective

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Pairs of folk lullabies and comparison songs from different cultures were presented to adult listeners, who were required to choose the simpler song in each pair. Adults judged the lullaby excerpts as simpler whether presented with original field recordings, low-pass filtered versions that made the words unintelligible or excerpts synthesised with a uniform (piano) timbre. Structural analyses of the songs failed to reveal musical features that differentiated lullabies from other songs. Nevertheless, such analyses revealed melodic features that predicted adults' identification of lullabies.

Singing is a universal form of expression and an important vehicle for enculturation (Dowling and Harwood, 1986; Nettl, 1983). Exposure to this mode of expression begins early in life with lullabies and play songs. In fact, the widespread practice of singing to infants is suggestive of universal functions relevant to caretaking.

Although the act of singing is universal, the structure of songs across cultures seems hughly varied, with little evidence of musical universals (Harwood, 1976). Even if some similar melodic and rhythmic features could be identified across cultures, the manner in which they are perceived and interpreted is likely to differ (Blacking, 1977; Meyer, 1960).

Unlike adults, infants have had relatively limited exposure to the musical style of their culture and are therefore unlikely to perceive musical structures in culture-specific ways. In the domain of speech perception, young infants exhibit behaviour that is relatively free of cultural influence. For example, although adults have difficulty distinguishing certain foreign speech sounds, 6-month-olds and younger infants seem to differentiate foreign and native-language sounds with equal ease (Trehub, 1976; Werker and Tees, 1984; Werker and Lalonde, 1988). If infants approached musical forms in a similar (*i.e.* culture-free) manner, they would be better served by music emphasising universal features and de-emphasising culture-specific features.

Songs in general vary in style and structure cross-culturally but lullabies in particular may share common features because of their more uniform function and audience. Indeed, infant-directed (ID) speech exhibits similarities in form across a wide variety of tonal and non-tonal languages (Ferguson, 1964; Fernald, Taeschner, Dunn, Papoušek, de Boysson-Bardies and Fukui, 1989; Grieser and Kuhl, 1988). When talking to prelinguistic infants, adults typically speak with higher pitch, wider pitch range, and use smooth, simple and highly modulated intonation contours (Fernald and Simon, 1984; Papoušek, Papoušek and Bornstein, 1985). They also use shorter phrases, longer pauses, a slower rate and more prosodic repetition (Fernald, 1984; Stern, Spieker and

MacKain, 1982; Papoušek, Papoušek and Haekel, 1987; Warren-Leubecker and Bohannon, 1984; Snow, 1977). These features jointly confer a *musical* quality to such speech.

The distinctive character of ID speech across several cultures (Ferguson, 1964; Fernald *et al.*, 1989) suggests a universal function for such speech (Ferguson, 1964; Blount and Padgug, 1977; Fernald and Simon, 1984; Sachs, Brown and Salerno, 1976; Watson-Gegeo and Gegeo, 1986). One prominent notion is that ID speech is highly salient for infants, facilitating the capture and maintenance of infant attention (Fernald, 1984). Indeed, when ID and adult-directed (AD) speech are both made available, infants exhibit a consistent preference for ID speech (Cooper and Aslin, 1990; Fernald, 1985; Fernald and Kuhl, 1987; Werker and McLeod, 1989).

The contours of ID speech do not embody the abrupt pitch transitions that characterise AD speech. Instead they are relatively simple and distinct, being separated from one another by substantial pauses (Fernald and Simon, 1984). One can consider them to display *good Gestalten* in comparison to adult speech, which presumbly facilitates their encoding by infant listeners. ID speech may be a vehicle for conveying affective meaning to prelinguistic infants (Fernald, in press; Werker and McLeod, 1989). Caretakers use high, rising contours to arouse infants (Stern *et al.*, 1982) and low, falling contours to soothe them (Papoušek and Papoušek, 1981; Fernald, in press). Moreover, infants listening to ID speech are judged to be more pleasant, friendly, likeable and cuddly than those listening to AD speech (Werker and McLeod, 1989).

One could refer to lullabies, which are also intimate, aural communications between caregivers and infants, as ID music or song. Such music might well share some of the features of ID speech such as higher pitch, wider pitch range, smooth, simple contours, and greater repetition but this issue has not been investigated to date. If ID music did exemplify some of the salient characteristics of ID speech, its potential impact on infants could be substantial.

That various musical or music-like elements are discernible to infant listeners has only recently become clear. For example, there is evidence that infants, on listening to a melody, can encode and retain global features, the contour being the most prominent of these (Trehub, Bull and Thorpe, 1984; Trehub, Thorpe and Morrongiello, 1985, 1987). Just as infants can recognise a pattern when it is transposed to new pitches (Trehub *et al.*, 1987), they can recognise it with different tempos (Trehub and Thorpe, 1989) or timbres (Trehub, Endman and Thorpe, 1990). Moreover, when a melody is structured according to Western musical conventions (*i.e.* what adults would consider typical), infants encode and retain it in greater detail than when the melody violates such structural constraints (Cohen, Thorpe and Trehub, 1987; Trehub, Thorpe and Trainor, 1990). Infants also group the elements of patterns on the basis of similarity (Demany, 1982; Thorpe, Trehub, Morrongiello and Bull, 1988; Thorpe and Trehub, 1989) and proximity (Trehub and Thorpe, 1989). In short, their musical pattern processing skills are qualitatively similar to those of adults (Trehub, 1987, 1990; Trehub and Trainor, 1990). This implies that infants would likely be capable of discerning the distinctive features of ID music, if such features were present.

As noted, the cross-cultural similarity of ID speech in the context of dissimilar AD speech has been well documented (*e.g.* Fernald *et al.*, 1989). Lullabies have also been documented in the folk music of many countries and the art music of all periods (*New Grove Dictionary of Music and Musicians*) but they have not been the focus of cross-cultural comparisons. Anthropologists have described some of the stories conveyed in lullaby lyrics, relating the story themes to the social context of the singer (*e.g.* Hawes, 1974; Sands and Sekaquaptewa, 1978; Spitz, 1979). However, they have tended to ignore information accessible to the infant listener, notably the musical form.

Adults seem unaware of the full range of their ID vocal modifications (Papoušek and Papoušek, 1987) but this speech is still distinguishable to other adults, even those from a different language and cultural background. There are recent suggestions that adults can also distinguish foreign ID from AD songs. Trehub, Unyk and Trainor (in press) examined this question with a sample of lullabies and adult songs from several different cultures and geographic locations. Each ID song was paired with a song similar in cultural origin, tempo, and musical style but one not intended for infant listeners. Western adults were asked to identify which song in each pair was intended for infants. They succeeded in identifying the lullabies above chance levels but their performance was far from perfect. What was notable, however, was the relative uniformity of performance across listeners, with some lullabies consistently identified and others consistently misidentified. Surprisingly, factors such as Western versus non-Western musical style, type of instrumental accompaniment and sex of the singer were unrelated to the ease of lullaby identification. Similarly, the listener's age, sex and years of musical training had no effect on performance. These findings imply that listeners have some notion, necessarily culture-free, about what a lullaby *should* sound like or what features it should embody.

The purpose of the present investigation was twofold. First, we sought to determine whether there are structural features that differentiate lullabies from other songs. Second, we attempted to identify features that underlie adults' assignment of songs (correctly or incorrectly) to the category of lullabies.

Experiment 1

A content analysis of participants' reported criteria for lullaby identification in Trehub *et al.*'s (in press) study revealed simplicity and repetitiveness as the most frequently cited features. Structural simplicity can occur on a number of levels. Songs may be simple in the information-theoretic sense of redundancy or repetitiveness. For example, a melody can be considered repetitive if it consists of a few pitches that are repeated frequently (Vitz, 1966; Crozier, 1974). Repetitiveness can also be defined in terms of the transitional probabilities of component pitches. Thus greater repetitiveness would be associated with frequent as opposed to infrequent repetition of sequences. There is evidence that children's songs contain considerable redundancy or repetitiveness in this latter sense (Pinkerton, 1956).

