

# The Physics And Psychophysics Of Music An Introduction

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Introduction to the Physics and Psychophysics of Music  
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The Physics and Psychophysics of Music  
The Psychophysics of Speech Perception  
Psychophysical Approaches to Cognition  
Psychophysics in Action  
Introduction to the Physics and Psychophysics of Music  
Cognition, Information Processing, and Psychophysics  
Introduction to the Physics and Psychophysics of Music  
Modern Psychophysical And Scaling Methods And Experimentation  
Sensation and Judgment  
Psychophysics  
Fundamentals of Scaling and Psychophysics  
Physics and psychophysics of weightlessness  
visual perception  
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Psychophysics  
Vision  
Psychophysics of the Human Short Wavelength Sensitive Pathways  
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this book uses acoustics psychophysics and neurobiology to explore the physical systems and biological processes that intervene when we hear music it incorporates the latest findings in brain science and tone generation in musical instruments

this book deals with the physical systems and psychophysical processes that intervene in what we broadly call music we shall analyze what objective physical properties of sound patterns are associated with what subjective psychological sensations of music we shall describe how these sound patterns are actually produced in musical instruments how they propagate through the environment and how they are detected by the ear and interpreted in the brain we shall do all this by using the physicist's language and his method of thought and analysis without however using complicated mathematics this of course will necessarily impose serious limitations on our presentation although no previous knowledge of physics physiology and neurobiology is required it is assumed that the reader is familiar with music in particular with musical notation musical scales and intervals that he has at least some basic ideas about musical instruments and that he has experienced typical musical sensations books are readily available on the fundamentals of physics of music e.g. benade 1976 pierce 1983 and music psychology e.g. deutsch 1982 an excellent and up to date general text on musical acoustics is that of sundberg 1991 the purpose of the present volume is not to duplicate but to synthesize and complement existing literature

viii book we shall refer a great deal to the discipline of psycho physics which in a broad sense tries to establish in a quantitative form the causal relationship between the physical input from our senses and the psychological sensations and physiological reactions evoked in our mind and body respectively actually we shall try to weave a rather close mesh between physics and psychophysics or more precisely psychoacoustics after all they appear naturally interwoven in music itself not only pitch loudness and timbre are a product of physical and psychoacoustical processes but so are the sensations related to consonance and dissonance tonic dominance trills and ornamentation vibrato phrasing beats tone attack duration and decay rhythm and so on many books on physics of music or musical acoustics are readily available an up to date text is the treatise of john backus 1969 no book on psychoacoustics is available at the elementary level though several review articles on pertinent topics can be found in tobias 1970 and in plomp and smoorenburg 1970 a comprehensive discussion is given in flanagan's book on speech 1972 and of course there is the classical treatise of von bekésy 1960 a comprehensive up to date analysis of general brain processes can be found in sommerhoff 1974 musical psychology is discussed in classical terms in lundin 1967

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system in the actual perception identification and evaluation of musical sounds the highly mechanistic approach of 19th century researchers notably the great von helmholz 1863 persisted well into the first half of this century

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the following is a passage from our application for nato sponsorship in the main the participants in this workshop on the psychophysics of speech perception come from two areas of research one area is that of speech perception research in which the perception of speech sounds is investigated the other area is that of psychoacoustics or auditory psychophysics in which the perception of simple non speech sounds such as pure tones or noise bursts is investigated in order to determine the properties of the hearing mechanism although there is widespread agreement among both speech researchers and auditory psychophysicists that there should be a great deal of cooperation between them the two areas have generally speaking remained separate each with its own research questions paradigms and above all traditions psychoacousticians have so far continued to investigate the peripheral hearing organ by means of simple sounds regarding the preoccupations of speech researchers as too many near empty theories in need of a more solid factual base speech perception researchers on the other hand have continued to investigate the way human listeners classify vowels and consonants claiming that psychoacoustics is not concerned with normal everyday human perception

