The Musical Timespace

Vol. I: Text
Vol. II: Notation Examples & Graphs

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To Poul Borum

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Preface

The first impulse for this book came from Ingmar Bengtsson, Swedish professor of musicology. In a Nordic seminar on music theory in 1971, Bengtsson played a recording of contemporary music for us and asked, "What kind of theory will you apply to this music?". This book is an attempt to answer that question.

The theory presented in this book is derived from the listening of contemporary music. There is a gap between classical music theory and the theories of contemporary music, and it is my intention to contribute to the closing of that gap. Another intention is to illuminate connections between music theory and the findings of research in music psychology.

Everything in this book is based on listening. Repeated listening is the basis of musical insight, and I recommend to the reader to listen at least seven times to any piece of music discussed in this text.

For each work, reference to the timing of a particular CD recording is given, except for three works which are not yet issued on CD. The description of music with reference to minutes and seconds does not imply that clock time is considered particularly relevant for music listening. On the contrary, the nature of musical time is basically different from measured time. The indication of timing is simply a means of precise reference to a particular passage of the musical flow. Descriptions of the flow and form of the music based on listening are supplemented by score analyses wherever necessary for clarification and verification.

For copyright reasons, it has not been possible to enclose a CD of musical examples with the present book. All CD's referred to are, however, commercially available.

I wish to express my gratitude to Kjeld Fredens, Danish neurobiologist, for his explanation of relationships between music and neurobiology in lectures and articles and personal communication, to Julio Estrada,

Mexican composer, for convincing me that a theory of listening is not identical with a theory of composition, to Carl Bergstrøm-Nielsen, Danish composer, for valuable criticism and discussion, to Mette Stig Nielsen, Lecturer at the Carl Nielsen Music Academy, Odense, for many years of cooperation and intense discussions of music listening, and to Nikolaj and Mathias for opening my ears to the qualities of rock music.

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The publication of the present book would not have been possible without the linguistic advice of Stanley T. Bento, M.A. I have benefited not only from his linguistic revision of my manuscript, but also from his precise criticism of substance and argumentation. Special thanks to Jens Brejnrod, who provided the layout and the setting of notation examples, and to Jytte Fassov, manager of Aalborg University Press, for her kind and open-minded cooperation.

The Musical Timespace is dedicated to Poul Borum, an insightful poet, a sensitive music listener and a generous mind.

Copenhagen, spring 1996
Erik Christensen

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The Basic Listening Dimensions

Listening is essential for survival

Hearing is not designed for music listening. Hearing is designed for survival in a natural environment. Hearing arouses attention of events and dangers, and it is a vital means of spatial orientation. Hearing permits the localization and distinction of sounding objects, and it evokes and maintains awareness of the movement of sound sources.

Attention

When the auditory system is activated by sound hitting the two eardrums, it is aroused to a state of attention. The listening mind becomes aware that something is happening, auditory awareness is oriented towards the occurring event, and the awareness is enhanced and maintained by emotional response.

The sense of hearing is active even when we are asleep, and when we are awake, it warns us against dangers we cannot see. The emotion of surprise evoked by a powerful sound can immediately be followed by an emotion of fear, inducing the listening person to flee for his life, or an emotion of aggression preparing him to fight against a potential danger. So a primary survival value of hearing is the arousal of attention.

Localization and estimation

Instantly, when auditory perception is activated by a sound event, two questions are asked subconsciously; what is the source of this sound, and where is that source? Both questions are important for survival. It is wise to ascertain immediately if the sound source is potentially dangerous like a hissing snake or buzzing insect, howling wind, sneaking footsteps, crackling fire or rolling thunder. And it is equally wise to gain an idea of the direction and distance of the sound source.

The sense of hearing is well equipped for both tasks. It has a great potential for detecting the quality of sound as a basis for estimation and identification of sound sources. And hearing yields immediate information about the possible location of the sound source, as the minute differences between the sound that hits the two eardrums are sufficient cues for the auditory perceptual processes to provide awareness of the directions and distances of sound. All this happens within a fraction of a second. Within a moment, the sense of hearing shows its value for survival, the potential of attention and the ability of estimating and localizing the sources of sound. These perceptual potentials constitute the underlying basis of three dimensions of listening; intensity, timbre and space.