It is possible that ID songs, like ID speech, have simpler pitch contours than their AD counterpart. If so, ID songs might successfully engage infant attention just as ID speech does (Fernald, 1985; Fernald and Kuhl, 1987; Werker and McLeod, 1989).

To evaluate whether lullabies are perceived as simpler than comparison songs from the same culture, listeners were presented with the taped excerpts from Trehub *et al.* (in press). Instead of judging which member of each pair was the ID song, listeners were asked to judge which was simpler. On the basis of the greater simplicity of ID over AD speech (*e.g.* Fernald, 1984) coupled with listeners' reported use of simplicity in ID song identification (Trehub *et al.*, in press), we expected lullabies to be rated as simpler.

Method

Subjects. The participants were 20 university students (10 female, 10 male), 18 to 49 years of age, about half (45 per cent) of whom had no formal training in music.

Materials. Recordings of 30 lullabies from various cultures and geographic regions (African, Asian, European and North American Indian) were used (see Discography). The majority (57 per cent) were solo vocal renditions of lullabies obtained from field recordings. For 28 of the lullabies, a matching adult song was chosen from the same collection. The matching songs were from the same culture, approximating the tempo, singing style, and orchestration of the lullaby as closely as possible. In some cases, the lullaby and comparison song were performed by the same singer. For two lullabies, a matching children's song was chosen because no available adult song met the aforementioned criteria. There were 14 pairs of songs that were Western European in origin or musical style (*e.g.* Norwegian, Czechoslovakian, Irish, Russian), a style more familiar to the listeners in this study. In nine of the 30 pairs of songs, there was instrumental accompaniment, with two pairs having instrumental music without voice. In five songs, the lullaby was unaccompanied and the adult song accompanied. Finally, the sex of the singer differed across song types in five pairs, the lullaby being sung at times by a male and at times by a female. None of the songs was sung in English.

There were two audiotapes, each of which included 20-second excerpts from the beginning of each pair of songs, with the order of presentation of the song pairs as well as the position of the lullaby in each pair (first or second) randomised. Each pair of excerpts on the tapes was preceded by an announcement of the trial and excerpt number (*e.g.* "Number 1a", "Number 1b"). A 12-second silence followed each pair.

Procedure. Participants were tested individually. They were randomly assigned to one of the two tapes, resulting in 10 participants for each tape. The test session was conducted in a quiet room (3·05 m×3·66 m) with cassette tape deck (TEAC V-300), amplifier (Realistic SA10) and two speakers (Radio Shack NOVA-6). Participants were told that they would hear pairs of musical excerpts from around the world and that they were to indicate which excerpt in each pair was simpler. They were also asked to indicate how much simpler it was on a three-point scale, ranging from not much simpler (1) to very much simpler (3).

Results

Judgements of simplicity for each paired comparison were scored as 1 if the lullaby was chosen as simpler and 0 if the matching excerpt was chosen. The mean score averaged across the 30 excerpts for each participant was ·60. Lullabies were rated as simple significantly more often than chance (0·5), $t(19) = 7{\cdot}03$, $p < {\cdot}0001$. A multiple regression analysis revealed that age, sex and musical training were unrelated to the perceived simplicity of lullabies.

Confidence ratings (3-point scale) were transformed into a 6-point scale. If participants chose the lullaby as simpler, they were assigned scores of 4, 5 or 6 corresponding to their original rating of 1 (not much simpler), 2 (somewhat simpler), and 3 (very much simpler), respectively. If they chose the matching song as simpler, they were assigned scores of 1, 2 or 3 if they had rated their chosen song as very much simpler, somewhat simpler, or not much simpler, respectively. In this way, the transformed scores reflected the relative simplicity of the lullaby in each pair. A mean score across comparisons was calculated for each listener. The mean of these scores (across listeners) was 3·78, which differed significantly from chance (3·5), $t(19) = 7{\cdot}24$, $p < {\cdot}0001$.

In the Trehub *et al.* (in press) study, four lullabies (Pygmy, Creek Indian, Czechoslovakian and Irish) had been identified correctly by more than 85 per cent of adult listeners. For convenience, these can be considered prototypical (*i.e.* readily recognisable) lullabies. On the other hand, four adult songs (from Chad, Ecuador, Samoa and the Ukraine) had been consistently misidentified as lullabies. The lullabies in these latter pairs can therefore be considered atypical. The simplicity judgements for these *typical* and *atypical* lullabies were subjected to further analysis. For each participant, the mean transformed simplicity score (1–6) was calculated for the *typical* and *atypical* lullabies. The mean simplicity score of the *typical* lullabies (4·09) was significantly greater than that of the *atypical* lullabies (3·28), $t(19) = 3{\cdot}8$, $p < {\cdot}001$, indicating that listeners perceived the *typical* lullabies as simpler than the *atypical*.

To determine the association between simplicity ratings (from the present experiment) and lullaby identification (from Trehub *et al.*, in press), a Pearson product–moment correlation was calculated between the proportion of listeners correctly identifying the lullaby in each of the 30 comparisons and the proportion rating each lullaby as simpler in the present experiment. Lullaby identification and simplicity were positively associated, $r = {\cdot}48$, $p < {\cdot}01$.

Discussion

Adult listeners rated the lullabies in this cross-cultural sample as simpler than the comparison songs. Moreover, judgements of lullaby identification and simplicity were related, implying that perceived simplicity plays a role in lullaby identification. These findings are in line with adults' self-reports of simplicity and repetitiveness as lullaby identification criteria (Trehub *et al.*, in press). However, lullabies were not uniformly perceived as simpler than their comparisons songs. In fact, those that were consistently misidentified were notable exceptions. This implies that some lullabies may be more typical of the real or "imagined" category of lullabies and that such prototypicality is associated with simplicity (Trehub and Unyk, in press).

Experiment 2

ID speech is simpler than AD speech in its syntax, semantics and prosody but it is the prosody that is especially salient for prelinguistic infants (Fernald, 1984; 1985). Although the melodic simplicity of lullabies may have contributed to the findings of Experiment 1, simplicity of the lyrics could have played the principal role. Simpler lyrics of lullabies compared to adult songs could provide inadvertent cues to lullaby identity, even for foreign listeners. Thus short words and repetitive word sequences could provide suggestive information about the intended audience. As a consequence, the contribution of melody to simplicity judgements would be obscured. For example, some lullabies sung by the Yuma Indians of North America (Curtis, 1921) involve a simple verbal phrase alternating with repetitive nonsense syllables such as *loo loo loo* or *ma ma ma*. The use of repetitive untranslatable (nonsense) syllables and extended vowels is also prominent in Mohave (Devereux, 1948), Arapaho (Hilger, 1952), Chippewa (Hilger, 1951) and Hopi (Sands and Sekaquaptewa, 1978) lullabies. It is important to ascertain, then, whether lullabies would be perceived as simple independent of their lyrics. To do so, we filtered the 30 pairs of excerpts from Experiment 1 to eliminate the verbal content. Adult participants were then required to select the simpler excerpt from each pair of filtered songs.

Method

Subjects. There were 20 university students (13 female, 7 male), 18 to 29 years of age, 30 per cent of whom had no formal training in music.

Materials and Procedure. The 30 pairs of excerpts from the first tape of Experiment 1 were filtered so that frequencies above 500 Hz were eliminated. This resulted in songs with unintelligible (*i.e.* muffled) words but with the melody, rhythmic information and voice quality largely preserved. The test procedure was the same as in Experiment 1, participants being required to select the simpler song of each pair.

Results

As in Experiment 1, judgements of simplicity for each paired comparison were scored as 1 if the lullaby was chosen as simpler and 0 if the matching excerpt was chosen. The mean score averaged across the 30 excerpts for each subject was ·55, which was significantly greater than that expected by chance (·5), $t(19) = 2{\cdot}32$, $p < {\cdot}04$. Confidence ratings were transformed to a 6-point scale as in Experiment 1. The average transformed simplicity score across comparisons and listeners was 3·65, which significantly exceeded chance levels (3·5), $t(19) = 2{\cdot}81$, $p < {\cdot}02$. A comparison of the *typical* and *atypical* lullabies revealed a transformed simplicity score of 4·06 for the *typical* lullabies, which significantly exceeded the rated simplicity of the *atypical* lullabies (3·56), $t(19) = 2{\cdot}17$, $p < {\cdot}05$.