our lives are informed by perceptual and cognitive processes at all levels from instrumental learning to metaphorical discourse to memorial representation yet historically these two branches of experimental psychology perception and cognition have developed separately using independent methods of experimentation and analysis this volume is motivated by the assumption that a fundamental integration of the two fields is fruitful methodologically and indispensable theoretically it explores how the notion of psychophysics aligned with cognitive processes shapes the study of perception and cognition and illuminates a variety of contemporary research issues from a novel theoretical perspective the papers raise conceptual and metatheoretical issues against the background of relevant empirical

data the authors provide a virtually narrative account of the most recent developments in their respective fields of expertise in psychophysics and cognitive psychology hence this volume gives the interested reader an opportunity to reflect critically upon some of the current issues defining the two domains and their conjunction topics discussed include the psychology and psychophysics of similarity the psychophysics of visual memory and cognitive factors in judgment the emerging notion of cognitive psychophysics may well warrant the attention of experts in the field

gunnar a v borg was born in stockholm on 28 november 1927 educated at stockholm university he obtained his ph d from the university of lund in 1962 subsequently he held various teaching and research appointments at the university of umea in northern sweden where he also served as president of the graduate school of social work and public administration in 1966 1967 in 1971 he was appointed professor at stockholm university where he headed the institute of applied psychology for over a decade since 1980 he has been at stockholm university s department of psychology and in 1987 he received a professorship in perception and psychophysics over the last 20 years he has held several visiting appointments abroad particularly in the usa and has lectured at many universities both in and outside europe from the beginning of gunnar s research career his thinking has been affected by gestalt psychology as well as by some principles of theoretical philosophy the former has not only influenced gunnar s early unconventional works on gestalt strength but also one of his major areas of thinking the notion of total perceived effort which can be seen as a gestalt underlain by a variety of sensory data the philosophical influence is obvious gunnar s papers reveal an abiding concern with epistemological issues issues that are linked to his persistent attempts at making interindividual comparisons

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psychophysical theory exists in two distinct forms one ascribes the explanation of phenomena and empirical laws to sensory processes context effects arising through the use of particular methods are an unwanted nuisance whose influence must be eliminated so that one isolates the true sensory scale the other considers psychophysics only in terms of cognitive variables such as the judgment strategies induced by instructions and response biases sensory factors play a minor role in cognitive approaches this work admits the validity of both forms of theory by arguing that the same empirical phenomena should be conceptualized in two alternative apparently contradictory ways this acceptance of opposites is necessary because some empirical phenomena are best explained in terms of sensory processes while others are best ascribed to central causes the complementarity theory stresses the mutually completing nature of two distinct models the first assigns importance to populations of sensory neurons acting in the aggregate and is formulated to deal with sensory effects the second assigns importance to judgment uncertainty and to the subject strategies induced by experimental procedures this model is formulated to explain context effects throughout the text the exposition is interlaced with mathematics graphs and computer simulations designed to reveal the complementary nature of psychophysical explanations

this third edition of a classic text which was first published in 1976 is the only comprehensive up to date presentation of psychophysics currently available it has been used by undergraduate and graduate students and scholars throughout the world and is consistently thought of as the best single source for learning the basic principles of psychophysics the coverage of the field is comprehensive including topics ranging from the classical methods of threshold measurement to the modern methods of detection theory to psychophysical scaling of sensation magnitude the approach is one in which methods theories and applications are described for each experimental procedure new features found in this third edition include methodological and theoretical contributions made in the field during this time period descriptions of adaptive procedures for measuring thresholds context effects in scaling theory of quantal fluctuations multidimensional scaling nonmetric scaling of sensory differences and the relationship between the size of the dl and the slope of the sensation magnitude function new methods for measuring the observer s sensitivity of criterion and an expanded discussion of category scaling including the range frequency model and verbally labeled categories and methods used to control the observer s nonlinear use of numbers in magnitude estimation such as line length scaling magnitude matching master scaling and category ratio scaling

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