Intensity, the arousal of attention

Physical intensity is the prerequisite of sound. Above a certain threshold of physical intensity, auditory perception is activated, and the listening mind experiences sound of a certain loudness. Below that threshold, the mind experiences silence. The alternation of sound and silence is the fundament of music.

As a listening dimension, intensity is a subjective quality, largely dependent on the loudness of sound. But other factors contribute to the experience of intensity, such as distinctness, sharpness, duration and temporal density of events. Intensity perception is delicate. We can detect infinitesimal variations of intensity in a continuum from tender whispering to violent explosions. Intensity is a characteristic quality of sound, permitting us to distinguish between a storm and a breeze, a waterfall and a brook. Thus intensity is a contributing factor in the identification of sound sources. It also contributes to the estimation of the distance of a sound source.

Space, the ability of localization and orientation

The experience of space is multidimensional in nature. Visual space is experienced in the dimensions of height, length and width. Visual spatial orientation is limited by the borders of the visual field, but the auditory space is not limited in the same way. With the head as center, the listening mind experiences a surrounding space of sounding events variable in character, quality, distance and direction.

The impression of distance is produced by the composite sensation of loudness and distinctness, resulting in an approximate estimation of distance. The experience of direction is somewhat more precise. With normal hearing in both ears, we can localize sounds at reasonably precise angles between left and right, and we localize sounds in front of us or behind, high up in the air or near the ground. Sounds of high frequency and clearly defined attack are more easily localized, while low-frequency sounds appear to fill the space without well-defined direction.

Spatial hearing is the result of accurate perceptual processing arising from the comparison of the sound signals arriving at each ear. The spatial

omnipresence of sound gives rise to infinitely variable and multifaceted experience. Listening draws the world into the mind, contrary to vision, which has a tendency to draw the mind out in the world. Vision often dominates hearing, reducing sound events to concomitant phenomena in a visual space (Fredens & Fredens, 1991). As such, the full and intense presence of auditory space is experienced with eyes closed.

Timbre, the ability of estimation and identification

Simultaneously with the localization of sound, we gain an idea of the nature of the sound source. Some sounds are sharply attacked, like the breaking of a dry twig, the cracking of ice or the sound of a falling waterdrop. Other sounds have no distinct beginning like blowing wind or splashing waves.

Sound conveys information of events and objects. When an object is struck, it emits a sound that reveals its material, size and character. The sound of a hollow tree is different from the sound of a massive trunk and the sound of an oil barrel. Stone, wood and metal reveal the nature of their material when struck, and the sounds of large and small objects are significantly different. Voices of living beings like cats, lions, sheep, mice, birds and children each have their peculiar characteristics, and in the case of birds and human beings, different species and individuals possess their own unmistakable quality of voice.

The ears constantly receive large amounts of detailed information about events, objects and beings in the surrounding world. The characteristic and distinctive qualities of sound conveying this information are timbres. By comparison of perceived timbre with earlier experience, the listening mind can estimate the nature of sound sources and, if necessary or relevant, identify them. Differences in timbre permit the experience of many simultaneous events or the focusing on one kind of event, eliminating others. Hearing has a great capacity for the immediate and differentiated processing of timbre, providing precise auditory images of an infinitely variable multitude of sounds.

The potential of hearing essential for survival is the arousal of attention and the orientation in the surrounding space by localization, estimation and identification of sound sources. The basis of this potential is the auditory perceptual processing of intensity, timbre and spatial cues.

Intensity, timbre and space are three basic listening dimensions, experienced instantly and simultaneously; they are *microtemporal* listening dimensions, within a fraction of a second providing information about the relation between the listening body and mind and the surrounding world. Their correspondence with perceptual potentials are shown in *Fig. 1.1*