Discussion

Even with words eliminated, the lullabies in this cross-cultural sample were perceived as simpler than the comparison songs. Furthermore, the greater simplicity of the so-called *good* lullabies was preserved. These findings indicate that the perceived simplicity of lullabies is influenced, in part, by features that are unaffected by the filtering process. It is likely that these features include melodic form and some aspects of voice quality.

Experiment 3

Adults rated lullabies as simpler than other songs both in the original version (Experiment 1) and in the filtered version that obscured the words (Experiment 2). Since much of the vocal quality remained intact in the filtered version, it is possible that vocal quality as opposed to melodic structure was principally implicated in the simplicity judgements. To clarify this issue, we assessed the simplicity of lullabies and comparison songs with synthesised versions that incorporated a uniform (piano) timbre. These synthesised versions were considerably simpler than the original and filtered versions of Experiments 1 and 2 because they presented the melody line only.

Method

Subjects. There were 20 university students (15 females, 5 males), 18 to 49 years of age, about half (45 per cent) of whom had no formal training in music.

Materials. Tapes 1 and 2 from Experiment 1 were used as the basis for creating two additional tapes of paired excerpts of lullaby/non-lullaby comparisons. The melody lines from the 20-second paired excerpts on these tapes were transcribed (by E.G.S.) and then performed in real time (also by E.G.S.) on a touch-sensitive Casio HT-6000 keyboard connected through MIDI to a Yamaha TX-816FM tone generator set at a piano timbre. The pitches and durations of tones as well as the tempo were matched as closely as possible to the original recordings. These paired excerpts were recorded onto two tapes, preserving the order of the excerpts from Tapes 1 and 2 in Experiment 1. Two of the 30 paired excerpts from the original tapes were omitted because the melodic form of these songs could not be captured with a single melody line.

Procedure. The procedure was the same as in Experiment 1. Listeners were randomly assigned to either Tape 1 or Tape 2.

Results

As in Experiment 1, judgements of simplicity for each paired comparison were scored as 1 if the lullaby was chosen as simpler and 0 if the matching excerpt was chosen. The mean score averaged across the 28 excerpts for each subject was ·56, which was significantly greater than chance (·54), $t(19) = 3{\cdot}07$, $p < {\cdot}01$. An analysis of variance indicated that performance differences between Experiments 1, 2 and 3 were not significant.

A 6-point scale was created from transformed confidence ratings, as in Experiment 1. The averaged scores across comparisons and listeners was 3·7, which significantly exceeded the scores expected by chance (3·5), $t(19) = 3{\cdot}69$, $p < {\cdot}003$. The mean transformed simplicity score for the *typical* lullabies was 4·18, which significantly exceeded that for the *atypical* lullabies (3·31), $t(19) = 3{\cdot}97$, $p < {\cdot}001$.

Discussion

Even with lyrics and voice quality removed from the songs, listeners continued to rate the lullabies as simpler. This indicates that some structural features of the melody such as pitch range, contour and interval size must contribute to perceived simplicity and must therefore provide cues to the identity of lullabies.

Experiment 4

In Experiments 1 through 3, adult listeners judged lullabies from a wide variety of cultures as simpler than comparison songs from those cultures. The lullabies were considered simpler whether they were presented as originally recorded (Experiment 1), filtered so that the words were unintelligible (Experiment 2) or synthesised with uniform timbre (Experiment 3). Although these experiments confirmed the perceived simplicity of lullabies, they failed to identify the specific musical features contributing to lullaby identity. This was the focus of the present study.

Accordingly, we analysed the structure of 56 songs, specifically, the 28 lullabies and matching songs from Experiment 3. First, the complete recorded versions of these songs were transcribed into standard Western musical notation by a musician (E.G.S.). The transcription specified the pitches in the melody line, their durations and the phrase boundaries.

For the purposes of our structural analyses, simplicity was defined in the information-theoretic sense of variety in pitches (*i.e.* number of different pitches in the song) as well as variety in contour direction (*i.e.* average number of contour changes per minute). For example, after an ascending interval, a change in pitch direction could be either a descending interval or unison.

Other measures were derived from the literature on ID speech. To examine whether expanded contours prevail in lullabies as they do in ID speech (*e.g.* Fernald and Simon, 1984), the song range in semitones was calculated as was the average interval size (in semitones) between successive pitches (unison counted as zero). Similarly, to determine whether ID songs have higher pitch and shorter phrases than AD songs, we calculated the median pitch and mean length of phrase in all songs. The median pitch or pitch at which half the tones in the song were higher and half lower was tabulated. A median pitch of C_4 or middle C was arbitrarily assigned the number 28. Songs with a higher or lower median pitch were assigned numbers greater or lesser than 28 corresponding to the number of semitones above or below C_4. Thus songs with a median pitch of D_4 or G_3 would be assigned the numbers 30 and 23, respectively. The mean length of phrase was defined as the average number of tones per phrase. The rate of singing was also calculated as the average number of tones sung per minute.

Participants in Trehub *et al.*'s (in press) study had cited the soothing quality of the melody, over and above simplicity, as a lullaby cue. When ID speech is used for comforting infants, descending contours predominate in contrast to the ascending contours of arousing ID speech (Fernald, in press). On the assumption that lullabies would be soothing songs, we calculated the proportion of descending intervals.

Method

All calculations were performed on the written transcriptions of the melody line by one of the authors (A.U.). There were eight measures including median pitch, pitch range (lowest to highest pitch), rate of contour change (mean number of contour changes per minute), descending intervals (proportion), rate (average number of tones per minute), phrase length (average number of tones per phrase), average interval size and pitch variety (number of different pitches). Inter-rater reliability on these measures was ascertained by having eight undergraduate ethnomusicology students transcribe 16 songs from the cross-cultural sample. The songs included two lullaby/adult song pairs in which the lullabies had been consistently identified (Pygmy, Creek Indian) and two lullaby/adult song pairs in which the adult songs had been consistently misidentified (Samoan, Ukrainian) (Trehub *et al.*, in press). The transcribers were instructed to indicate phrase boundaries and the exact starting pitch of the songs. These ethnomusicology students were uninformed about the identity of the lullabies and comparison songs.

Average scores on each of the eight measures were calculated for the 16 transcriptions of the ethnomusicology students and compared to scores from the investigator's transcription. Differences between transcriptions (students' *v.* investigator's) were small, for the most part. Transcriptions differed by an average of one semitone in the case of pitch range, two semitones for median pitch and less than one semitone for average interval size. The number of different pitches differed by an average of 2·4, mean tones per phrase by 1·6 and proportion of descending intervals by ·027. Finally, transcriptions differed in rate by an average of 3·8 tones per minute and in number of contour changes by 7·2 changes per minute.

Results

To determine whether the 28 lullabies in the cross-cultural sample differed from their matching songs, scores on the eight measures were compared but were not found to differ significantly, Hotelling's $T^2 = {\cdot}436$, $p < {\cdot}42$. These lullabies, then, were not structurally distinct from the other songs.

To determine whether the eight structural measures predicted adult listeners' lullaby judgements (as opposed to the actual status of songs), scores on the eight measures for the lullabies and matching songs were entered into a multiple regression analysis. The percentage of Trehub *et al.*'s (1991) listeners who correctly identified the lullaby in each of the 28 pairs of song excerpts was the dependent variable. The 16 independent variables were the scores on the eight structural measures for the lullabies and matching adult songs. The multiple regression analysis was executed with forced entry of all independent variables. Scores on these structural measures were predictive of the accuracy of lullaby identification, $F(16,28) = 2{\cdot}67$, $p < {\cdot}052$. To ascertain which structural variables were the strongest predictors of lullaby identification, a stepwise multiple regression analysis was executed. This analysis revealed that three structural variables accounted for 49 per cent of the variance in correct lullaby identification: the proportion of descending intervals in the lullaby (DL); the median pitch of the matching adult song (MPA) and the number of contour changes per minute in the lullaby (CCL). The resultant regression equation

$$\% \text{ Correct Lullaby Identification} = 92{\cdot}4 + 1{\cdot}35\ (\text{DL}) - 2{\cdot}26\ (\text{MPA}) - {\cdot}20\ (\text{CCL})$$

indicates that the accuracy of lullaby identification was positively related to the proportion of descending intervals in the lullaby, negatively related to the median pitch of the matching adult song and negatively related to the number of contour changes per minute in the lullaby.

Discussion

The transcribed lullabies and matching adult songs did not differ on the structural measures, suggesting that lullabies are not characterised by features that distinguish ID from AD speech. A number of factors may be implicated in this outcome. The use of recordings as a source of songs obscured the actual context of performance. One wonders, then, whether the singers were providing functionally appropriate renditions of the lullabies or were merely complying with the researcher's request. In the latter case, particularly if no infant were present, the singer may have omitted critical lullaby features such as a soothing quality or slow tempo. The context of performance and resultant performing style may be even more important than the materials performed. For example, Hilger (1952) described Arapaho mothers' and grandmothers' occasional use of traditional dance songs as "lullabies" (p. 39). Similarly, Sands and Sekaquaptewa (1978) have distinguished soothing from admonishing lullabies, the former for co-operative infants and the latter for recalcitrant infants. In the case of ID speech, an infant's presence is known to be critical for the full range of vocal adjustments (Papoušek *et al.*, 1987). For ID song and lullabies in particular, the infant's presence and appropriate state may be essential.

The method of choosing comparison songs may have resulted in atypical adult songs. Recall that comparison songs were chosen to approximate the lullaby in tempo and singing style. This may have led to the inadvertent elimination of common adult songs that differed substantially from lullabies.

Nevertheless, some structural features of lullabies and adult songs were associated with the accuracy of lullaby identification. In line with the notion of lullabies as soothing or lulling songs, the proportion of descending intervals in lullabies was predictive of adults' correct identification. The greater the proportion of such descending intervals, the greater the likelihood that adults judged such songs as lullabies. This finding parallels the descending contours of soothing ID speech (Papoušek and Papoušek, 1981; Fernald, in press).

The lower the median pitch of the non-lullaby comparison, the more likely adults correctly rejected it as a lullaby. Again, this finding is consistent with the lower pitch of AD over ID speech (Fernald and Simon, 1984; Papoušek *et al.,* 1985) and, by extension, of AD over ID song. Finally, contour complexity was negatively associated with lullaby choices, songs incorporating fewer contour changes being more likely to be judged as lullabies.

Trehub *et al.* (1991) found that lullabies are perceptually distinct from adult songs and suggested that melodic form may provide distinguishing cues. Further support for their contention is provided by our finding that listeners identified lullabies more accurately if they contained more descending contours and fewer contour changes and if the matching songs had lower median pitch. It is possible that the use of contextually appropriate lullabies (*i.e.* for purposes of lulling) and typical adult songs would exemplify these features to an even greater extent than the songs in the present sample.

Overall, the results of the four experiments indicate that adult listeners perceive lullabies or infant songs from different cultures as simpler than other songs from the same cultures. Moreover, they are highly confident about their judgements of simplicity. In addition, their classification of songs as lullabies seems to be influenced by melodic features that parallel some prosodic features of infant-directed speech.

These findings raise provocative questions for further research. For example, are functional lullabies (*i.e.* those actually sung to sleepy infants) structurally distinct from other songs or from the same songs sung in other contexts? How does an infant's presence influence the performance of a song, notably the melody, rhythm and voice timbre? To address questions such as these, we are currently recording informal singing to infants in different cultural communities locally and abroad. We are also analysing a large collection of North American Indian songs, which will permit greater representativeness of the lullabies and adult songs. If we succeed in identifying common structural features in these songs, we must then establish whether these features are salient for infant listeners. To this end, we are attempting to acertain the musical preferences of infants and the structural features underlying such preferences.

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INFANT BEHAVIOR AND DEVELOPMENT **16**, 193–211 (1993)

Adults Identify Infant-Directed Music Across Cultures

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Paired excerpts of lullabies and comparison songs from different areas of the world were presented to Western adult listeners, who were required to identify the lullaby in each pair. In Experiment 1, when presented with original field recordings, adults successfully differentiated the lullabies from the other songs. In Experiment 2, this effect was replicated with a more diverse sample of listeners. In addition, feedback about correct performance failed to improve the accuracy of lullaby identification. In Experiment 3, adults successfully identified the lullabies even when all songs were electronically filtered to remove the words. In Experiment 4, adults were unsuccessful in lullaby identification when the melodies were synthesized to remove residual cues associated with voice quality. However, performance on the synthesized materials was correlated with performance on the original materials. Parallels between infant-directed music and infant-directed speech are noted.

infants music songs lullabies

The lullaby is a "soothing refrain used to please or pacify infants" (*Oxford English Dictionary*, 1989), "a type of song sung by mothers and nurses the world over to coax their babies to sleep" (Brakeley, 1950, p. 653). The relative paucity of psychological and musical research on lullabies is surprising in the context of this ubiquitous vocal genre. Its neglect in scholarly musical circles is sometimes attributed to the dismissal of lullabies as unimportant, being the sole prerogative of mothers (B. Cass-Beggs & M. Cass-Beggs, 1969). Moreover, gender inequities within particular cultures have sometimes led women's music (usually laments and lullabies) to be excluded from consideration as music and therefore from the scrutiny of outside scholars (Sakata, 1987). For example, some Afghani (Hazara) songs that community members identify as lullabies ("stylized lullabies") are sung exclusively by men, sometimes to the accompaniment of an instrument played only by men (Sakata, 1987). These songs are not *for* babies but are rather *about*

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babies. It is the women, however, who actually sing to infants, lulling them in a distinctive singing style ("functional lullabies," Sakata 1987).

The available information on lullabies stems largely from anthropological sources, where interest has centered principally on lullaby texts in individual cultures (e.g., Sands & Sekaquaptewa, 1978; Spitz, 1979). Nevertheless, such work has provided provocative clues to the musical form of lullabies and more extensive description of their social function. For example, the lullabies of the San Blas Cuna Indians of Panama (McCosker, 1974) differ from other songs in their more liberal textual and melodic improvisation. Cuna children hear lullabies several times a day from birth until 4 years of age. Lullabies, sung exclusively by women, provide an introduction to the social customs of this matriarchal society. The sung text, sometimes accompanied by a gourd rattle (Densmore, 1925; Vandervelde, 1940), is highly repetitive, featuring frequent word reduplication, sequence repetition, and the repeated use of common words. Moreover, the text is incorporated into repetitive rhythmic patterns.

In contrast to other Cuna songs, which are of fixed length, Cuna lullabies are of indefinite length, continuing until a child is quieted or a singer interrupted. Melodically, these lullabies have relatively few pitches (three main tones), a narrow pitch range, and repeating pitch contours. Overall, these melodic, rhythmic, and textual features confer a distinctive style as well as function to Cuna lullabies compared with Cuna songs in general.

Although descriptions of lullaby form and function are considerably more sparse for other cultures, features characteristic of Cuna lullabies are often encountered. For example, the Vietnamese lullaby (Cong-Huyen-Ton-Nu, 1979) is also a vehicle for enculturation, its text outlining Vietnamese values and advocating good conduct. The notion is that Vietnamese infants, too young to understand the verbal message, will ultimately internalize the familiar melody, at which time they will attend to the meaning. Moreover, early and frequent exposure to lullabies is considered to ensure a strong and enduring emotional response to these songs well into adulthood.