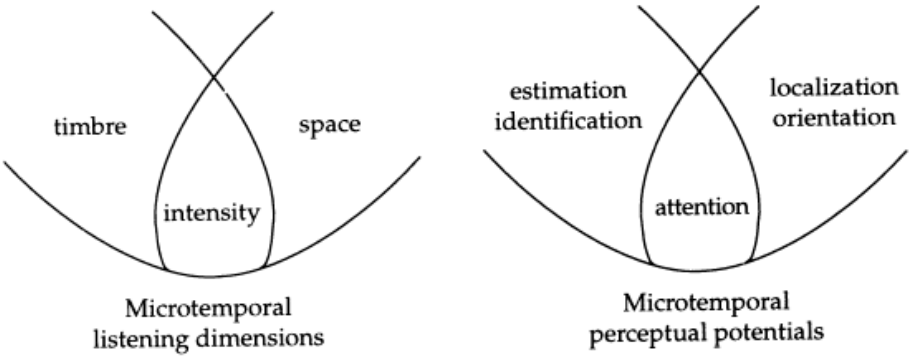

Fig. 1.1. Microtemporal listening dimensions

Movement, the stimulation of awareness and the emergence of time

Immediately after the arousal of attention by the microtemporal listening dimensions, successive information is provided by the experience of macrotemporal movement of sound; while the subconscious question evoked by sound arriving at the two ears, "What is it?" is being answered by the processing of timbre, and the simultaneous question "Where is it" is treated by the processing of spatial cues, a third question arises; "Is it moving?". If a sound remains constant for a while, arousal of auditory perception diminishes, and attention is weakened. The listening mind loses interest. But if the sound moves or changes, auditory attention is restimulated, and the sound event and its source is followed with renewed awareness. The listening mind is informed whether the sound source is approaching, passing by or receding, and has the chance to decide if it is necessary to run away or whether it might be a better idea to find and follow the moving sound source in order to fight, scare or eat it.

Hearing detects movement by changes in intensity, timbre and spatial localization. Increasing intensity is interpreted as approaching, decreasing intensity as moving away, and coherent continuous change in localization cues is experienced as movement in a certain direction.

To enable the listening mind to follow a directed movement, the instant processing of timbral and spatial information has to be supplemented by another perceptual potential, the processing of successive cues in short-term memory. In short-term memory, incoming information can be stored and kept in an active state for at least 5 or 6 seconds (McAdams, 1987). This means that the movement of sound can be perceived as a coherent process and estimated in terms of beginning and end, direction, course and goal.

Estimations of sound movement in memory evoke the concepts "before", "during", and "after", which are integrated in the idea of duration. This implies that movement is one of the essential factors underlying the sensation of time. The other essential factor is pulse.

Pulse, the awareness of regularity

Recurrent repetition of sound is heard in ocean waves, dripping water, specific kinds of birdsongs, heartbeats and the sounds of animals and human beings running or walking. If a sound event is repeated regularly, the listening mind estimates the regularity in short-term memory and experiences a pulse. Pulse and goal-directed movement evoke two kinds of temporal experience which are qualitatively different. The experience of regulated continuity and the experience of beginning, duration and end.

Movement and pulse are *macrotemporal* listening dimensions, creating the experience of time in the listening process. They represent two kinds of auditory awareness. Movement evokes the awareness of change, pulse the awareness of regularity.

Intensity is a microtemporal as well as a macrotemporal listening dimension. Intensity provides instant information about sound sources as well as information about the successive changes of states and events in the world. The correspondences with perceptual potentials are illustrated *in Fig. 1.2.*

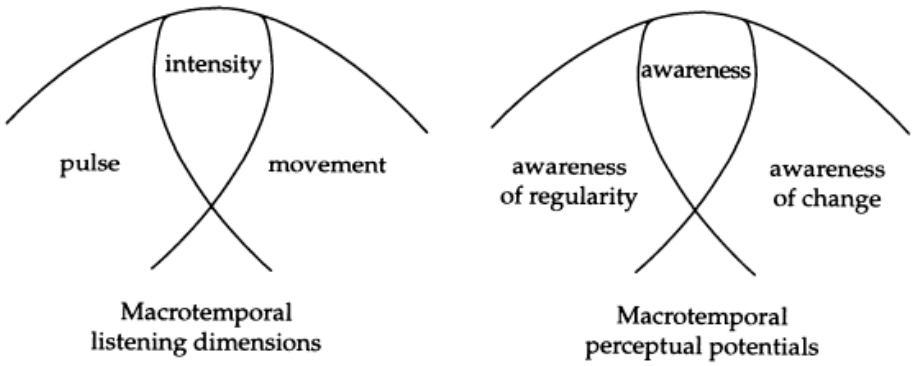

Fig. 1.2. Macrotemporal listening dimensions

Microtemporal and macrotemporal dimensions

The two models above are combined in one model in *Fig. 1.3,* showing the five basic listening dimensions. The upper half of the model represents the microtemporal dimensions, the lower half the macrotemporal dimensions.