In a description of Hazara lullabies (i.e., those actually sung to infants) in the mountains of central Afghanistan, Sakata (1987) noted "the use of words or sounds for the effect of the sound rather than for the sake of the meaning" (p. 91), including the deliberate alteration of words to produce mellifluous sounds. Indeed, humming and common nonsense syllables such as *loo-loo, lo-lo, lulla, ninna, nana, bo-bo, do-do*, and other untranslatable vocables pervade the lullabies of very different language groups (Brakeley, 1950; Brown, 1980; B. Cass-Beggs & M. Cass-Beggs, 1969). Similarly, smooth repeating contours, narrow pitch range, strong tonal center, extended vowels, and repetitive rhythms have been noted in conjunction with Norwegian (Kortsen, 1970), Vietnamese (Cong-Huyen-Ton-Nu, 1979), Hazara (Sakata, 1987), Columbian (List, 1973), and North American Indian (Curtis, 1921; Hilger, 1952; Sands & Sekaquaptewa, 1978) lullabies.

Some of these features are reminiscent of infant-directed speech, which is characterized by smooth, simple pitch contours, rhythmicity, and repetitiveness (Fernald, 1984; Fernald & Simon, 1984; Fernald et al., 1989; M. Papoušek, H. Papoušek, & Haekel, 1987; Stern, Spieker, & MacKain, 1982). Although expanded pitch contours and high pitch are often viewed as the most salient and distinctive features of infant-directed speech (e.g., Fernald & Simon, 1984; Fernald et al., 1989; Grieser & Kuhl, 1988), these features are especially characteristic of arousing, attention-getting utterances (Fernald, 1989; Stern et al., 1982). By contrast, soothing infant-directed utterances are usually marked by low, falling contours, a narrow pitch range, and a gentle tone (Fernald, 1989; Fernald & Simon, 1984; M. Papoušek & H. Papoušek, 1981; M. Papoušek, H. Papoušek, & Symmes, 1991). Nevertheless, soothing maternal utterances have received less descriptive and experimental attention than have playful utterances despite the obvious importance of soothing in infant care.

Adults are aware of some but not all of their vocal modifications in interacting with infants (Fernald & Simon, 1984; H. Papoušek & M. Papoušek, 1987). The consequences of such modifications seem to be obvious, in any case, to adult listeners, who readily distinguish maternal prosody associated with approval, attention bid, prohibition, comfort, and game playing (Fernald, 1989). It is notable that similar communicative categories are less prosodically distinctive in adult-directed speech, except for the category of comfort or soothing vocalizations (Fernald, 1989). It is not clear, however, whether soothing infant-directed vocalizations are perceptually distinct from functionally similar adult-directed vocalizations.

Although descriptions of lullabies within a number of cultures point to some common qualities, it is not known whether any of these qualities is universal and, therefore, whether infant-directed music or lullabies in particular would be recognizable in cultures with widely disparate languages and musical systems. Numerous attempts to document musical universals have met with very limited success (Harwood, 1976). Nevertheless, just as common structural features are absent in adult-directed speech but present in infant-directed speech across cultures (Fernald et al., 1989), such universals may emerge in infant-directed music.

Available translations of lullaby texts indicate that there is considerable variation across cultures in the verbal message that accompanies the lulling melody (Brakeley, 1950; B. Cass-Beggs & M. Cass-Beggs, 1969). Commonly, the singer reassures or praises the infant, sometimes promising rewards for falling asleep (e.g., a mocking bird), sometimes prophesying a bright future (e.g., becoming a harpooner or president, avenging an old vendetta); Brakeley, 1950). In some cases, she accompanies her praise with threats of punishment for staying awake (B. Cass-Beggs & M. Cass-Beggs, 1969; Curtis, 1921) or a description of nasty events, including kidnapping and death, that might befall the sleeping infant (Spitz, 1979). Thus, frightening bogeymen (human and animal monsters) appear frequently in lullabies as do benign sandmen (*La Dormette, Willie Winkie*). For example, a German lullaby warns of sheep that will nip the child's toes if he does not sleep and a French lullaby substitutes a werewolf (*un loup garou*) (Spitz, 1979). Similarly, *El Coco*, an evil Spanish Moor, devours crying babies, and no bad behavior escapes *Hotei*, a Japanese monster with eyes in the back of his head (Brakeley, 1950). In still other instances, the lullaby singer bemoans her lot in life, including her irresponsible husband and the lack of freedom to do as she pleases (B. Cass-Beggs & M. Cass-Beggs, 1969; Spitz, 1979). What remains unclear, however, is whether the emotional tone of the text is reflected in the melody or whether the plaintive, joyful, or threatening message can coexist with sweet singing. This issue is difficult to disentangle because most of the translated materials are available in written as opposed to recorded form.

Our interests related principally to the possibility of cross-cultural similarities in the infant-directed songs of diverse cultures. The existence of such similarities would be suggestive of a biological basis for the communication of emotion as expressed in infant-directed singing. As a first step toward this broad objective, we sought to ascertain whether adult listeners could distinguish lullabies or soothing forms of infant-directed singing from other songs in the same culture. To this end, we assembled 30 lullabies and comparison songs from widely different cultures and geographic regions. Each lullaby was paired with another song (not infant-directed) that was similar in tempo and musical style, two potentially obvious cues. The relatively slow tempo of comparison songs raises the possibility that these songs were also soothing and therefore less distinct from lullabies than typical (adult) songs. Nevertheless, adult listeners were required to judge, on a forced-choice basis, which song in each pair was intended for infants. The forced-choice procedure was selected because of the widely divergent musical styles represented in this cross-cultural collection of songs.

EXPERIMENT 1

Method

Subjects. The participants were 40 adults (28 females, 12 males, 18–50 years old) from the university community, about half (48%) of whom had no formal training in music. The others reported music lessons spanning a few months to over 8 years.

Materials. The 30 lullabies were obtained from recorded collections (see Appendix) representing a variety of cultures and geographic regions (African, Asian, European, and North American Indian). For our purposes, a song designated as a lullaby by a scholar of that musical culture was considered to be a lullaby. Most of the lullabies (57%) were solo renditions from the field recordings of various scholars. For 28 lullabies, an adult comparison song was selected from the same group of collected materials (i.e., from a single researcher or research team). Not only did the comparison songs come from the same culture, but they were also selected, to the extent possible, for similar tempo, singing style, and orchestration. For two lullabies, however, a matching children's song was used because no available adult song met the aforementioned criteria of similarity. There were 14 song pairs that were European in origin or musical style (e.g., Norwegian, Czechoslovakian, Irish, Russian), the remaining songs emanating from cultures with an oral tradition (i.e., no musical notation system) and a musical style that was much less familiar to Western listeners. In nine pairs of songs, there was instrumental accompaniment and two additional pairs (Balinese, Japanese) had instrumental music without voice. In a few instances, the lullaby or comparison song was unaccompanied but the other was not. In five pairs, the sex of the singer differed across song types, the lullaby being sung at times by a male and at times by a female. None of the songs was sung in English.

Four audiotapes were prepared, each including 20-s excerpts of each pair of songs. Tapes 1 and 2 contained excerpts from the beginning of each song, with the order of presentation of song pairs and the position of the lullaby in each pair (first or second) randomized. Tapes 3 and 4 contained 20-s excerpts (order also randomized) from the middle section of each song. Each excerpt on the tapes was preceded by an announcement of the trial and excerpt number ("Number 1a", "Number 1b"). A 12-s silence followed each pair.

Procedure. Participants were randomly assigned to one of the four tape conditions, resulting in 10 subjects for each condition. They were tested individually in a quiet room containing an audiotape player (TEAC V-300), amplifier (Realistic SA10), and two loudspeakers (Radio Shack NOVA-6). They were told that they would hear 30 pairs of musical excerpts from around the world, one excerpt being a lullaby or song for infants, the other an adult song. For each pair, they were to identify the infant song, recording all responses and judgments on a standardized response sheet. After listening to the 30 pairs of excerpts, they were asked to list the criteria used in selecting the lullabies.

Results and Discussion

Lullaby Identification. The mean proportion of correct identifications was .63, which significantly exceeded chance performance, $t(39) = 11.05$, $p < .0001$. To examine the possible role of age, sex, and musical training, these variables were entered into a multiple regression analysis. Age was categorized into five ranges ($\leq$ 19, 20–29, 30–39, 40–49, $\geq$ 50) and musical training into three (none, $\leq$ 7 years, $\geq$ 8 years). None of these variables was significantly related to the accuracy of lullaby identification.

Although lullaby identification overall was significantly greater than chance, performance was far from perfect. It was, therefore, of interest to determine whether some lullabies were more readily identified than others or whether performance was roughly equivalent across lullabies. An analysis of variance (ANOVA) with repeated measures revealed significant performance differences across lullabies, $F(29, 1131) = 9.41$, $p < .0001$. The effects of Western musical style, instrumental accompaniment, children's song as comparison, absence of singing, and sex of singer were examined by means of a multiple regression analysis. None of these factors was significantly predictive of the accuracy of lullaby identification.

It was apparent that listeners exhibited some consistency in their identification and misidentification of lullabies. For example, they were highly successful (.93 proportion correct) in identifying four lullabies (Pygmy, Czechoslovakian, Irish, and Creek Indian) and highly unsuccessful (.29 proportion correct) with four others (Samoan, Ukranian, Ecuadorian, and Chadian). Recall that Tapes 1 and 2 had excerpts from the beginning of each song (in different order) and Tapes 3 and 4 had excerpts from the middle. In fact, lullaby identification differed as a function of excerpt location (beginning vs. middle), with song beginnings (.67) identified more accurately than middles (.60), $t(38) = 3.42$, $p < .002$.

Not only were some lullabies systematically identified, but some other songs were systematically misidentified as lullabies. This suggests that listeners may have some abstract conception of a lullaby that defines what a lullaby "should be" rather than what it is, a conception that is relatively culture-free (Trehub & Unyk, 1991). In the absence of feedback, however, this conception may have misled them at times, resulting in less than optimal performance. It is possible, then, that the provision of feedback might enhance performance by guiding listeners in the appropriate use of potential identifying features.

Criteria for Lullaby Identification. A content analysis of listeners' reported (written) criteria for lullaby identification revealed the following frequently noted features together with the percentage of participants reporting each: repetitiveness (43%), soothing quality (38%), softness (28%), simplicity (28%), and slow tempo (25%).

Repetitiveness, soothing quality, and softness, all frequently noted features, figure prominently in descriptions of lullabies in a number of different cultures (e.g., McCosker, 1974) and in descriptions of soothing infant-directed speech (Fernald, 1989; Fernald & Simon, 1984). Simplicity, which was noted by 28% of participants, and repetitiveness by 43%, are in line with the greater simplicity of infant-directed over adult-directed speech (e.g., Fernald & Simon,1984). What is surprising, however, was the mention of slow tempo by 25% of participants. Recall that comparison songs were selected partly on the basis of similar tempo so that tempo differences were unlikely to have had any systematic association with lullabies. In fact, a precise tabulation of the number of notes per minutes revealed no differences between the categories of lullabies and comparison songs. It may be, then, that qualities arising from the repetitive, soft, and soothing nature of the music created the illusion of slow tempo. Alternatively, aspects of the phrasing of lullabies, such as the distinctive marking of phrase boundaries (e.g., by pitch or temporal accents), may have facilitated the parsing of such songs (Krumhansl & Jusczyk, 1990), promoting the perception of slow tempo. In Cuna lullabies, for example, most phrases end on the lowest scale note and with the word *maloye* (McCosker, 1974, p. 55). This marking of phrase boundaries in infant-directed music parallels the prosodic marking of important syntactic boundaries in infant-directed speech (Hirsh-Pasek et al., 1987; Kemler Nelson, Hirsh-Pasek, Jusczyk, & Wright Cassidy, 1989).

In sum, the results of this experiment indicate that adult listeners reliably but imperfectly identify infant-directed music from different cultures. Moreover, lullaby identification seems to be independent of listeners' musical training or their familiarity with the musical style in question. Despite a lifetime of exposure to Western music and Western culture generally, adults were no more proficient at identifying lullabies of European origin than those originating in vastly different societies and music cultures. To the extent that listeners were able to identify lullabies, then, it was not musical knowledge, explicit or implicit, that guided such identification. Thus, this experiment establishes infant-directed singing as a topic worthy of further psychological investigation.

EXPERIMENT 2

The purpose of this experiment was twofold. First, we sought to replicate the lullaby identification findings of Experiment 1 with a sample of listeners outside the university community. Second, we evaluated the effect of trial-by-trial feedback on the accuracy of identification. In other experimental contexts with indistinct cues (Trehub, Schneider, Thorpe, & Judge, 1991), such feedback is often used to improve performance.

Method

Subjects. The subjects were 84 adults (46 females, 38 males, 18–50 years old), about half (54%) of whom had no formal training in music.

Materials and Procedure. The materials were the same as in Experiment 1, except that only excerpts from song beginnings were used (Tape 1). Participants were randomly assigned to feedback (n = 43) or no-feedback (n = 41) conditions. They were tested individually in a quiet room in their own home or in one of several testers' homes. The experimenter remained in the test room for the duration of the test session. As before, participants were told that they would hear 30 pairs of musical excerpts from around the world and that one excerpt in the pair was a lullaby or song for an infant and the other was an adult song. After listening to each pair, they indicated to the experimenter which excerpt was the infant song. In the feedback condition, participants were told, immediately after responding (choice and confidence rating), whether or not their choice was correct.

Results and Discussion

The mean proportion of correct identifications was .66 for the feedback condition and .65 for the no-feedback condition, this performance being highly similar to the comparable condition (song beginnings) from Experiment 1 (.67). Performance in both conditions significantly exceeded chance levels, $t(42) = 13.13$, $p < .0001$, for the feedback group and $t(40) = 13.25$, $p < .0001$, for the no-feedback group, but did not differ from one another, $t(82) = .53$.

In Experiment 1, four lullabies had been consistently identified correctly. The proportion of listeners correctly identifying these lullabies across conditions in this experiment was .86. On the other hand, the four lullabies consistently rejected in Experiment 1 were correctly identified by only 25% of listeners. Independent ratings of how appropriate each of the four consistently identified and four consistently rejected lullabies was as a song for soothing infants (on a 7-point scale) revealed substantially higher ratings for the former over the latter. These ratings indicate that the identifiability of lullabies is largely derived from properties of the lullabies themselves as opposed to features of the comparison songs.

In short, the results of this experiment replicate and extend the findings of Experiment 1. First, they add weight to the contention that adults can distinguish foreign lullabies from other songs when the comparison songs are matched in tempo and general singing style. Moreover, they reinforce the conclusion that listeners have some conception or mental representation of lullabies, which facilitates their identification of most lullabies from widely different cultures. Second, these findings indicate that simple trial-by-trial feedback about lullaby identification performance does not lead to improved performance in the time frame used here. The ineffectiveness of such feedback makes it unlikely that very simple cues such as pitch level or pitch range underlie lullaby identification. Rather, the highly varied nature of the materials may have made it especially difficult to apply information gained from any song pair to subsequent song pairs. In making their judgments, adults may simply adopt a global, intuitive strategy, the basis for which remains unclear.

EXPERIMENT 3

Although listeners in Experiments 1 and 2 were relatively consistent in distinguishing infant-directed songs from other songs, the cues underlying these judgments are not known. It is possible that the lyrics of the songs, the voice quality of the singer, or aspects of the melody, either singly or in combination, provided potential cues about the intended audience. Many researchers consider infant-directed speech to be syntactically, semantically, and phonologically simpler than adult-directed speech (Malsheen, 1980; Snow, 1977; but see Newport, 1977). It is the intonation contour, however, that seems to be most salient for infant listeners (Fernald, 1992; Fernald & Kuhl, 1987). The melody of lullabies, which is the counterpart of intonation in spoken messages, may play a comparable role. Nevertheless, its independent contribution to lullaby identification could not be derived from Experiments 1 and 2.

The lullaby lyrics, although sung in foreign languages, still embodied potential cues to the identity of the songs. For example, repetition of individual words or word sequences, repetitive nonsense syllables, extended vowels, onomatopoeia, and diminutives are found in lullabies of the Cuna (McCosker, 1974), Yuma (Curtis, 1921), Mohave (Devereux, 1948), Arapaho (Hilger, 1952), Chippewa (Hilger, 1951), Hopi (Sands & Sekaquaptewa, 1978), Spanish (List, 1973; Raz, 1956), French (Mills, 1963), Scandinavian (Karpeles, 1956), Rumanian (Suliteanu, 1975), Caribbean (Morse, 1958), African (Thomas, 1950), and Asian (Tsugawo, 1959) cultures. It is possible, then, that the lyrics in this sample of lullabies provided comparable cues.

To ascertain whether infant-directed music was distinguishable from other music in the absence of the lyrics, the 30 pairs of excerpts from Experiment 1 (beginnings only) were electronically filtered so that the words became unrecognizable. The filtered songs still retained much of their original melodic, rhythmic, and vocal quality.

Method

Subjects. The subjects were 20 adults (11 females, 9 males, 18–29 years old) from the university community, about half (55%) of whom had no formal training in music.

Materials and Procedure. The 30 pairs of excerpts from Experiment 1, Tape 1, were low-pass filtered at 500 Hz (i.e., frequencies above 500 Hz eliminated), with a roll-off of 30 dB per octave. This resulted in the elimination of the words while preserving the melody and much of the rhythmic information and voice quality. The procedure was the same as in Experiment 1, with the exception that all participants listened to the same tape.

Results and Discussion

The mean proportion of correct identifications was .60, which significantly exceeded chance performance, $t(19) = 4.33$, $p < .001$. Performance on the filtered materials of this experiment was compared to performance by similar (i.e., university) listeners on the unfiltered original version (Experiment 1, Tapes 1 and 2). Not surprisingly, the filtering of materials significantly depressed performance, $t(38) = 2.79$, $p < .01$. Nevertheless, performance on the filtered and unfiltered versions was highly correlated, $r = .74$, $p < .001$. Filtered versions of the four well-identified and poorly identified lullabies from Experiments 1 and 2 were identified by 74% and 36% of listeners, respectively.

It is impressive that, even with the words eliminated, the lullabies in this cross-cultural sample were still identifiable at above-chance levels. This parallels adults' ability to identify broad categories of intended meaning (e.g., approval, prohibition, comfort) in filtered speech (Fernald, 1989). Nevertheless, the reduction in identification accuracy implies that the lyrics of foreign lullabies contribute to listeners' ability to recognize the intended audience. Moreover, features that survive the filtering process, such as melodic form and aspects of voice quality, are likely to play a key role, but their role was inseparable in this experiment. Also, the continuing distinctiveness of the four well-identified lullabies implies that they may embody important melodic and vocal features that guide listeners' judgments.

EXPERIMENT 4

The songs of Experiment 3 had been transformed by electronic filtering, a process that removed the words but left many other features intact, including the melody (i.e., pitch and rhythmic structure) and some aspects of vocal quality. The purpose of this experiment was to examine the exclusive role of melody in lullaby identification. Would adult listeners perceive a melody as soothing and sleep-inducing even when it was stripped of the soothing voice quality of the singer? To examine this question, we generated a synthesized version of the lullabies and comparison songs with uniform (piano) timbre. To do so, we transcribed the melody line from the original recordings, eliminating any accompaniment and all of the vocal embellishments. Each synthesized melody was prepared by using the transcriptions in conjunction with repeated listening to the original recorded version. In this way, we attempted to match the dynamic structure of the original as closely as possible. Nevertheless, the resulting lullabies and comparison songs sounded much more similar than they had originally, not only within pairs but also across pairs. Indeed, much of the distinctive "foreign" quality of many of the songs was now absent.

Method

Subjects. The subjects were 20 adults (12 females, 8 males, 18–39 years old) from the university community, about half (45%) of whom had no formal training in music.

Materials. Tapes 1 and 2 from Experiment 1 were used as the basis for creating two additional tapes of paired excerpts of lullaby–nonlullaby comparisons. The melody line from each of the 20-s paired excerpts was transcribed and then performed in real time on a touch-sensitive Casio HT-6000 keyboard connected through a MIDI interface to a Yamaha TX-816 tone generator set at a piano timbre. The pitches and durations of tones and overall tempo were matched as closely as possible to the original recordings. These paired excerpts were recorded on two tapes, corresponding to the order of excerpts on Tapes 1 and 2 of Experiment 1. Two pairs of instrumental excerpts from the original tapes were excluded because their melodic form could not be captured with a single melody line.

Procedure. The procedure was the same as in Experiment 1, with listeners assigned randomly to Tapes 1 or 2.

Results and Discussion

The mean proportion of correct identifications was .51, which did not differ from chance performance, $t(19) = .91$, $p < .38$. Nevertheless, the well-identified and poorly identified lullabies were still distinct, being identified by 74% and 21% of listeners, respectively. Despite the fact that listeners did not reliably distinguish lullabies from other songs when the materials were stripped of many qualities associated with performance in context, it is possible that they still used strategies similar to those used by listeners in the previous experiments. A Pearson product-moment correlation revealed a significant relation between the average proportion correct on the original versions of the 28 lullabies (from Tapes 1 and 2 in Experiment 1) and the synthesized versions in this experiment, $r = .52$, $p < .01$. Finally an ANOVA on lullaby identification scores across the 28 pairs of songs in the original (Experiment 1, Tapes 1 and 2), filtered (Experiment 3), and synthesized (Experiment 4) versions (beginnings only) revealed a highly significant effect of stimulus version (original, filtered, synthesized), $F(2, 57) = 15.3$, $p < .0001$. Newman-Keuls tests indicated that performance on the original version ($M = .67$, range = 57–82) significantly exceeded performance on the filtered version ($M = .60$, range = 37–77), which, in turn, exceeded performance on the synthesized version ($M = .51$, range = 43–71).

In sum, the results of this experiment indicate that the total elimination of voice cues degrades lullaby identification performance beyond that associated with the elimination of lyrics. In fact, lullaby identification fell to chance levels on the synthesized songs. Nevertheless, performance still remained good on lullabies associated with the best performance in Experiments 1, 2, and 3. Moreover, the correlation of performance on synthesized and intact materials implies that some melodic cues to the identity of lullabies were still operative in these very reduced versions of the songs.

GENERAL DISCUSSION

It is clear from these experiments that the category of music known as lullabies has psychological as well as musical reality, at least for adult listeners. This hypothesis was subjected to a particularly stringent test in this investigation. In the course of matching the tempo of lullabies and comparison songs, we were forced to exclude many adult songs, which tended to be much faster paced than infant songs. It is possible, then, that the restriction of tempo likewise restricted the mood and function of comparison songs. As is generally the case for recorded folk music (i.e., music in the oral tradition) from other cultures, there was limited documentation of song function. There is evidence, however, of a cross-cultural category of adult-directed comfort songs, including those for healing the sick. For example, the Menominee Indians (materials from 1925–1929) sing healing songs with descending melodies, preferring to sing them in the night because quiet and freedom from interruption are considered favorable for healing (Densmore, 1972a). Similarly, one Yuma healing song (material from 1922) is described as monotonous, although cheerful, having short phrases separated by pauses (Densmore, 1972b). These characteristics seem equally suitable for promoting sleep and are noted, as well, in descriptions of native lullabies (e.g., Curtis, 1921; McCosker, 1974).

Perhaps slow, adult-directed songs share the gentle, soothing tone of lullabies, aimed as they are calming the distressed (e.g., sick, mourning, jilted) listener or touching the heart of a loved one. It is possible, then, that infant-directed songs, in general, are much more distinct from other songs than is suggested by this examination of the subcategory of soothing songs known as lullabies.

We had no information about whether the specific lullabies in this investigation were actually recorded in appropriate contexts (i.e., lullabies for actual lulling, or "functional lullabies"), or whether they were usually sung to infants but not in this instance. It is likely that the performing context has considerable impact on song features just as infant-directed speech differs in actual and simulated contexts (M. Papoušek et al., 1987). No doubt various aspects of the infant's state and demeanor would influence the manner in which a song unfolds over time. These influences may be mediated by the singer's experienced emotions and by the singer's explicit or implicit attempts to alter the infant's state and corresponding behavior. There are indications, for example, that facial gestures (e.g., smiling) and body movements alter the shape of the vocal tract, the acoustic characteristics of a song, and the singer's emotional expressiveness (Fonagy, 1981; Laver, 1980; Sundberg, 1973, 1982). Perhaps these gestures confer a distinctive timbre or voice quality on materials sung to infants. In future research, it should be possible to specify the vocal alterations and acoustic consequences of singing the same materials to infants compared to others. Only then will it be possible to separate the contributions of song structure and performance features to the identification of infant-directed songs in general or lullabies in particular.

Adults' consistency in identifying and misidentifying lullabies provides evidence that they associate complex auditory patterns such as songs with complex social functions such as caretaking. Moreover, the irrelevance of the listener's musical training or familiarity with the musical culture is indicative of cross-cultural universals in the perception or interpretation of songs. A subset of songs seemed to match adults' conception or stereotype of soothing infant-directed song, the as yet undetermined features of this stereotype being applicable to widely disparate musical materials and styles. What was remarkable, moreover, was that lullaby identification remained above chance under degradation by filtering and that performance on the most degraded (i.e., synthesized) materials was still correlated with that on the original materials. It is unclear whether the relevant cues simply survived such degradation or whether the presence of multiple cues ensured the retention of some of these cues under various transformations.

In an attempt to identify acoustic features that differentiated the lullabies from the comparison songs, Unyk, Trehub, Trainor, and Schellenberg (1992) conducted a musicological analysis that included measurements of pitch, pitch range, phrase length, contour complexity, and contour type. None of these features, either separately or in combination, reliably distinguished the lullabies from the nonlullabies. However, some features were associated with the accuracy of lullaby identification performance in these experiments. Specifically, listeners were more likely to accept as lullabies songs with prominent descending contours and to reject those with many contour changes. In other words, listeners were in considerable agreement on the defining features of soothing infant-directed songs, even if the resulting category excluded some lullabies and included some adult songs.

The most frequently cited criterion for lullaby selection, repetitiveness, captured a clearly perceptible quality in the consistently identified lullabies. Nevertheless, this quality was particularly difficult to quantify. In searching for repetition, is exact repetition neccessary or would near repetition suffice? Should one search for repetition of individual notes or of musical phrases? If the latter, how could one reliably demarcate phrases in foreign musical systems? To illustrate the relative repetitiveness of the lullabies, we generated a visual schematization of the songs by plotting the melody line of three consistently identified lullabies together with the relevant comparison song from each culture (see Figure 1). Inspection of these schematic representations reveals substantial repetitiveness in the lullabies. Some repetitiveness was also apparent in the comparison songs, but these repetitions occurred over a larger time frame. Thus, although global properties such as repetitiveness may play a key role in lullaby identification, they are not readily amenable to parametric analyses.

Adults' modest success in identifying the intended function of songs parallels their success in identifying the affective meanings embodied in infant- and adult-directed intonation patterns (Fernald, 1989). In the case of speech, adult listeners have been presented with highly contrastive meanings and intonation/acoustical forms from their own culture such as those associated with stereotyped solicitations of attention, sudden prohibitions of an action, and soothing. By contrast, the forms embodied in the foreign song pairs in

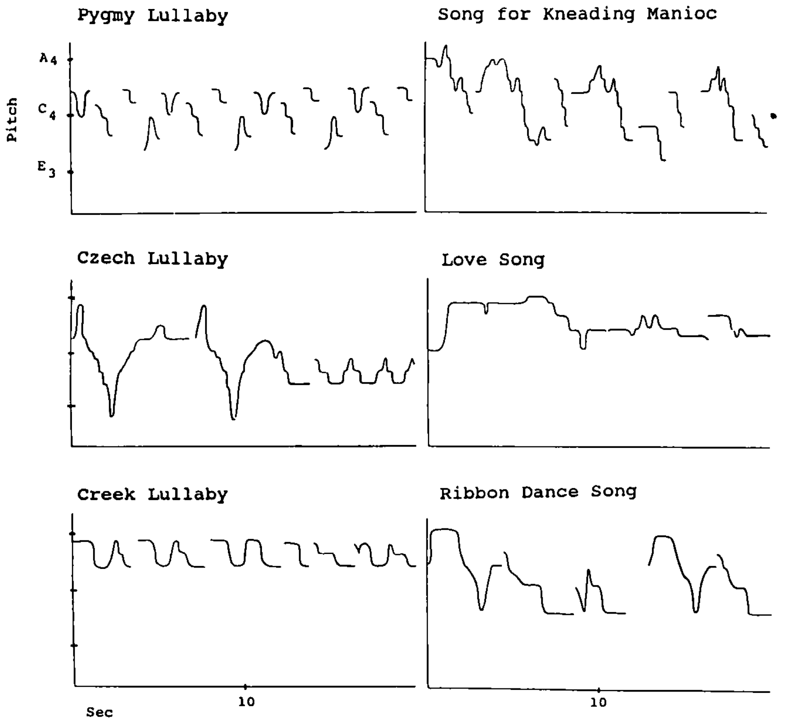

Figure 1. The pitch of the melody line is plotted against time for three consistently identified lullabies and corresponding comparison songs. The letters (A, C, E) refer to musical note names and the numerical subscripts, to the relevant octave (C_4 is middle C and E_3 is in the octave below). The fundamental frequencies associated with A_4, C_4, and E_3 are 440, 262, and 165 Hz, respectively.

these experiments were much less stereotyped and much less familiar. Moreover, adult listeners have had minimal practice discerning the external meanings of music (if such meanings exist) compared to a lifetime of practice with the subtleties of speech. In this light, their lullaby identification performance is all the more impressive. Perhaps the perceived simplicity of lullabies plays a role in this regard. Unyk et al. (1992) presented adult listeners with the same lullabies and comparison songs and asked them to choose the simpler of each pair. Lullabies were selected as simpler significantly more often than were the other songs whether they were presented in the original, filtered, or synthesized form.

Adults listeners may also be capable of tapping primitive emotional meanings that are common to infant-directed speech and music. Nonverbal but vocal aspects of speech are presumed to convey emotional meanings that are independent of cultural conventions (Frick, 1985). Infant-directed songs may convey similar emotional meanings through vocal and melodic features.

In short, these findings establish infant-directed singing as an important, likely universal, and universally recognizable form of caretaking. Lullaby singing as a part of caretaking is unlikely to have persisted over centuries and across continents without proven soothing or soporific effects. Nevertheless, the impact of lullabies on their intended audience (infants), although widely documented anecdotally, remains to be established formally. We do know, however, that infants process musical sequences in an adult-like manner (Trehub & Trainor, 1990), categorizing melodies on the basis of their pitch contour (Trehub, Thorpe, & Morrongiello, 1987) and rhythm (Trehub, & Thorpe, 1989), encoding *good* melodies in greater detail than *bad* ones (Trehub, Thorpe, & Trainor, 1990), even exhibiting sensitivity to the musical phrase structure of Mozart minuets (Krumhansl & Jusczyk, 1990). We know, as well, that infants exhibit attentional and affective preferences for infant-directed over adult-directed speech (Cooper & Aslin, 1990; Fernald, 1985; Fernald & Kuhl, 1987; Pegg, Werker, & McLeod, 1992; Werker & McLeod, 1989) and for approving over disapproving pitch contours typical of infant-directed speech (M. Papoušek, Bornstein, Nuzzo, H. Papoušek, & Symmes, 1990). It is very likely, then, that they would be capable of differentiating the various songs, perhaps exhibiting listening preferences for one form over the other. Finally, the adult singer's act of lulling may soothe the singer as well as the listener and this self-soothing quality may have contributed equally to the survival of lullaby singing.

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